The Product Development Process within a Multinational Company

A Case Study of the Work Procedures and Interactions at an Indian Subsidiary

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Abstract

The demands on companies with industrial product development have become higher these days regarding the time-to-market, customer needs, and environmental requirements. Multinational companies have subsidiaries all over the world, which makes the efficiency in the communication between headquarters and subsidiaries substantial. It is also considered vital to have an efficient product development process and a good interaction between the people involved in the process.

This thesis work has been executed at Atlas Copco Compressor Technique. The major part of the study was performed at the foreign subsidiary in Pune, India, although the study was initiated with a short visit at the head office in Antwerp, Belgium. The purpose of the study was to investigate and evaluate the product development process at one of the divisions in Pune and with that as a base, give suggestions for improvements. In addition, it was the purpose to investigate how the cross-functional and cross-national interaction could be enhanced. Qualitative, semi-structured interviews were carried out with 30 persons in total, and the results of the study were related to relevant theories within the area.

The major finding was that the subsidiary in Pune follows the main phases of the company’s general product development process to a certain extent. However, there is no documentation of the activities and responsible persons involved in the shared work procedures. Furthermore, there are many issues in serial production. Regarding the project work and interaction, there are some complications considering the project facilities and the exchange of information.

A number of suggestions for improvements have been concluded and most important is the need for a well-visualised and shared product development process at the studied division in Pune. Other recommendations regard the interaction between the functions and the exchange of knowledge between the divisions in Pune. In addition, some suggestions for how to enhance the cross-national communication have been presented.
**Sammanfattning**

Marknaden idag är i allra högsta grad global och företag har dotterbolag över hela världen vilket ställer höga krav på effektiviteten gällande kommunikationen mellan huvudkontoret och de utländska enheterna. Det är även viktigt att ha en välfungerande produktutvecklingsprocess, likväl god interaktion mellan de involverade aktörerna.


De främsta slutsatserna från studien vad gäller processen är att dotterbolaget i Pune följer huvudfaserna i företagets produktutvecklingsprocess till viss del. Det finns dock ingen gemensam dokumentation av de aktiviteter och ansvariga personer som inkluderas i processen. Vidare pekar resultaten på att många problem upptäcks först i serieproduktionen, vilket har flera möjliga orsaker. Med avseende på interaktionen i projektarbetet finns det komplikationer vad det gäller mötesmöjligheter och utbyte av information.

Ett antal förbättringsförslag har tagits fram varav det viktigaste var behovet av en väl visualiserad och gemensam produktutvecklingsprocess på den studerade divisionen i Pune. Andra rekommendationer rör möjligheterna till en förbättrad interaktion mellan funktionerna och utbytet av kunskap mellan divisionerna i Pune. Utöver detta har förslag presenterats gällande hur den globala kommunikationen kan öka.
Preface

This thesis work was the last part of the Master of Science Programme in Design and Product Realization, with focus on Integrated Product Development, at the Royal Institute of Technology (KTH) in Stockholm, Sweden. The thesis work corresponded to 30 credits and proceeded for six months, October 2008 – March 2009. The work was performed at the company Atlas Copco, within the business area Compressor Technique, and the study was mainly performed in Pune, India.

We want to take this opportunity to address our thanks to Atlas Copco for giving us the opportunity to perform this thesis work, and to thank all the persons in Antwerp and Pune that have taken care of us and made us feel welcomed. Furthermore, we would like to thank all the persons who have contributed to the results, by giving us of their time for discussions and questions.

We would especially like to thank Rajesh Yadav and Vijay Sharma, our supervisors at Atlas Copco in Pune, and Luc de Beul, Christophe Gregoir, and Kristof Suykerbuyk, at Atlas Copco in Antwerp, for their guidance and helpful advices throughout the thesis work. We would also like to give our greatest thanks to our academic supervisor Sofia Ritzén, at KTH in Sweden, for guiding us through the thesis work.

We would also like to express our gratitude to Jo Cronstedt and Sverker Hartwig, at Atlas Copco in Sweden, for assisting us with practical details and contacts within the company.

We would also like to thank Seshadri Seetharaman, Ujjwala Andersson, Evert Andersson and Lila Poonawalla for helping out with the initial contacts for the thesis work. In addition, we would like to thank Fredrik Bertilsson, at Alfa Laval, for preparing us for India and helping us to settle down in Pune.

Stockholm, 13th March 2009

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# Glossary of Used Terminology

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>A&amp;D log</td>
<td>Action and decision log, used at PTM’s</td>
</tr>
<tr>
<td>BOM</td>
<td>Bill of Material</td>
</tr>
<tr>
<td>BPCS</td>
<td>Business Planning and Control System, an enterprise resource and planning software</td>
</tr>
<tr>
<td>CT</td>
<td>Compressor Technique, a business area within the Atlas Copco Group</td>
</tr>
<tr>
<td>Design Centre</td>
<td>The place for development of new products, which belongs to a Product Company</td>
</tr>
<tr>
<td>DFA</td>
<td>Design for Assembly</td>
</tr>
<tr>
<td>DFM</td>
<td>Design for Manufacturing</td>
</tr>
<tr>
<td>DR</td>
<td>Design Review, a control of product design in the end of prototype phases</td>
</tr>
<tr>
<td>Flow-team</td>
<td>Part of the production unit at Atlas Copco</td>
</tr>
<tr>
<td>FMEA</td>
<td>Failure Mode and Effect Analysis</td>
</tr>
<tr>
<td>Local Production</td>
<td>The location for production of products, which belongs to a Product Company</td>
</tr>
<tr>
<td>Lotus Notes</td>
<td>Communication and collaboration software</td>
</tr>
<tr>
<td>MS</td>
<td>Master Specification, a project specification</td>
</tr>
<tr>
<td>PCM</td>
<td>Product Committee Meeting, on local level at each Product Company</td>
</tr>
<tr>
<td>PiBa</td>
<td>Pilot Batch</td>
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<tr>
<td>PQM</td>
<td>Product Quality Meeting</td>
</tr>
<tr>
<td>Product Company</td>
<td>Can consist of either a Design centre and Local production, or both</td>
</tr>
<tr>
<td>PSM</td>
<td>Product Strategy Meeting, on divisional level</td>
</tr>
<tr>
<td>PTM</td>
<td>Project Team Meeting, local meeting</td>
</tr>
<tr>
<td>QC</td>
<td>Quality Control, function within the engineering department</td>
</tr>
<tr>
<td>QFD</td>
<td>Quality Function Deployment</td>
</tr>
<tr>
<td>Qualification</td>
<td>Control of process and logistics in the end of Pilot Batch phase</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>ROI</td>
<td>Return of Investment</td>
</tr>
<tr>
<td>SQA</td>
<td>Supplier Quality Assurance, function within the sourcing department</td>
</tr>
<tr>
<td>Stage-Gate</td>
<td>A sort of product development process</td>
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1 Introduction

In this opening chapter the thesis work is introduced by describing the background, purpose, and delimitations. In the end of the chapter, the disposition of the report is given. This thesis work was the last part of the Master of Science Programme in Design and Product Realization at KTH in Stockholm, Sweden.

1.1 Background

The business environment for industrial companies today is highly competitive considering the demands on shortening the time-to-market for products, increasing the insights about customer needs, and being cost-effective. To maintain a leading position in this kind of marketplace, it is important to constantly improve the way of working and try different approaches, for example, it has become more common to work in cross-functional teams and follow a product development process. When firms operate within the global market, additional issues arise, such as how the procedures used at headquarters could be implemented at the subsidiaries. Another example is how differences in national cultures should be managed when headquarters and foreign subsidiaries interact and communicate.

1.1.1 Atlas Copco

Atlas Copco Compressor Technique (CT) is one of three business areas within the Atlas Copco Group, where the products that are developed are complex industrial compressors. Headquarters of this business area is located in Antwerp, Belgium and there are seven divisions with different focus, which results in a wide range of application areas for the products. The divisions are represented within several Product Companies, which include a Design Centre and Local Production, or only one of them. The development of a global product design takes place at one of the Design Centre, which is later transferred to Local Production. To reach the global market and to be closer to the customers Atlas Copco CT manufactures compressors at Product Companies in several parts of the world, where India is one of them.

Atlas Copco CT in Pune, India is a Product Company with Local Production, where five divisions are represented. At this subsidiary, the products developed at a Design Centre are localised to fit Indian conditions and customer requirements, using local sourcing. During this ‘localisation process’, the interaction between the different functions is of great importance as well as between the Product Company in Pune and in Antwerp. The interaction takes place across functional and national borders, cultural diversity, and differences in working methods and premises, which makes it complex.

1.2 Assignment Description

The base for this thesis work was a request from Atlas Copco CT to investigate what the process looked like at one of the divisions in Pune when localising the products, since the current development time was perceived to be too long. Included in this task was to define the activities and the involved actors included in the localisation process, but also the interaction between different functions, as well as between Pune and Antwerp. This would give all involved persons a good overview of the process and a view of when interaction takes place.

Another request from the Atlas Copco CT was to evaluate and compare the findings from this study with the product development process at one of the divisions in Antwerp and with the process at the two other divisions in Pune. An approach like this was believed to enable
identification of differences and possible areas of improvement, to be able to rationalise and make the process and interaction more effective.

1.2.1 Purpose and Research Questions

With the assignment request as a starting point, the purpose and research questions were formulated. The purposes of this thesis work were to:

“Identify areas of improvements within the localisation process at one of the divisions at Atlas Copco CT in Pune.”

“Enhance the cross-functional as well the cross-national interaction by, for example increasing the understanding for differences in cultures and working methods.”

A more efficient process and interaction would make it possible for the company to shorten the development time and become more competitive on the market. Four central research questions were defined:

Q1: What are the activities in the localisation process at one of the divisions in Pune, and what can be improved?
Q2: How and when do functions interact in the process and what difficulties do they meet?
Q3: Are there any differences in the way of working between the three divisions in Pune?
Q4: How do the people in Pune and Antwerp interact?

These four questions characterize this thesis work and are to be answered through final discussion and conclusions.

1.2.2 Objective

The objective of the thesis work was to study and evaluate the localisation process including the main activities and involved functions, which was to be visualised by creating a process chart. With that as a base, suggestions for areas of improvement were to be presented for Atlas Copco CT. Another part of the objective was to present this thesis work in this report and in oral presentations at KTH and at Atlas Copco CT.

1.3 Delimitations

The assignment of this thesis work was limited to study the product development process at one of the divisions within Atlas Copco CT in Pune. Information that was collected from the two other divisions in Pune was only used as external input and reference material. The investigation was performed with an engineering point of view.

The procedures in Pune was not studied and compared to the procedures in Antwerp in detail, the comparison was only on a high level. There was no comparison of the work procedures and application of the company’s product development process at other Product Companies, carried out within this thesis work. Neither was there any investigation of the use of product development processes at other business areas within the Atlas Copco Group. The general product development process was not evaluated in reference to the processes at other companies or to the theory.

When studying the interaction between different departments it was limited to the marketing, engineering, production, and sourcing functions. Regarding the interaction between Antwerp and Pune, the study was focused on one of the divisions.
The execution of several projects was followed and observed in order to study the interaction between the different functions. The ongoing projects were in different phases but most of them in later phases, meaning that they were about to, or recently had, reached serial production. There has not been a comprehensive study of any specific project throughout the complete product development process.

During the study, there has not been any contribution to the work within the localisation process. The activities have only been observed and discussed with involved persons. The functionality and impact of the database management systems used in the daily work, for example the PDM- and ERP-system, have not been analysed in this thesis work.

The suggestions and recommendations presented in this report were not supposed to be implemented during this thesis work. The objective for the development of the process chart only was to provide an overview of the main activities, and not a detailed work description.

1.4 Road Map of the Report
Ten chapters are included in the report of this thesis work and in this initial chapter; the background of this thesis work is introduced as well as the assignment description, purpose, objective, and delimitations. The methodology that explains how the thesis work was performed is described in the second chapter. The third chapter gives an insight about the company Atlas Copco, especially the business area CT and the product development process that is used there. Thereafter, in chapter four, the theoretical frame of references is presented. The results from the empirical study in Pune and the opinions and thoughts by the interviewees are presented in chapter five and six. In the seventh chapter, analyses are made that relate the empirical study to the theoretical frame of references. The suggestions for improvements are described in chapter eight. A summary that relate to the research questions and the purposes of the study are found in chapter nine. The final chapter comprises reflections regarding the reliability and validity of the thesis work and a discussion about future work.

In this report only selected parts that are thought to be interesting for the reader has been included, that is to say, not all information that has been gathered during this thesis work. In the report, it might exist some terms that the reader is not familiar with and therefore, there is a glossary of used terminology in the beginning of the report, on page IX.
2 Methodology

In this chapter the way this thesis work was performed is described, that is to say the methodology of the study, which include how the collection of data was performed for the theoretical frame of reference and the empirical study, as well as how the data was analysed.

2.1 Step One – Theoretical Frame of References

A literature research was performed as a first step in order to find and collect relevant data to create a frame of references suitable for the area of this thesis work. In this way, a better understanding and knowledge about the topics included in the assignment was obtained in order to be prepared for the empirical study and to be able to compare the empirical and the theoretical data. The focus of the literature research was four subject areas. The first two subjects, product development processes, and interaction during project work were perceived as important since the main purpose was to study the product development process and interaction at Atlas Copco CT. The two latter areas, cross-cultural communication, and cultural diversity in a business related context, were also essential due to the global aspect, with the authors from Sweden, the head office of Atlas Copco CT located in Antwerp, and a foreign subsidiary in Pune. The literature was searched for on the Internet, at libraries and in databases, and the main literature sources were scientific studies, articles, books, and other master thesis reports.

2.2 Step Two - Empirical Study

The second step was the empirical study, which can be qualitative or quantitative or a combination of both. Quantitative methods are usually based on pre-structured approaches that tend to involve relatively large-scale and a representative sets of data, often presented in numbers (Blaxter, Hughes and Tight, 2006:64). Qualitative techniques, on the other hand, tend to focus on non-numerical, in-depth exploring of smaller and particularly interesting examples that often are based on the clarification of the thoughts and perspectives of the persons involved in the research. Blaxter et al further claim that qualitative methods often aim to achieve depth rather than breadth. Wilkinson (2000:79) adds that qualitative research usually is analysed by subjecting it to some form of coding process.

There is a widespread and ongoing debate regarding what method that is the most reliable for generating “facts” and quantitative approaches have earlier been seen as more objective and scientific than qualitative, but that seems to have changed lately (Blaxter et al, 2006:64). When trying to distinct these two approaches questionnaires are often seen as a quantitative method whereas interviews and observations often are seen as qualitative ones. Blaxter et al mean that it is more complicated than this, since interviews can be structured and analysed in a quantitative manner while surveys may allow open responses and lead to in-depth studies of individual cases.

However, for this thesis work, a qualitative approach was chosen since it was a case study of explorative character with the aim to gather information and personal opinions about the way of working in Pune when localising the products to the Indian market. Several methods were used to be able to gather empirical data from multiple sources, the main techniques for this study were personal interviews, observations of the employees work and study of internal company documents.
2 Methodology

2.2.1 The Interviews

Interviews can be structured or un-structured or a combination of both, which can be referred to as semi-structured interviews. A structured interview focuses on a predefined set of questions that are covered one by one, to be able to compare the answers from different respondents in a controlled order (Wilkinsong, 2000:47). An un-structured interview on the other hand, allows an open discussion to take place, which focus on a predefined theme or area without having any precise interview questions prepared (ibid).

The interviews in this thesis work, was chosen to be semi-structured, and had as a starting point, themes with a number of predefined questions prepared in an interview guide that was discussed with the academic supervisor at KTH. Anyhow, the interview guide was not strictly followed, and other relevant questions could be added during the interviews. In this way, the interviews became more like a conversation, where the interviewees could respond freely to the questions and bring up additional information relevant for the subject. Nothing during this study was recorded in order to make the interviewees to feel comfortable and encouraged to talk freely. The interviews were performed with one respondent at the time and lasted for 30 to 90 minutes. Both of the authors participated in all the interviews and the responsibilities of taking notes and leading the interview forward were alternated. It was the authors’ intention to verify that the interviewees’ answers were interpreted correctly by rephrasing the responds during the interviews.

