LUND INSTITUTE OF TECHNOLOGY
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Quality Assurance of Prototype Parts

Scania CV AB, Södertälje

SCANIA

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Abstract

Title Quality Assurance of Prototype Parts

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Purpose

The purpose of this Master thesis is to create tangible suggestions that finally will lead to a standardised working method for quality assurance of prototype parts (QAPP), according to Scania's internal principles. The working method should balance the need for requisite quality assurance and the need for flexibility and speed when dealing with procurement of prototype parts. The QAPP-process should be possible to use within all Scania departments concerned about procurement of prototype parts.

Methodology

The study is mainly done as a qualitative study where the results of several interviews with employees from different departments within Scania, as well as the company's suppliers have been analysed. The thesis work started with a period of observation of the employees in their daily work situations to get an understanding of Scania, its philosophies and working principles. At a relative early stage in the thesis work, a preliminary suggestion was presented. This suggestion was worked up during the rest of the thesis work to finally end up in a proposal possible to implement.

To involve Scania employees in the development process of QAPP, a number of workshops were organised to get valuable feedback on the current proposal.

At the end of the thesis work, a finished proposal was presented together with recommendations for implementation as well as a time plan for the implementation.

Conclusions

A process controlling procurement of prototype parts has been developed and the process is ready to be implemented within all departments concerned of prototype procuring within Scania.

Three main advantages will appear due to the implementation of a new quality assurance process:

- Comprehensive picture of Scania's product development process
- Clarified responsibility division and information sharing
- Improved traceability in the product development through preventative work methods

A start of usage of QAPP will imply that Scania employees and prototype suppliers should use and work with three documents:

- Prototype Design Specification – PDS
- Prototype Part Warrant – PPW
- Prototype Deviation Report - PDR

These documents should be used in *all* prototype activities, regardless of part or supplier.

Implementation of QAPP are done step by step and has started with a number of pilot cases to get direct feedback from the users when the process and its companying documents have been used in reality.

Key Words Quality Assurance, Quality Systems, QS 9000, Prototype Parts

Acknowledgements

In early November when we; two students from the southern part of Sweden, actually called Scania, were informed that we were welcome to write our master thesis at Scania CV AB in Södertälje, we did not know which challenge we were up to. During the first weeks at the global purchasing department at Scania we learned a lot about this multinational company. For us, like for most of the Swedes, Scania was equivalent to heavy trucks and buses. Now, after almost five months at Scania, we are much more familiarized with the automotive industry and have gained many interesting impressions.

We would like to express our gratitude to all employees within Scania as well as the company's suppliers involved in the development of QAPP. Without your patience during our interview sessions and engagement in the project, the thesis would not have been realised.

Further, we especially wish to thank our supervisors at Scania; Owe Claesson, Jesper Wiklander and Anna-Carin Törenholt, our tutors and supervisors from the university Christer Kedström and Bertil Nilsson as well as Hampus Hellsvik from Accenture, for their guidance, support and contributing thoughtful comments throughout the project.

> *"An education isn't how much you have committed to memory, or even how much you know. It's being able to differentiate between what you do know and what you don't"*
>
> Anatole France (1844-1924)

Södertälje, May 2005

Malin Blanck Rasmus Larsson

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1 Introduction

To give the reader an introduction to the master thesis and the purpose with the work at Scania, a brief problem background is presented in this chapter. When the problem was defined, some delimitations was made to further define and narrower the purpose.

1.1 Background

Development and testing of prototypes are important to Scania CV[1] AB to be able to introduce new products on the market. Considerable amounts of time and money are spent on development work and it is always of interest to make the development process more efficient. The background to this master thesis is the need to improve the quality assurance of prototype parts purchased from suppliers. There is also a significant need to make the requirements and actual deviations more visible to the concerned parties when dealing with procurement of prototype parts.

Scania's purchasing organisation was re-organised 1998 and is since then divided into commodity teams for a better focus on purchase of prototypes used during development respectively products used in the serial production. Quality assurance activities for production parts are well-developed as well as the work to certify developed products before start of serial production. However, quality assurance of prototype parts, i.e. parts which are not yet ready for serial production, gets a subordinate focus. As things are at present, there is no standard way of dealing with quality assurance of prototype parts for testing, although standardised working method[2] is a basic principle within Scania for all processes and activities.

The first attempt from Scania to standardise and improve the company's quality assurance activities of prototype parts was to assign an internal change group. This attempt was however terminated because of shortage of time and resources, but there was still a consciousness that the problem should be highlighted. Many of the buyers, as well as the designers, have mentioned the problem followed by deficient quality assurance of prototype parts during development. An easy-to-use manual with a standardised working method of how to assure the right quality of the prototype parts would be of great value to make Scania's product development process (PD process) more efficient.

The above facts led to the idea to assign a master thesis for two graduate students to be completed in five months. The thesis work is managed through the purchasing department at Scania but studies and interviews have also included Scania's R&D department as well as some of the company's prototype suppliers.

When referring to prototype parts, parts used during the development of a new or modified product are considered. The parts are normally ordered from an extern supplier and the parts are either developed by the supplier in cooperation with Scania, only by Scania or only by the supplier. A major difference of prototype parts and production parts is that the prototype parts do not end up at Scania's customers and are therefore not objected to the quality system QS 9000, generally used in the automotive industry.

[1] Commercial Vehicles
[2] Scania Production System (SPS)

1.2 Problem Definition

As most companies in the automotive industry, Scania and the company's suppliers, work according to the quality system QS 9000[3]. The initial aim with QS 9000 is to secure the quality of products supplied to a customer from a process oriented view. The fact that Scania's supplier quality assurance engineers (SQAs) primary focus on securing the quality of the products ready for serial production and their manufacturing processes makes the prototype parts not prioritized.

During Scania's PD process there is a vast number of prototype parts purchased that are not quality assured before the parts are ready to undergo tests. The test procedures form the basis of how the work should be developed, even though Scania employees not for certain know if the prototype parts are in accordance with the drawing and specification. The consequence of this uncertainty is that the value of a test is indecisive and all involved parts might have to be considered whether they are correct or not. Because of lack of this quality assurance, traceability of the parts is incomplete, which imply a lot of work to find the part with insufficient quality when a deviation is detected. To facilitate this handing and quality assurance of the prototype parts, a new standardised working method would benefit Scania's product development as well as the suppliers of prototype parts.

1.3 Purpose

The main objective and final goal of this thesis is to create tangible suggestions that finally will lead to a standardised working method for Quality Assurance of Prototype Parts (QAPP), according to Scania's internal principles. The working method should balance the need for requisite quality assurance with the need for flexibility and speed when dealing with procurement of prototype parts. QAPP process should be adopted within all Scania departments concerned with procurement of prototype parts.

1.4 Delimitations

This study is limited to focus on Scania as the customer of prototype parts used for tests during the product development. QAPP process is developed according to the needs and resources available at the different departments within Scania. The suggestions are also limited to be able to implement in the nearest future.

The fact that the prototype procurement process is a complex process handled cross functional between several departments has led to identification of other problems not appropriate to consider in this thesis. Such subjects regard to how Scania can develop better products of higher quality and to improve the efficiency of the internal and external logistics of prototype parts. These suggestions will be forwarded to executive committees and managers at Scania.

[3] QS 9000 is described in section 4.4

2 Scania Overview

Understanding of the case company is important to be able to understand the problem that should be dealt with. In this chapter a short presentation of Scania is made together with the company's organisation and core values.

2.1 History

Scania was founded in 1891 and have since then produced more than a million vehicles for heavy transport work. Today the production consists of heavy trucks, buses and marine engines. In addition to the company's production of vehicles, Scania also offers service related products and customer financing. Scania is a global company with operations in Europe, Latin America, Asia, Africa and Australia. Eleven production units in five countries are involved in the manufacturing of the vehicles. Today Europe is the largest market and Latin America is the second largest. In addition to the production units in Europe and Latin America, Scania have local assembly plants in Africa, Asia and Australia. The number of employees is around 30 000.[4]

In the 1950's, Scania developed a technologically advanced modular specification system that strongly reduces the components in the vehicles. At the same time the system gave customers the possibility to order more tailor-made vehicles after their own desires. This has made Scania the heavy vehicle industry leader in terms of profitability. To ensure that the products will maintain a high, uniform quality, Scania has standardised the work process within the company. This means that they perform tasks in a specific way, until they figured out an improvement.

The modular product program and standardised working methods are two of the basic principles in Scania Production System (SPS). This system implies that philosophies, principles and priorities are the same, as well as the components, regardless where the production takes place. SPS is based on a global product platform and a global supply system. The global supply system consists of one common supplier base for all purchase activities in the company around the world, one purchasing centre for all new parts to be introduced in the production and two purchasing centres for all parts in running production. A further description of the purchase activities at Scania is presented in section 2.2.[5]

2.2 Scania's Global Purchasing Organisation

Scania has a centralized global purchasing organisation situated in Södertälje and in São Paolo, Brazil. Purchasing involves parts and components to both new products and products for the running production, spare parts, special projects and non automotive parts. Buyers belonging to the purchase organisation are situated globally. The organisation is structured as shown figure 2-1 and includes six different departments. Of these six departments, five are situated in Södertälje and one in São Paolo. Purchasing in São Paolo is responsible for purchasing of parts and components within running production in Latin America. Different departments are responsible for purchasing certain parts of the vehicles. In each department, the employees are divided into commodity groups consisting of three different roles; project

[4] Scania Annual Report 2004
[5] Scania InLine

buyers, production buyers and supplier quality assurance engineers. Each commodity includes different product segment, which are the base on which the supplier structure is built.

Scania's suppliers consist of 550 manufacturers to the automotive production in Europe and 230 suppliers in Latin America. Non automotive products are purchased from 1500 suppliers in Europe and 1100 suppliers in Latin America.

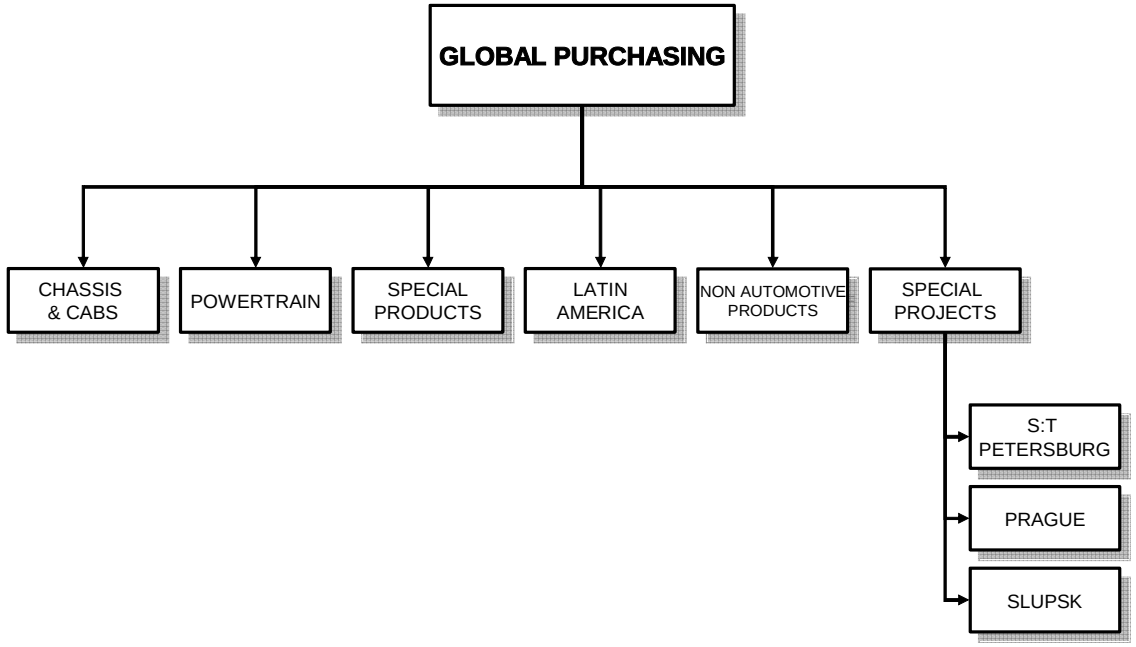


Figure 2-1 ***Global Purchasing Organisation (Source: InLine)***

2.2.1 The Purchasing Process at Scania

Scania's purchasing process is a process where the employees are divided into commodity teams. Each commodity team has the main responsibility of either a product or a group of products. Depending of the products' levels of complexity, the groups can be of varying sizes. Normally four employees work together in a commodity group; project-, production- and spare parts buyers and a SQA.

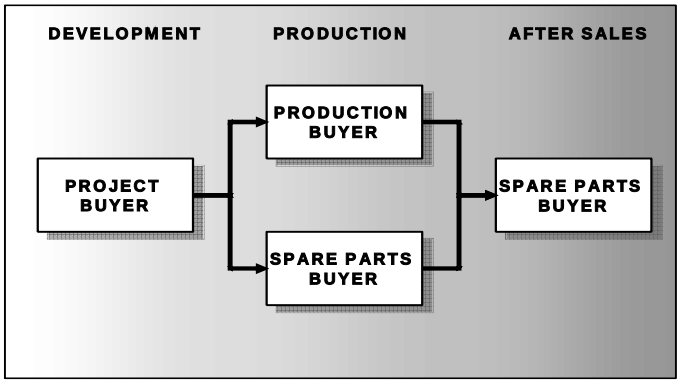


Figure 2-2 ***Different Purchasing Activities***

Project Buyer
The project buyers are involved in the product development process. Their main task is to purchase new parts and spare parts for prototypes. They evaluate quotations from suppliers, negotiate and choose suppliers which can be qualified or not qualified for serial production. The project purchasing groups in Södertälje are responsible for purchasing of all new parts for prototypes. The project buyers are also responsible for purchase to serial production during approximately six month after Start of Customer Order Production (SOCOP), when the project is handed over to the line organisation.

Production Buyer
The production buyers are responsible for purchase of parts for the running production. This includes approval of the performance and status of appointed suppliers regarding quality, environment, delivery performance and total cost.

Spare Parts Buyer
Scania has separated unique spare parts from production parts although spare parts can be identical to the parts in the running production. Spare parts might also be older parts not running in production. Unique spare parts are purchased by a separate department called special products.

Supplier Quality Assurance Engineers
Scania's supplier quality assurance engineers (SQAs) works with quality assurance and verification of the suppliers' production processes. The SQAs are responsible for risk classification, supplier evaluation, setting up quality plans and dealing with deviations from specifications. To secure the quality, they visit the suppliers' plants and request certificates proving that they achieve Scania's requirements which are in accordance to QS 9000. A SQA normally forms a commodity group together with project and production buyers.

2.3 Product Development at Scania

Scania's global product development is concentrated at Scania Technical Centre in Södertälje, Sweden. The product development department is divided into trucks, buses and marine engine, in the same way as the purchasing organisation is structured. The designers work in teams, where each team normally is responsible for a test or a part of a test. Project coordinators are responsible for that all parts in a test are designed and ordered. A number of object leaders supervise the projects and coordinate the tests.[6]

[6] Object leaders, project coordinators at R&D dept

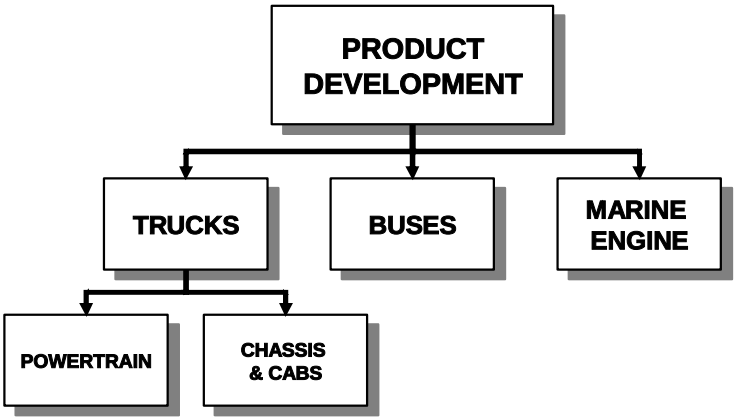


Figure 2-3 ***Organisation R&D (Source: InLine)***

Scania's PD process is further described in chapter 5. The PD process does not present a structured working method of how development and procurement of prototype parts should be carried out. The PD process neither describes which quality assurance activities that should be performed by the supplier.

Normally three or four generations of complete prototypes are set up and tested before the prototype is ready for Start of Production (SOP). The prototypes can be modified during the tests, which demand a constant need of new and modified prototype parts.[7]

Further description of the PD process is given in chapter 6.

[7] Designers, project coordinator at R&D dept

3 Methodology

The activities carried out to solve the defined problem are described in this chapter. Each activity is explained according to the chronological order in which they were carried out. Finally a description of the research methods is given to clarify for the reader the choice of methodology.

3.1 Thesis Perspective

The research perspective used in the thesis is more positivistic than hermeneutic. As engineering and business students, together with the demands from the university on theoretical connections, this view is more natural to use. Positivistic philosophy sees a complex social world that needs to be simplified and reduced, which is what needs to be done when developing general routines and standards for the purchasing process of prototype parts. On the other hand, more intangible and non-measurable factors such as peoples' unwillingness to change an existing system are also taken into consideration, and hence a combination with a hermeneutic approach is used.[8] Many persons within the Scania organisation as well as its suppliers will be concerned about a new or changed standardised working method.