After each interview, the notes, impressions, and interpretations were resumed according to certain themes and discussed by the authors. The information that was collected about the process was also arranged in a work breakdown structure and flowcharts in order to have an easy overview of the data. A weekly briefing was compiled, including a selection of the gained knowledge from the performed interviews that particular week, which was sent to stakeholders in Pune as well as in Antwerp so they could follow the thesis work to some degree. The empirical study lasted for three months. The main part of the study was performed at Atlas Copco CT in Pune, but first, an initial visit for three days took place at one of the divisions in Antwerp.

An Initial Visit in Antwerp

During the visit in Antwerp, an introduction was given to the CT business area and the product development process that is followed at the studied division in Antwerp, which also is related to the Local Production in Pune. A program was arranged by the company, in purpose to get in touch with persons from different functions involved in the development process, such as engineering, production, and logistics. The program included meetings with six persons from these functions and a tour in the factory, to see the work at the production lines and in the test laboratory. The meetings were open and the persons met talked freely about their work in Antwerp, and the interaction with other functions, as well as with persons in Pune. Prepared topics and a checklist of questions were used so that all possible and relevant data for the thesis work surely would be collected. Written summarises of all meetings, impressions and interpretations were made in the end of every day.

The Main Study in Pune

The study at Atlas Copco CT in Pune lasted for a period of three months, which gave the authors the opportunity to observe the way of working comprehensively. In the study in Pune, documents about the process in Antwerp were used as reference material. A first set of interviews was scheduled, including respondents with different positions within six different functions, which were marketing, engineering, production, sourcing, custom design, and
quality control. Before the interviews were performed, all the involved persons received information about the thesis work, the purpose of the study and what information that was of interest for the study. In this way, the respondents could be better prepared and the time for interviews could be effectively used.

The focus of the study was the working procedures at one of the divisions in Pune. However, to increase the understanding for the work procedures in Pune, and illuminate the differences between the divisions, a benchmark was performed at two other divisions. Persons within the engineering and production departments at these divisions were included in the first set of interviews, which then involved 23 respondents. After completing the first set of interviews, an overview of the localisation process was obtained and an evaluation was made considering where more information was needed and whom it would be necessary to talk to again. This was discussed together with the supervisors in Pune. A second set was arranged where eight persons were interviewed once again in purpose to cross-check the authors’ interpretations of earlier information, fill the gaps, follow-up particularly interesting areas and make sure to gather opinions from different respondents about the same theme or issue. In addition, a telephone interview was performed with one respondent in Antwerp.

The study in Pune also included participation in meetings, more specifically the weekly Project Team Meetings at the studied division. The authors also attended some other meetings, such as one production meeting, two Product Strategy Meetings, and a few telephone conferences between Pune and Antwerp. Besides these meetings, internal company documents were overviewed and analysed, for example meeting summaries and project specifications. In addition, the opportunity to eat lunches and have other informal meetings with the employees in Pune was given during the study.

2.3 Step Three - Analysis
The third step of the thesis work was to analyse the results from the empirical study and relate it to the theoretical data. Since a substantial amount of material was collected, it was necessary to reduce the size of it. The analysis was therefore divided into two parts, the condensation of the empirical data and the comparison between the empirical data and the frame of reference. Apart from the condensation and comparison, an analysis was carried out continuously through the completely empirical study.

2.3.1 The Continuously Accomplished Analysis
Kvale (1996:205) claims that analysis is not an isolated stage of the process when performing an investigation and in this thesis work, there were several ways of persistently analysing the interviews and the collected data as also mentioned earlier. First, the interviewees’ answers during the interviews were rephrased by the authors, to have a chance to be corrected immediately. Second, the interview results and observations were summarised, ordered according to themes, and discussed between the authors after each interview session. Third, the respondents’ descriptions about the activities and actors in the process were arranged in a work breakdown structure, as well as in flowcharts to receive an organised overview and be able to analyse where more information was needed. This structuring of information established a foundation for the discussion with the supervisors in Pune, and facilitated the finding of areas of improvement regarding the process and way of working. Furthermore, some of the persons in Pune were re-interviewed.
2.3.2 The Condensation of the Empirical Data

One part of the analysis was to condense the general work procedures in Pune and the opinions about it to a résumé. This was executed in accordance with four of the five analysis approaches described by Blaxter, Hughes, and Tight (2006:203), which were annotating, labelling, selection, and summary. To start with, the summaries from the interviews from Pune and Antwerp and the weekly reports were reviewed. The parts considered as most significant were highlighted, commented, and some sections were labelled with words that related to the subjects in the theoretical frame of reference, referring to what Blaxter et al call annotating and labelling respectively. With this as a foundation, a selection was made regarding which parts of the empirical results to include in the résumé and a reduced version of the interview summaries was developed, referring to the terms that Blaxter et al call selection and summary.

2.3.3 The Empirical Data Related to the Frame of Reference

After the condensation of the collected empirical data to a résumé, a comparison of the empirical and theoretical data, together with the authors’ own thoughts, was performed. The work procedure for this analysis followed the previous, with annotation, labelling, selection, and summary, but this time the material to focus on was the empirical résumé and the theoretical frame of reference.

The analysis led to the formulation of several suggestions for improvements, which was discussed with the supervisors in Pune.
3 The Company - Atlas Copco

In this chapter, a short introduction about the company Atlas Copco is given, including the history and an organisation description. Furthermore, the general idea of the product development process at Atlas Copco CT is described. An overview of the transfer of projects from Antwerp to Product Companies all over the world is given. The information has been collected from company documents, and through interviews at Atlas Copco CT in Antwerp.

3.1 The Atlas Copco Group

Atlas Copco was founded in 1873, and is today one of the worldwide leaders of providing industrial productivity solutions, with about 33,000 employees (Atlas Copco & n3prenör, 2008). The vision is to be First in Mind – First in Choice® within the product range, which reaches from compressed air, construction tools, and drilling equipment to industrial tools and assembly. The group owns more than 30 brands and have a multi-brand strategy, the main brand is however the Atlas Copco brand. Atlas Copco is organised in three different business areas: Compressor Technique, Construction and Mining Technique and Industrial Technique. These business areas are divided into different divisions, depending on the products, each one responsible to deliver growth and revenue. Each division generally consist of Customer Centres, Distribution Centres, and Product Companies.

Within the business area Compressor Technique there are seven divisions; Oil-free Air, Industrial Air, Portable Air, Gas and Process, Speciality Rental, Compressor Technique Service and Airtec. The head office for Compressor Technique is located in Antwerp, Belgium and other units are located all over the world, for example China, Brazil and India. The idea is that the local customer comprehends Atlas Copco as a local company that has the resources of a global company.

3.1.1 Atlas Copco in India

Atlas Copco India Ltd. was founded in 1960 and all business areas are represented in India (Atlas Copco). The business area CT is located in Pune where the divisions Oil-free Air, Industrial Air, Portable Air, Gas and Process and Compressor Technique Service are represented. There are several different types of compressors produced within this business area.

3.2 The Product Development Process

The product development process at Atlas Copco CT is independent of what is produced and it is the responsibility of each Product Company to decide how to implement it and apply it to the business.

There are different types of projects, which can be classified into four categories depending on the grade of innovation. The class A projects are new technologies and mainly involve Research and Development (R&D) activities and the B classified projects consist of new products, based on proven technology. The class C involves new products based on a proven concept and the D classified projects are entailing new components on existing products. The Product Companies with only Local Production are usually involved in class C or D projects. The intention is to have a process that can be adapted depending on the different project requirements.
The product development process comprises five phases: Feasibility, Functional Prototype, Production Prototype, Pilot Batch (PiBa) and Field Follow-up, and five gates: Master Specification (MS), two Design Reviews (DR’s), Qualification, and Project Closure, see figure 1. The gates are decision points where the outcome of the stages are evaluated and approved before the project can move on.

![Development Process at Atlas Copco CT. (Source: Revised by authors, original by Gregoir, Antwerp, 2008)](image)

3.2.1 The Ideation step
Before entering the product development process, there is an Ideation phase with the primary R&D activities. The outcome of this phase is a scope for the project and a plan for the execution of the Feasibility phase.

3.2.2 The Feasibility Phase
The main objectives with the Feasibility phase are to identify a business case, which is the foundation for the MS and to establish a project definition. In the Feasibility phase the product is defined, the market needs are compared to technical possibilities, and the project is planned regarding time, cost, resources etc. The outcome of the Feasibility phase is the MS, which is an important document that entails the business plan and all information for the entire project that is needed through the whole process. All project members and the management take part of the MS and sign it, and a frozen MS cannot be changed further on.

3.2.3 The Functional Prototype Phase
The input to the Functional Prototype phase is the MS and an approval from the management to let the project proceed. The main objective with this phase is to confirm the functionality of the product defined in the MS. In this phase, the product design is completed and a prototype is built. When the functional prototype is finished, all departments inspect the prototype and makes comments. In the end of the phase, there is a DR, which is a tool to ensure that the objectives are achieved and that the project is ready for the next phase. There is a team who is responsible for the DR’s that inspects the work and the test results to make sure that everything is correct in relation to what is stated in the MS. It is important to mention that the DR-team is independent from the project team. The outcome of this phase is a reviewed functional prototype and an action list.
3.2.4 The Production Prototype Phase

The objective with the Production Prototype phase is to confirm that the product is able to produce according to the requirements in the MS. The inputs to the phase are the comments on the functional prototype and an action plan. In the Production Prototype phase, a prototype is built on the production line with all the right tools and personnel. After the prototype is tested, there is a final DR, performed by the same DR-team as in the previous phase. The output of the Production Prototype phase is a reviewed production prototype design and a specification of the final product.

3.2.5 The Pilot Batch Phase

The input to the PiBa is the reviewed production prototype and an action plan. For the PiBa the main objective is to confirm that the product can be ordered, built, tested, certified, sold, and distributed according to the MS. In the beginning of the phase, the responsibility is shifted from engineering to production. The units produced in the PiBa have to pass a Qualification before serial production is entered, to verify if the objectives are met. The Qualification is performed by the Production Quality Assurance and reported to the management. The output of the PiBa is a qualified logistics and production process.

3.2.6 The Field Follow-up

During serial production, field follow-up activities are performed, and the objective with this phase is to confirm that the product fulfil the requirements in the MS regarding performance, cost, sales, ordering, production and delivery. The input to the field follow-up phase is a qualified product and process, and the output is a closure of the project, which can be accomplished after the product has been used one year in the field earliest.

3.2.7 Meetings

To monitor the process and the projects there are different levels of meetings. The Product Strategy Meeting (PSM) is the highest level of meeting and it is on divisional level, for product portfolio management. All Product Companies report the status of their projects to the PSM, which is held from once a month to every third month, chaired by the president of the division.

The Product Committee Meeting (PCM) is held at the Product Companies with the management. These meeting are primarily for managing the projects and assigning resources. The PCM approves gates and project closures, and is usually once a month.

To manage quality issues from production or the field there is a Product Quality Meeting (PQM) and it is held at Product Company level.

The status and progress of the projects are discussed in a Project Team Meeting (PTM). Once a week the project team members that represent the departments (marketing, sourcing, engineering, and production) meet and discuss the ongoing projects.

3.3 The Transfer of the Projects

All Product Companies consist of either a Design Centre or Local Production and some have both located at the same site. Both a Design Centre and Local Production are situated at the head office in Antwerp, Belgium. One Design Centre has the main responsibility for the product design, which is called the Lead Design Centre. When the product is transferred to Local Production, it is sometimes beneficial to use locally produced components, to save
money or to adapt the product to the local market, the product is ‘localised’. When a product is localised, the Product Company takes over the responsibility for the product from the Lead Design Centre.

3.3.1 Transfer to Pune

The products that are now produced in Pune have first been developed in Antwerp and gone through the complete product development process, and reached serial production. The products have first been exported to India and sold on the Indian market. If there is a need for a localised product, the localisation process begins.

The project is transferred to the Product Company through the DR-team, which coordinate the communication between the Lead Design Centre and Local Production. There are two contact persons for each Product Company within this DR-team, these contact persons is also the link between the project team in Antwerp and the project team in Pune. In the beginning of the project, in the Feasibility phase, the MS from Antwerp is adapted and reworked by the project team in Pune and needs to be confirmed by the division through a PSM. The DR-team performs the reviews of the products in the end of the prototype phases according to a checklist. After the reviews are closed, the Local Productions manage the forthcoming part of the projects by themselves. The DR-team at the studied division typically executes about five times more major reviews in Antwerp than in Pune.
4 Theoretical Frame of Reference

For this thesis work, the theoretical frame of reference is multifaceted and earlier research within four subject areas will be presented. These subjects are product development process, project work in teams, communication in a global surrounding, and cultural diversity.

4.1 Product Development Process

When developing products today, many companies follow some sort of product development process and the range of companies using a product development process reaches from small enterprises to large multinational companies. There are several different types of processes, depending on the products, market, and company strategy. Some companies have developed their own process, whereas others have taken the advantages of an existing process and adapted it to suit their own business.

A product development process is described by Engwall (2003:20f) as the grammar for the language of product development; it tells how it should be done. Ulrich and Eppinger (2003:12) define the product development process as “a sequence of steps or activities, which an enterprise employs to conceive, design and commercialize a product”.

4.1.1 The Benefits with a Product Development Process

There are several benefits with a well-defined product development process regarding quality assurance, coordination, planning, management, and improvement (Ulrich & Eppinger 2003:12). It is argued that product development processes is independent of organisation structures and it makes sure that everyone acquire a common overview of the activities in the project as well as it enable follow-up activities, evaluation and control (Öhlund, 2007). A product development process clarifies the importance of an integrated way of working, and an owner and a responsible for the process and the work tasks, are provided. Brethauer, 2002:49 mean that it is also necessary to improve and adapt the process over time and to perform a process audit, which is agreed by Öhlund (2007). By planning, executing, evaluating, and follow-up activities, the process can be continuously improved, which is visualised in figure 2. The success of a product development process can be evaluated according to; product quality, product cost, development time, development cost, and development capability (Ulrich & Eppinger, 2003:2f).

![Figure 2. Continuously improving a product development process by planning, executing, evaluating, and follow-up. (Source: Revised by authors, original from Öhlund, 2007)](image)

4.1.2 The Generic Product Development Process

Ulrich and Eppinger (2003:12ff) describe a generic development process with six phases; Planning, Concept Development, System-level Design, Detail Design, Testing and
4 Theoretical Frame of Reference

Refinement, and Production Ramp-up, see figure 3. Each of these phases is like a small process, divided into different steps of activities (ibid). In the process, there is a wide range of concepts in the beginning of the process in the Concept Development phase and then it narrows down like a funnel to the final product, which is shown in figure 3. To achieve a satisfying result with the process it is crucial with involvement from several functions that work in parallel, it is supposed to be an integrated way of working (Engwall, 2003:192f).

![Figure 3](image1)

**Figure 3.** The Generic Development Process, illustrated like a funnel, including six phases. (Source: Öhlund, 2007, original by Ulrich & Eppinger, 2003:14)

Depending on the organisation and products, the requirements for the product development process varies and it is essential to adapt the process to the product. Therefore, within the same enterprise, different processes can be followed depending on the differences in the projects (Ulrich & Eppinger, 2003:12ff).

### 4.1.3 The Stage-Gate Process

One variant of the generic development process is the Stage-Gate process, it is more or less the same concept as the generic product development process, although with more clearly defined decisions points and gates between each phase (Cooper & Kleinschmidt, 2001 and Engwall, 2003:194), see figure 4. An increasing number of organisations are using this model in order to minimise problems regarding product performance, increasing development costs and development time slippage (Phillips, Neailey & Broughton, 1999). The number of stages differs between industries and companies depending on the type of products (ibid). The main idea with the Stage-Gate process is to execute activities at stages, and evaluate at the gates in relation to, the use of resources, time plans, and goals. The activities in the stages are executed in cross-functional teams and performed in parallel, while the gates are checkpoints for quality control, and to plan the next stage (Cooper & Kleinschmidt, 2001 and Brethauer, 2002:49). At the gates, a decision is taken by the gatekeepers whether the project should receive a go, kill, hold, or iterate (ibid). The cost for the projects increase with every stage, therefore it should be a review with the major decisions in the end of each stage to avoid the project from unnecessary moving to far (Brethauer, 2002:52).