Furthermore, a system-oriented approach is used in the thesis where a comprehensive picture makes it possible to understand all the processes.[9] The standardised working method will be used by all buyers, quality engineers, designers and suppliers who interact and hence create a system.

3.2 Activities

Numerous activities were carried out to be able to gather enough and appropriate information to develop the QAPP process. The activities are shown in figure 3-1 which shows the activities as a flow in chronological order. The implementation activities refer to the work that will be completed when the organisation is ready for a formal implementation within all departments. Due to Scania's implementation and change routines, this final implementation work will not be started before the end of the thesis work.

[8] Holme et al
[9] Ibid

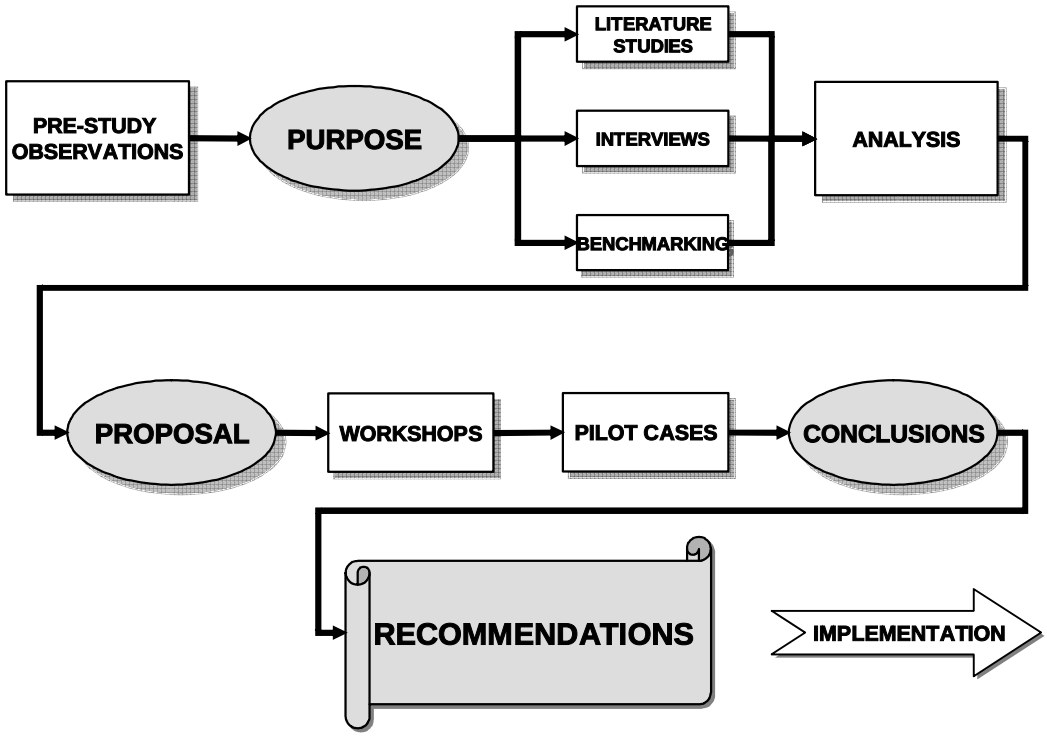


Figure 3-1*Chronological flow of thesis work*

3.2.1 Pre-study and Observations

To get a deeper understanding of the problem that should be dealt with, it was necessary to acquire information about how Scania is organised and which goals the employees are working towards. This observation period reached over the first week and implied document reading and visit to different departments within Scania. To further improve and broaden the knowledge about Scania's working methods, a number of employees were chosen for introductory interviews. These employees represented both R&D activities and the purchasing organisation. The interviews were of informal nature and the answers resulted in an overall understanding of work situations and organisational issues. This fact made the interviews more similar to discussions where each question covered a broad area.

The introductory interviews were complemented with further observations of the employees in their daily work situations. An advantage with observations is that a comprehensive understanding of the organisation and the processes was created, instead of the interviewees filtering the shared information. The information given by the introductory interviews and the observations was used to evaluate and map today's quality assurance situation. At the end of the pre-study and observation period, the purpose was formulated. Of course this purpose was modified and complemented during the thesis work, but an initial purpose was good to start with to know in which direction the work should be lead.

3.2.2 Literature and Document Studies

Literature study means going through existing printed works; e.g. articles, books, essays and thesises, which most of them are of theoretical and scientific nature. Document means written material, in this case documents found on Scania's intranet InLine. A number of documents were studied and evaluated to find relevant information to the problem. The literature study was done parallel with the interviews. The most rewarding documentation useful for the development of QAPP was the internal documents, were employees describe processes for possible future process development.

3.2.3 Interviews

About twenty in-depth interviews with people representing the different stake-holders for a quality standard for prototype purchasing were carried out. The interviewees included different commodity buyers, SQAs, design engineers and suppliers. The in-depth interviews were more focused and structured than the introductory interviews and the questions were adjusted for every interviewee.

The aim with these interviews was to get a good understanding of how employees with different roles within the organisation experience the present situation. The intention was to interview as many parties as possible to get a higher degree of involvement which might simplify the implementation of the results.

3.2.4 Benchmarking Studies

Benchmarking is a method to systematically compare with and learn from other companies, within or outside the industry. To map and evaluate possible solutions to the problem, benchmarking studies among suppliers and competitors were carried out. These studies strengthen the validity of the results and added value to the final result. The companies chosen to benchmark were all in the automotive industry but not directly competitors to Scania. All chosen companies have well-developed quality assurance activities and the aim with benchmarking was to study how their prototype processes were managed and also get ideas to implementation stages.

Before the studies started, preparing activities were done to understand the case companies' products as well as their development and prototype activities. It is important to consider the aim and expected results of the studies to be able to do research about the right things. Each study was completed step-by-step in five steps, described below.

1. **Identification of what to be compared**
   Through initial mapping of Scania's quality assurance situation today, a solid base was created to be able to benchmark against other companies. By identify critical topics in Scania's system, issues that could be interesting to compare were identified. The information given from the benchmarking companies should facilitate the development of an internal quality system at Scania.

2. **Identification of suitable companies to benchmark**
   To get as useful information as possible, companies with similar demands on quality assurance as Scania, were selected. To get a broad understanding, companies manufacturing different type of parts in different countries were chosen. Six companies in

Sweden, Germany and the US were studied and they represented a wide range of sizes and product families.

3. Method for collecting data
The data collection was concentrated on study of quality documents used by the benchmarking companies completed with visits to selected companies. The visits involved deep interviews with concerned parties, such as quality engineers and production managers.

4. Analysis of advantages and disadvantages with the companies method
After the visits, the information collected from the interview was analysed from a critical point of view. Advantages and disadvantages with the benchmarking company's system were compared with the system aimed to be implemented at Scania. The evaluation of other companies' quality assurance activities resulted in many good suggestions for development of the QAPP process within Scania.

5. Ideas and suggestions to use for QAPP
Finally, the rewarding suggestions were collected and used to further improve the QAPP process within Scania.

3.2.5 Creation of Initial Proposal

After the interviews and benchmarking studies were carried out, enough information was collected to create a first proposal for how the QAPP process could be formed. The aim with creating a proposal at this early stage was to have the opportunity to change and improve the process along the way and to let the employees be familiar with the new way of thinking. This was done by letting the working methods be tested on a number of employees and suppliers to get direct feedback to continue the development.

3.2.6 Workshops

To test the developed process and working methods in the employees daily work environment, a number of workshops were carried out. Designers, project buyers and SQAs were invited and given the opportunity to attend. Before the workshops, the developed proposal was distributed to the participants together with a couple of issues to be discussed during the workshop. The participants represented different groups at Scania, and debated regarding the suggested standard and new routines.

The ultimate size of a workshop group was about four people from different departments, both purchasing and R&D. The workshops were arranged as two similar sessions on different days with about 25 participants at each time. By way of introduction, a brief presentation of the QAPP proposal together with the purpose and aim of the workshop were presented. The introduction was followed by a case practise where the participants were divided into groups consisting of persons acting all stakeholders to the QAPP process; namely designers, buyers, SQAs and suppliers. The case was based on a normal procurement situation where the start of the process is the fact that the designers require a prototype part for testing. All developed documents were used in the case and in conjunction to every step in the process; advantages and disadvantages with the new system were discussed within the groups. The workshops ended up with a full group discussion where every group gave an account of their views of the new system.

The workshops lead to direct response on relevant suggestions for improvements; and they were also a chance to discuss recommendations with employees with different opinions. After the workshops, the suggested proposal for QAPP were adjusted according to the designers', buyers' and SQAs' desires.

3.2.7 Pilot Cases

When the development of the proposal for a new working method was in its final phase; a number of pilot cases were executed. Members of a pilot group were designer, project buyer, supplier and SQA. All developed documents were tested in practice by the pilot group. The aim with these cases was to get an even broader understanding of difficulties and inconveniences that can occur due to a new working method. The pilot cases lead to valuable feedback and comments on the proposal.

3.2.8 Conclusions and General Recommendations

The conclusions and general recommendations were formulated when the results of a couple of pilot cases could be analysed. At the end of this report, general recommendations are given to Scania concerning the QAPP process and implementation of the system.

3.2.9 Implementation

Implementation of QAPP is not included in the actual purpose of the thesis. But throughout the work some implementation activities have been carried out, such as pilot cases. Experiences learned and conclusions drawn from these first-stage implementations are valuable to use in further implementation after the thesis work is finished.

3.3 Research Methods

3.3.1 Triangulation – A Method in the Analysis and Data Gathering Processes

When research is to be performed, a number of different methods for data collection can be used. In this thesis the following methods are used to create a data base; observation, introductory interviews, literature and document studies, in-depth interviews, benchmarking, workshops and finally a number of pilot cases. The technique that should be used in the analysis phase is determined by the problem. According to Darmer et al:

Triangulation implies an attempt to combine quantitative and qualitative techniques to illustrate the problem from different views to improve the validity of the result.

It is suitable to use this method both during the data gathering phase and the analysis phase. The two techniques are used simultaneously to supplement each other during the research phase. [10] See figure 3-2.

[10] Darmer et al

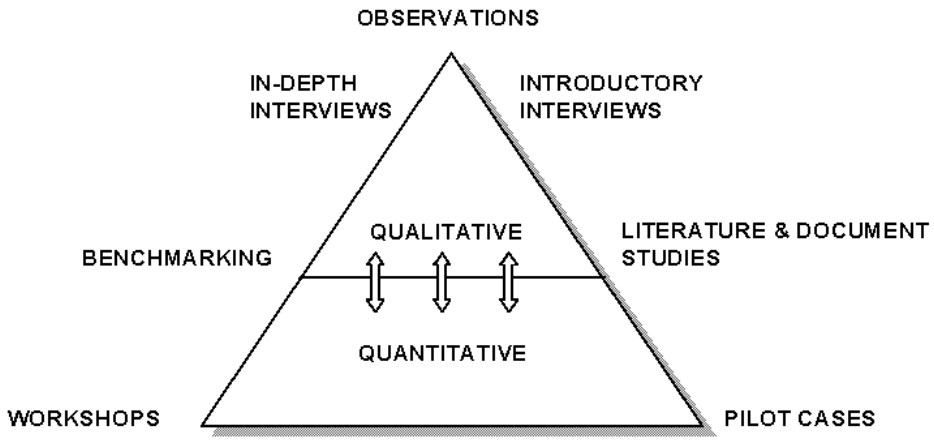


Figure 3-2 ***Synthesis of the different methods used to gather and analyse data, known as triangulation***

Qualitative Perspective

The information from the interviews was analysed from a qualitative perspective due to the careful and accurate performed interviews. The purpose of using the qualitative perspective is primary to gain knowledge to get a deeper understanding of the identified problem. This means that the method is less formalized and concentrated on testing the validity of the collected information.[11] By introductory interviews this wide understanding of the problem area was covered and a comprehensive picture of the organisation was given.

Quantitative Perspective

The data and results of the workshops were quantitative and supported the results of the interviews and improve the reliability. A quantitative method is important to be able to do a formalised analysis, make comparisons and test if the obtained results are valid for all described situations. Statistic methods of measurements usually play a central role in the analysis of the quantitative information, which in this case was not necessary because of the visibility of the results in the workshops.[12] The pilot cases can also serve as a form of quantitative data; the results from the cases was thoroughly analysed to be able to make possible improvements of QAPP.

In most cases there is a relation between the data gathering method and the analysis of the data. The triangulation method is applicable for data which can be characterized as qualitative or quantitative, but also another division of the data can be used.

Secondary Data

Secondary data can be collected by a wide study, called "desk research". The resource consumption needed to collect the secondary data is proportionately small because existing information and statistics provides a good overview of the situation.[13] For this thesis work, Scania's internal documentation was the main source of information. Reports, manuals and Scania's standardised working methods such as Scania's Production System, PD process and the testing process were studied to collect secondary data.

[11] Holme et al
[12] Ibid
[13] Darmer et al

Primary Data
Primary data can also be referred as specific data. When more complex problems should be solved, secondary data is not enough to get material for a deeper analysis, why secondary data needs to be completed by primary data.[14] At the early phase of the work, primary data were gained mainly through observations of employees at Scania's development and purchasing departments. When a broad understanding was given, the interview process started. The questions were revised during the period and complemented continuously.

3.4 Creation of a Standardised Working Method

After analysing the interviews, questionnaire and the desired changes of the proposals, a general standardised working method was created. An aim was to make it easy for designers and buyers at Scania to read and follow the instructions. The standard should be used in the same way; irrespective of what parts that are bought and which sort of suppliers there is. Furthermore, it should follow Scania's recommendations of standardised working methods, according to Scania's Production System.

The manual and new standardised working method will be handed over to Scania at the end of the thesis work. These manuals will be the base for a final implementation of QAPP throughout the organisation.

[14] Darmer et al

4 Knowledge Framework

In this chapter the theoretical base of the thesis is presented. Theories about quality, quality assurance and quality systems are valuable knowledge when developing a new process such as QAPP.

4.1 Quality and Quality Assurance

Quality can be defined as the features and characteristics of a product which helps it to satisfy a given need. When a product or service is of high quality, both supplier and customers agree on requirements and these requirements are met. The requirements can concern technical properties of a product as well as delivery agreements and packaging instructions. It is important to take into account not only the physical properties of a product but also the more abstract characteristics.[15]

During the last decade, another concept has started to be highly used, namely quality assurance. There is no clear-cut apprehension of the meaning of this concept; for some people it simply means the same as quality control for other activities that aim to secure that intended quality is achieved and maintained. According to ISO 8402 quality assurance is defined as:

"…all the planned and systematic activities implemented within the quality system, and demonstrated as needed, to provide adequate confidence that an entity will fulfil requirements for quality" [16]

Quality assurance needs to be an integral part of all of an organisation's processes and functions, from the conception of an idea throughout the lifecycle of the product, determining customer needs and requirements, planning and designing, production, delivery and after-sales services. The objective of quality assurance should be that every person in the organisation takes personal responsibility for the quality of the processes for which they are accountable. This includes treating following processes as customers, and endeavouring to transfer conforming products, services, materials and documents to them, monitoring quality performance, analysing non-conformance data, taking both short- and long-term actions to prevent the repetition of mistakes, and feedforward and feedback of data.[17]

4.2 Purchasing and Quality Control

The importance of a linkage between the purchasing and quality functions have increased with the percentage of finished products purchased. When a joint project is undertaken quality training, process capability studies and corrective action planning becomes an obvious part of the supplier contact.[18]

When a product specification has been released and the product should be manufactured by a supplier, the purchasing department has to secure that the specification is really understood by the supplier. The buyer needs to reflect a total quality management approach to consider

[15] van Weele
[16] Dale
[17] Ibid
[18] Monczka et al

delivery time, delivery quantity and price. The term quality control can be defined as "making sure that the requirements are met". The requirements have to be seen as technical requirements.[19]

Every transaction between the customer and supplier will agree on:

- Basic requirements of the transaction
- The way in which requirements have to be realised
- How to control that requirements are fulfilled
- Actions to be taken when the requirements/expectations are not met

The quality assurance work is an important criterion when suppliers are chosen. The supplier has to be able to keep up with the design and the technical specification. Quality assurance concerns definition of the requirements, realisation of the purchase, check and verification and finally the feedback to the system. See figure 4-1.[20]

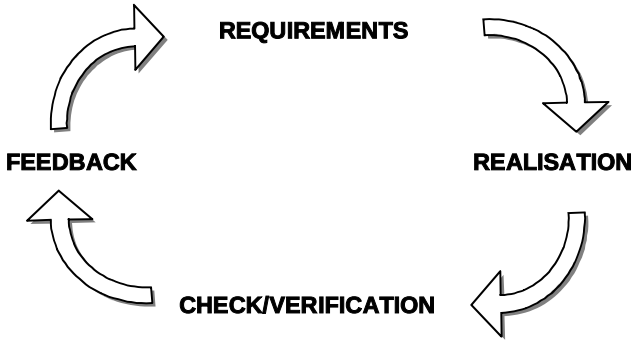


Figure 4-1 ***Quality Assurance***

4.3 Quality Systems

There are a number of quality systems not mentioned or described in this theory section, but to understand the base of a quality system and how different systems can vary, a few different systems are mentioned.