![Figure 4](image2)

**Figure 4.** The Stage-Gate Process (Source: Öhlund, 2007).
Advantages and Disadvantages with Stage-Gate

By using a Stage-Gate process, a company can acquire several advantages. It is considered to be a simple process that easily gives an overview, provides control, and conveys trust (Engwall, 2003:197ff). If it is used in the right way it gives a guarantee for quality in the execution of activities, it shortens development time and reduces the risks (Brethauer, 2002:48). A study of 21 firms, which have implemented a Stage-Gate process, showed that the teamwork had improved as well as there were less iterations and shorter cycle times (Cooper & Kleinschmidt, 2001). Engwall (2003:197ff) and Brethauer (2002:48) agree to a certain point, and argue that the Stage-Gate process facilitates easier organisation of work and encourage cross-functional work.

The disadvantages with the Stage-Gate are most often discussed when innovation is the topic, the Stage-Gate is considered too bureaucratic to encourage innovation (Engwall, 2003:187). The process is conceived to be good for quality assurance in projects with predefined goals, however when the uncertainty of the project is high it is difficult to make early decisions and the process becomes a limitation instead of help (ibid). A commonly mentioned disadvantage is that the Stage-Gate gives rise to congestions at the gates. Engwall (2003:18f) means that all processes represent how the projects should be executed, however, in reality the processes are often not followed as planned.

4.1.4 How to Get the Most Out of the Process

A product development process does not make the work more effective and reduce time by its own, it needs a well thought-out implementation plan and maintenance to give the desired improvement and results (Edgett & Jones, 2008). According to Chu, Chang, and Cheng (2006), the key to a successful project is to have an effective project management and IT solutions that support the product development process. Cooper, Edgett & Kleinschmidt (2002) argue that the Stage-Gate process can be applicable also on small projects, if it is designed in a way that makes it scalable and flexible.

While the project proceeds the cost for changes increases. In the beginning when the uncertainty is high, the cost for changes is low, and it is the opposite in the end of the project, see figure 5. It is therefore important to focus and put a lot of effort in the early phases in order to make the critical decisions in time, this is commonly referred to as “front-end loading” or “front-end process” (Ulrich & Eppinger, 2003:16f and Brethauer, 2002:45f).

![Figure 5. The relationship between uncertainty and cost in a project. (Source: Revised by authors, original by Brethauer, 2002:46)](image-url)
There is a lot of responsibility on the gatekeepers, they need to have transparency in their work, an objective view of the projects, and they must be able to prioritise the resources (Cooper et al, 2002). There are often too many “must do” projects and no killing of projects; it is up to the gatekeepers to make correct and strategic decisions (ibid).

### 4.2 Interaction during Project Work

To be successful in today’s demanding marketplace it is vital how industrial companies evaluate, develop, and commercialise new technologies. With product development processes as the Stage-Gate process, where the activities are executed in parallel, companies are thrusting for a highly collaborative way of working. This is one reason why it has become popular to conduct work in teams, another reason is that many organisational objectives cannot be obtained by persons working alone (Brooks, 2006:80). Team members that are working together can produce more than if working alone; a synergy occurs (Michalski, 1998:26).

#### 4.2.1 An Integrative Way of Working

A team can generally be defined as “an intact group of employees who are responsible for a ‘whole’ work process or segment that delivers a product or service to an internal or external customer” (Michalski, 1998:10 after Wellins, 1991:3). There are different types of teams for different kinds of tasks, on different levels within an organisation. Michalski (1998:10) describes two basic types of teams that have been identified, functional and cross-functional, where the latter has become very common today.

The development of products in cross-functional teams requires involvement from individuals from various functions within the company and most central are marketing, design, and manufacturing (Ulrich & Eppinger, 2003:3). Thus, a common problem to all companies of all sizes is when transferring a new product from R&D to manufacturing (Brethauer, 2002:3). Many times the product development is accomplished serially, one department complete their activities and then pass over to the next department, see figure 6. This sequential way of working seldom works out well and new ways of working is needed (ibid). Brethauer mean that the best would be a process that integrates all functions to work in parallel, builds on solid tools and techniques and is implemented so that the whole company embraces it.

*Figure 6. A sequential way of working, where the functions throw the work over the wall. (Source: Kihlander & Öhlund, 2007)*
Improved communication and collaboration between functions within a company is seen as one way to remain profitable and competitive (Langerak, Peelen & Commandeur, 1997). It is a widespread view that firms that have increased the cross-functional interaction achieve a more effective product development process and a higher percentage of new products that are successful on the market. The study of Olson, Walker Jr, Ruekert and Bonner (2001) reveal that to achieve higher product development project performance it is not only a question about increasing the level of cross-functional interaction. Olson et al mean that it is a question about which functions that interact, at what stage in the development process interaction takes place and on the innovativeness of the project.

Many studies have indicated that early interaction between marketing and R&D functions is important and has to be increased. In the investigation made by Olson et al, operation is also included and the results from their study imply that:

- High integration between marketing and R&D during early stages\(^1\) of a project would be positively related to project performance.
- For R&D and operations, high cooperation during both early and late stages\(^2\) was proved to have a positive relation to project performance.
- High interaction between marketing and operations during later stages of a project seemed to be significantly related to project performance.

Olson et al also make the conclusion that the overall interaction between marketing, R&D and operations become higher in the later stages of a project because there is a greater need for information sharing, feedback and coordination of activities, and decisions. Brethauer (2002:21) suggests that marketing and manufacturing should be more involved early in the product development process to improve the communication and make the work proceed in a smoother manner.

When talking about cooperation it is also important to consider the frequency of interaction as well as the amount of information and resources that is shared, though observations show that there is no guarantee that functions with frequent interaction exchange any useful information (Olson et al, 2001).

### 4.2.2 Means for Enhanced Integration

The establishment of teams in a cross-functional way is one approach to obtain success and effectiveness, but a team also needs tools to perform well (Brethauer, 2002:13). This is also the opinion of Michalski (1998:30ff), who mean that all teams needs tools to be able to solve problems, whether it is for developing new products or enhancing existing processes. Several tools can be used to enhance the collaboration, especially to integrate the different functions in the cross-functional team. Means that can be valuable to evaluate, if striving for an enhanced integration, are teambuilding, the organisational structure, incentives and rewards, IT-solutions, visible planning, personnel movement, physical facilities and formal integrative tools (Griffin & Hauser, 1996, and Kihlander & Öhlund, 2007).

Johannesson, Persson & Pettersson (2004:249) mention Quality Function Deployment (QFD), Failure Mode and Effect Analysis (FMEA), and Design for Manufacturing or Assembly (DFM or DFA), as examples of some integrative tools that can be used during different stages in the product development process. The main purpose of using integrative tools is, according

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\(^1\) The early stages - product conceptualization and evaluation.

\(^2\) The late stages - production and commercialization of the products.
to Johannesson et al., to reach a consensus among the team members. Another is to increase the traceability, since it forces the team to document the product development work and decisions, when earlier only relying on drawings and bill of materials.

### 4.2.3 Effective Team Work

Working in a competitive business environment with challenging and changing work tasks compels teams to be efficient to reach success, but teamwork itself can be difficult. About cross-functional teams McDonough, Kahn and Griffin (1999:376) says, “Hence, while cross-functional teams are associated with decreased product development times and increased product success in the marketplace, they are difficult to manage”. It is claimed that one reason for difficulties when working in cross-functional teams are to overcome the differences in the departmental cultures, jargon, and orientation towards time among the various disciplines (ibid). Barriers like these result in complications in understanding one another’s goals, solutions, and trade-offs. This is agreed by Griffin and Hauser (1996), who especially discuss the differences between R&D and marketing, and give the example with personnel from marketing, which prefer a short time horizon, while R&D personnel prefer a long time horizon.

Teams can fail for many reasons and it can be discussed what failure means in this context, Michaliski (1998:22) state that many times it is about not producing significant results despite the teams efforts in spending time in team meetings, on research and data collection, and problem-solving activities. The most common factors for not succeeding according to Brethauer (2002:13) are unclear and changing objectives. Brethauer also brings up lack of role clarity and low priority of the team as important aspects in this issue.

When discussing generally about how teams can become successful, Michalski (1998:12) says that a shared purpose, respected and shared leadership, a clearly defined task, and a common goal to work towards are central. Brethauer (2002:15) mentions that one way of setting clear objectives is to set SMART objectives, Specific, Measurable, Achievable, Realistic, and Time specific. It is also suggested that to form and develop an effective team, the following guidelines could be followed (Michalski, 1998:12):

- Teams must have direction and purpose
- Teams must reflect an egalitarian member status
- Team members must engage in open communications
- Team action items must be completed on time
- Teams must receive training on a required basis
- Resources and time must be available to the team
- Team facilitation must reflect a participatory management style
- Team decision making must be via consensus
- Teamwork and results must be recognized and rewarded

There is much to be said about teams and there are many studies and opinions to take into account, the way to become a successful team is not free from implications.
4.3 Communication in a Global Surrounding

Writing, reading, talking, and listening are parts of a communication process that takes place in all business activities. Harris and Moran (1996:19) mean that everything ultimately comes down to transactions and interactions between individuals. Communication is the tool to exchange meaning or information (Adler, 1997:68), and occurs when a source transfers information to a receiver via one or more channels (Moenaert, Caeldries, Lievens & Wauters, 2000). Another way of describing the communication process is as a circular interaction that includes two roles, a sender and receiver, and a message (Harris & Moran, 1996:21 and Adler, 1997:68). The message can be sent verbally or nonverbally, where both the content of the message, as well as how it is sent is significant.

4.3.1 Cross-Cultural Communication

Communicating effectively can be challenging, especially in today’s international business environment where distance and cultural boundaries have to be managed. Trompenaar and Hampden-Turner (1997:74) states, “Communication is only possible between people who to some extent share a system of meaning”. If the sender and receiver do not share the same frame of reference, such as age, gender, experience, language, customs, behaviour, think patterns, norms and values, they will probably interpret information and act or react differently (Adler, 1997:71 and Arredondo, 2000:24).

When a person from one culture sends information to a person from another culture, it is named cross-cultural communication (Adler, 1997:70). When the person from the second culture does not interpret the sent information as intended by the sender, cross-cultural misunderstanding occurs. While working internationally there is a risk of reading other persons in the wrong way and vice versa not realising that the other person’s background is different, or in what way there is a difference (Harris & Moran, 1996:27). If not recognizing or respecting the assumptions and perspectives of a person from another culture it can be very difficult to communicate (Hartley & Bruckham, 2002:10). It is the opinion of Adler (1997:71) that “communication does not necessarily result in understanding” and that “cross-cultural communication continually involves misunderstandings caused by misperception, misinterpretation and misevaluation”. This can make the work ineffective and cause frustration.

4.3.2 Efficient Communication

Moenaert et al (2000) state that two circumstances have to be met in order to achieve effective communication, especially regarding globally distributed teams. First, the sender has to intend to share information, be able to codify the material and to locate the relevant receiver(s). Second, the receiver has to welcome the information and depending on how it is sent, it could affect the receiver in different ways. There could be different reasons for not fulfilling this. Maybe the source is not able or willing to transmit the information, believes that sharing the information is not necessary, or does not know whom it may concern (ibid). Because of limited transparency in the organisation, it could be difficult to identify to whom the information should be sent or for that matter, from whom it should be received. To use information from a source, the receiver has to register it as relevant, novel, and credible.

A sent message is the senders output while it is the input for the message receiver who will process the input, form perceptions and respond to the sender; see figure 7 (Arredondo, 2000:23f).
Adler (1997:68) claims that the sent message never can be identical to the received message due to differences in how it is encoded by the sender and decoded by the receiver. Therefore, it is important to consider how the message will be perceived by the receiver. Arrendondo (2000:76) says about effective communication, “You’ll be more effective in your interaction with others if you customize your communications to their profiles and preferences”. When talking about cross-cultural communication one of the most important keys is to “put yourself in the other person’s shoes” (Harris & Moran, 1996:20ff). Hartley and Bruckham (2002:10) agree and mean that a first critical step in improving the cross-cultural communication is to understand the most significant differences between cultural perspectives. Another principle that is highlighted by them is the importance of clarifying assumptions and avoiding misleading stereotypes. Adler (1997:75ff) state that stereotypes are good as a first best guess about a person, group or situation, however, when faced with contradictory evidence the stereotypes should be set aside to not be misleading.

4.3.3 Electronic versus Face-to-Face Communication

The demand to overcome the distance barriers in globally distributed work has forced communication technology to be developed. Communication modes such as email, telephone or videoconferences, and shared information databases facilitate the interaction requirements in the business of today. The tendency is to use these electronic communication modes more frequently than face-to-face contact since it enables effective interaction at low variable cost that otherwise might never would have taken place (Moenaert et al, 2000). It can be questioned how to balance face-to-face and electronic contact in order to make the communication efficient, and at the same time as good as possible. The electronic communication modes are considered as suitable for making appointments and schedules but not really for moral support or for issues that are of a more emotional character, and it is debated if electronic modes should be used in the large scale as of today (ibid).

A case study with nine globally distributed work groups showed that one of the main problem areas was misunderstanding in communication (Hinds & Kiesler, 2002:168f). The members of the working groups used several electronic communication modes such as email, voice mail, fax, telephone conferences, and computer conferences. From the study, Hinds and Kiesler (2002:168) discovered that some of the difficulties by only using electronic communication was, citation: “confusion in telephone conferences, with persons on different pages of documents. Group members failed to return phone calls or respond to inquiries from distant members. Key group members at remote sites were left off e-mail distribution lists. Distant members were not informed of key decisions or information. Misunderstandings developed on the basis of different assumptions about the tasks and assignments.” Because of the communication issues, project start-ups took longer time and the steps in the working process could be delayed (ibid).

Even though meeting face-to-face in globally distributed work is expensive and time-consuming Moenaert et al (2000) claims that if electronic interaction is to be valuable, personal relationship and trust must be established and maintained through regular face-to-face contact, informal as well as formal. This is also confirmed by McDonough, Kahn and
Griffin (1999) and Hinds and Kiesler (2002:179). Everyday discussions and “chatting in the hall” often has a positive effect when cooperating in a team and key decisions and exchanges often occur in these situations. Since there is a limited personal contact between geographically spread co-workers the development of stable relationships and trust gets complicated and there is little known about how this best can be accomplished (Zolin, Hinds, Fruchter & Levitt, 2004). What Zolin et al say about this dilemma is that trust should be built from the beginning to avoid misunderstandings during later non-personal communication.

### 4.3.4 Communication Modes Related to the Purpose

When talking about which communication mode to be used, team performance and purpose has to be considered. McDonough et al (1999) found out from their explorative study that good performance is positively related to a more often use of a variety of communication modes that meet different requirements. Different kinds of modes can be used for different purposes. In the study, three main purposes to have in mind were identified, the speed when transferring data, the information’s richness or complexness and the volume of information (ibid). One communication mode cannot meet all of these three demands at the same time so the mode has to be chosen so it suits the purpose, see table 1. For example, face-to-face meetings, mail and company databases are suitable for handling large volumes of information.

<table>
<thead>
<tr>
<th>Table 1. Communication modes related to the speed, richness, and volume.</th>
<th>Speed</th>
<th>Richness</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone Calls</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Fax</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>E-mail</td>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Teleconference</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Face-to-face Meetings</td>
<td>2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Mail</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Company Databases</td>
<td>5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Videoconference</td>
<td>2</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

When relating speed, richness and volume to high performance in global teamwork McDonough et al discovered that frequent use of telephone calls had the most positive impact, probably because of the telephones ordinariness. This was the case even if other tools provided faster transfer of information or that the content of the data was richer. Besides thinking about purpose and performance when choosing how to exchange information, Arredondo (2000:188f) suggest that what the recipient prefer also should be considered, again when talking about communication, it is about relating to the other persons’s point of view.

### 4.4 Cultural Diversity

Many companies operate all over the world today, and the market is becoming smaller. During those circumstances, the ability to handle cultural differences is of great importance for an efficient organisation (Brooks, 2006:270). There are different types of culture, national and organisational, and the definition of culture differs depending on the perspective. Culture has by Hofstede G. & Hofstede G.J. (2005:16ff), been described as our mental programming. Harris and Moran (1996:30) use the metaphor of an iceberg when describing culture, since only part of the iceberg can be seen and most of it is hidden below the surface.
4.2.1 National Culture

In multinational companies several different national cultures are combined and the strategy for the whole company has to be compatible with all of them, however when companies become multinational the processes for planning and controlling are often in great extent still affected by the original culture (Hofstede et al., 2005:272). Furthermore, when foreign theories are introduced abroad, they are more often preached than practised and in silence, they are adapted to be compatible with the local culture (op cit, 287). This scenario could be the outcome of what Adler (1997:10) and Steers & Nardon (2005:121) refers to as when seeing the world through one’s own eyes only and not being able to recognize the difference or understand how it affects their behaviour. Meade (1994:77) describes the ignorance of not being able to understand different views in cultures. The own culture is often considered as the best and the one to be followed and it is assumed that other persons should embrace those views, even if they originate from another culture. This view highlights the need for cultural understanding within multinational companies.