Six Sigma[21]

Six Sigma is a method for implementation of quality principles and techniques and aims for virtually error free business performance. By training individuals in a handful of methods to achieve green belt, black belts or master black belt the focus is to reduce waste and hence improve quality. Six Sigma measures the waste in parts per million influenced by the letter Sigma (Σ) from the Greek alphabet where Σ represent the sign for variability. The aim is to reduce the defects to 3.4 parts per million.

[19] van Weele
[20] Ibid
[21] http://www.pyzdek.com/six-sigma-revolution.html

Baldrige Criteria[22]
Baldrige Criteria is a result of the need for a comprehensive set of quality related criteria in the 1980. The system is based on criteria in:

- Leadership
- Strategic Planning
- Customer and Market Focus
- Information and Analysis
- Human Resource Focus
- Process Management
- Business Results

A company has to develop or adopt a quality system and are scored and assessed on basis of these criteria. The Baldrige Award is handled and issued by the US government and certifies that an organisation reach a certain quality level.

ISO 9000
The ISO 9000 standards were developed in Europe in 1987 by the International Organization for Standardization as a set of process quality standards to which certifications could be achieved. ISO 9000 has been criticised for not being customer oriented but to only focus to achieve the same quality over a period of time. An ISO Technical Committee was set out to revise the system which ended up in an eight underlying principles:[23]

- Customer Focus
- Leadership
- Involvement of People
- Process Approach
- System Approach to Management
- Continual Improvement
- Factual Approach to Decision Making
- Mutually Beneficial Supplier Relationships

QS 9000
The Quality System QS 9000 was developed in the 1990 by the three big U.S automakers GM, Chrysler and Ford to better fit their suppliers. QS 9000 is further described in section 4.4.

4.4 QS 9000

QS 9000 is an industry standard for quality systems within the automotive industry. It is based on ISO 9000 and was developed by "The Big Three" in the U.S; Chrysler, Ford and General Motors. The background to why QS 9000 was created was a long-felt desire from the suppliers of "The Big Three" that the customer specific demands on the suppliers should be co-ordinated. The work with QS 9000 started 1988 by Automotive Industry Action Group,

[22] Monczka et al
[23] Nilsson
Monczka et al

AIAG, which is the American trade association of the automotive industry. "The Big Three" where of the opinion that ISO 9000 could not enough guarantee the demands of the industry concerning quality assurance and continuous improvements. By the year of 1994, the first QS 9000 manual was published.[24]

The purpose and goal with QS 9000 where, and still are, that the suppliers should create a quality assurance system adjusted for the automotive industry. With the support of QS 9000, the supplier should develop systems that secure:

- Continuous Improvements
- Prevention of Deviations
- Reduction of Unnecessary Work

QS 9000 defines the basic expectations on the quality systems that Chrysler, Ford and GM have, but the standard is to be used by other customers within the automotive industry.[25]

Main Differences Between ISO 9000 and QS 9000[26]

QS 9000 has ISO 9000 as the base and completes, specifies and elucidate its demands. The most important differences between the standards are the purpose, target group and application of the two. ISO 9000 is general and assures the quality of a contract situation. The purpose of QS 9000 is however to co-ordinate the demands and to increase the efficiency in the automotive industry. QS 9000 is also more modern, customer focused and process oriented than ISO 9000.

	ISO 9000	QS 9000
PURPOSE	Assure quality of a contract situation	Coordinate demands and increase efficiency
TARGET GROUP	All industry sectors	Automotive industry
APPLICATION	General	Customer focused Process oriented

Figure 4-2*Difference Between ISO 9000 and QS 9000*

Certification

QS 9000 compensates for the quality standards "The Big Three" earlier had for suppliers and by that mandatory for direct suppliers. All requirements stated in QS 9000 should be incorporated in the supplier's quality system and controlled in the way the customer requests.

The supplier can be certified either by the customer (second part revision) or by a third part, independent of customer and supplier (third part revision). The certification process follows the process for ISO 9000.[27]

[24] Kinde et al
[25] Ibid
[26] Ibid

QS 9000 Contents

In addition to the main documents in ISO 9000, QS 9000 contains another requirement manual and five reference manuals.

Quality System Requirements (QSR) is a manual which describes the requirements based on ISO 9001:1994 and the requirement specific for QS 9000. Production Part Approval Process (PPAP) is the requirement manual which describes the process for approval of serial products. PPAP will be further explained in section 4.4.2.[28]

The five reference manuals in QS 9000 give guiding principles about working methods to fulfil the intention. The reference manuals do not contain requirements, but the main document QSA sometimes refers to them, and therefore they contain indirect requirements.

1. **QSA – Quality System Assessment**
   The manual is used to judge the conformity between the company's own quality system and the requirements in QS 9000.

2. **APQP – Advanced Product Quality Planning and Control Plan**
   The manual gives general guidelines for the quality planning of product development.

3. **SPC – Statistical Process Control**
   The manual is an introduction and guidance for statistical process control.

4. **MSA – Measurement System Analysis**
   MSA is an introduction to measurement systems and analysis of measurement capability. Also criteria for smaller and larger deviations are defined.

5. **FMEA – Failure Mode and Effect Analysis**
   In the FMEA-manual, a step-by-step failure analysis is described. Both Design-FMEA and Process-FMEA are included.

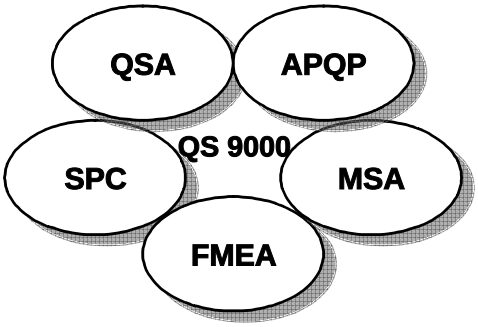


Figure 4-3 ***Elements of QS 9000***

Testing and Prototype Development

[27] Kinde et al
[28] Ibid

According to the Customer Prototype Support the supplier shall, when required, have a comprehensive prototype program. The supplier shall also have the same subcontractors and use the same tools and processes as when manufacturing for serial production.[29]

The supplier is demanded to present a control plan for the prototype part when required.[30] The control plan is further discussed in section 4.4.1.

4.4.1 APQP – Advanced Product Quality Planning

Quality planning can be described as a cycle (Plan-Do-Check-Act) without an end where continuous improvements are achieved by experience from earlier work. APQP is a structured method of defining and establishing the steps necessary to assure that a product satisfies the customer. The purpose with the quality planning is to facilitate the communication between all individuals involved to assure that the necessary steps are accomplished on time. Efficient quality planning depends on the engagement of the top management in achieving customer satisfaction. Some of the benefits of APQP are:

- To direct resources to satisfy the customer
- To promote early identification of required changes
- To avoid changes
- To provide a quality product on time at the lowest cost

The supplier's first step in APQP is to assign responsibility to a cross functional team. Effective product quality planning requires the involvement of more than just the quality department. At an early stage, it is important that the team identify customer needs, expectations and demands. The quality planning team should establish communication channels with other customer and supplier teams.

Control Plans

Control plans are written descriptions of the systems for controlling parts and processes. Separate control plans cover three distinct phases:

- Prototype
- Pre-launch
- Production

The control plan for prototypes is a description of dimensional measurements, material and functional tests that will occur during prototype build. The quality team should ensure that a prototype control plan is prepared. A check list is provided to assist in the preparation of the prototype control plan. The prototype build is a unique possibility for the team and the customer to evaluate how the product meets customer needs. The quality planning team should for every prototype part which they are responsible for:

- Assure that the product fulfil specifications and that the supplier encloses required data
- Give specific attention to special products or process characteristics

[29] QSR manual and control plan manual
[30] Ibid

- Use data and experience to establish preliminary process parameters and packaging instructions
- Communicate all deviations, changes and cost affections to the supplier

Product Quality Timing Plan
The first assignment the quality planning team is given is to set up a time plan. A well-organised time plan should include information about meetings, mile stones and other important points in the project. An effective status reporting is also important to complete the product quality time plan.

4.4.2 PPAP - Production Part Approval Process

QS 9000 consists of different manuals, of which two of them are requirement manuals. PPAP is a requirement manual which describes the process for approval of serial products. It defines generic requirements for production part approval, including production and bulk materials. The purpose of PPAP is to determine if all customer engineering design record and specification requirements are properly understood by the supplier and that the process has the potential to produce product consistently meeting these requirements during an actual production run at the quoted production rate.

General
The supplier shall obtain full approval from the customer product activity for:

1. A new part or product
2. Correction of a discrepancy on a previously submitted part
3. Product modified by an engineering change to design records, specifications, or materials.

PPAP Requirements
For production parts, a product for PPAP should be taken from a significant production run and the specific production quantity should be minimum 300 parts. For bulk materials, no specific number of "parts" is required. The sample should represent a "steady-state" operation of the process.

The supplier should meet all specified requirements and any results that are outside specification are cause for the supplier not to submit the parts. Every effort should be made to correct the process so that all design record requirements are met. If the supplier is unable to meet any of these requirements, the customer shall be contacted for determination of appropriate corrective action. Inspection and testing for PPAP shall be performed by a qualified laboratory. The supplier shall have the applicable items and records listed below, for each part, or family of parts, regardless of the part submission level.

1. Design Records
2. Any authorized Engineering Change Documents
3. Engineering Approval
4. Design FMEA
5. Process Flow Diagram
6. Process FMEA
7. Dimensional Results

8. Records of Material / Performance Test Results
9. Initial Process Studies
10. Measurement System Analysis Studies
11. Qualified Laboratory Documentation
12. Control Plan
13. Part Submission Warrant
14. Appearance Approval Report
15. Bulk Material requirements
16. Sample Production Parts
17. Master Sample
18. Checking Aids
19. Customer-Specific Requirements

4.5 Integrating Buyer and Supplier in Product Development

When new products should be developed the buyers have a unique position to include the experience and knowledge of the suppliers in the early design process. The buyer can also supply the product development with information about substitutes for high cost or bottleneck materials or components. The possibility to incorporate new technological innovations through purchasing department should also be considered.[31]

When a supplier is integrated in the product development much information will be shared. It is therefore important to specify who owns the right to a product when part of the design function is outsourced. The supplier will act differently depending on who owns the intellectual right of the product. The geographic location of the supplier is also important to consider. A development project can benefit from having an engineer from the supplier position with the development group in the early design state to minimize future design or process risks.[32]

4.6 Total Quality Environmental Management

Total Quality Environmental Management (TQEM) is defined as a more holistic view of how a company interacts with the environment. Rather than with TQM, the company has to strive for responsibility of the whole business process. The company has to concern real quality rather than aiming for certifications of quality work.[33]

When a company wants to implement a TQEM-system it has to study the main principles and define an appropriate tool. It is more important to understand and control the process than the product. The management must be aware of the processes and the problems to be able to foster a culture with more focus on quality achievements.[34]
The process to achieve TQEM goes through organisational boundaries and makes teamwork necessary while the management leads and engages everyone in the process. The quality improvement is emphasised producing benefits over time, whether developed continuously or project by project. Quality is a process, and not an instant cure and it is the process which

[31] Monczka et al
[32] Ibid
[33] Sammalisto
[34] Ghobadian et al

should be controlled and not the product**.**[35] To focus on the process rather than the output problems with undetected waste and suppliers not using a standardised method are highlighted. The responsible process owner is also revealed which is important to avoid irresponsible delegation to sub contractors.[36]

4.7 Process Improvements

The final result of an organisational improvement depends on a number of facts where the most important is the way the improvement is introduced and how well the communication works. The final solution can be excellent, but if it is not communicated and accepted within the organisation, nothing will change.[37]

A quality process is divided into four phases. It is important to understand how the process improvement is undertaken for better quality assurance.[38]

- Insight to the situation
- Preparations
- Education and training
- Improvements/changes

It is important to involve all employees in the process. Preparation and planning are important factors to fulfil to succeed. Following moments are important to consider when a process for quality assurance is developed.[39]

- Give quick feedback to new suggestions.
- Reward employees who come up with improvements to the quality process
- If a suggestion is not possible to implement, make sure you motivate why
- Implement as many changes as possible even though the improvements are small

Business and quality assurance are team involvements which indicate the need of clear organisation and responsibility information. Management must set down a policy for quality attainments which must be trained and understood by all involved employees. To achieve this, clear management initiative is necessary.[40]

Activities concerning quality must be carried out in the most effective and efficient way for the business. Good training and properly thought-out procedures for those who will implement changes is important. Business scopes and technologies changes imply a need for dynamic and flexible management and quality assurance systems. Reviews and audits of all systems are needed as well as a general understanding of the changed needs.

4.8 Purchase of Goods

The purchasing function traditionally comprises the process of buying and involves determining the need, selecting supplier, negotiate price, issuing order and following up

[35] Sammalisto
[36] Monczka et al
[37] Darmer et al
[38] Ibid
[39] Edvardsson et al
[40] Duncan et al

ensure proper delivery. The purchasing function should obtain proper equipment, material supplies and services of the right quality, in the right quantity, at the right price and from the right source.[41]

4.8.1 Raw Material

Purchase of material often involves large sums of money and the price of the raw material plays a significant role for the cost of the finished product. The raw material can be divided into natural raw materials (natural products such as corn, wheat, coffee, sugar) and minerals (for example coal and copper). For many manufacturing companies the raw material is the most important component in their purchasing portfolios. Commodity exchanges highly affect the purchasing of raw material where for example metals are traded and the world-market price is set. This fact makes it hard for smaller manufacturing companies highly dependent on only one or a few raw materials when a significant price increase occurs.[42]

4.8.2 Components

Parts which are to be built in the final product sold by the manufacturer are called components. For standard components, the supplier provides specifications for which the components are manufactured from, for example tyres and light bulbs. Specific components and designed and specified by the buyer, for example forgings and castings. When components are purchased for serial production, it enables buyers to negotiate long-term agreements with suppliers. This gives the buyer economies of scale because the administrative process is simplified and orders can be placed directly at the supplier. Quality aspects play an important role in buying components and require special attention. This is because the quality in the constituent parts determines the quality of the finished product. Suppliers are chosen after carefully evaluation of their quality system. They are only included to the “approved suppliers” after they have been determined that they are capable of delivering products of the required quality.[43]

[41] van Weele
[42] Ibid
[43] van Weele

5 Manuals and Standards Developed by Scania

This chapter provides a brief description of the general manuals used at Scania. The manuals have been developed for different departments or for the Scania organisation in general. It is important that the manuals are kept up to date as they regard the employees' daily work. The chapter begins with a description of Scania's Production System which forms the basis for all work at Scania. The chapter continues with the PD process and finally manuals concerning procurement of prototype parts. These manuals provide the basic knowledge of the activities and principles that affects the quality assurance of prototype parts.

5.1 Scania's Production System - SPS

SPS is the common platform for increase of profitability, growth and competitive power. The system describes basic philosophies, priorities and principles for the work at Scania. The Scania House is a well-established model that comprises the basic values and principles described in SPS, see figure 5-1. The model acts as a guide for the entire value chain and is also used in supplier development.[44]

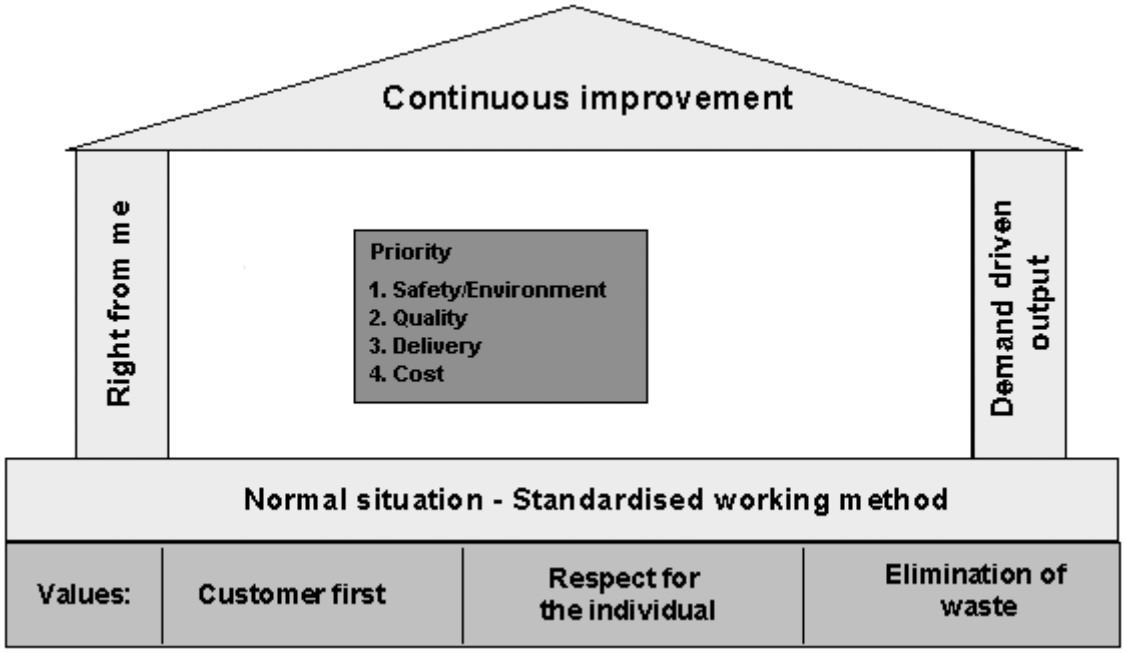


Figure 5-1 ***The Scania House (Source: SPS manual)***

[44] Scania supply chain development group, SPS manual

5.1.1 Philosophies and Priorities

Values

The production system can be compared to a house built upon three philosophies:

- Customer first
- Respect for the individual
- Elimination of waste

There is a logical connection between these philosophies. When Scania's customers ask for high-class products, Scania needs committed employees who are ready to meet the customers' needs. To strengthen the company's competitive edge, the goal must always be to eliminate waste.