Several minor studies have been performed regarding the issues of cultural differences in a work related context; however, most of them are based on a study among IBM employees in several countries performed by Geert Hofstede, published in 1980. Four different dimensions were explored in Hofstede’s study; power distance, individualism versus collectivism, uncertainty avoidance, and masculinity versus femininity. The indexes for India, Belgium, and Sweden are listed below in table 2. However, to assume that an entire country has the same culture, as in the IBM study, can be a huge mistake, especially for large countries (Meade, 1994:73). Consequently can culture only be seen as an indicator of what most of the people would do in a routine situation (op cit, 76).

**TABLE 2. Hofstede’s five dimensions, index for India, Belgium, and Sweden (Source: Hofstede et al., 2005)**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>India</th>
<th>Belgium *</th>
<th>Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Distance (PD)</td>
<td>77</td>
<td>61</td>
<td>31</td>
</tr>
<tr>
<td>Individualism (IND)</td>
<td>48</td>
<td>78</td>
<td>71</td>
</tr>
<tr>
<td>Uncertainty Avoidance (UA)</td>
<td>40</td>
<td>97</td>
<td>29</td>
</tr>
<tr>
<td>Masculinity (MAS)</td>
<td>56</td>
<td>43</td>
<td>5</td>
</tr>
</tbody>
</table>

* For Belgium, the index is for the Flemish part, since the head office of Atlas Copco CT is located in Antwerp.

**Power Distance**

Hofstede et al (2005:59) defines power distance (PD) as in what extent the less influent members of organisations and institutions in a country expect and accept the power to be uneven divided, it gives a measurement of the interdependences in a culture. In countries with high PD, like India, it tends to be hierarchical at workplaces and it is a big difference between the top and bottom. For countries with low PD like Sweden, the distance between the employees and management is short and they have an equal relationship, individuals do not receive any special treatment as a result of a higher position (Hofstede et al, 2005:70f).

An additional differentiation between countries with high and low PD is that in cultures with high PD it is considered as insubordination to bypass a superior. It can sometimes be an emotional relation between subordinates and superiors and the boss is often seen as a father.

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1 The index for Sweden is included since the authors are from Sweden, and thus many readers of this report probably will be Swedish, they should be able to identify and relate to the information.
(op cit, 68ff). In countries with low PD, on the other hand, it is expected to bypass superiors if it is required for the work task (Adler, 1997:51). In addition, status difference is considered important when interacting with team members, in countries with high PD (Dekker, Rutte, Van den Berg, 2008).

**Individualism versus Collectivism**

The definition made by Hofstede et al (2005:89f) of an individualistic culture is that there are poor links between individuals; everyone is expected to look after themselves and the closest family. Collectivism is defined as when people from birth are integrated in a group with strong cohesiveness, which provides safety for the individual in interchange for loyalty. This affects the work goals for employees in individualistic and collectivistic cultures. However, for people in individualistic cultures, the work goals were found to be spare time, freedom and challenge. For people in collective cultures on the other hand, the work goals were practise, physical circumstances, and the use of skills (ibid).

Furthermore, the way to show organisations differs between the two cultures; in individualistic societies, organisation charts show detailed job descriptions with tasks and responsibilities. In collectivistic societies, the organisation charts are more group oriented and show department or division instead of single people as responsible (Adler, 1997:25f). In addition, personal relationship and trust are considered as very important in collectivistic cultures (Hofstede et al, 2005:116). The group orientation is also present if there is a mistake; the whole group takes responsibility for it (Trompenaar & Hampden-Turner, 1997:63ff).

Steers & Nardon (2005:22) imply that globalisation leads to more individualistic cultures and this is the case for India according to Bhasin (2007). India was less individualistic before (index 48 in table 2), although India has changed lately because of external influences.

**Uncertainty Avoidance**

Uncertainty avoidance (UA) is defined as in which extent the people in a culture feel threatened by duplicitous and unknown situations (Hofstede et al, 2005:183). There is a big difference between Belgium and India regarding uncertainty avoidance, the index is 97 for Belgium and 40 for India. For countries with low UA like India and Sweden, ambiguousness can sometimes be positive and a supposition for creativity. People from cultures with low UA might perceive rules as inefficient and do not realise that these may satisfy peoples emotional need for structure in cultures with high UA (op cit, 198f). The index of uncertainty avoidance can also be related to the attitude towards employment; lifetime employment is more common in countries with high UA and the opposite in countries with low UA were people tends to change employer more often (Adler, 1997:51f).

**Masculinity versus Femininity**

Depending on if a culture is perceived as more masculine than feminine different factors is considered important in work associations. In masculine cultures, income is thought as most important, thereafter comes recognition and promotion. In feminine cultures like Sweden, the relation with the boss is considered as most important, and cooperation comes second (Hofstede et al, 2005:132). Adler (1997:55ff) has chosen to call this Career success and Quality of life instead of masculinity and femininity, which gives it another aspect and might reflect the important factors in a better way. An additional difference is that goals in feminine culture are perceived as means, not ends, to a good life (Steers & Nardon, 2005:136).
Time Perception

The perception of time differs between cultures. In India, it is something to orient towards, not something to always keep an eye on, as it is in Sweden and Belgium (Hofstede et al, 2005:198). The result is that the time for meetings and projects differs a lot between the countries (Adler, 1997:31). Adler also comments that there exist past-, present-, and future-oriented persons in all cultures and therefore it is important not generalise too much.

4.2.2 Organisational Culture

In a similar way as alternative national cultures exist among groups in different countries, different organisational cultures are present within different corporations. Harris and Moran (1996:83) describe organisations as “microcultures that operate within the larger context of a national macroculture”. Since the microculture is a reflection of the macroculture the existing major national culture, where the company is situated, has an impact on the corporate culture (op cit, 85).

Hofstede et al (2005:300), defines organisational culture as the collective mentally programming that distinguish members of one organisation from another, which is agreed by Cooper, Cartwright & Earley (2001:289f, relating to Schwartz and Davis). According to Harris and Moran (1996:69) some may refer to corporate culture as “the way we do things around here” and the behaviour, morale and productivity of the members of the corporation are affected by the organisational culture. It is argued that to capture the loyalty of the employees, the organisational culture cannot turn too much away from the national culture of the employees (Meade, 1994:156). A corporate culture is strong if the expressed values reflect the members’ feelings about their organisation as well as their national culture (ibid).

It is particular important to consider national and organisational culture when a company operates in several countries. It is discussed whether an organisational culture can be applied in different national cultures and according to Meade (1994:148) everything is dependent on the relation between the head office and the subsidiaries. Trompenaar and Hampden-Turner (1997:19) argue that there is no “one best way of organising” that can be applied in all cultures. The question is, whether the subsidiaries should have the permission to act freely, alternatively be controlled by the head office. Steers & Nardon (2005:16) argue that the subsidiaries should be given freedom to act on the local market. Mead (1994:157ff) agree to a certain point and argue that the methods applied must be in line with the subsidiaries need for local freedom, and in the same time Mead argue that the head office need to be in control of the subsidiaries. The subsidiaries should represent the head office and still respond to local market demands (ibid). The organisations worldwide are becoming increasingly similar but persons within the organisations still have their cultural behaviour, according to Adler (1997:60f).

When a company have new product development all over the world the use of a product development process in the global perspective can be challenging since the cultural dimensions can have both a positive and a negative influence (Nakata & Sivakumar, 1996). However, a process that brings several cultures together can be designed in such a way that it maximises the benefits of the cultural differences (ibid).
5 The Work Procedures in Pune

This chapter presents the current work procedures when localising products at the studied division in Pune including the activities, actors, and required cross-functional interaction. A short description of the functions involved in the process is provided as well. The information has been gathered through interviews at Atlas Copco CT in Pune, and from company documents.

5.1 The Organisation of the Division

The project team at the division in Pune include persons from various functions, which are marketing, engineering, production, sourcing, aftermarket, and quality control (QC). In each project, there are about five key persons involved and for the moment, this team handles eight ongoing projects that are in different phases. Three of them are new projects that are in an initial phase, and five projects are old with products that are in serial production.

Since the middle of the year 2008, Pune has experienced a tremendous increasing demand for the products that are offered within the division. The number of orders has increased tenfold. Besides the increased sales, there are space constraints in the factory that the team has to deal with. There have also been changes in the organisation at the division, which means that some of the employees recently have started working there, some of them come from other divisions within Atlas Copco, and some are completely new at Atlas Copco. The functions that are affected most are engineering and production.

5.1.1 Description of the Functions

As mentioned above there are several functions involved in the process of localising products, however the focus when describing the localisation process are marketing, engineering, sourcing and flow-team. At the site in Pune, all four departments are located on separate floors.

Marketing

Marketing do not belong to a Product Company, it is an own company together with the sales department, which is named Customer Centre. There are separate marketing functions for each division, given that the products are different and require different knowledge and way of thinking.

Engineering

At Atlas Copco CT in Pune, engineering is the gathering department and the project leader is always from engineering. Besides from a project leader, there are other positions such as a design, develop and test engineer, thus at the studied division there are four persons within engineering. The test engineer is though the same person for all three divisions. Engineering’s main responsibilities are to design and adapt the local parts and conclude the bill of material (BOM). Sometimes this department is referred to as standard engineering.

Sourcing

The sourcing function operates within all divisions and within sourcing there are purchasing and supplier quality assurance (SQA) with the main tasks to identify and negotiate with suppliers and establish a process to assure the correct quality at the suppliers. The relationship with the suppliers is very important and since a partner cannot be changed easily, Atlas Copco CT helps the supplier to reach the right quality level if that is not the case from the beginning.
Flow-team

Within the production department, there is a flow-team, line operators, line inspectors, and test managers. However, most of the time when talking about the localisation of products it is the flow-team that is mentioned, which consists of four main positions; the flow-team manager, methods, order income, and call-off. The flow-team is responsible to make the production possible and keep it flowing, which involves activities such as planning material locations at the factory, layout for the production lines, assembly instructions etc.

5.2 The Localisation Process

The products that are localised in Pune usually originate from Antwerp, that is to say, Antwerp is most often the Lead Design Centre. When the product reaches serial production in Antwerp, it is transferred, and Pune disposes approximately six months until the product should be localised and have reached serial production.

There are five phases in the general product development process, as described in chapter three. In the present process at the studied division in Pune there are four phases; Feasibility, Prototype, PiBa and Field Follow-up. Before entering these phases, a pre-study is performed that is called Ideation. These stages together are regarded as the localisation process and in section 5.2.1 – 5.2.5 the included activities, actors and the necessary functional interaction are described further.

5.2.1 Ideation - the Initial Step

The very first step before starting the localisation process in Pune is to study the new needs on the Indian market; this is regarded as a pre-study and is called Ideation. It is accomplished by the marketing department, which also is the responsible function for this step.

The main objective with this step is to investigate if there is a future need on the Indian market for a localised product and both existing customers as well as new customers are considered in this research. Product localisation becomes interesting if the Indian customers have special requirements or if there is a need to reduce the price of the original product designed by the Lead Design Centre.

The findings from the investigation have to pass two approval procedures, first a PSM and secondly a PCM. The findings are presented on a local PCM in Pune for the general manager of Atlas Copco CT in India, the head of engineering and the head of sourcing. If marketing receives an approval on the PSM to move on, they present their findings on a local PCM. If the outcome from that meeting is an approval, the first phase in the localisation process can be entered, the Feasibility phase.

5.2.2 Feasibility Phase

The objective with the Feasibility phase is to transform the customer needs into an action plan and the marketing department is responsible for this phase as well. Usually this phase lasts for two to four months. Apart from marketing, the engineering and the sourcing departments are to a great extent involved in this phase.

Marketing prepares a MS where they describe the Indian customer requirements and present a sales forecast and an estimated return of investment (ROI), among other sales numbers. Furthermore, the product that is going to be produced is specified regarding the variants, features, and options. The input for marketing’s work is the basic data from the MS established in Antwerp and the new information is added to this document. The revised MS is
forwarded to the engineering, sourcing and flow-team functions so that they can present the evaluated cost for their work. This is part of the project budget. A broad time plan is sketched for the project, where the time for executing the phases is approximated.

Engineering department gathers information about the project from Antwerp. As a starting point, they use the BOM and drawings from Antwerp as references together with the MS document from marketing to evaluate and prepare how to adapt the design to the local conditions. Then, the engineering and sourcing department decide together, which parts in the product to be procured locally or globally. Purchasing identifies suppliers and negotiates about price etc and the SQA starts to prepare and specify the process for the supplier so the quality will be assured when manufacturing the parts. When meeting the local suppliers both engineering and sourcing are present, or only the latter.

Marketing compiles and finalises all information about the project, in the final MS where the main data is the ROI, project cost and time plan. The MS is approved at two meetings, a local PCM and a global PSM.

5.2.3 Prototype Phase

The general product development process includes two phases where a functional and a production prototype are built, however, at the studied division in Pune these phases are usually merged together to one Prototype phase and several reasons were given. One is that the main functionality for the product already has been developed and proven in Antwerp and when localising the product, the functionality is not changed.

The main objective with this second phase is to confirm the ability to produce the product that includes the localised parts, according to what has been specified in the MS. Engineering is the responsible function for the Prototype phase. The involved functions besides from engineering, are flow-team, SQA, QC, design reviewer from Antwerp, but also to lesser extent, marketing.

Engineering and marketing choose which standard options/features to include when building the prototype. Engineering makes the design of the localised components and produce the required drawings and BOM’s. These changes are released as design notifications in a database by engineering. Other functions like flow-team and sourcing must accept the design notifications. In the same time as the drawings are released in the system, a BOM is released for the prototype, which is done by engineering. When the design notifications have been approved, the sourcing department procure the parts for the prototype. In this phase, the procurement is handled manually except for already known parts that can be ordered through the Business Planning and Control System (BPCS)\(^1\).

If the parts of the prototype are completely new, SQA does a “First Part Approval”. This is done together with QC and the parts are tested regarding dimension, material, and performance. The result is concluded in a report, which has to be approved by engineering before the parts have entered the factory, and are used in the prototype.

The engineering build the prototype together with two operators from production, it is done either in the test cell or on the production line depending on the size of the products. Engineering and flow-team make remarks of the prototype, these remarks are documented.

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\(^1\) BPCS is Enterprise Resource Planning (ERP) software, which is used to control the operations of manufacturing companies.
with photos, and the remarks and photos are stored separately. A test engineer performs the testing of the prototype and the test results are concluded in a test report that is sent for evaluation to the project leader in Pune and the DR-team in Antwerp.

A design reviewer from Antwerp performs a DR of the prototype according to a defined checklist. The open points from the DR are summarised in a “To Do” list that is to be followed up as soon as possible. The outcome of this phase is an assembled, tested, and reviewed prototype. The information is presented on a local PCM and a global PSM.

5.2.4 Pilot Batch Phase

In the past, there has not been a definite and separate PiBa phase at the studied division in Pune. Instead, the first units of the serial production have been considered as a PiBa, and these have been made on customer orders. Only once before, there has been a separate PiBa with one or two units. Involved in the work are flow-team, engineering and marketing and if necessary SQA and QC.

The orders of parts are released through the system as in serial production and are not handled manually as in the Prototype phase. If there is a change of parts after the Prototype phase, a “First Part Approval” is done by SQA and QC for these new parts. The units are assembled on the production line and the operators list their assemble problems and hand the list over to engineering. The units are tested with the same requirements as in serial production. At the studied division in Pune, the Qualification procedure is not implemented to the same level as in Antwerp.

5.2.5 Field Follow-up

The last phase in the process is the Field Follow-up with the main objective to investigate if the products are performing as intended. Unfortunately, this phase was not explored as much as the other phases in this thesis work; nevertheless, what can be said is that one or two compressors are evaluated after one year in the field by engineering. Furthermore, marketing receives customer complaints that are stored in a service report database.
6 Opinions about the Work Procedures and Interactions

The opinions and thoughts by the respondents in Pune and in Antwerp regarding the work procedures and interactions, both cross-functional and cross-national, are presented in this chapter. In addition, observations made by the authors are described.

6.1 The Work Process

In Pune, the employees mean that they are aware of the product development process, it is not documented, but as one person said, it is there. It is also stated that all persons in Pune know the basic procedures, but that it is not followed in reality. According to one respondent, the reasons for not following the process as in Antwerp might be because there has not been any training for working according to processes and it has not been necessary before, however it is changed now when the sales has increased. The respondent also argued that they have the required technical knowledge in India, but are not so experienced in working according to structured procedures. Moreover, it is hard to implement changes and new routines in Pune, and it is indicated that management do not see the profits. Instead, it is often seen, as it will lead to more administrative work for the employees.

6.1.1 Time Planning

The timeframe in the MS is preliminary and very broad. Some persons state that the reason is that the project can be delayed and if they would specify dates and the project gets delayed, they might “lose face” in front of Antwerp who expects that the specified time plan according to the MS is followed.

The broad time plan causes problems in another way. Today, marketing starts to accept orders after the Feasibility phase. One person states that it would be desirable if the orders were collected after the prototype phase instead, and mean that the accurate time plan for the project can be estimated first after the review of the prototype. A respondent with a contradictory opinion argued that the functionality already has been tested in Antwerp, therefore the prototypes in Pune should not fail, and it should be possible to estimate the time before that phase.

When comparing the time for localising or developing products between different Product Companies, the development time in India is said to be one or several times longer.

6.1.2 Development Issues

Regarding the localising of the products in Pune there are several different opinions concerning if there should be both a functional prototype and a production prototype or only one, if it should be kept for future use and how the Prototype phase should be executed.

Involvement of Flow-Team

The flow-team has not been much involved in the Feasibility phase earlier, which is considered to be substantially for their work. With the changed organisation in Pune, since a couple of months back, it is now the intention to let flow-team start their work earlier, for example, plan for the location of parts at the factory, the production layout, the assembly instructions and plan the tooling.

For the flow-team, it is also desirable to be involved in the Prototype phase if it is not decided to build a separate production prototype. They need to have the time and possibility to understand the new product together with engineering in an early phase of the development
Opinions about the Work Procedures and Interactions

process. From the engineering point of view, only one prototype is necessary for them to be able to test the local changes and they do not see the need for two prototypes. If only one prototype is built, several respondents argue the PiBa becomes essential for the flow-team; they must have the possibility to learn how to assemble the product before it reaches serial production. At some divisions in Pune the PiBa is a reality, were they tried to cover all variants, and produce four to five compressors. Since the main development of the compressor already is done in Antwerp, the opinion of a respondent in Antwerp is that only one prototype might be needed in Pune, if the methods for the production line used in Antwerp are implemented in Pune.

What Features the Prototype Should Include

A prototype is built according to the standard options in the MS and engineering and marketing choose which options to include in the prototype, although in some cases only the simplest options are tested according to one respondent. It is argued that it would be preferable if engineering always did a prototype of the worst-case scenario, especially, if the localised parts result in a change of functionality, which not has been tested in Antwerp.

Keep or Sell the Prototype

The prototypes at the studied division are sold to customers since they are expensive and it is important to get return of the cost. If it is a design change later on and a prototype is needed for testing of the change, a compressor from the serial production is used. In Antwerp, the prototypes are saved, and used later on, to test design changes, and according to a respondent, it would be useful if the same could be done in Pune. That is to say, to save the prototypes for future work and make sure they are not sold to customers before all the testing and design reviews are finished. The opinion is that the engineers should have the possibility to experiment with the prototypes and not have to wait for customer orders until they can test, review, and release a new function.

Review and Testing of the Prototype

Today the DRs usually are not closed during the visit of the design reviewer, which is desirable according to one person in Antwerp; instead, the DRs are closed later by telephone or by e-mail. One respondent at the studied division in Antwerp described that, in order to make the DR of the prototypes easier; a Design Preview is performed in the beginning of the Prototype phase in Antwerp. The respondent further said that it would be desirable to have a complete Design Preview in Pune as well, which is not fully implemented today. One respondent in Pune comment and say that this is already the case. However, the preview in Pune is not as detailed as in Antwerp.

At another division in Pune, an internal DR of the prototypes is performed to facilitate the external DR, and a checklist is used that is the same for both reviews. When asking if the same was performed at all divisions, one respondent claimed that this was the case. However, this has not been documented in a formal way.

One observation regarding the testing of the products is that there is no scheme, which makes it difficult to estimate the workload, and the required space in the test cells and the newly built test laboratory.

6.1.3 Serial Production

There have been some issues in serial production for the latest projects and the engineering team have spent a lot of time supporting the flow-team. There is a wish for more structure of the work routines, which is an ongoing process right now. One explanation to why situation
became so troublesome is given by one person who says that marketing experienced pressure from the market and they received many orders. The engineering department had limited resources and could not manage the workload and the orders were pushed forward and managed as quickly as possible. An additional factor, according to one respondent is that there are more often problems with larger products than with smaller and fitment issues are the most common, and the reason might be new technology that is unfamiliar for the suppliers.

Space Constraints
Atlas Copco CT in Pune has experienced space constraints in the factory; for example, it affects the location of incoming parts and the assembly line. As one person says, until recently, a lot of the material that arrived was stored “somewhere” and instead of having a 100 meters long production line, they only have 30 meters. Several persons also mentioned that when a product has been assembled, it has to be moved back and forth, before the testing can take place. That is because there are four assembly lines but only two test cells. In Antwerp they are informed about the space constrains and know that it makes it difficult for Pune to do a better organisation and to optimise the production lines. However, several respondents tell that there have been big improvements lately, considering the storage of material and organisation of the production line.

6.2 Non-Standard Variants
As mentioned before, the MS defines the standard variants and features of a product. Sometimes there are customer requirements for variants that are not mentioned in the MS, these are then called non-standard variants or custom design orders, which are quite common for the bigger products in Pune. When major design changes for non-standard variants are needed in the product, this should be handled by a department called custom design. In Pune, there was no such department until year 2008, and these non-standard variants were handled by standard engineering. When custom design was introduced in Pune, it was on request from engineering in Pune, who wanted someone from Antwerp to start up the custom design. By having someone, who already was familiar to the persons and procedures at custom design in Antwerp, it was believed to make the communication between Pune and Antwerp easier.

At present, the custom design manages the non-standard variants with major design changes and engineering handles the non-standard variants with minor changes. Since the process at custom design is perceived as complicated, it claimed to be unnecessary to involve them for minor changes; it is better and more time-effective if standard engineering takes care of it. It is however not clear how many non-standard orders the standard engineering team in Pune handle, how much time they put on these orders compared to standard design, and there were contradictory opinions in Pune and Antwerp regarding this issue.

Many persons have expressed that one of the biggest challenges at the studied division is that there are many variants, which are not clearly specified in the MS. To facilitate the understanding for differences between standard and non-standard variants, marketing and engineering worked out a standard description that was finished in September 2008. If a variant is not presented in that standard description, it is regarded as a non-standard order and custom design should handled the order.

In Antwerp, a definition of the standard variant for each product is essential. One person in Antwerp stated that a standard BOM does not seem to exist in Pune and guess that the reason might be the many options and variants. If the standard BOM is clearly defined and easy to
find it is much easier when changes need to be done. Another person in Antwerp suggested that non-standard orders should be handled by custom design, and if some options later on turn out to be very popular, they could be converted to standard options.

6.3 Interaction

The interaction between the functions and between Pune and Antwerp is of great importance, especially regarding how information and knowledge is exchanged and which communication modes that are used.

6.3.1 Cross-functional Interaction

It was observable that the project team members often knew their functional work routines well, but they were not always aware of what work tasks that other functions had or how they affected each other’s work. Several persons indicated that there is a need for a deeper and mutual understanding of what each function actually does, and what information that is required from the other functions. For example, it was stated by one person that it differs how much time that is needed for the work at different functions and that engineering was regarded to need less time to perform their work tasks compared to the other functions. The person further claimed that this was because the other functions did not have any insight in the factual work tasks and therefore did not realise the necessity to put more time on their activities, why they were stuck with a lot of work but not enough time to perform it.

6.3.2 Cross-national Interaction – Pune and Antwerp

The interaction between Pune and Antwerp is a critical part of the process, and high transparency in the organisation is very important. After the projects have been transferred to Pune, it is important to keep Antwerp up to date about how the projects are proceeding. One person within the studied division in Antwerp stated that it should not only regard things that are going well, when an issue comes up it should be reported as soon as possible, indicating that some information might be kept in Pune. When discussing the way of reporting to Antwerp with the team in Pune, one person claims that there are specified forms of what information that should be reported to Antwerp, for instance regarding the progress of the projects and these forms have been worked out in Antwerp. The person further says that not all details of the issues they are facing in Pune can be reported to Antwerp, they do not want to know every little detail of the projects; it would be an overload of information to transfer and to receive.

As mentioned before, the connection point for the flow of information is the DR-team in Antwerp. When the division in Pune want information, they send a request to Antwerp. It was observed that during project work, the team in Pune requested information several times before the information actually was transferred. It was though claimed that sometimes the information was not yet official and could not be distributed.

6.3.3 Communication Modes

The communication modes used between the different functions in project work are computer systems: the BPCS and Lotus Notes\(^1\), where email and design notifications can be handled among other things. Meetings are another used mode, for example, there are a production

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\(^1\) This is a communication and collaboration software solution, which enables accessing to email, calendar and notebook functions and sharing and approval of documents, but it also works as a platform for collaborative applications.
meeting every morning, a PTM once every week, and a design notification meeting every week as well as several informal “chat in the hall”.

The most common communication modes between Pune and Antwerp at the studied division are through telephone conferences, BPCS and Lotus Notes. The frequency of the communication varies among the functions and differs regarding what kind of information that is exchanged. For example, the status of ongoing projects is reported to and discussed with the DR-team in Antwerp once a week by the project leader in Pune in a telephone conference. After each weekly telephone conference there is a summary made by the representative in Antwerp, which includes actions and decisions. This report is sent to the representative in Pune as well as to management in both Pune and in Antwerp, which is said to increase the transparency.

6.3.4 Knowledge Exchange

It is an on-going process to increase the level of knowledge about the products, processes, and working routines within the company. One way of doing this is to have an exchange program where persons from Antwerp can come to Pune and vice versa. At present there are several persons from Antwerp that have come to work in Pune for a longer time and hold positions within engineering and flow-team among other functions. There is also one person that recently has come back to Pune after a couple of years in Antwerp. Several persons in Pune seemed to emphasise the positive effects of having persons from Antwerp in Pune for a longer time to support and help them to organise the procedures and routines.

One person at the studied division in Pune stated that it would be good to start sending key persons to Antwerp, but the team is so small and need all resources. In addition, it is difficult to promote persons to go, especially if it is a long time contract; a few weeks are seen as a more likely scenario. One person at the studied division in Antwerp agrees that it would be profitable to send key persons from the division in Pune for training in Antwerp. When these persons return to Pune, they can share their knowledge; it is though important to establish a good distributions system for knowledge within the organisation in Pune.

6.3.5 Project Team Meetings

During the PTM’s at the studied division in Pune, the participating functions were engineering, marketing, sourcing, and sometimes flow-team. The representatives were on management level for each function and they were responsible for the transmitting of information to their subordinates. During the thesis work, the authors attended five PTM’s. A time for starting the meetings was specified, however that time was fluctuating, and the participators dropped in one by one. Some were arriving later and some did not arrive at all, sometimes there was an excuse and sometimes not. Occasionally, the project leader had to call persons to join the meeting, since their presences were vital.

The agenda for the PTM was written in a Word-document, which included a list of the active projects, to do actions, if the action was performed, and sometimes when the action should be executed and by whom. During the meeting, the project leader used a printout of this document to write down the updates of the projects. Team members started discussions with a few of the other team members, and sometimes there were a couple of discussions going on at the same time. It was also common that persons talked on their phones during the meetings.

Other Divisions

At other divisions, an Excel-sheet, called Action and Decision (A&D) log, was used to document the status of the projects. In that document, there was a list of all the active projects,
the actions that needed to be done, when it was performed, if an action was postponed, and the responsible persons to execute the actions. This document was showed on a large screen during the meeting, while the project leader took notes on the computer. The A&D logs at these other divisions showed that many actions had been postponed one or a couple of times. According to one person it is difficult to specify dates and deadlines and make persons understand and follow these, therefore, it was common that actions were postponed a couple of times in Pune.

Meeting Rooms
The place for having meetings was restricted to one conference room, for all divisions and functions, except for marketing that had their own room, which was not used for PTM’s. A accurate booking system for the used conference room did not exist and many times two meetings collided, which resulted in that one of the meetings were postponed or cancelled since there was no other place to have the meeting.

6.3.6 The Structure of Information
What can be said about the structure of maps and information needed for project work in Pune is that it was not organised in a way that makes it easy to find what is searched for. It does not seem to be a responsible person for managing the structure of the documents. One person in Pune stated that people could choose their own way of organising the maps instead of having a fixed order that everybody are aware of and share. It is claimed by one respondent that this was the reason to why Antwerp earlier sometimes had to send the same information a couple of times. The lack of organised information was experienced by the authors when requesting some documents, many times persons had to search for the document in several maps and databases before finding it and in some cases, the person could not find it at all and had to come back later on.

6.4 Cultural Influence
In Pune the phenomena of hierarchies could be witnessed, for example it was recognised in the layout of the workplace in Pune, where all the managers had their desk in an own cabin while all others had their desks in an open workplace. This can be compared to Antwerp where all persons sat together in an open workplace, even some of the managers. There were also hierarchies among the functions, and one person in Antwerp said that for an outsider it is not clear, but it is observable. For example, engineering appeared to be lower in the hierarchy compared to marketing. It was observable that in some situations it was difficult to claim one’s opinions, if lower in the hierarchy.

When performing the thesis it was sometimes difficult to reach certain persons to book a meeting, if they were regarded as higher in the hierarchy, it was necessary that a manager with more respect booked a meeting with that person. It was also necessary to establish a personal contact before a person could “air the opinions” which was experienced by the authors when having meetings with persons in India. Sometimes it was required with one first meeting with the purpose of “get to know each other” and later another meeting where a more open discussion could take place.
7 Analysis and Discussion

In this chapter the results is analysed, discussed, and related to the theoretical frame of reference. The analysis is divided into three areas, the process, the project work, and global communication. In addition, the cultural differences was analysed and when reading this it is important to have in mind that the authors emanate from the Swedish culture, which probably have affected the analysis.

7.1 The Product Development Process

The general product development process used within Atlas Copco CT can be related to the generic process or the Stage-Gate process described in the theoretical frame of reference. These are to some extent similar regarding the thoughts of having stages and gates, being worked out as a “funnel”, the facilitating of integrative work, the built-in quality control etc.

7.1.1 The Process in Pune

The way of working in Antwerp and Pune differs and the product development process is used differently at these two sites. In Antwerp, the procedures in the product development process have always been regarded as essential to follow in the project work. In Pune, on the other hand, the way of working were more like *get the work done* and it was not considered as central to follow a specific process. Engwall (2003) mean that a process is only giving a guideline of how projects should be executed, while in reality, they are not followed properly since an execution of all the activities in the stages, would extend the development time. This accord with people’s attitude in Pune, and the approach to only *get the work done*.

Earlier this has not been a concern since the number of orders was quite low. However, today when the number of orders has increased in Pune, the question is if the need to structure the procedures during project work and to follow a declared process have risen, to shorten the development time and maintain the level of quality. It is important to ask why there are differences in the way of working in Pune and Antwerp, and to seek several reasons.

The Product Company in Pune includes Local Production and as mentioned in chapter 3.2, these sites are usually involved in projects classified as C or D, indicating a lower level of innovativeness and uncertainty. When discussing the disadvantages with a Stage-Gate process, Engwall (2003) claims that, a process is too bureaucratic and becomes a limitation if the level of uncertainty and innovativeness of a project is high. With the reasoning above, a process could not be regarded as a limitation in Pune, rather the opposite.