Priority

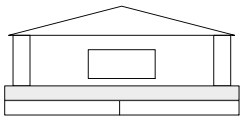
The priorities in everyday work at Scania are important to the health of the company. These priorities are equally important to the success of Scania and are easier to relate to in the day to day business.

1. Safety/Environment
2. Quality
3. Delivery
4. Cost

5.1.2 Basic Principles

Leadership is an important key to success in the working method and it is one of the basic elements of the work, which rests upon four principles:

- Normal situation – standardised working method
- Right from me
- Demand driven output
- Continuous improvements



Standardised Working Method

According to the SPS manual standardisation can be defined as:

"The best well known way to repetitively perform an activity"

The starting point for Scania's work is that everything should be done according to a standardised working method. The aim of this is to always strive after continuous improvements.

All assignments within Scania must be completed properly, using standardised working methods. This ensures that the products have consistently high quality; if different methods are used, quality and production time will vary. The standardised working method reflects the

best known way to deal with a situation. When a better way is discovered the standard is revised and changed. The aim is to have a standardised working method for all processes within Scania throughout the world.

Following principles should be pursued when establishing a normal situation; in other words a situation where there are no quality deviations or production interruptions:

- Standardisation

Standardisation means that Scania's employees carry out assignments in the same way until they discover a better way of doing the things, in other words they use the best known solution.

- Pace

The pace at which Scania works reflects the sales in the market. The pace-time is constant until there is a decision to alter it, for example if new facts arise that demands changing of the production rate for a given period. The volume produced is varied by adapting the production time.

- Levelled/balanced flows

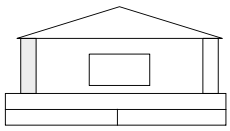
To ensure that the equipment is used efficiently and the employees level of efficiently is maintained, physically-demanding jobs should be phased at an even level throughout the production time. In the same way activities should be divided evenly within and between work stations throughout the flow.

- Visual

It should be easy for everyone to see what is normal or abnormal.

- Real time

Real time means that there are no delays in the production system, which means that Scania employees see things straight away and act immediately.



Right From Me

The statement means that the Scania employees do things properly and right from the start. They have the right tools and instructions, and use methods that make it virtually impossible to make things wrong.

- The next manufacturing stage – your customer

The right from me philosophy is the basis of quality assurance at Scania. The next production stage is always your customer and it is every person's responsibility to hand over a product with the right quality.

- Sort out problems

Attention must be taken to every possible cause of an error and be sorted out. When there is a deviation from a standardised working method, a machine function is wrong or a fault is detected a special care must be taken to proactively solve the problem.

- Stop problems

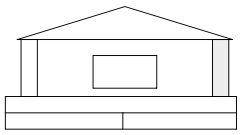
The problem shall be corrected immediately to avoid waste and unnecessary work. This might mean to stop the whole process to find the cause of the problem. In the long run the positive effects will overcome the short term losses.

- Fast feedback

When an error is detected, it is always necessary to find and alert the person who caused the problem and others affected by the problem. Problems should not be hidden and only solved by the person who detects them. The real responsible to solve a problem lies on the one who caused it.

- Machines can help

There is an idea that the process and machines shall help the Scania employees to detect mistakes. The machines used at Scania should when possible stop when a quality deviation arises. A component should not fit in the next production step if the quality is faulty.



Demand Driven Output

The production does not start until the customer has signalled a need. This means that the production is customer controlled and no large stocks of finished products are established. The customers order how many trucks, buses or marine engines they need which should be reflected in the entire manufacturing chain.

- Production to meet customer requirements

Every product is produced to a special need. This will eliminate waste and requires right levels of buffers throughout the production chain.

- Visual buffers

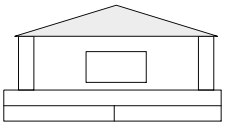
A correctly dimensioned visual buffer helps every stage of the manufacturing to produce and order the right amount of material. With maximum and minimum levels it is easy to see when it is a normal or abnormal situation.

- Small batches

Small batches help Scania to eliminate waste and keep fast production at a low cost. This requires good order and right tools available at right places.

- Consumption controlled order of material

Various systems are used to control the order of material. Kanban, Sequence or Re-order point are used depending on which is the most appropriate. The goal is however to have the right material in place at the right time. Another simple and basic principle is that the information flow mirrors the physical flow. This gives Scania a self regulating system that works in real time.



Continuous Improvement

Continuous improvements mean that Scania creates a new and better normal situation by cutting waste. This challenging and improving of the work is part of the daily work and priorities based on product follow-up are set.

The work of continuous improvement considers that it is equally important to conserve energy as it is to find a simple solution and avoid overproduction. Three headlines describe continuous improvements.

- Learn to detect waste

Waste is the biggest threat to profitability. To avoid waste visible workplace and processes must be set up. Different forms of waste are:

  - Overproduction
  - Over processing
  - Unnecessary movement
  - Unnecessary transport
  - Unnecessary inventories
  - Errors, rework and rejects
  - Waiting

- What does efficiency mean?

Efficiency means to spend as much of the production time as possible on activities adding value on the product. This work should be done smart without increasing the workforce. False efficiency is to produce more than the customer demands. False efficiency is usually shown when machines are at 100% utilisation instead of 100% availability. The work should therefore be focused on real long term efficiency.

- Working in improvement groups

Improvement work covers all levels and is achieved by using facts to challenge the process. Every problem should be seen as an opportunity which leads to a new and better normal situation. The improvement group takes the initiative to do this by working in close co-operation with supporting staff.

The following principles are used by each improvement group to achieve continuous improvement:

  - React to deviations
  - Facts as a basis
  - Make improvements
  - Standardise
  - Challenge the process – again and again

5.2 The PD-Guide

Scania's PD process is a well formulated normal status for development work at Scania. The process described in the PD-guide contains three arrows which divides the process depending on if a change regards Pre-development (yellow arrow), Continuous Introduction (green arrow) or Product follow up (red arrow).[45]

Figure 5-2 ***Scania Product Development Process (Source: PD Guide)***

5.2.1 Pre-development – Yellow Arrow

This arrow is a preparing phase where ideas of new products or improvements are analysed. All the work in this stage is supervised by cross-functional groups with different perspectives. The main reasons for working with pre-development are to reduce and clarify risks further on in the product development. The work creates a portfolio of ideas for technical solutions possibilities of Scania patents. A rough timetable for further work is also developed.

All through the Pre-development phase, research and tests are performed and analysed by the cross functional teams. The executors of the assignment such as line organisation, project groups, suppliers and institutions are held up to date and consulted.

5.2.2 Continuous Introduction – Green Arrow

The main idea with the stage of continuous introduction is to use a standardised working method to develop and bring new products to the market. Before the green arrow begins there has been a decision to go on with an idea from the yellow arrow to produce a real product or a modification of an existing one. It is in this stage where the real development work is undertaken and will result in finished products ready for market introduction.

The green arrow is divided into five phases which should be executed in the right order with main deliverables (MD) and decision points (DP) for every employee involved in each stage. There are several success factors which involve clear directives and early identified MDs, meetings and status reports and a high involvement from all parties.

[45] PD-guide

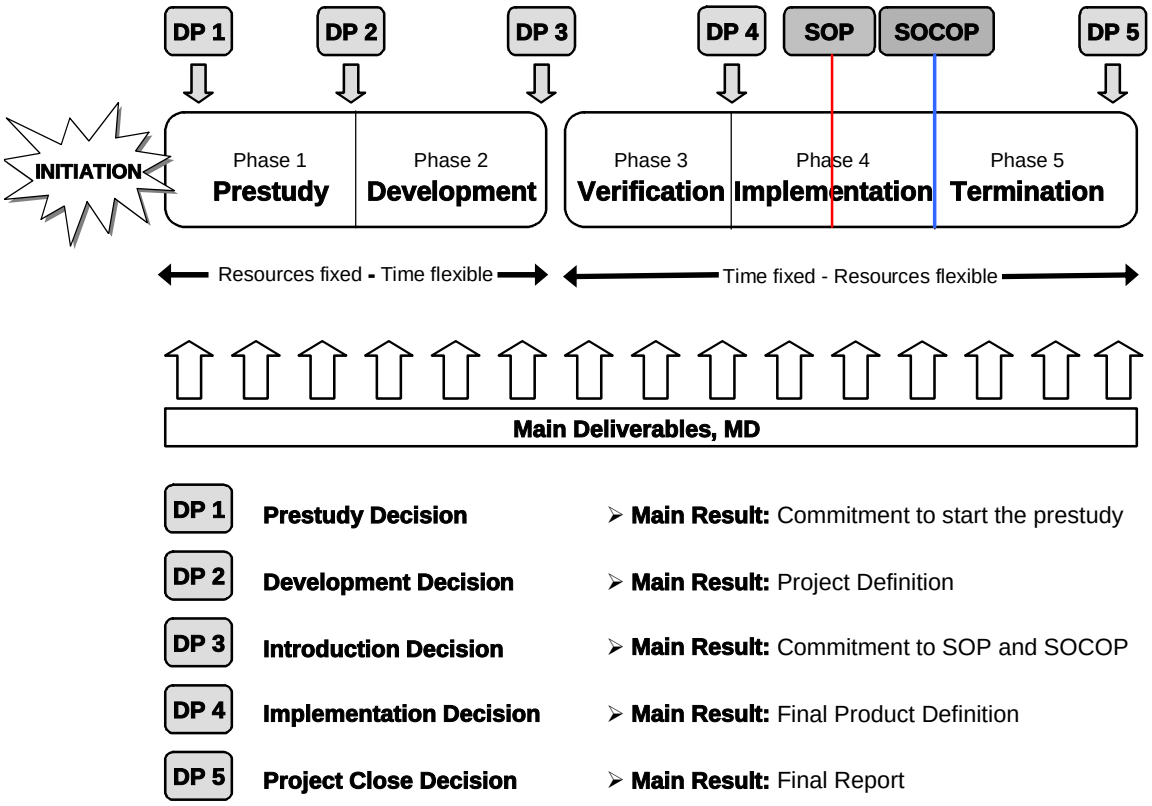


Figure 5-3*Green Arrow (Source: PD Guide)*

Phase 0, Initiation

Every development project starts with the initiation where a project manager assigns the project. The prestudy is compiled and a development decision is taken.

Phase 1, Prestudy

This phase begins with the project manager creates a project team. The team puts together a Project Definition which is the most important basis for the project. The project definition contains effect objectives, project target restriction, budget, organisation and time schedule. A foundation and a commitment within the line and project organisation are created. The design concept is finished and the parts are established. The MD checklist and MD matrix are put together.

A project is divided into several objects which are the lines undertaking. Project manager together with the line manager define the scope of the object. These object definitions are produced parallel to the project definition and are ready at the end of phase 1.

Phase 2, Development

In this phase the final demands on the product are set. The decisions on whether to make or buy certain parts are taken. Development tests are carried out and at the end of this stage the Introduction Decision Point (DP 3) is taken. MD checklist and matrix provides objectives for each department for this phase. These MDs are checklists to minimize the risk of missing important activities.

Phase 3, Verification
This phase will verify that the product is ready to be approved for series production. The strategy for ramp up is made and parts for SOP are ordered from the suppliers. Field tests are performed to provide Scania with further adjustments and as a verification of the quality of the product. MD checklist and matrix guide provides the involved parts with a working method to succeed in this phase. The phase ends with an implementation decision.

Phase 4, Implementation
In this phase the strategy for marketing and after sale are finished. It is important to make an early SOP to verify that the production process with the serial parts. This verifies that both Scania and the supplier can manage the production capacity. Spare parts and after sale service are ready for production. The phase ends with the decision to have reached SOCOP.

Phase 5, Termination
During this phase the product reaches the end customer with the help of the plan for ramp up. All after sale service are ready and supports the customers. Reports are written and after approximately six months the project organisation hands over the responsibility to the line organisation. The project is then terminated.

5.2.3 Product Follow Up – Red Arrow

The red arrow is a process to maintain and update the current product range. The process takes place after a product is in serial production and introduced on the market. The process can be divided into assignment types such as field quality, product change request, design adjustment, specification adjustment and cost reduction.

The functions of the red arrow are managed by a Quick (Q), Medium (M) or Heavy (H) team depending on how difficult and complex a task is. These teams consist of employees from the line organisation at Scania. The Q team is used when a problem can be solved within 24 hours. If the Q team cannot solve the problem the M team takes over. If the problem comes out to be more of a long term one the H team is sent in.

5.3 The Testing Process

Scania's testing process is part of the PD process. The testing process includes all the procedures necessary to initiate, plan, perform and analyse a test of a prototype.

The testing process is divided into a number of part processes where each process includes criteria and control points to secure that the part process is terminated. The control points are also the basis of follow-up of the test. The main purpose with the testing process is to secure that a product fulfils all defined requirements. To get there a number of intermediate goals are set up:

- Secure that a test plan is set up as early as possible in the testing process
- Reduce risks for material shortage upon test start
- Secure that information is available to follow up the process
- Secure that responsible person gets information about deviations to take actions

The testing process can be performed in all phases of the PD process. The features and goals of the testing process are very depending on where in the PD process the development work is

and how far it is to reach SOP and SOCOP. Generally the testing process can be described according to the following phases of the PD process.[46]

Phase 1: Tests of orientating nature are performed during this entire phase. Time plan and lead time are essential depending on the product.

Phase 2: Development tests are the general test in this phase.

Phase 3: Verifying tests are executed.

Phase 4: In this phase the testing process for a product is terminated by validating tests.

The testing process contains checklists and descriptions of what to be done in each part of the testing process. The work method and procedure is however described in the documents STD 3636 for the designer and APM 003 for the project buyer and supplier quality assurance engineer, further described in sections 5.3.1 and 5.3.2.

5.3.1 Design and Testing Assignment, STD 3636

STD 3636 describes the project assigner's and the test leader's responsibilities during a test. A test can be performed for a new prototype but can also be performed for an improved existing prototype. Assignments can include measuring, test assembly, calculation, analysis, design and physical testing in order to determine the properties of the objects. Inspection can also be included in testing.

STD 3636 is a part of the product development process and the testing process, described in chapter above, with the perspective and as a guide for work procedure of the designer. The standard gives a general description to the physical and informative routine flow when a prototype part shall be ordered and tested.[47]

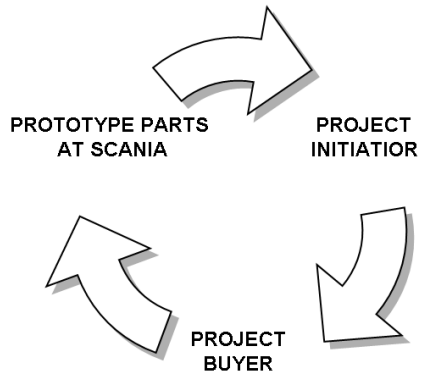


Figure 5-4 ***Design and Testing Assignment***

STD 3636 further describes how a tests order, called PA[48], should be handled and performed. The test order is a system consisting of information about the test assignment and the test

[46] Scania InLine
[47] STD 3636
[48] Swe PA = Provanmodan; Eng Test order

procedure to co-ordinate resources and visualise the time plan. The test order shall be written to identify the overall need of resources and equipment for a test. Object leaders and co-ordinators work in this system to facilitate and improve the development and testing work.[49]

5.3.2 Automotive Purchasing Manual – APM 003

An APM is a document consisting of the aim and purpose of a work method together with a short description what it will imply. APM standards are used as a checklist for different procedures at Scania's purchasing department and are handled by the process control group of each sub department.50

The APM 003 controls the certain activities that need to be performed at the purchasing department during the phases off the product development process. The work is divided into three activities, see figure 5-5:[51]

- Development and testing process
- Serial and spare part process
- Quality assurance process

	Phase 1 Prestudy	**Phase 2 Development**	**Phase 3 Verification**	**Phase 4 Implementation**	**Phase 5 Termination**
Development and Testing Process	Potential development supplier selected	Development agreement placed Test parts for development ordered	Test parts for verification ordered		
Serial and Spare Parts Process	Preliminary time schedule, product and investment cost estimated	Potential production supplier selected	Tool order and open order for production and spare parts placed		Handover from project to production and spare parts purchase
Quality Assurance Process	Quality assurance plan defined	Manufacturabiliy assured	Pre-serial production process assured	Serial part production process approved	

Figure 5-5 ***Activities involved in Design and Testing Assignment (Source: APM 003)***

[49] Scania Design and Testing Assignment
[50] Pettersson, Marianne; Purchasing department, Chassis and Cabs
[51] APM 003

The phases are the ones described in section 5.2.2, the green arrow. APM 003 emphasises that the focus of purchasing department changes regarding product development as the project moves towards phase 5 termination. A more detailed list of the activities can be found at Scania's intranet, InLine.[52]

[52] Scania InLine

6 Empirical studies

In this chapter the interviews with Scania employees, suppliers and benchmarking parties are described. The chapter is primarily focused on the work concerning prototype procurement and the different aspects of the stakeholders in the process.

6.1 The Development Project

When a development project is initiated, many decisions have to be made on how to fulfil the given need of a new or modified product. Many of these decisions have to be addressed early in the yellow arrow, see section 5.2, before the actual product development of the parts has started. The decisions will also make impact on the possibilities of and work with quality assurance.

6.1.1 Initiation of a Development Project[53]

A new development project is in most cases initiated by a demand for a design change of a part. The change can be initiated from the line organisation or a specific development group. For every project there is a project owner and an assigner who initiates the development project. The assigner should establish goals and frames for the project and also approve, inspect and finish the project.

When parts for Scania's prototypes are developed it can be done in two ways; either by the designer at Scania or by the designer in cooperation with designers at the supplier. Both types of development projects require an assigner and a project manager. Before the planning phase in the testing process is initiated, the project must be approved by responsible design manager.[54]

6.1.2 Products Developed by Scania

Prototype parts developed internally are designed and constructed by a Scania designer. The part is shown in a drawing with specific requirements of tolerances of measurements and material specifications. With the Scania developed parts, Scania takes full responsibility of whether the part functions as it is intended to do. The supplier's responsibility is to manufacture the part according to specifications, drawings and 3D-models offered by Scania. There might be a discussion with the supplier and the designer depending on the relationship to the supplier. When disagreement about the product occurs or when the part technically can not be done in the right way, the supplier might give inputs of how to better construct the part. This communication is very important to be able to manufacture the product properly and pay attention to new or changed requirements.[55]

6.1.3 Products Developed by Supplier in Co-operation with Scania

When the supplier possesses deeper technical knowledge about a parts construction and characteristics, than Scania, the supplier is assigned to carry through the actual product development work. These parts are often of a complex nature or have functions that require specific core competence not available at Scania. The designer's role at Scania will be to

[53] STD 4210
[54] Project coordinator; R&D dept
[55] Scania designer; R&D dept

make a functional and technical specification of the part as well as the measurements of interfaces. The part can be a completely new product or merely an adjustment of an existing one. There is usually more interaction between the Scania designer and the potential supplier before a purchase of complex parts than with low technology standard parts. There are both advantages and disadvantages with assignment of development of parts to the supplier.

6.2 Prototype Procurement Process

The process for procurement of prototype parts at Scania today is shown in figure 6-1. The figure describes the overall informal flow but is in reality completed with informal discussions between the three parts; designer, buyer and supplier. There are a few, poorly compatible, internal IT systems at Scania used to facilitate the development work and the purchasing of parts. As these systems are not fully compatible to each other there is a risk of loosing information and a problem to get a transparent view of the process. There is however plans to restructure and reorganise these IT systems within a few years for better compatibility.[56]

Today, much of the procurement of prototypes is carried through by using certain employee's special knowledge and relation to parties and within and outside Scania. Special work procedures are used and many important steps are done individually and not documented or followed up.[57]

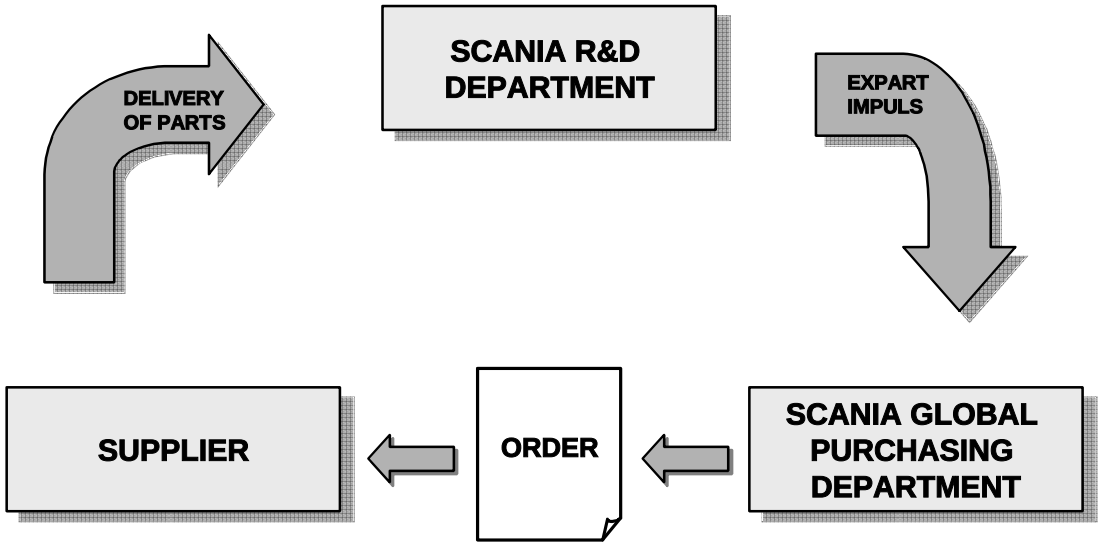


Figure 6-1 ***Prototype Procurement Today***

6.2.1 Designer Requires a Part for Testing

When the development process has reached the stage where the designer is in the phase before test start, the parts have to be ordered. In this stage the development of the certain part should

[56] Managers; R&D dept
[57] Scania designers; R&D dept, project buyers; purchasing dept

be finished and drawings and specifications should have been set up. Test procedures for the prototypes are documented by the project coordinator on a test order, PA. The PA contains information of which parts that should contribute in the tests and the number of parts needed. Designer responsible for each part in the test reports the information to the project coordinator, who in turn compiles the information to a PA.

Expart
Expart is the R&D department's internal system and the system supporting the testing process at Scania. Expart communicates to the other internal IT systems via different windows, starting with XXX and followed by a specific number. Expart consists of a database with information about all ongoing projects and also information about tests, time schedules and coming projects. Furthermore, Expart is a planning system for controlling start of test mountings according to part access. [58]

Matris
Matris is the IT-system used at Scania's global purchasing department, i.e both in Sweden and in Brazil. Matris consists of information about all suppliers, parts to be purchased and the status of orders. Quality status of serial parts is also documented in Matris. Matris can be reached by all buyers and quality engineers at Scania. It is Matris that handles the impulse for purchase from the Expart system at the R&D department.[59]

Impulse for Purchase
When the PA is ready the designer takes the decision to send an impulse to the buyer for order of the part. In this phase the test procedure is planned and the parts in the prototype that should be tested have to be ordered. Information about a part such as, PA number, drawing or technical specification is sent into Matris via the Expart impulse. In practise, the buyer only opens the PA if some special information about the part is needed. There are fields on the impulse document where the designer can comment on the part and give the buyer specific information about the test procedure. This is however often not used and depends on the routines of the designer and the buyer.

The designer will usually discuss the possible supplier of a prototype part with the buyer. The designer might also inform the buyer about important dates and other critical information about a test. This is however much up to every designer and buyer to keep a good contact. Some designers will rarely contact the buyer as they know that there is much relevant information in the PA that the buyer can search for. The reality is that the buyer does not have time to investigate and understand critical information about a test which might result in poor basis for supplier selection. Other relevant information is not forwarded to the buyer who usually will not demand or search for information and non written requirements about the part and the test.[60]

Not all sharing of information is supported by the systems Expart and Matris. For example does not Matris support different versions of a drawing which is highly used in some of the design sub departments. When the designer sends an impulse for purchase and makes changes

[58] Designers; R&D dept
[59] Process developer, purchasing dept
[60] Designers; R&D dept, project buyers; purchasing dept

on the drawing afterwards, there is a source of uncertainty of which version of the drawing that corresponds to the ordered part. Consequently there is a need for the buyer to know from which version of the drawing the part is ordered.[61]

6.2.2 Order of Part

Purchasing of prototype parts are handled by project buyers situated in each commodity group at Scania's global purchasing department in Södertälje. Upon reception of the Expart impulse from the designer, the buyer starts the work to find a suitable supplier for the parts. If possible, a supplier proposed for the future serial production is used.

The project buyer places the order at a suitable supplier who usually should have been contacted for technical discussion and improvements of drawing before order is placed. However the orders of prototype parts are quite often placed without thoroughly survey of the suppliers, based on experience to save time. An advantage when the supplier is contacted before order is that preparation for the manufacturing and improvements of the drawing can be done and hence the total lead-time can be shortened.[62]

A usual problem with the orders for prototype parts is that it is hard to afterwards get a clear picture of what was really agreed upon. The basis for this is the both informal communication and the lack of documentation of the communication between designer buyer and supplier. The quality engineer at Scania is usually not involved in this work due to high demands of focus on parts to be put in serial production.[63]

6.2.3 Supplier Reception of Order

Upon reception of order, it is not always that the supplier starts to manufacture the parts at once. In many cases the information on the order and the enclosed drawings or CAD-models are incomplete. This is due to tight time margins and the designer's anxiousness to get the parts ready for testing. Hopefully the supplier will contact the responsible designer at Scania, but even when there are uncertainties with a drawing or a technical specification, many suppliers do not contact the responsible designer for clarification.[64]

The total lead time from purchasing to delivery of parts is often a mean of uncertainty for the design department. It is very much up to each designer to keep a good contact with the supplier.

6.2.4 Manufacturing of Parts

The work of a supplier to manufacture a part is highly dependent on whether the part is designed by Scania or by the supplier. In cases where Scania's designers have developed the parts from start, they provide the supplier with drawings, CAD-models. If the part is developed by the supplier the designer will specify measurements of interfaces and provide a technical specification for the function.[65]

[61] Designers, R&D dept
[62] Project buyer; purchasing dept
[63] Quality engineers, project buyers; purchasing dept
[64] Project buyer; purchasing dept
[65] Designers; R&D dept

The supplier's task is to manufacture parts that fulfil requirements and specifications. In those cases where the parts are developed in cooperation with the supplier, the responsibility is shared between the designer at Scania and the supplier. The advantage with this collaboration is the possibility for Scania to concentrate on its core competencies and let the suppliers develop parts which requires highly specialised technology. Possible disadvantages are the fact that Scania can be too dependent on a supplier which possesses a unique knowledge.[66]

When a supplier manufacture a part there are often uncertainties of the importance to follow the exact specification. It is not uncommon that the supplier makes changes that are needed to be able to keep cost down or make the part function. Much too often these changes are not established at Scania and some times not discovered until the serial parts are to be produced. If the Scania designers and quality engineer are not aware of the changes, the specification is not changed and the deviation not addressed in a proper way.

If there is a quality deviation in the produced prototype part the supplier is supposed to contact Scania. The time for this contact is not clearly specified today which leads to that the supplier in some cases writes a note on a measurement protocol that is send with the prototype to Scania. It is then usually too late to change the time plan and the test will be carried out anyway. The result of the test is however damaged by the uncertainty of how the deviation impacts the test result. All too often the supplier will not report a deviation at all, even though they might know about it, in hope of that Scania will not comment on it. Designers and buyers at Scania have the opinion that it is profitable for suppliers to deliver prototype parts to Scania as the price and quality don't have the highest priority and is given less focus by the Scania designers and buyers.[67]

6.2.5 Delivery of Parts

When parts are ready for delivery and the supplier has executed internal tests, parts are packed and shipped to Scania. Measurement protocols are in some cases sent to Scania in the same package as the prototype. There is no formal description of how and where the protocols are to be sent to Scania. The protocols are seldom analysed and never filed at Scania.[68]

6.2.6 Reception of Parts

When the prototype parts arrive at Scania they are put in different warehouses before the tests is started. Today there are difficulties to, in a comprehending way, report and supervise which prototype part that have arrived at Scania. There is a group appointed to revise the procedure of internal inbound material flow.

Today there is no internal quality and measurement control performed at Scania for prototype parts as the quality assurance work is delegated to the supplier. This means that a deviation not reported by a supplier will probably not be found until the part is tested.[69]

[66] Designers; R&D dept
[67] Designer; R&D dept, project buyer; purchasing dept
[68] Material planner; purchasing dept, designers; R&D dept
[69] Designers; R&D dept

6.2.7 Parts Ready For Testing

When all parts are received for a test the testing engineers begins with the tests. The tests are performed in different ways depending on the need. In the beginning of the PD process many tests are carried out in order to test functions and new ideas. When SOP approaches the tests are more focused on wearing and long term field tests.[70]

If a deviation from specification is found in a test the value of the outcome might seriously be reduced. The deviation does not have to mean lower quality but is less likely to be found if it means higher quality. When the serial production tools are used around SOP, problems that could have been found earlier might cause serious costs and delays.[71]

6.3 Supplier Quality Assurance and Testing Engineers

6.3.1 Supplier Quality Assurance Engineers

When a product development project is initiated in the green arrow the work of preparing for a PPAP should be started. PPAP begins as a plan for the future manufacturing of serial parts and ends with a certification of the manufacturing and delivery processes of a supplier for serial parts. PPAP is further revised during the serial production process when changes are done to the parts or the manufacturing process. In reality much of the work to prepare for PPAP is first initiated when a development project approaches SOP. This is due to the heavy workload on each SQA. This differs somehow depending on the employee and sub-department.[72]

At Scania the SQA, situated at the purchasing department, is responsible for the parts in each commodity group. This responsibility implies that the SQA has to follow the development of the parts and the manufacturing methods used at the suppliers. This is necessary to be able to take actions when there is a risk that the supplier will not be able to provide a Part Submission Warrant (PSW) guaranteeing the other 18 PPAP documents at the SOP.[73]

Scania has a well documented method of how to follow PPAP during the PD process. This is described in APM 003 “Main Deliverables, Deliverables and Activities for Purchasing”. The routine is used to different extents depending on how suited the routine is for a certain part. This is generally depending on the complexity of the part and whether the part is Scania or supplier developed. The availability of time for the SQA is also a factor that influence to what degree APM 003 is followed.[74]

The work by the SQA preparing the PPAP does not include the quality assurance of the prototypes delivered to Scania for testing. The suppliers and processes are however evaluated according to the prototypes delivered and how well the testing process falls out. The quality of the serial products is affected by how well the PPAP work fell out. The PPAP work is in turn depending on the quality of the prototype parts in the early PD process.[75]

[70] Designers; R&D dept
[71] Designer, testing engineers; R&D dept
[72] SQA, project buyer; purchasing dept
[73] SQA; purchasing dept
[74] SQAs; purchasing dept
[75] SQAs; purchasing dept, designers; R&D dept

6.3.2 Agreement Impact on Quality

The way in which an agreement is set with a supplier affects the quality assurance work and dedication of the supplier. There are generally three kinds of agreements for delivery of prototype parts to Scania.

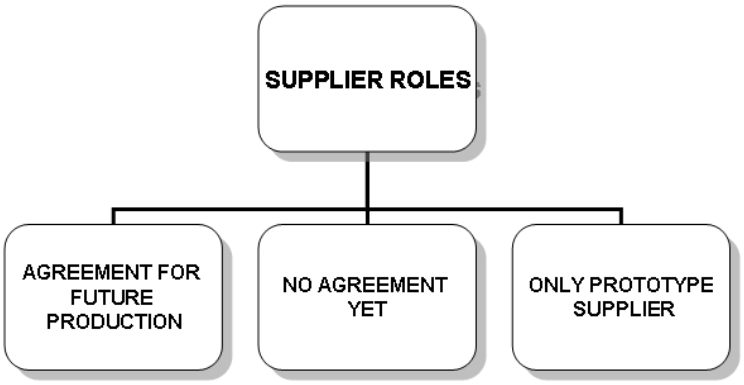


Figure 6-2 ***Alternative Supplier Agreements***

Agreements for Future Production

When the supplier manufactures parts that are of complex nature or demands tools that are too expensive to develop only for prototype part manufacturing, the supplier is often aimed to get the order for the future serial parts. In these cases, Scania needs a well-developed relation with the supplier to minimize risks. Responsible project buyer has closer contact with the supplier and work in cooperation with the production buyer that will take over the responsibility six months after SOP.

The advantage for Scania to use the same suppliers the entire process from prototype phase to serial production is the longer experience the supplier will have acquired when serial production starts. In some cases the work of PPAP is started earlier as the supplier knows they will get the order for serial production.

By starting the PPAP work early during the prototype manufacturing, SOP delays due to PPAP delays can to a higher extent be avoided. This agreement does however not guarantee that the supplier focus more the quality of the prototypes hence the agreement for serial production is already set. There are other disadvantages with early agreements with suppliers about serial production as Scania becomes dependent of the supplier and loses the power to negotiate during the development.