Cultural Aspects

When trying to understand why the processes differ between Pune and Antwerp, the differences in national cultures can be considered as one possible reason and it can be discussed if some approaches suit certain cultures better than others do. Traditionally, Indians do not seem to be very structured or see the need for structure. One respondent said that in India, people have the required technical knowledge, but are not used to work in a structured way. This is also discussed by Hofstede et al (2005) who concludes that the need for rules may differ between countries with high and low index of uncertainty avoidance. For that reason, in Antwerp (Belgium = high index), they might want a defined process to orient towards when they meet unknown situations, meanwhile in Pune (India = low index), they do not see any problem with uncertainty.
Anyhow, it is important to remember the competitive business environment of today, where a short development time or time-to-market, being cost-effective and the fulfilment of customer requirements are vital to be able to succeed. It is because of these circumstances; the need for a structured way of working and the use of a process has increased for all firms, and has been a great challenge for all firms, not just in certain cultures. On one hand, Antwerp has to consider the cultural differences. On the other hand, since working in a multinational company persons in Pune have to increase the knowledge and understanding of the process at the head office in Antwerp. The chosen way of working in the company should be accepted, and followed by the subsidiaries. Both point of views have to be considered and a balance must be found, though it may be difficult when people tend to believe that the own view is the best, as mentioned by Meade (1994).

7.1.2 Adaptation of the General Process

Ulrich and Eppinger (2003) mean that a process should be adapted according to the products and state that several different versions of a process can be used within the same company. To enable adaptations it is important that the process is scalable and flexible and that the adaptations are worked out in detail. To benefit the most of the general product development process used at Atlas Copco CT it can be questioned whether it should be modified to suit the Product Company in Pune.

Cultural Aspects

When designing a process for a multinational company it is important to think about who will be involved and what background and culture those persons have. The general product development process is developed in Europe and it may not consider cultural differences at the subsidiaries. The process is supposed to be independent of what kind of product that is developed, but the question is whether it is independent of culture. According to Nakata and Sivakumar (1996), a process can be designed to suit different cultures. The thoughts and expectations of a process are different in Belgium and India.

A mistake when trying to operate cross-culturally is to not be aware of the own culture (Adler, 1997 and Steers & Nardon, 2005) and not recognise that in other cultures other views and beliefs are central. In Antwerp, they are convinced that the process would suit the work in Pune, but as one of the respondents in Pune put it, it is difficult to create an Antwerp behind the gates in Pune, when the country outside the gates is India.

According to Trompenaar and Hampden-Turner (1997), there is no best way of organising and it is important to compromise between corporate culture and national culture and make the right adaptations. The culture in the home country of the company affects the multinational company (Hofstede et al, 2005) and the culture where the company operates affects the corporate culture (Harris & Moran, 1996). The connection between headquarter and the subsidiary is therefore of great importance (Mead, 1994). If a strong corporate culture is desired, it is important to consider the national culture. It is therefore important for the persons in Antwerp to consider the Indian culture when trying to implement work procedures and routines.

The Number of Prototypes

The general product development process can be considered as scalable, which makes it possible to reduce the number of phases, if necessary. This is of interest regarding the Prototype phases in Pune and there are different opinions whether it should be one or two prototypes. Some persons both in Pune and in Antwerp argue that it is only necessary with one prototype since the technology already has been proven in Antwerp and when localising
the product, the functionality is not changed. Another opinion is that it is very expensive to manufacture these kind of compressors, and there are often not enough time nor space in the factory in Pune for two prototypes. In the same time, it is necessary for the flow-team to have one prototype to be able to prepare for serial production in time. Today, only one prototype is usually built at the studied division in Pune, without sufficient involvement of all concerned functions. If only building one prototype, the importance to have a definite PiBa is even higher.

Remarks on the Prototype
Today, the problems that are found during the building of the prototypes are listed and photographed; in addition, other functions give remarks on the prototype. These remarks are documented by engineering, and the photos and remarks are not registered in the same document. It would be easier to follow-up the remarks if the photos and remarks were concluded in the same document, with a responsible person for executing each remark. This could also be applicable for the remarks on the PiBa. This way of handling the remarks, have recently been introduced at another divisions in Pune, and it is said to make the work more efficient.

Internal Design Review
The concept with DR is substantially in product development and since the design reviewer only comes for one visit, it is important with good preparation in Pune. It is claimed that is it good to accomplish an internal DR before the design reviewer from Antwerp come, which is performed at one division in Pune. This model could be investigated and evaluated by the studied division to decide whether it could be interesting to implement there as well.

Design Preview
In order to make the work procedures in the Prototype phase more efficient and to work towards a clear goal, it would be desirable for the studied division in Pune to implement a design preview, which is already used in Antwerp. This would also result in that the processes in Pune and Antwerp are uniform. In Pune, it is believed that a design preview already is performed, but that is not the case according to Antwerp. It is therefore important that the DR-team is clear about what a design preview should include and how it should be executed.

7.1.3 Implementation and Application of the Process
The thoughts about the general process at Atlas Copco CT are that all Product Companies should follow the same process, though the procedures can vary to some degree to suit certain conditions. It is the responsibility of each Product Company to establish and implement the process and the included procedures. The general process does though not seem to be used in the same way at all Product Companies, at least when comparing Pune and Antwerp.

As described by Hofstede G. and Hofstede G.J. (2005) it is common that when foreign theories are introduced abroad they are more often preached than practised. The result is that the process is adapted to the local culture, but there is no confirmation of that it is done in the right way and the idea of following the same process throughout the whole company fails.

Earlier there has not been any active initiator to introduce a process-based way of working and one respondent claim that people in Pune is not used to work according to a process. The product development process used in Antwerp is well documented but it is not clear if they have seen these documents in Pune. According to Edgett and Jones (2008) a well thought-out implementation plan is of great importance to successfully introduce a process. If it is desirable that Pune follows the same product development process as in Antwerp, it would be
necessary to explain and show how it works and discuss the advantages and disadvantages, which is in progress.

**Visualisation**

A process can be used to give everyone a common overview of the project and the activities, to achieve this, one presumption is that the process is clearly visualised (Öhlund, 2007). Today it is not done in Pune; the opinion is that everyone knows what his or her assignments are. Each function has documents that describe what they are supposed to do, but no documents that describe the general process for the whole division are available. Neither do there exist a checklist for the activities to be executed in the project. The visualisation of the process would enable all involved persons to get a greater understanding for each other’s work, which is especially needed since there are many newcomers in Pune.

A well-visualised process should show both activities and responsible persons, which makes it easy to know whom to collect information from and whom to ask. In more group-oriented cultures, it is more common to show functions as responsible and not single persons (Adler, 1997). This difference can for example be observed in the documentation of the PTM’s. At the studied division, only functions are written as responsible, in the A&D log on the other hand, that is used by other divisions and introduced from Antwerp, single persons are put as responsible for activities.

**Follow-up and Lessons Learned**

An additional important factor with a process is to improve and adapt it over time (Öhlund, 2007 and Brethauer, 2002) and the process should be evaluated continuously. In Pune only informal and not well-documented lessons learned are performed, which results in that the old projects are not followed-up before the next project begins. It would therefore be desirable to execute lessons learned in the end of each phase or at least in the end of the projects, to be able to improve the process and the way of working. It is also important to evaluate the process to decide whether it fulfils the requirements as planned. According to Ulrich and Eppinger (2003), a process can be evaluated regarding product quality and cost, as well as development time, cost and capability. All these factors should be taken into consideration when a project is evaluated in Pune.

**Time and Planning**

It has been commented that it is not easy to set deadlines for activities and if there were any specified deadlines, they were often delayed, and the activities were postponed, as was observed in the A&D logs at the PTM’s. Without specific deadlines is it difficult to follow-up the work and make a detailed time plan. As has been mentioned, the time plan in the MS is broad and to make it more specific it is necessary to set deadlines for the activities in the project. The connection between the deadlines and activities would serve as a checklist to ensure that all activities are performed in time. This would require a breakdown of all activities and of course to have a realistic time perception. A clearer time plan would also benefit for example the testing of the prototypes since it could be planned and prepared in advance.

According to Adler (1997) and Hofstede et al (2005) there can be differences in the perception of time between the cultures. In Sweden, time is perceived as something definite while in India it is not as precise. This was experienced during the thesis work since it was quite hard to get the respondents to have the meeting at the specified time. Several times, the meetings were postponed, sometimes more than a week.
7.1.4 Difficulties in the Serial Production

There have been delays and issues in the serial production at the studied division in Pune during the last year, there are many possible causes, and some of them are listed below.

- There has not been a declared process with structured work procedures to follow.
- There have been an increased number of orders, but the available personnel resources have not increased distinctly, which has created a tremendous pressure on the involved and accessible employees to perform their work tasks in higher speed than before.
- There are many newcomers at studied division, who need to learn about the products and the work procedures from scratch.
- The complexity of the product is high, and sometimes the technique of the product is new and unfamiliar to the involved persons, for example, the suppliers and the production line operators, who actually would require some extra effort and time to receive a better understanding of the product.
- As mentioned before, there has only been one Prototype phase at the studied division. Since primarily engineering has been involved in the activities when building the prototype, no preparatory work has been possible for the flow-team. The activities that have been suffering are for example, the layout of the production line, the assembly instructions, and the location of parts/material at the factory.
- The first compressors in the serial production are regarded as a PiBa, and these are not qualified according to the procedures used in Antwerp, called Qualification. Without a separate PiBa and a Qualification, there is no clear evaluation and confirmation of the logistics and manufacturing processes, among other things.
- There are many different variants, standard and non-standard, and it is claimed that not many compressors is similar to its predecessor, which makes it hard to get a continuity in the workflow in serial production, to follow the same work instructions from time to time.
- At the factory in Pune, there is an obvious space constraint, which has caused complications regarding the planning of the production line, the organisation of the material and the testing of the manufactured products. In addition, the compressors for both custom and standard orders sometimes were assembled on the same production line, that is to say, the standard and non-standard variants got into a conflict about the same space.

Front-end Loading

As described in chapter six, engineering has been much engaged in solving issues in the serial production, which should not be the case, the issues should not be revealed in that late stage when it is so costly to make changes. It is questioned whether standard engineering are too busy with the handling of non-standard orders. However, if a process had been well implemented and followed, the likelihood for discovering these issues before serial production would have increased.

To be able to avoid problems in serial production in the future, several persons, and functions need to elaborate, and a lot of work needs to be done earlier in the projects. Both Ulrich and Eppinger (2003) and Brethauer (2002) describe the importance of focusing on the early phases in product development. To apply this to the work in Pune would mean to involve all functions in the Feasibility phase and have a front-end loading approach. This is agreed by Olson et al (2001) and Brethauer who argue that it is beneficial to involve production early in the process. However, today it is not done in Pune, and if it would be introduced, the flow-team needs to be more engaged so the production can be better prepared.
There are some other issues mentioned above that emanate from reasons that cannot be solved with just a front-end loaded processes. For example, the space constraints are an issue that needs to be solved by the management, which is in progress at present.

**Pilot Batch**

Some persons have argued that it would not be fruitful to have a separate PiBa phase since there are so many variants that the PiBa would not be representative anyway. Furthermore, the products that are manufactured in serial production would be more or less different from the PiBa. As mentioned before it is though essential for the flow-team to have a PiBa especially if they are not involved in the Prototype phase. It is claimed that it will be more central to think about having a PiBa in the future. It is the authors’ belief that the more time to practise, evaluate, and confirm the ability to manufacture the products the better, and it might prevent some issues from reaching serial production.

**Standard Variants versus Non-standard Variants**

Many persons in Pune have expressed the challenge with having many variants. Now there is a definition of what features that are included in the standard variants for each product, the variants not defined are regarded as custom design. However, the use of this definition has recently started and to make the definition more clear and to avoid confusion it needs to be better visualised in the MS and throughout the division in Pune. In addition, the team in Pune should question why there are so many variants and if they might need to limit the options for the customers, so that there are a decreased number of variants in the future. It is understandable that the customer plays an important role for the business, but the customer requirements must be related to the available resources or the other way around.

The fact that standard engineering still, to some degree, is involved in non-standard variants may be one reason why the development time in Pune is longer than for other Product Companies.

**7.2 Interaction**

The cross-functional organising of teams has become very common today, as a result of the need to shorten the development time. Several authors have stated that an open dialog and a high level of interaction between the functions are necessary to make the projects efficient and to achieve wanted results (Olson et al, 2001, and Langerak et al, 1997). In the literature many issues regarding this way of working is mentioned, such as differences in departemental cultures and difficulty to avoid a sequential way of working (McDonough, Kahn and Griffin, 1999 and Brethauer, 2002).

The general product development process at Atlas Copco CT supports an integrative way of working and therefore it becomes natural to work in cross-functional teams. When looking at the cross-functional project team at the studied division in Pune from the outside, the functions work in parallel during the phases and they seem to collaborate to some extent during the project work.

Anyhow, the persons who represent different functions in the team sometimes seemed to be “locked” and more loyal to their function than the project team. Persons appeared to more likely prioritise orders from their functional boss, who is seen as a father and sets the salary, rather than the project leader. This can be linked to the Indian culture with hierarchies and high power distance (Hofstede et al, 2005). When working in projects it is though important to prioritise the project team and the decisions taken there. This is claimed by Brethauer (2002),
who implies that low prioritise of the team is one factor for not having an effective and successful team work.

The complications that were mentioned above can be referred to as cultural issues and it might be difficult to change a cultural way of thinking to privilege a certain way of working, and one way of working may suit one culture better than another. However, these difficulties can also be referred to as a problems that many cross-functional teams in companies struggle with today, regardless the culture.

7.2.1 An Integrative Way of Working

In the localisation process one function is responsible for certain activities and sometimes more or less a whole phase. The functions need to be more involved in each other’s activities to reach a better project performance and to improve the cross-functional work procedure. For example, flow-team needs to participate more in the Feasibility and Prototype phases. This is also agreed by Olson et al (2001), who mean that interaction between R&D and operations should be increased during early and late phases of a project to enhance the results.

Limited Insight

McDonough et al (1999) and Griffin and Hauser (1996) have highlighted the difficulties in understanding one another when working in cross-functional teams, since having different departmental cultures and attitudes among the functions. During the thesis work, it was observed that the functions insights in each other’s work tasks sometimes are limited. When trying to describe the work procedures in the localisation process, persons within different functions came with contradictory information about the same activity. Furthermore, it did not always seem to be clear what the requirements or expectations from the other functions were on one’s own work.

There are some examples regarding the attitudes between the departments. As mentioned before, the engineering thought their work was low prioritised considering the time allocation. Marketing’s attitude appeared to be that engineering do not have to make any new design, only adapt according to the local circumstances, indicating that those activities do not require as much time. In the discussion about if only one prototype is required, it seems like engineering have been thinking that the involvement of flow-team is not compulsory and that they should be able to prepare their work in the later phases. However, the opinion of flow-team is that they have to be involved earlier.

The lack of insight in each other’s work tasks seems to have resulted in the present attitudes among the functions, and to some extent a disrespect of each other’s work. By visualising the activities and actors in the process, the truth would be printed black on white and a deeper understanding could be achieved.

Functional Hierarchies

There are also hierarchies among the functions, for example, engineering appears to be lower in the hierarchy compared to marketing. It was observable that in some situations it was difficult to claim one’s opinions, if lower in the hierarchy. It was mentioned before that engineering has the “gathering” role in project work among the functions, but this sometimes seems to be questionable because of the functional hierarchies. Hierarchies together with

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1 Many authors describe R&D and maybe operations, in this thesis work it is interpreted that the information presented can be applicable regarding engineering and production in Pune.
attitudes and bad insights in each other’s work tasks complicates the cross-functional project work.

7.2.2 Means for Enhanced Integration

Efficient collaboration requires tools, according to Brethauer (2002) and Griffin and Hauser (1996) and in Pune, several built-in mechanisms are used that support interaction, for example PTM’s and approval processes of design changes. However, other tools such as QFD, DFM, DFA etc seemed to be unusual in Pune. For example could DFM and DFA be used to be more profitable and for making the assembly and manufacturing processes more efficient, which would result in an improved process in general. These tools facilitates a structured way of working in the team and it is not sure that these methods would suit the Indian culture. It is though believed that if these methods have been used by teams in other cultures that has experienced a transformation to cross-functional teams, and have resulted in good performance, it should be the same in Pune.