No Agreement
Depending on the features of the product a common scenario is that the purchase of prototype parts is separated from the order of serial parts. When the date of SOP approaches orders for the serial production are placed. In those cases, it is possible that another supplier takes over the manufacturing when SOP is reached. One reason to why the original supplier is not used for the serial parts production can be considerable quality deviations of the parts. A supplier can also loose the possibility to manufacture parts for serial production if a competing supplier offers a more advantageous price.[76]

The relation of Scania and the supplier can sometimes be frozen when the supplier only waits to get informed of its possibilities to get the manufacturing for serial parts. Usually no PPAP work is conducted by the supplier before this determining factor is decided. This consideration is logic hence there is no point for the supplier to conduct any PPAP work if it not will manufacture parts for Scania's serial production.[77]

Only Prototype Part Supplier
Some commodity groups require very special manufacturing of prototype parts. This is sometimes done at special prototype supplier who are specialised in producing a variety of product in short series of complex products at a tight time schedule. The main part of their production is prototype parts and they usually have no intention of becoming the future serial parts supplier. When the prototype is fully developed by Scania and the testing process is finished, the manufacturing of the parts is handed over to a serial supplier.[78]

Disadvantages with core prototype suppliers are that the serial supplier who takes over when SOP is reached has no experience of the manufacturing of that part and hence there are normally a running-in period before required quality is maintained and SOCOP can be started. Changes in drawing might be necessary as if the serial tool can't produce the parts that have been tested during the product development. The prototype supplier does not usually give criticism for this as they are only specialised in producing prototypes. In general, different production processes are used for the prototype parts and the serial parts, which might result in higher or lower quality of the prototypes. A worst case scenario is that the serial producer is not able to manufacture the part at all.[79]

6.3.3 Designer and Testing Engineer

When a deviation is reported before or during a test of a prototype part there is seldom enough time to demand a new part from the supplier for the test. The test has to be conducted with the knowledge that the result might be affected by the deviation. The supplier will be informed by the problem and are usually told to correct the deviation for the next delivery. This communication is not structured and is often done informally by the designer at Scania in some kind of collaboration with the project buyer.[80]

The filing of deviation occurring in the PD process is not structured an in many cases not performed at all. As the designer and the buyer discuss the problem with the supplier an

[76] Project buyers; purchasing dept
[77] Suppliers
[78] Prototype supplier
[79] Project buyer; purchasing dept
[80] Designers; R&D dept

agreement for removal of the problem is set. This makes it difficult to trace the reason to a late discovered deviation as no documents are filed.

When a deviation occurs after the Start of Production there is a more formal way to document and file the problem. An IT system called EFR – Exemption From Requirements assigns the deviation a number and requires information to be filled in about the deviation and how and when it will be corrected. The information in an EFR is open to every employee at Scania to survey and gives a clear picture of which deviations that have occurred for a certain part.[81]

[81] Designers; R&D dept

7 Development of QAPP

In this chapter the development work of the process concerning Quality Assurance of Prototype Parts (QAPP) is presented. The chapter begins with a description of the basic ideas about the quality assurance system followed by a description of the process and stakeholders that will be effected. Finally the work procedure for QAPP is presented in six steps.

7.1 Basis for Suggestions

To create a practical and feasible proposal for a new quality assurance system, the data from the empirical research has been analysed with regard to existing problems, inefficiencies and obscurities. To facilitate the introduction of QAPP and to motivate the employees to follow the procedures, a suggested working method is presented which forms the basis of a new APM together with an updated version of STD 3636.

7.1.1 Prototype Procurement Process – A Cross-Functional Process

The prototype procurement process is a parallel process where different departments within the Scania organisation are involved as well as the company's suppliers. To achieve cross functional and efficient work with a system for quality assurance, a number of principles have to be conducted, see figure 7-1.

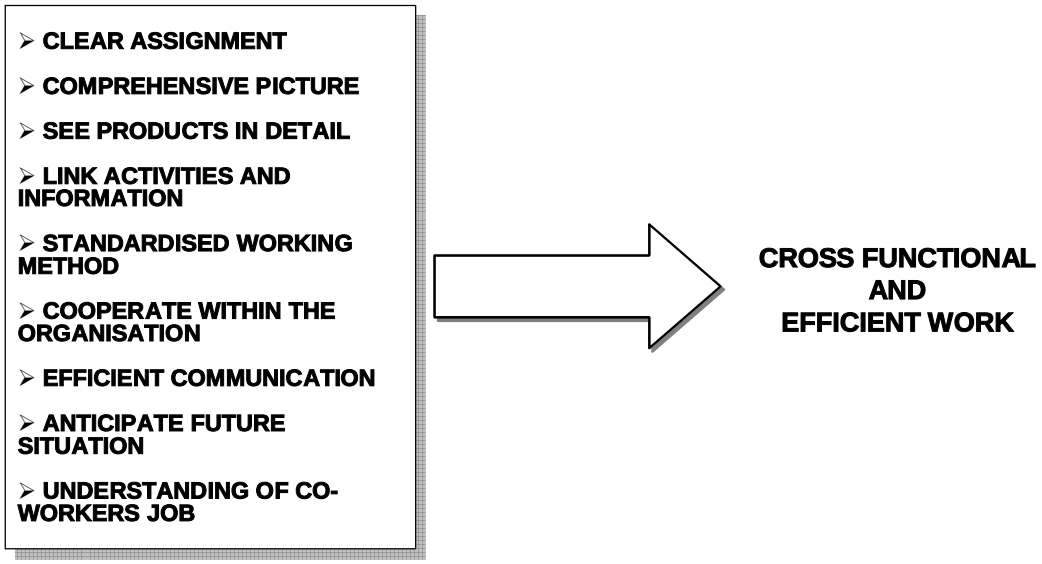


Figure 7-1 ***Factors leading to Cross Functional and Efficient Work***

An initial fundamental success factor is to make the assignment clear to all concerned individuals. This includes understanding of the purpose of the assignment, stakeholders' requirements as well as a realistic time schedule. All involved parties must also see the assignment from a comprehensive picture and be aware of all activities included. This is connected to the importance of seeing the result in detail early in the process as well as the ability to link activities and information in a flow to support all parts of the assignment.

A standardised working method should be introduced and agreement upon as well as which documents that should be included in the procedure. The working method will give

recommendations about cooperation within the organisation to receive basic data to get information and feedback as early as possible. Moreover it requires direct and reliable communication between the parts to act fast on changed demands. By visualising the present situation anticipation about future deviations are facilitated. During the process it is also important that the employees take part of co-workers' activities and work methods to create understanding of different situations.

Furthermore, general theories about purchasing, quality assurance and process based work agree with the principles about prototype procurement process. To be able to take these principles into account in a system for quality assurance of prototype parts, the present situation with bottlenecks and problems has to be stated and visualised. Different stakeholders in the process are also of great importance to consider.

7.2 QAPP Process

7.2.1 A Part of Scania's PD Process

Prototype procurement process is part of Scania's PD process. The testing process is an important part of the PD process where decision is taken about which tests a prototype part should undergo. As illustrated in figure 7-2 the prototype procurement process starts as soon as the parts are developed so far that the first generation of the prototype should be mounted and tested. The work that has been conducted in the testing process at this point concerns planning of the test procedures.

Start of prototype procurement process does not necessary imply that the parts are in their ultimate development phase, but they are developed so far that a drawing exists. In other words, the beginning of prototype procurement process implies that a need for parts for testing of prototypes has arisen. Because of the fact that this process is not quality assured today, QAPP process will also be a natural part of the PD process. The quality work will be carried out throughout the prototype procurement process and therefore be a parallel process focused only on quality and not, for example, logistics and storage of the parts.

There is no description of the prototype procurement process in the form of a single manual but the responsibility of the process is divided between the design and purchasing department. Considering that the present description is done in STD 3636 for designers and in APM 003 for buyer, the need for QAPP to be cross functional is further stressed. A general description for all departments within Scania and also for the suppliers would help to achieve the goal to work according to Scania's principles for standardised working methods.

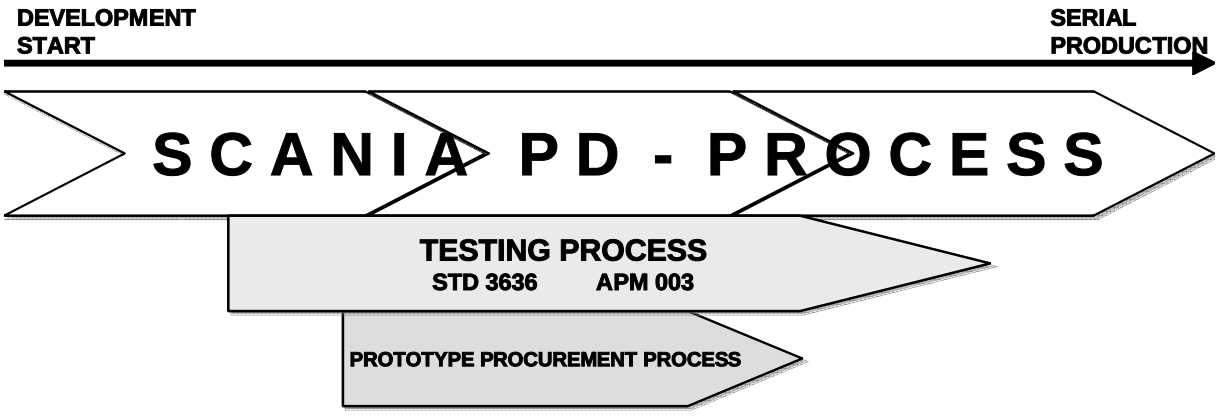


Figure 7-2 ***Prototype Procurement Process Part of Scania's Product Development Process***

7.2.2 A Structure in the Prototype Procurement Process

As a structure of the prototype procurement process, QAPP should be conducted throughout the entire process which means that the activities start when there is a need for parts to be tested. The quality work of the prototypes will be finished when the parts are fully ordered according to QS 9000 with all PPAP documents accepted. Figure 7-4 illustrates the fact that QAPP is an ongoing process and occurs every time prototypes are purchased during the PD process.

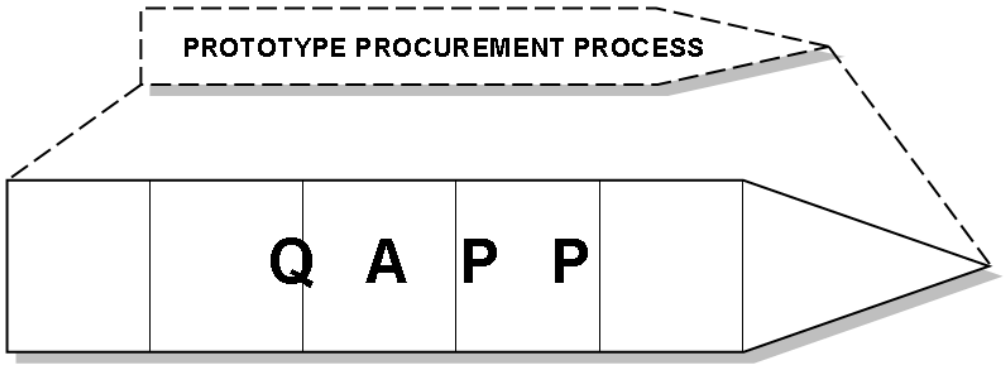


Figure 7-3 ***QAPP – Part of Prototype Procurement Process***

By dividing QAPP into six steps, the understanding and acceptance of the new work method are facilitated. Each step implies necessary communication and action by the stakeholders of the process. To make the communication more formal, as desired from the employees at Scania, and easier to follow up, three documents have been developed.

- Prototype Design Specification - PDS
- Prototype Deviation Report - PDR
- Prototype Part Warrant - PPW

The documents should be used by all designers, project buyers and SQAs within Scania, as well as concerned parties at the suppliers.

QAPP documents will facilitate the communication as the information will be more structured and clarified to the involved parties. In figure 7-4 the QAPP process is illustrated and the new documents are marked in the figure and further described in this chapter. The actual information flow is not changed compared to how it was earlier. The difference lies within the communication and its level of formality. The formality is not a mean to replace the informal communication but to support and improve the benefits of sharing knowledge.

7.3 Documents Developed and Used With QAPP

Three documents have been developed to support the structure of QAPP and assure the proactive work of quality and transparency in the prototype procurement process.

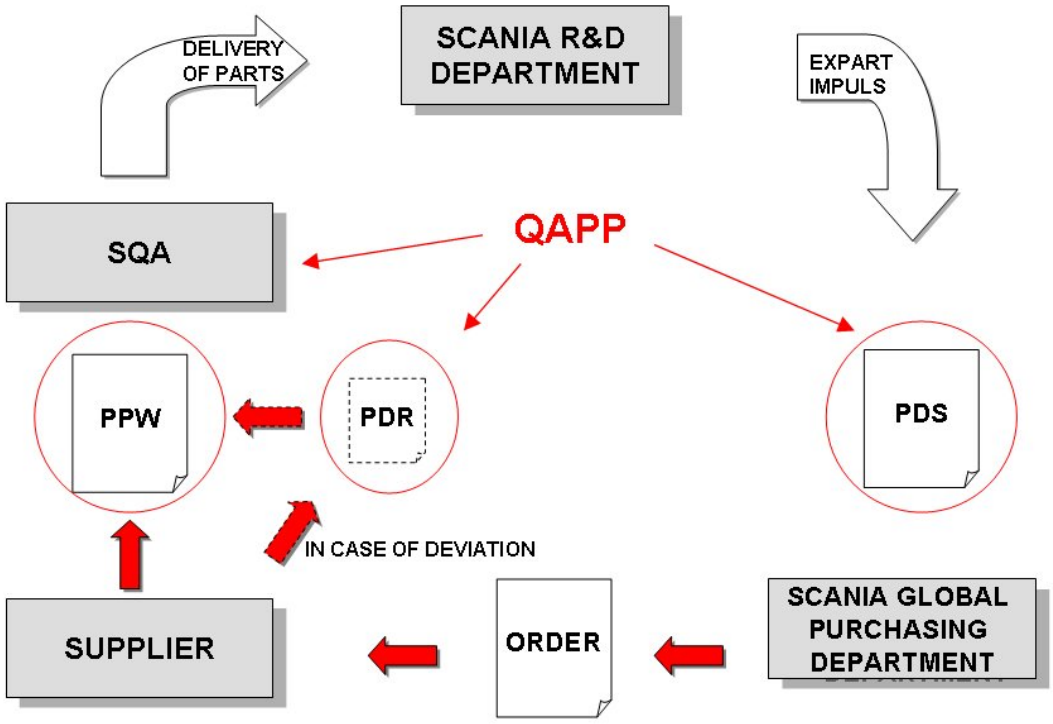


Figure 7-4 ***Structure of QAPP and the documents involved***

7.3.1 Prototype Design Specification, PDS

When part is ready to be ordered from supplier, a Prototype Design Specification (PDS) should be issued by the designer. PDS is a complement to the drawing or technical specification to help the buyer and supplier to understand the critical features and the requirements of the part.

PDS is a mean to get the designer to share more information with the buyer and supplier. The document will therefore be the basis of what was agreed upon in the early stages. PDS reduces the problem with unfinished drawing or technical specifications hence they are referred to and explained on the document.

Relevant information and requirements should be defined on the Expart impulse according to paragraphs 1-20 on PDS template; see appendix I. All designers have access to this template and it is up to the designer to decide which of the 20 paragraphs he/she requires that the supplier should carry out before or upon delivery. When PDS is finished and documented in field on XXX32A window on the Expart impulse, the order is sent into the Matris system; see section 6.2.1. Responsible project buyer collects waiting orders in Matrix and communicates with the designer if questions about the information stated on PDS arise.

The information stated on PDS, see appendix I, is divided into three groups:

- *Information about the part to buyer and supplier*
- *Requirements on supplier for protocols about the part*
- *Requirement on supplier for process descriptions*

The template will help the designers to specify right information at the right place on PDS. It is important to understand that the designer is in full control to specify the information on PDS. The designer will take the decision on what information is needed which makes PDS easy to fill in for standard products where the drawing or technical specification is enough to make an order.

The first part of PDS contains information about the characteristics of the part and testing process that the designer finds essential for the supplier to know to facilitate manufacturing. This information will also set the priorities to the supplier and is a basis for criticism of the drawing or technical specification. Critical features of a product that does not show in the other specification will be described.

The second part of PDS clarifies the requirements on the supplier to deliver measurement protocols and what to be measured. The designer can refer to drawings to specify what measurements or material that should be tested. Number of tests can also be specified as well as how the tested parts should be marked or in what form the measurement protocols should be sent.

The third part of PDS is used when there is a need to either specify the manufacturing process or get the supplier to describe the process used. This part will also be used by the quality engineer and buyer who are responsible of understanding and plan for the manufacturing process of the suppliers.

The advantage with a PDS is that the buyer gets all necessary information about the part in written form which makes it easy to return to the specification when a quality deviation has occurred. PDS will not replace informal discussion but act as a catalyst to highlight possible risks of misunderstanding and solve problem early and proactive. It will be revised during the PD-process to fit to each procurement process and the special needs of clarification of requirements and sharing of information.

7.3.2 Prototype Deviation Report, PDR

If a deviation from specification or drawing arises during manufacturing of the parts or a deviation is detected when parts are ready for delivery, the supplier should conduct a PDR. A PDR should also be conducted if changes from requirements need to be done in order to get

the right function or to be able to manufacture the part in a proper way. This document could be sent electronically or by regular mail to Scania and is approved or rejected by responsible designer. It is important to stress the need for the supplier send PDR immediately when a deviation is detected. It is preferable to contact the designer already when a deviation is expected to proactively take appropriate actions. A deviation is everything that affects the part, process, time schedule or testing of the part.