Informal Meetings and Tools

If considering informal tools to increase the level of interaction, lunch meetings and teambuilding can be mentioned. It did not seem to be common that project team members from different functions in Pune ate lunch together, only a few times it could be observed during the thesis work. Since the departments are located on different floors it seemed like the only occasions for the whole project team to meet and discuss are on the weekly PTM’s. It was observed though that the team members sometimes contacted each other person to person or by telephone, if needed. Neither there seemed to be any kind of teambuilding to make the team feeling stronger and improve the interaction during project work. Other mechanism for increasing the interaction is discussed below.

A Shared and Clear Objective

Having a clear and shared objective is seen as one of the most important factors for succeeding as a team according to both Michalski (1998) and Brethauer (2002). In one of the MS’s all the characteristics for the product was defined, there were also several design objectives and a general objective with the project. It is though unclear whether the team in Pune had formulated that objective together or if it originated from Antwerp. However, to make the team feeling stronger it might be a good idea to decide together in the team in Pune what the objective should be for the project, and as Brethauer (2002) describes, the objective should be specific, measurable, achievable, realistic, and time specific. In this way, all functions are working towards the same project goal. Perhaps, the objective decided by the project team could be visualised on a board through the whole project and serve as uniting for the team.

Project Meeting Room

When questioning whether the project team used to visualise information about the projects the answer was more or less that it is in the computers and reachable for everybody. This indicated the rarity to show time plans, the project status, or responsible person for actions, in a printed form, such as on big boards.

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1 When the thesis work was performed, a restoration of the engineering floor had recently been made and the department had just moved in, meaning that they did not have had the opportunity to establish the usual routines, if there were such routines.
To make the project team feeling stronger and improve the understanding of work tasks of each function, it could be valuable to regard to have a separate team room to use for meetings, discussions, and visualisation of the project information. This is also referred to as an “obeya room” or big room, originating from the Toyota way of managing projects (Morgan & Liker, 2006:21). The thought is that it is easier to have the latest updated information visualised to be able to discuss and make decisions about it in the project team.

However, the space constraints in Pune make it complicated to find a separate room to claim. As described in chapter six there is only one room for having PTM’s and project discussions, the conference room. Added to these circumstances is a poor booking system, which cause problems like postponed or cancelled PTM’s. Despite the space problems, there are available solutions, one is to use the office of the project leader to visualise the information about the projects, which would be at the engineering floor.

**PTM’s**

The managing of PTM’s differs between the divisions. At two divisions, an A&D log is used and the project leader is showing this document on a big screen while taking notes about the progresses of the projects. It was indicated that one reason to why not all divisions use the A&D log was not to confuse in between the projects and when starting the new projects they were planning to use that document instead of what was used at present. The document used today has the same layout as the compilation of the weekly telephone conference with Antwerp. The way the meetings were executed today, with discussions on the side etc, a change could be needed, in order to organise and use the meeting time in a more efficient way.

The use of the A&D log makes it easier to overview the projects, what actions and decisions that is taken during the meeting, the deadlines for the actions, and who is responsible. By using the A&D log, and showing it on a big screen in real time, it would be clearer for all team members where the projects are moving. Furthermore, it would support a more streamlined meeting where all persons are active in the same discussion.

**The Structure of Information**

As described earlier, the map structure in Pune does not facilitate to, in a simple manner, find documents, and needed information. When working in cross-functional teams, the sharing of information between the functions is crucial for making progress in the projects. It is even more important when not being located together on the same floor. Collaboration is made easier if the information is structured in the same way for everyone in the project team so that all persons put the right information in the right place. Instead of spending time on looking for the right documents there should be a fixed structure that everyone follows. This is to some extent agreed by Chu, Chang, and Cheng (2006).

**Divisional Interaction**

The teams are small in Pune, and the engineering function is gathered on the same floor for all divisions and the flow-team of all divisions are also allocated together. One might think such circumstances would support exchange of resources and knowledge between the divisions. Today, it is done to some extent, for example, the flow-team for all divisions order some of the parts and material together.

Anyhow, it was noticeable that the different divisions do not utilise the near location to exchange for example thoughts about project handling. One person stated that, it might not have been any interest for an exchange since the teams are small, so it is easy to have an
overview of the function even if working at another division. Besides, there is no time to add
more meetings to the already busy schedule. Furthermore, the person claimed, the products
within the divisions are so different and for that reason, divisional exchange was not seen as
profitable. Still, it is the authors belief that it could be profitable to exchange knowledge
among the project managers from different divisions about how to handle the projects. The
sharing of different experiences and received training would increase the possibility to
improve the work procedures, but also the personal relationships.

7.2.3 Cultural Aspects Regarding Interaction

There are cultural aspects that have to be considered in project work and during interaction
between persons. Hierarchies, personal relationship, and meeting behaviour are discussed in
the following section.

Hierarchies

In Pune the phenomena of hierarchies could be witnessed, which goes along with the fact
presented by Hofstede et al (2005), that India has a relatively high power distance. For
example it was recognised in the layout of the workplace in Pune, where all the managers
have their desk in an own cabin while all others have their desk in an open workplace. This
can be compared to Antwerp where all persons sit together in an open workplace, even some
of the managers.

If lower in the hierarchy, it is difficult to give an order to a person higher in the hierarchy, it is
less likely that this person will follow the order or meet the request. For this reason, to make
sure that orders will be executed, the request always have to come from the right person. As
described before the manager of the function is seen as a father and is a person that persons
listen to. Furtermore, it seems important that the orders are given; otherwise, the actions are
not executed, you do not want to bypass your superiour by doing something on your own, as
also mentioned by Adler (1997).

The importance of status has to be considered in some occasions, for instance, when booking
a meeting. When performing the thesis work it was sometimes difficult to to book a interview
with certain persons, especially if they were regarded as high in the hierarchy. Then, it was
necessary that a manager higher in the hierarchy booked a meeting with that person.

Personal Relationship

The establishment of personal relationships seems to be of great importance in India,
especially since it is a collectivistic culture, as mentioned by (Hofstede et al, 2005).
Generally, when manufacturing products a good contact with suppliers and customers is vital,
and it is even more significant when operating in collectivitic cultures. It was the impression
that in these cultures the customers can decide almost whatever they want, and it is most
important to satisfy a customers requirements. This might be one of the reasons to why there
are so many variants of each product and so many non-standard orders in Pune.

Meeting Behavior

By participating at several PTM’s some cultural differences could be observed. Specifying a
starting time for the meeting did obviously not mean to be in the meeting room at that time, as
it probably would have been in both Sweden and Belgium. Instead, persons could drop in one
by one. The perception of time is clearly different, as described by Adler (1997) and Hofstede
et al (2005), and in India, the time is stretchable. Furthermore, it would never have been
accepted to answer a phone call during a meeting in Sweden, which was often the case at the
meetings in Pune, but there it rather seemed to be rude if not answering. Moreover, several
discussions about different subjects at the same time would have been seen as impolite at meetings in Sweden, while in India it was fully accepted.

7.3 Communication in a Global Surrounding

When studying a multinational company with the head office in one part of the world and production in another, it is important to take the way of communicating into consideration. It is also interesting to analyse the cultural aspects of the communication.

7.3.1 Cross-Cultural Communication

Electronic communication modes are often used to communicate across distances, as is the case at the studied division, it is though too comfortable sometimes. The importance to meet face-to-face cannot be enough emphasised. Especially, when regarding collectivistic cultures as India, where the establishment of a personal relationship is essential to be able to discuss the “real issues” and air the opinions openly (Hofstede et al, 2005). Even if personal trust has been established, too much of electronic contact can cause misunderstandings, as the study of Hinds and Kiesler (2002) showed. The cultural frame of references plays an important role in the communication process, the sender of a message has encoded the information in one way and the receiver decode and interpret the information in another way (Adler, 1997). Therefore it is possible that the message can be misunderstood.

Situations when not having efficient communication can easily arise, regarding cross-cultural communication (Harris & Moran, 1996). There are several circumstances that have to be fulfilled. The sender of a message has to be willing to share information, encode the material in a good way and in addition locate the relevant receivers. The receiver, on the other hand, has to welcome the information and realise that it is important Moenaert et al (2000).

The importance of a willingly sender and reciever becomes clear when analysing the transfer of information between Pune and Antwerp. When Pune request information from Antwerp to perform their project activities it can take a while before that information is transferred and their work are put on hold. In the same time do Antwerp request an action plan from Pune, which they cannot, or do not want to, set up without the information. In addition, there seems to be a disagreement about the content and amount of information that the studied division in Pune share with Antwerp. Persons in Antwerp wants to receive more information, particularly regarding encountered issues, while the team in Pune mean that all details cannot be reported, especially not since such information is not required in the official forms that has been established by Antwerp. Both sides seems to have different opinions of how the transfer of information should be carried out. Maybe, a clear communication plan must be established that both parties agree about. There has to be a discussion about how to improve the way of reporting information, and perhaps the content of what is reported must be reevaluated and the forms redesigned.

7.3.2 Electronic vs Face-to-Face Communication

At present, there is no person from Antwerp within the engineering function who works at the studied division in Pune, as it is at the other divisions. The weekly telephone conference between the project leader in Pune and the DR-team in Antwerp can though be seen as an alternative, where both parts see the advantages of having such open communication about the projects and clarify the requirements from both sides. Anyway, there is of course a difference between an interpersonal contact that can take place every day and a weekly telephone contact. It is though important to utilise the non-personal communication modes as
well, such as telephone calls, since it facilitates easy, cheap, and effective interaction as Moenaert et al (2000) argue. Otherwise, perhaps no contact at all would have taken place.

At the studied division today, the occasions that enable face-to-face contact and “chat in the hall” between persons from Pune and Antwerp is when the design reviewer comes to Pune. Since it is the same design reviewer that comes every time and who also participates in the weekly telephone conference, the parties are at this time well known to each other. A personal relationship and trust have been established and is maintained during these design review occasions, which is important to be able to use electronic communication modes successfully the rest of the time, as also stated by Moenaert et al (2000), McDonough et al (1999), and Hinds and Kiesler (2002).

*Increasing the Interpersonal Contact*

It is the authors’ belief that the face-to-face meetings across the national borders should be increased to improve the cross-cultural understanding for both parties. Perhaps it is especially important that persons from Pune are taking the opportunity to visit Antwerp, key persons to start with, but later also other persons. In this way an increased knowledge and understanding of the process-oriented way of working in Antwerp could be received. It is more advantageous that persons from Pune goes to Antwerp, than vice versa, since the received knowledge will be kept in Pune after these persons have returned.

One area where interpersonal communication could be profitable is when Antwerp transfer projects to Pune. Representatives from Antwerp with insights in the project could come to Pune to handover the project. Alternatively, key persons from Pune could go to Antwerp, though this seems to be more complicated, where one reason is that the teams are so small in Pune and need all the available resources. Anyhow, by accomplish such transfer procedure, a more open discussion about the objectives with the project would be enabled, and moreover, an occasion for building trust and cross-cultural understanding would be given. That would not be possible if only electronic modes are used.

The travelling costs and the environmental effects during the transport between the countries are though two aspects that have to be considered if the face-to-face communication between Pune and Antwerp would be increased.
8 Suggestions for Improvements

In chapter eight, 20 suggestions for improvements that have been developed within this thesis work are described. The suggestions are organised according to three areas, the process, the interaction, and global communication and are listed with benefits and complexities. Some of the suggestions might be able to implement at once, while others require a bit more effort before implementation.

8.1 The Process

The primary suggestion regarding the process is that the studied division in Pune should have a well-documented, visualised, and declared product development process that is followed in a structured manner. It is important that the employees within the divisions in Pune together decide about a layout for the activities in the product development process so that all projects follow the same procedures and that all involved persons know how the tasks are linked. In addition, it is important that engineering focus on the development of standard products and lets custom design handle the non-standard orders as much as possible.

When it has been decided to have a common process in Pune, and it is about to be introduced, it is necessary with a well thought-out implementation plan. It needs to be planned how, when, and by whom the process will be implemented, and how information will be distributed. In addition, there needs to be someone responsible to follow-up the process. It is also necessary that the process is well-visualised for everyone in the project. To achieve this there could be a checklist that shows activities and responsible persons and that is easy accessible for all team members.

A proposal for what an adapted process for Pune could look like have been developed within this thesis work for the phases Feasibility, Prototype, and PiBa. This is a first version, and can be found in appendix 1-3, which regards the studied division in Pune, but parts of it could probably be applicable to the other divisions as well. The proposal though needs to be evaluated and discussed by the involved persons in Pune, and worked out in detail before it can be implemented. The proposed process has the layout of a work breakdown structure and flowchart for each phase. In this section, ten suggestions regarding the process are presented. The suggestions are collected from the proposed process and are on different levels regarding the complexity of implementation. Some of them can be implemented immediately, or when the next project begins, while others require comprehensive preparation before they can be set into action.

S1: Front-end Loaded Process

The work ought to be front-end loaded, that is to say focus on the early phases of the process, in this case, the Feasibility phase. This is one way to make the critical decisions regarding the project when the cost for changes still is low. To avoid issues in serial production the flow-team should be involved in the Feasibility and Prototype phase, not only to evaluate whether production is possible, they could start preparing the production regarding the layout of the production line etc.

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Complexity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less surprises in the end of the project, preparations are done in time.</td>
<td>It might be difficult to make decisions early in the project when the uncertainty is high, even though Local Productions as Pune do not manage projects with the highest level of innovativeness.</td>
</tr>
</tbody>
</table>
S2: Deadlines in the Master Specification

The MS used in Pune need to be more detailed regarding the deadlines. The project team should together go through the activities and decide about main activities, for example DR and testing, and set definite and reachable deadlines for them.

**Benefits**
It is easier to plan the activities that involve persons and resources from the project team and the extended team.

**Complexities**
There is no guarantee that the deadlines are followed even if they are specified, a change in the way of regarding deadlines might be necessary.

S3: Variants and Options in the Master Specification

In the MS, there should also be a clear definition of variants and options for the product, with no possibility of misinterpretations. Presumably, the variants and options will have to be reduced and set in relation to the available resources in Pune. This definition will also work as a foundation to distinct the standard and non-standard orders, and to decide what to include in the prototype.

**Benefits**
A clear definition and a reduced number of variants and options early in the project make it easier for the team members to focus the localisation of parts to the standard variants.

Clarifies what standard engineering is responsible for and which orders that belongs to custom design.

S4: One Prototype Phase

Since the functionality already has been tested in Antwerp and that it is expensive to build prototypes it can be agreed to that there could be only one Prototype phase, however all the necessary activities from both Prototype phases in the product developments process have to be included. It is important that the prototype work as an engineering prototype as well as a production prototype. In addition, it is essential that the features of the prototype are decided together in the project team so the most difficult combination, with locally produced parts, is built. In addition, it should be evaluated if it is possible to keep the prototypes for future use.

**Benefits**
The issues are discovered earlier and the issues in serial production can be reduced. It is less expensive with only one prototype.

**Complexities**
It might be difficult to arrange the activities from the two prototype phases in the general process into one phase.

S5: Design Preview

In the same way as it is done in Antwerp, there could be a Design Preview in the beginning of the Prototype phase in Pune. For a Design Preview, the design reviewer together with the project leader will go through what is going to be tested and evaluated in the DR in the end of the phase. All project team members should take part of the Design Preview.

**Benefits**
Clear objectives to work towards are provided so that everyone knows what the prototype is expected to perform.

**Complexities**
Need introduction, which would be an additional activity that requires time, though the project work might be more efficient with clearer objectives.
S6: Well-documented Remarks
Problems that are found during the assembly of the prototype should be listed in one document together with the photographs, and the responsible for concluding this document should be engineering. In addition, all project members should give remarks on the prototype and this ought to be added to the list, by engineering. All remarks should have a deadline, be assigned to a responsible person, and the document should be available for all project members. Maybe, inspiration could be obtained from other divisions in Pune.

**Benefits**
Clarifies what actions that need to be taken for everyone.
Easy to follow-up the remarks when the photos and text are in the same document.

**Complexities**
Might require more time to conclude one document including remarks and photographs than today’s solution with separate locations, but that time will might be paid back when avoiding to search for several documents.