When the supplier contacts Scania regarding a deviation, PDR is handled by the system Exemption from Requirements (EFR). This will assign the deviation a unique number to keep a good traceability when the parts are sent to Scania and evaluated at a test. It is important that the designer describes the problem in the EFR and if possible attaches a picture of the deviation. Appropriate action taken should also be documented in PDR.

PDR also solves the problem with suppliers who do not report deviations to Scania. With QAPP it is mandatory for a supplier to conduct a PDR which makes it easier to take measures on supplier who do not report deviations. The filing of PDR as a document in EFR system makes it easy to trace a deviation and also to provide a visual description on how well a supplier has performed in the manufacturing of prototype parts.

PDR is an excellent help both for the supplier and the employees at Scania when any deviation arises. Many suppliers perform internal failure reports when deviations are detected, but the results are not always sent to Scania because it is not often required. A PDR helps to structure and handle deviations and also make the process quicker by getting clear answers whether the deviation is critical for the testing of the part or not.

7.3.3 Prototype Part Warrant, PPW

When order is placed by the buyer, an empty PPW document, see appendix II, should be enclosed the order. This document could be compared to Part Submission Warrant (PSW) used in a corresponding way for serial parts according to QS 9000 requirements.

PPW solves the problem of a formal guarantee that the requirements of Scania are complemented and fulfilled by the supplier. Earlier the requirements on supplier for prototype parts were diffuse. PPW makes the supplier take a second thought about the requirements before a part is delivered, which will help Scania to receive prototypes that better meet requirements and to achieve shorter total lead time in the long run.

PPW should be signed by quality manager or equivalent at the supplier before delivery of parts. PPW is sent to SQA together with the required measurement protocols and should be approved before the parts can be shipped. If a PDR has been approved, it should be referred to with an EFR number, given by the Scania designer, and stated on PPW. The document is handled by the SQA group at Scania for coordination with designer and buyer when required.

PPW is a mean to make the supplier study the specification of Scania and to a higher degree contact the designer when there are uncertainties. If there is a deviation not accepted earlier and stated on PPW the supplier has failed to meet Scania's requirements and has to be dealt with. This further indicates that it is the responsible of the supplier to understand the specification and requirements of Scania.

7.4 Stakeholders in QAPP Process

The main stakeholders in QAPP process are at four different functions; designers at Scania, project buyers, SQAs and finally the suppliers. These parts will hold different responsibilities in the process for quality assurance. It is important to identify the needs and agendas for the stakeholders to minimise risk and visualise the benefits of the system. To make QAPP as effective as possible it is important that the different stakeholders have a common understanding of the concept and realise the benefits of using it. The attitude between the parts must be that cross-functional work is necessary to carry out and attain the advantages gained by better quality assurance.

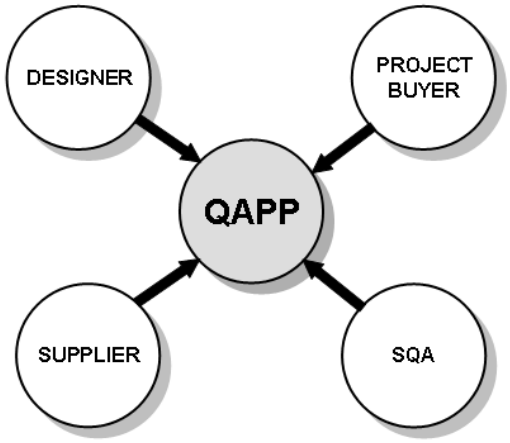


Figure 7-5 ***Stakeholders of QAPP***

Designer

The primary function of the designer is the role as the end customer for the prototype parts. The designer has deep knowledge about construction and design of the part and its function but also information about the tests the part will undergo. Better quality assurance of the prototype parts are of great interest to the designers, since it can improve quality of the end product and decrease the amount of prototype bought which leads to a more efficient PD process.

It is the responsibility of the designer to support the buyer and supplier with technical and non technical information about the parts and tests. This is done by a relevant PDS, drawings or technical specification. The designer will also approve or reject suggestions for improvements and deviations from the supplier and document PDR in the EFR system.

Project Buyer

The project buyer at Scania is responsible for the commercial relation with the supplier. The buyer will need PDS information, drawings or technical information to be able to choose a supplier who can manufacture the part at the right quality to the right prices. The buyer has the formal responsibility of the supplier contact and must receive copies of accepted or rejected PDR.

The project buyer will receive PDS, revise it and transfer it to the order. As the formal contact to the supplier the buyer is also responsible of supporting the supplier with working manual of QAPP; PPW and PDR.

SQA
SQAs at Scania are responsible for quality assurance of the suppliers, both in the development phase and in serial production. The major interested is how well suppliers can control a steady manufacturing with low risks over time.

The fact that Scania SQAs primarily focus on PPAP included in QS 9000; quality assurance of parts to serial production, will not change in the future. The focus will rather be broadened to take problems with quality of the prototype parts into account. This will lead to a better visibility of the quality assurance of prototype parts for the SQAs. The proactive work will reduce and simplify the work with PPAP and also put less focus on reactive action plans in late stages.

The responsibility of the SQAs during QAPP process is to receive PPW with its accompanying measurement protocols to file and co-ordinate these within Scania. The SQA will via Matris control that all the measurement protocols required are attached and that the PPW is signed. If the designer has requested the measurement protocols they will be sent as a copy to the designer.

Supplier
The primary function of the supplier is to satisfy the needs of the designer at Scania by delivering right parts at the right quality. Another important issue is to give critics to the designer's drawings or technical specification. To be able to do this the supplier will need as much information about the application and interfaces of the part as possible.

When order is received the supplier needs to consider any uncertainties of the specification. The supplier will sort this out with the responsible designer as well as discussing improvements of the specification and part.

If there is a deviation in the manufacturing or if measures have to be taken to secure function of the part this must immediately be reported to responsible designer via a PDR for acceptance or rejection. The PDR number must be noted on PPW. PPW is sent to Scania SQA with required protocols before shipment of the part.

7.4.1 QAPP in Six Steps

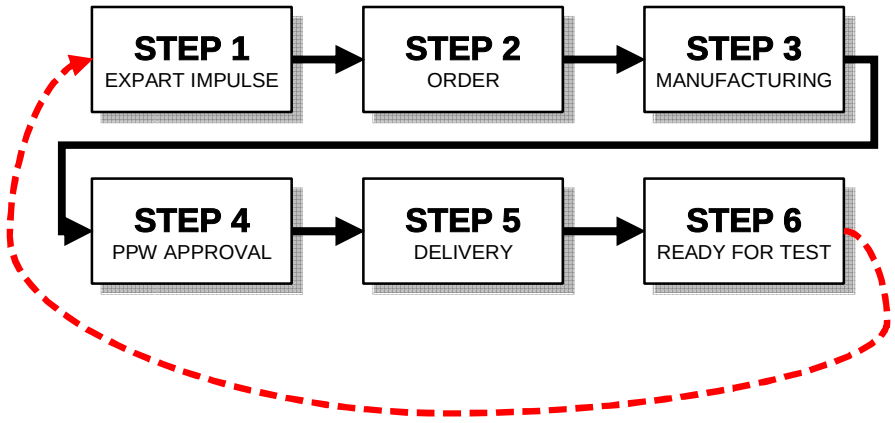


Figure 7-6 ***QAPP in six steps***

As mentioned, QAPP process is divided into six steps. Each step involves different departments within Scania and their contacts with suppliers. The six steps also entail information flow between the involved parts; usually two parts are involved in each step. The basic idea with the new QAPP system implies that the designer at Scania to a higher extent than today specifies the parts. This facilitates the entire procuring process of the prototype parts since more formal communication makes deviations easier to avoid and hence shorten the total lead time of product development.

QAPP is an iterating process which continues until the development of the part is terminated and the part is introduced into serial production. The natural sequel to QAPP is that the supplier's work with PPAP will be facilitated due to better control of quality and transparency of the prototype parts.

The new QAPP system implies new demands on the communication between all parts involved in the prototype development. Most of the information was handled in an informal way before, but QAPP requires information to be treated more formal and hence more documented as a complement to the informal communication.

Step 1 – Expart Impulse

When the development work is in its ultimate phase and the designer wants to order the parts needed for testing, an Expart impulse must be sent to responsible project buyer. The impulse is sent by responsible designer through the internal system Expart and reaches the purchasing department in the Matris system. The project buyer gets information about the part via the impulse.

The first step in QAPP will imply that the designer carry through a more detailed specification of the required part by stating relevant parts of the PDS. PDS is inserted on the Expart impulse XXX32A. By creating a PDS, the important and relevant information will reach the project buyer in a formal way which improves the possibilities of choosing right suppliers and efficiently carry through the negotiation.

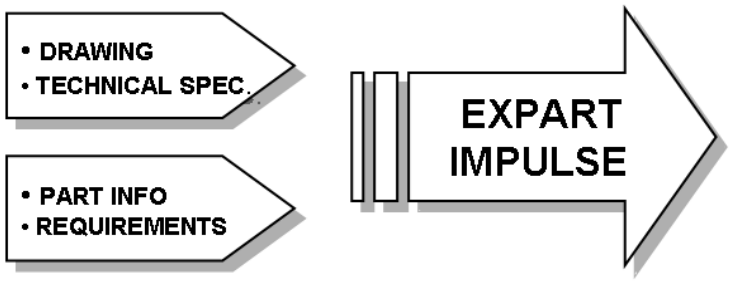


Figure 7-7 ***Step 1 of QAPP***

It is in the first case up to the designer to decide which requirements that are needed. In some cases the buyer or SQA can be interested in the manufacturing process, for example if there has been problems during earlier development phases or if the manufacturing process will change when serial production is initiated.

More explicit demand for measurement protocol can help Scania to quicker discover deviations not reported from the supplier. The protocol can support the drawings, material tests or functional tests. Standardised and filed measurement protocols are especially important when the real cause to a late discovered deviation is to be traced.

The communication between the Scania designer and the supplier is dependent on such factors as geographic location and former development performed together. A good relationship and understanding of what difficulties Scania faces with the test the part, the more knowledge and support can be given from the supplier to manufacture a part that Scania really needs. The need might be better or more serial production like material, more exact measurements or simply shorter lead time.

Step 2 – Order the Part

When the project buyer has received the impulse and evaluated alternative suppliers, he/she chooses the most appropriate supplier according to the requirements stated by the designer. QAPP implies that the buyer considers all information sent by the designer through the impulse and transfers this information to the order. In cases where the buyer or SQA requires any additional information from the supplier besides what is stated by the designer, it is possible to add this to PDS.

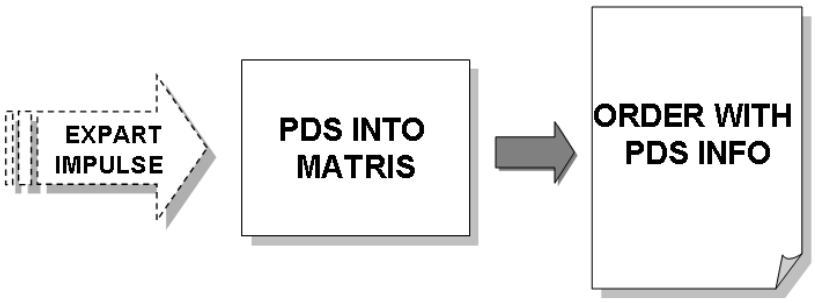


Figure 7-8 ***Step 2 of QAPP***

QAPP gives recommendation for the general procurement situation. The normal situation is that the information given to the buyer through PDS is enough to make a selection of possible

suppliers and start the initial discussion. There are still differences of what degree the designer at Scania needs to join the discussion from a technical perspective. Every case must be treated separately, because of the different levels of complexity of the parts.

The buyer must in any cases know what the part is to be used for and what is important and critical for the part, to be able to make a well founded decision. This information is also stated on the PDS and goes through the buyer. When the impulse is received, the project buyer adds or removes information on PDS supplemented with other requirements he/she or SQA have on the supplier. The revised PDS is added to the experiment order and sent to chosen suppliers.

As drawings and technical specifications of prototype parts seldom are exact and fully completed it is important that the designer specifies on PDS what is critical and not critical. In the cases where certain materials specified on the drawing are not possible to use in the manufacturing of prototypes, this must also be stated on PDS.

Step 3 - Manufacturing of Parts

When the supplier has received the order, the manufacturing process is normally started. If there are uncertainties these should be solved with the responsible designer immediately when order is received or when they arise. The supplier should manufacture the parts according to drawings or specifications stated by Scania's designer. QAPP will integrate the supplier in Scania's quality assurance work by providing them with information and quality and measurement documents to fulfil.

When a deviation is found by the supplier it is also extremely important that the deviation is reported to Scania for feedback on how the deviation should be dealt with. Hopefully the deviation is not critical and the part can be delivered to Scania. It is however important to have all deviation filed in order to trace the source if the result of a test not is satisfactory.

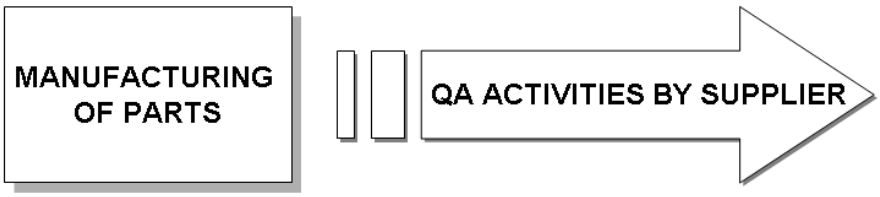


Figure 7-9 ***Step 3 of QAPP***

Step 4 – PPW Approval

To assure that the manufactured parts achieve the required quality and that the supplier has carried out all quality assurance activities required by Scania's designer and buyer, a Prototype Part Warrant should be signed and sent to Scania for approval before delivery of parts. PPW is sent to responsible SQA who has to approve it before shipment of parts.

The possibility to analyse measurement protocols and the supplier control plan for prototypes must be used when a prototype part is critical. If the part is standard, PPW handling is easy and filed quickly.

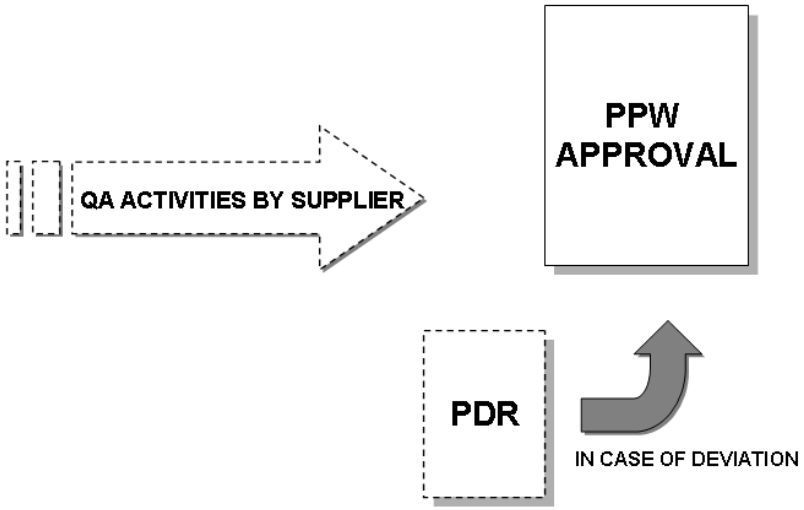


Figure 7-10 ***Step 4 of QAPP***

Step 5 – Delivery of Parts

When PPW is approved by responsible SQA the part is ready for shipment. The parts are delivered to Scania and stored in a prototype warehouse before parts are sent to responsible designer for mounting and preparation for tests.

The supplier is normally contacted by the SQA group when PPW is accepted. In cases of time pressure the supplier will have had an acceptance from designer to deliver the parts before PPW is accepted.

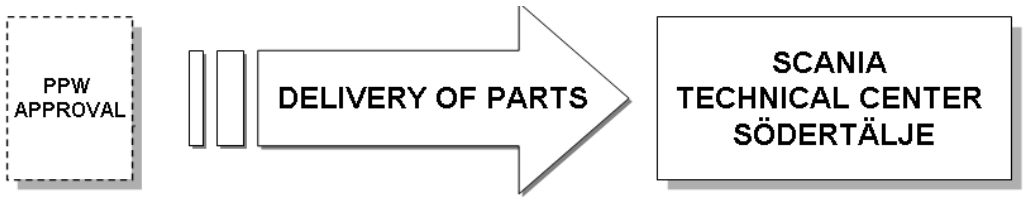


Figure 7-11 ***Step 5 of QAPP***

Step 6 - Parts Ready for Testing

When the designer has received the parts and checked all required documents, the parts should be mounted and prepared for testing. If a deviation is discovered at Scania the designer, buyer and SQA will decide appropriate actions to take on the supplier.

Figure 7-12 ***Step 6 of QAPP***

8 Implementation

During the period of development and improvement of the QAPP process, questions about implementation have arisen. Recommendations for implementation methods have been developed and are presented in this chapter. Again, it is worth to remark the importance to have an employee as main responsible for QAPP process, implementation and operation, as well as continuously updating the system. This chapter does not respond to the purpose presented in the introduction but is a natural sequence of the recommendations given. The chapter should not to be taken as a strict part of the academic research but rather as a complement.

8.1 Organisational Implementation at Scania

Implementation of QAPP will require changes in procedures for the suppliers, purchasing and design department. The fact that most people resist change and change is a slow process considerable planning and effort is necessary for the person responsible for the implementation. To facilitate the introduction and continued existence of QAPP, the four broad stages shown in figure have to be followed through.

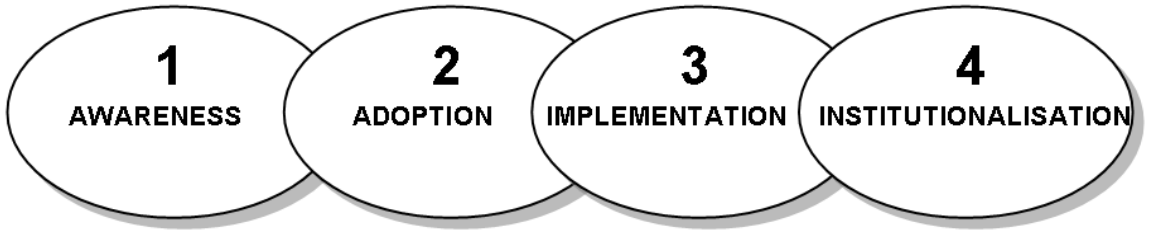


Figure 8-1 ***Implementation Stages***

Each stage is important to develop and execute to maintain a successful quality assurance standard. The first two stages imply to prepare the organisation for the changes and in stage three the actual changes are carried out. The last step concerning institutionalisation is important to consider because a system is seldom everlasting. Resistance will probably arise and a revised and better version of the work method will be developed. The old system will be replaced by the new QAPP process simultaneously. New work methods must be introduced and the four phases will start from the beginning.

When a cross functional standardised working method is to be implemented at Scania the decision have to be taken at an organisational level where the interaction of the involved departments is managed. At Scania the RM[82] meeting is an appropriate level to decide upon an implementation of a cross functional system such as QAPP.

When a formal decision to further investigate a plan to implement QAPP is taken at a RM meeting, executive committees will drive the questions at R&D department and global purchasing department. There is a need to devote an employee to coordinate the development of the suggested APM and adjusted STD 3636 during the implementation period. This person will coordinate the time plan and management teams and report to the monthly RM meeting.

[82] Cross functional meeting concerns changes in working method and resources of the PD process.

The employee will also keep the executive committee for the testing process and process developer at purchasing department up to date.

8.2 Manuals for QAPP

If a decision to implement QAPP is taken at a cross functional meeting there is a need to develop working manuals for each department. As a part of the thesis a new suggested APM manual and suggested additions and changes to STD 3636 have been developed. It is stressed that these manuals in the future will be revised cross functional with consideration of each other.

8.2.1 A New APM for Quality Assurance of Prototype Parts

An implementation of QAPP requires a new APM for the purchasing department. This APM will supplement the quality assurance work described in the APM 003 but will focus on the prototype parts and not the future serial production. The APM for QAPP is based upon the suggestions of QAPP in six steps described in chapter 7. The APM will be further revised by the responsible process control group if a decision for implementation is taken.

8.2.2 Changes in the STD 3636

STD 3636 is the most detailed working manual for designers when ordering prototype parts for a test. This standard is described earlier in chapter 5. Since quality assurance of prototype parts have not been a major concern to the responsible designer this has not been considered in the standard. The suggestions of QAPP imply that the designer will take a greater responsibility in the quality assurance work and therefore changes in STD 3636 must be undertaken.

Recommended additions in STD 3636 are based upon the six steps described in chapter 7. The form has been adapted to one of STD 3636 and presented to the executive committee for the testing process. If there is a cross functional decision to adapt the organisation to QAPP the executive committee of the testing process will further revise and manage the suggested changes.

8.2.3 Supplier Manual for QAPP

To facilitate the implementation of QAPP and to involve the suppliers, a supplier working manual has been developed. The manual is based upon the suggested structure with six steps, described in section 7.4, and is highly adjusted to the suppliers.

8.3 Plan for Implementation

During the second part of the work with this thesis a couple of pilot group, consisting of all four stakeholders in the prototype procurement process have been followed through. The work method used has been according to the suggestions of QAPP. The participants of the pilot groups will be used as focus groups for the management when deciding upon the further implementation of QAPP. The pilot groups are also a mean to develop the suggested working method by the experience of QAPP in real situations.

If a decision to further implement QAPP is taken at a cross functional management meeting the work must be planned and coordinated. Because of the scope of the working method and the influence on many hundred of employees at Scania, an appropriate method for

implementation is to drive focus groups of designers sitting together to initiate the process of QAPP while ordering prototype parts. This will lead to that project buyers, SQAs and suppliers belonging to the same commodity groups will use QAPP. These larger groups will be a good source of competence to further adapt QAPP to the situation at Scania and the suppliers.

The possibility to implement QAPP all over Scania at once is considered not appropriate. The project will need a few groups of devoted users of QAPP who can act as the base of knowledge about the system when other departments will take up QAPP. The benefits of QAPP in the user groups will via workshops and daily conversation interest other employees to work according to QAPP. When these large groups of different departments have worked according to QAPP for approximately six month the decision for a complete implementation of QAPP have to be taken. It is then time to confirm and establish the new APM and the revised version of STD 3636.

The standardised working method of QAPP has to be continuously revised and challenged according to the SPS described in chapter 5. This will be coordinated by the assigned manager of QAPP. A revision of the system must be done with participants from the larger groups before a decision about a total implementation is to be taken. It will be up to the assigned manager of QAPP to decide upon and coordinate such a revision.

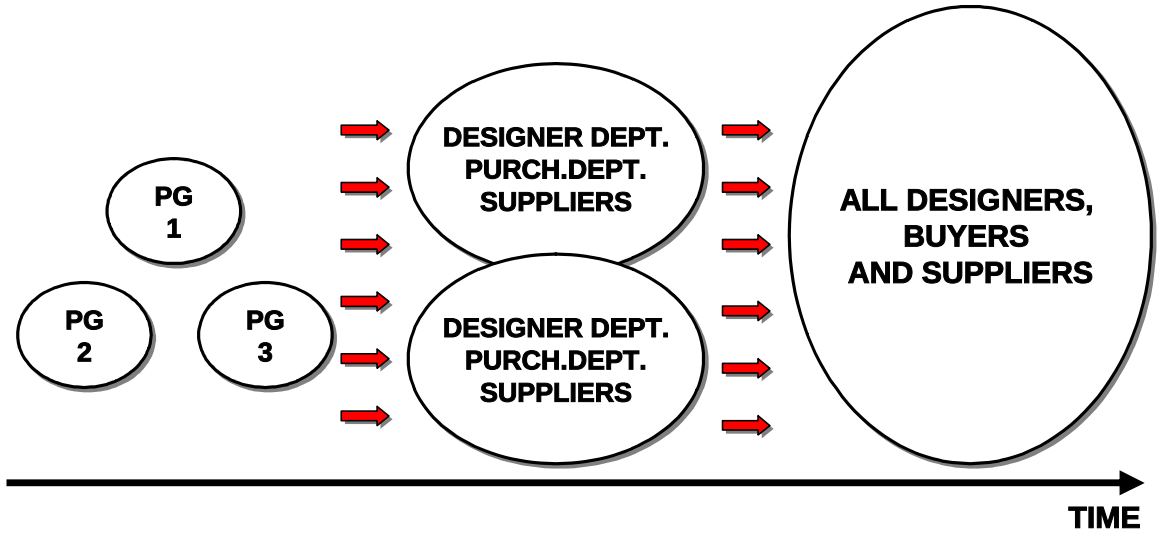


Figure 8-2 ***Implementation of QAPP***

8.3.1 Time Plan

The time plan for further implementation work is guidance to Scania if a decision to proceed with QAPP is taken. The plan is based upon the time for handover of the work to Scania and experience of the time needed to conduct pilot cases. See figure 8-3

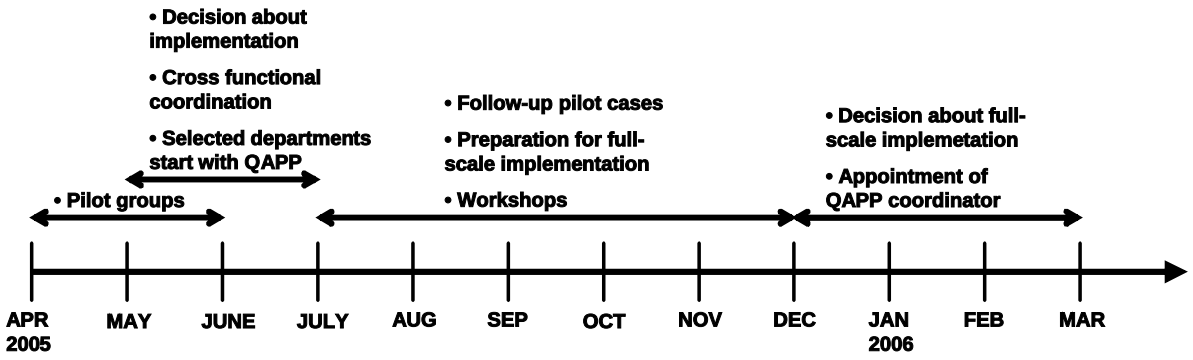


Figure 8-3 ***Time Plan for Implementation***

8.4 Resources Needed for Implementation

R&D Department

At the R&D department there will be no need for further resources due to an implementation of QAPP. When the working method is fully operating the procurement of prototype parts will lead to a reduction of the needed resources.

Buyer

At the purchasing department, not too much time is needed for the project buyer to deal with PDS. With a more efficient testing process the work of project buyer will be reduced due to less prototype parts to be purchased.

SQA

The SQA group at Scania purchasing department might meet a relevant increase of work. To accept and administrate the filing of PPW and the measurement protocols there is a need to allocate extra resources to this group. The expectation is however in the long run that QAPP will facilitate PPAP to an extent that the total work load will be reduced.

There is an approximate need for an extra man year for the complete SQAs at Scania purchasing department to coordinate and file the PPW arriving from suppliers. Year 2004 there was 3800 prototype orders which would be needed to coordinate. Consider that the responsible SQA will take care of high risk and complex PPW the work load of a coordinating role is reasonable.

Supplier

The work to perform QAPP activities for the suppliers will to a minor extent increase the work load. When the work load is increased it is however due to an uncertainty and a need to sort it out. The suppliers visited during the development of QAPP were however positive to perform the work as it resulted in a clarification of the demand. The suppliers were also used to other customers with greater demand on quality assurance during the purchase of prototype parts.

9 Conclusions and recommendations

To fulfil the purpose of the thesis, a number of recommendations have been formulated. The recommendations are created on the basis of conclusions drawn during the end of the thesis work.

The main issue; the problem with not adequate quality assurance of prototype parts, has been focused on and the need of the four major stakeholders in the prototype procurement process have been taken into consideration. To further clarify the aim with a new quality assurance system, the recommendations will involve guiding principles for the implementations as well as suggestions for further work and improvements of the system.

The suggested quality assurance system has been developed with the guidance of existing theories of quality assurance and process improvements. Together with empirical findings the system has been adjusted to fit Scania's specific needs and organisation. The gathering of information at Scania has been conducted in a way to involve the employees and start the implementation in an early stage. The fact that the earlier academic research on the specific subject is neglect able, this report can be used as a base for further research in the area.

The purpose was to develop tangible suggestions to a new standardised working method for quality assurance of prototype parts. The question of whether a suggestion is tangible is not always obvious but real document such as PDS, PDR and PPW must be more tangible than intangible. The fact that QAPP has been tested in live pilot cases implies that the suggestions are tangible and hence the purpose fulfilled.

To simplify the understanding of the connection between the conclusions drawn and their corresponding recommendations, three main headlines will represent the fulfilment of the purpose. Each section considers an important part to complete a successful introduction of QAPP within Scania, and can be summarized as followed:

- Comprehensive picture of Scania's product development process
- Responsibility division and information sharing
- Improved traceability through preventative work methods

9.1 Comprehensive Picture of the Product Development

Scania's PD process is, as earlier described, a well-established process with many constituents worth to further spread throughout the organisation. One of the major improvements with QAPP is the improved visibility of the product development. QAPP will help the concerned parties to understand difficulties and possibilities early in the product development. First and foremost the comprehensive view will give the concerned employees a better understanding of the other parties' obligations

Recommendations

SQA will follow up and engage in prototypes in the early development stages to better prepare for PPAP work. A good order of QAPP document will facilitate the general understanding of the development process. Cases when deviations arise must be handled

quickly and discussed at management level which improves the possibility of good management at Scania R&D department.

9.2 Responsibility Division and Information Sharing

The problem with responsibility for the prototypes when drawing or technical specification is not complete is addressed. The increased amount of sharing of soft information and clear requirements is a step in removing this problem. When the supplier feels that there is an uncertainty about a part the responsible designer must be contacted which clarifies the responsibility of supplier to manufacture what Scania really wants. If Scania does not know what is really wanted the responsibility lies upon the designer.

Recommendations

Better distribution of the responsibility for the prototype parts during their way from drawing to finished part ready for testing are achieved through clear directives to all involved parties. Scania must enclose an adequate PDS on the order to help the supplier to deliver the right part. As QAPP process is divided into six steps, each step is supervised by a main responsible for this part of the process. The clarified responsibility is eventually stated on PPW which is the final agreement about the delivery. PPW makes the involve parts to take actions earlier when there is an uncertainty.

9.3 Improved Traceability

The handling and documentation of PDR and PPW are important procedures when the source of a poor quality case has aroused. There is a need to have the possibility to trace the development of prototype parts to its origin after the test procedures are performed.

Recommendations

After arrival of parts and completed tests the documents should be archived manually or preferably electronically. If a document is uncompleted, the responsible party must be contacted to fulfil the commitment. The person responsible for the current step of QAPP should always secure that all documents follow the part to the next step and that the documents are marked properly.

Glossary

APM	Automotive Purchasing Manual
APQP	Advanced Quality Planning Process
DP	Decision Point
EFR	Exemption From Requirements
FMEA	Failure Mode and Effect Analysis
MD	Main Deliverables
MSA	Measurement System Analysis
PA	Provanmodan (Test order)
PD process	Product Development process
PDR	Prototype Deviation Report
PDS	Prototype Design Specification
PPAP	Production Part Approval Process
PPW	Prototype Part Warrant
PSW	Part Submission Warrant
QAPP	Quality Assurance of Prototype Parts
QSA	Quality System Assessment
QSR	Quality System Requirement
SOCOP	Start of Customer Order Production
SOP	Start of Production
SPC	Statistical Process Control
SPS	Scania's Production System
SQA	Supplier Quality Assurance
STD	Standard
TQEM	Total Quality Environmental Management

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Interviewees and Workshop Participants

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Fredrik Karlsson
Per-Erik Ståhl
Bertil Tamm

Brand Development
Ing-Mari Hagström

Appendix I – Prototype Design Specification Template

TEMPLATE
PROTOTYPE DESIGN SPECIFICATION

Information to the Supplier via Buyer

1 Application of part
2 Test methods for part at Scania
3 Time plan for testing
4 Critical characteristics of the part
5 Critical measurements
6 Special packaging information
7 Other information

Special Requirements on Part

8 Measurement protocol
9 Numbers of parts to be tested
10 Test of material
11 Functional testing
12 Requirements for D-FMEA
13 Part mass documentation
14 Requirements for individual marking
15 Other protocols wanted
16 Other requirements

Requirements Regarding Manufacturing Process

17 Process flow diagrams
18 Requirements for P-FMEA
19 Management and control plan
20 Other information wanted

Appendix II – Prototype Part Warrant

SCANIA

PROTOTYPE PART WARRANT

I. Part Information

Order Number:_____ PA Number:_____
Part Number:_____ Version:_____
Part Name: _____ Quantity:_____

II. Supplier Information

Company Name:_____ Phone:_____
Address: _____ Contact Person:_____

III. Submission Results

Included are: Measurement protocol Material test results
Functional test result Process description
Other information required on PDS .....
.....

These results meet all drawing and specification requirements: Yes No
(If "No" - A Prototype Deviation Report must have been approved by designer before PPW approval)

Following Prototype Deviation Reports have been approved:
Nr: .....
Nr: .....

IV. Declaration

I guarantee that the parts represented by this warrant meet all inspection requirements, are representative of our parts and have been produced to the applicable customer drawings and specifications noted above. Any deviations are noted in a PDR and approved by responsible designer at Scania prior to shipment.

Comments:_____
_____

Name:_____ Title:_____ Phone:_____

Signature:_____

V. Scania Use Only

Approved □ Rejected □

Explanation:_____

Responsible SQA:_____ Date:_____

Appendix III – Prototype Deviation Report

SCANIA

PROTOTYPE DEVIATION REPORT

Date:……..

Supplier:……..
Contact:……..

Order Number:……..
Part Number: ……..
Version Number: ……..

Deviation:_____
_____
_____
_____
_____
_____
_____

Explanation:_____
_____
_____

Comment:_____
_____
_____

Approved: ☐ Rejected: ☐

EFR number……..

Comment:_____
_____
_____

Responsible Designer Scania R&D:
Date:

PDR approval should be sent to responsible designer by mail or e-mail