S7: Internal Design Review
To enhance the chance for the DR to be closed in the same time as the visit by the design reviewer from Antwerp there could be an internal DR in advance. In this way, possible issues will be discovered in time. It needs to be evaluated if someone from another division could perform the internal DR’s, since it is preferable with someone with an objective view. In the same time, it is necessary to have a good product understanding to be able to perform an Internal DR; an alternative is that the project team could do it together. Since it already is done at one division in Pune, inspiration may be gathered from them.

**Benefits**
The project and prototype would be better prepared for the real DR, which enhance the chance for the DR to be closed at the visit and not later by e-mail or telephone contact.

**Complexities**
Might be difficult to find a person with both an objective view and a good product understanding.

S8: Pilot Batch Phase
In order to be well prepared for serial production there should first be a separate PiBa phase. Since the compressors are expensive, the PiBa could be based on customer orders, however, the orders produced in the PiBa should cover as many variants and options as possible to test the most challenging variants.

**Benefits**
The process and logistics can be tested to make sure everything is in order before the serial production start.
A wide range of variants will be developed in time and tested and issues in serial production might be reduced.

**Complexities**
In the serial production there will be variants that differs from the PiBa, so there will be new things to consider, but at least to a lesser extent than if no PiBa at all.

S9: Qualification
There should be a Qualification of the PiBa to make sure that the process and the logistics are prepared for serial production. The model for the Qualification should be the same as in Antwerp, and how to implement it should be worked out thoroughly.

**Benefits**
The project would be well prepared to move on to serial production and there will be fewer problems later on.
8 Suggestions for Improvements

**Complexities**
Training and time for the implementation are required to perform a Qualification according to the routines in Antwerp.

**S10: Lessons Learned**
In the end of each phase and in the end of the project the project team should perform a lessons learned. This enable follow-up and improvement of the process and project handling, but it needs to be done in a formal and well-documented way, to make it possible to go through the documentation later on.

**Benefits**
The process can be improved and mistakes will be avoided.

**Complexities**
Require time and engagement from the team members.

8.2 Interaction
There are eight suggestions for how the interaction can be improved in Pune, both regarding the cross-functional interaction and between the divisions. These suggestions are on different levels regarding the complexity of implementation. For example, the suggestions for a booking system of the meeting room and the A&D log could be implemented immediately while others, like organising the map structure require some preparation before it can be implemented.

**S11: Visualisation**
To enhance the understanding and interaction between the project members the project status, time plan, resources etc ought to be well visualised, for example on big boards. Desirable is to place these boards somewhere where they are accessible for all project members, all the time. However, one solution to deal with the space constraints could be to put them in the office of the project leaders.

**Benefits**
Everyone gets the same overview of the project status and can easy get an update about the latest information. All project members are informed about each other’s work tasks, how they affect other persons work tasks, and whom to ask if there are any issues.

**Complexities**
Require that a responsible person always keep the boards up to date.

S12: A Fixed Map Structure
The map structure should be better organised with a separate project map arranged according to the process phases and activities. Only one person should be responsible for the structure so it becomes fixed.

**Benefits**
Easy access to all documents and easy to interchange information. This would facilitate an easier exchange of information within the project team. It would also make it easier to distinguish the phases and deliverables from each other.

**Complexities**
People have to learn a new structure.

S13: Integrative Means
To improve the group feeling and the interaction within the team some teambuilding activities could be useful, for example a kickoff when starting the projects. Furthermore, to enhance the project work informal meetings could be held in addition to the PTM’s. For example, lunch meetings together in the team or with persons connected to the projects. These meeting could
ventilate trivial issues regarding the projects. Another suggestion is to consider the usage of integrative tools such as QFD, DFA etc.

**Benefits**
- The PTM’s can be more focused on important decisions.
- The team feeling and personal relationships is enhanced.

**Complexities**
- Might be difficult to schedule for the persons within different functions.

**S14: Objectives for the Project Team**

Another way to improve the teamwork would be to decide the objectives for the projects together in the team; this would give the group a shared and common goal. The objectives in the MS could be extended since they are more focused on the product rather than the project. The objectives should be specific, measurable, achievable, realistic, and time specific.

**Benefits**
- The team will work towards a shared objective.

**S15: A&D log at the PTM’s**

One way to make the PTM’s more efficient would be to use the A&D log. It should be visualised on a big screen so everyone have the possibility to follow the actions and decisions during the meeting. The A&D log support the concept with clear deadlines and one responsible person for each task.

**Benefits**
- It is easy for everyone to follow the meeting and easier for the project leader to keep everyone in the same discussion.
- This makes it easy to follow-up the work.

**Complexities**
- Requires good attendance to the meetings to keep the A&D log up to date.

**S16: Booking System for the Meeting Rooms**

The booking system for the meeting rooms in Pune needs to change since an overview of the bookings not is available for the users today. To obtain an all time access and easy to use booking system, whiteboards could be put outside the meeting rooms, were everyone by themselves could book the room. In the future, the booking system could be in the Lotus Notes and be used in a similar way as people schedule meetings.

**Benefits**
- Everyone can book a room and see when it is occupied, when it is clearly visualised.
- This forces the meetings to be more efficient since they are limited by the timeframe.

**Complexities**
- It requires a responsible person, and if only using whiteboards it is difficult to display bookings weeks or months in advance.
- It requires respect for the bookings.

**S17: Project Room**

A solution for the future could be to give each project team at each division, a project room, or a so-called obeya room. In this room, all documentation regarding the projects could be visualised and the project team would have a meeting room that always would be accessible for them.

**Benefits**
- It would be more inspiring for the work and give the team members from the different functions a common ground.

**Complexities**
- Require space.
S18: Divisional Interaction
To improve the exchange of experience and knowledge between the divisions, shorter meetings or lunch meetings could be held at least once a month. These meetings would preferably include the project leaders from each division and the head of the department.

**Benefits**
This would facilitate an enhanced insight in each other’s work, and advices and knowledge could be exchanged regarding project management.

Can maybe result in an exchange of resources between the divisions.

**Complexities**
Require personal engagement and decisions about when to meet between the involved parts.

8.3 Global Communication
Regarding the communication and interaction between Pune and Antwerp two suggestions are presented about the transfer of information and the exchange of knowledge. In addition to these suggestions, it is important to consider the cultural differences, and understand how it affects the work.

S19: The Personal Contact
To increase the personal contact between Antwerp and Pune, key persons could be sent from Pune to Antwerp for training. It is important to have a good distribution system of the gained knowledge so as many people as possible can take advantage of that knowledge. In addition, when a project is transferred, someone from Antwerp could do a personal visit in Pune.

**Benefits**
Increased personal contact and establishment of trust.

A possibility is given to exchange knowledge about the project and the product.

**Complexities**
Require time from the daily tasks and more travelling, which do not harmonise with today’s environmental thinking.

S20: Transfer of Information
When the personal contact is established, it is important to maintain the communication. Today this is mainly done through telephone conferences and email. In order for both sides to get the most out of the contact there should be a discussion about what information that should be transferred from Pune to Antwerp and vice versa, and a communication plan could be established. This plan needs to be discussed and developed by representatives from Antwerp and Pune.

**Benefits**
No information is missing, the communication flow will be faster, and the execution of project work will be improved.

**Complexities**
Require that the parties can agree about common routines.
9 Summary

This chapter summarise the empirical study and refers to the four research questions mentioned in the introduction. Furthermore, a summary of the suggestions, mentioned in chapter eight, are presented, regarding how the process and interaction can be improved.

9.1 Summary of the Study

The results and the analysis in chapter five, six, and seven regarding the process, interaction, and communication during the localisation process are summarised in this section. During the thesis work several aspects turned out to affect the work at the studied division in Pune, these are listed below. It should be mentioned though that a lot have improved lately in Pune and changes are in progress.

- The number of orders has increased tremendously in the last year.
- There are many newcomers at the division, but there are still some vacancies and the resources are limited.
- There are space constraints, both at the production line and in the office building.
- There are many non-standard products, which limits the possibility of continuity in the workflow on the production line. The non-standard orders also occupy the time of standard engineering.

The research questions listed in the introduction have characterised this thesis work. The summarised answers that are given here, originate from the discussion in earlier chapters.

\[ Q1: \text{What are the activities in the localisation process at one of the divisions in Pune, and what could be improved?} \]

- There is no documented, visualised, and declared process for the projects, though each function has their own work description.
- The work follow the main phases in the general product development process, although:
  - There is only one prototype built.
  - There is no distinct PiBa phase and consequently, there is no comprehensive Qualification.
- There is no formal feedback of the projects, and no lessons learned are performed.

\[ Q2: \text{How and when do functions interact in the process and what difficulties do they meet?} \]

- There is cross-functional interaction in project teams.
- The involved persons do not have enough insight in each other’s work tasks.
- Regarding project facilities, there is a lack of meeting rooms and project space.
- There is no common map structure of the project information.

\[ Q3: \text{Are there any differences in the way of working between the divisions in Pune?} \]

- The level of complexity of the products differs between the divisions.
- There are more influences from Antwerp at the engineering departments at other divisions than the studied, that is to say expatriates with experience from Antwerp, which result in different project management and routines.
9 Summary

Q4: How do the people in Pune and Antwerp interact?

- There are formal opportunities for exchange of information and project status, for example telephone conferences and scheduled meetings (PSM and DR).
- There are contradictory wishes for the transfer of information.

9.2 Summary of the Suggestions

The assignment was not only to map the localisation process but also to give some suggestions for improvements. These suggestions were described in detail in chapter eight with benefits and complexities. How these answers to the two purposes of this thesis work is summarised below, one part is about the process, and one is about the interaction.

The purpose regarding the process was to identify areas of improvements within the localisation process and give suggestions for how to make the process more efficient.

- The process should be well-visualised for all the team members.
- Time and effort should be put on the early phases, front-end loaded.
- The general process needs to be adapted to the Product Company in Pune and improved by:
  - Only have one Prototype phase with the activities from both the Functional Prototype phase and the Production Prototype phase.
  - Perform a Design Preview in the beginning of the Prototype phase and an internal DR in Pune before the real DR.
  - Build a separate PiBa, with a following Qualification.

Regarding the interaction, the purpose was to give suggestions for how to enhance the cross-national and cross-functional interaction.

- The cross-functional teamwork could be improved and simplified by:
  - Make the booking routines of the meeting room easier, and in the future dedicate one room to each project team.
  - Organise the map structure for project information.
  - Investigate the possibility to use integration mechanisms like QFD, FMEA, DFA and DFM as well as teambuilding activities.
- The divisional interaction could be increased with informal lunch meetings for exchange of project management knowledge.
- The face-to-face contact between Pune and Antwerp could be improved and enhanced by:
  - Personal project transfer, a project member from Antwerp visit Pune or vice versa.
  - More training in Antwerp for persons from Pune – more sharing of knowledge when returning.
- The transfer of information between Antwerp and Pune needs to be discussed and a communication plan established.

It is believed that if Pune embraces some of the findings and recommendations from this thesis work, the development time could be shortened and the project work more efficient. It is also necessary to consider the cultural differences both in the work with adapting the process and especially regarding the interaction between Pune and Antwerp. The discussion about how to implement the suggestions from this study needs to continue as well as the discussion about how to increase the cultural understanding.
10 Reflections

The strengths and weaknesses of this study are identified in this chapter, in order to evaluate the reliability, validity, and generalisability of the findings and used methods and to discuss whether the objective and purposes are fulfilled. Moreover, some further reflections regarding this thesis work is presented as well as recommendations for future work.

10.1 The Trustworthiness of the Study

The findings from a study are supposed to be reproducible, verifiable, and consistent in order to regard the study as trustworthy, reliable, and valid. Reliability refers to the likelihood to obtain the same outcome if replicating the study under similar conditions, while validity relates to the extent to which an instrument measures what it is claimed to measure (Wilkinson, 2000:42). In qualitative investigations, the techniques and the involved persons include a high level of subjectivity, and it becomes complicated to verify the reliability. The focus when claiming the reliability of qualitative studies is to consider the role of the subjective dimension, which is agreed by Gillham (2000:6) when talking about interviews. There is though uncertain if high reliability ensures high validity or vice versa, for example, validity in interpretation may be associated with low reliability, which is referred to as the reliability-validity dilemma (ibid). The evaluation of the level of reliability and validity of the study in this thesis work is performed through an identification of strengths and weaknesses.

10.1.1 The Strengths of the Study

Since the qualitative study in this thesis work included interviews and meetings it meant interaction between persons, and under such circumstances, there is always a level of subjectivity and a risk of misunderstandings or misinterpretations. Several control approaches were undertaken to avoid sources of error and verify that the interpretations of the results were made accurately during this thesis work. These are seen as the strengths of the study, and are summarised in table 3.

TABLE 3. A summarise of the strengths of the study.

<table>
<thead>
<tr>
<th>Strengths</th>
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<tbody>
<tr>
<td>A variety of techniques was used to collect and analyse the empirical data</td>
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<tr>
<td>A high number of interviews were performed in Pune</td>
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<tr>
<td>The interviewees had different positions within the company</td>
</tr>
<tr>
<td>Both the authors participated in all interviews</td>
</tr>
<tr>
<td>Clarifying questions were asked during the interviews</td>
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<tr>
<td>The authors discussed and summarised the interviews together immediately after the interview occasion</td>
</tr>
<tr>
<td>Weekly briefings were sent to stakeholders in Pune and in Antwerp</td>
</tr>
<tr>
<td>Two sets of interviews were performed</td>
</tr>
<tr>
<td>A benchmark study at two other divisions in Pune was performed</td>
</tr>
<tr>
<td>The findings about the process in Pune were compared to the process used in Antwerp</td>
</tr>
<tr>
<td>The findings and suggestions for improvements were discussed with the supervisors in Pune and to some extent with the stakeholders in Antwerp</td>
</tr>
<tr>
<td>The used methodology is described in a detailed way in this report</td>
</tr>
</tbody>
</table>
All the listed strengths are seen to have increased the validity and reliability of the study, a valid picture is believed to have been received. The authors have reviewed the situation from different perspectives by using at least three different techniques to collect the empirical data; the two sets of interviews, the participation and observation in formal as well as informal meetings, and the review of company documents. The risk for misunderstandings and misinterpretations was reduced by interviewing many persons, with various positions, asking clarifying questions during the interviews, and performing a second set of interviews. That risk was further reduced by the fact that both the authors participated in all interviews, summarised the information together after the interviews and discussed the findings after the first and second set with the supervisors in Pune. In this way, a more inter-subjective agreement was achieved. To make the way of performing the study clear and the collected information to some extent visible, weekly briefings were sent to stakeholders at the studied division in Pune and in Antwerp.

10.1.2 The Weaknesses of the Study

Even though many arrangements were made to increase the reliability and validity of the study, some circumstances have probably had a negative effect on the reliability and validity of the study and these are called the weaknesses of the study and are listed in table 4.

**TABLE 4. A summarise of the weaknesses of the study.**

<table>
<thead>
<tr>
<th>Weaknesses</th>
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<tbody>
<tr>
<td>Only a few interviews were accomplished in Antwerp</td>
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<tr>
<td>Difficulties in managing contradictory responds from the interviewees in Pune</td>
</tr>
<tr>
<td>No interviews were recorded or fully transcribed</td>
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<tr>
<td>Many interviews were not performed in a private room</td>
</tr>
<tr>
<td>Only a few occasions for discussions of the findings and suggestions for improvements</td>
</tr>
<tr>
<td>Limited opportunities to ask follow-up questions when returning back to Sweden</td>
</tr>
<tr>
<td>Difficulties of making the respondents feeling comfortable enough to talk freely about issues</td>
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</tbody>
</table>

**Few Interviews in Antwerp**

As mentioned above, a strength with the study was that a high number of interviews were performed in Pune, where the respondents had different positions within the company. It would though have been desirable to perform more interviews in Antwerp to obtain a more balanced empirical result. Initially it was the authors’ intention to spend several days in Antwerp, to receive a better understanding for the process followed in Antwerp, but that was not realised and the reasons seemed to be a lack of communication. The authors have tried to give a justified and objective picture of the situation in Pune, but the time spent in Pune might have influenced the authors, so when describing the situation it was with a “Pune way of thinking”. As stated by one person in Antwerp, it would maybe have been better to perform the study where the time was equally spent between Pune and Antwerp.

**Contradictory Information**

Sometimes the managers seemed to have different thoughts than other employees, perhaps since they had a different overview of how everything should be. This might have influenced their answers, so it came to be more how it should be instead of how it is. There were also some new employees that did not had the possibility to obtain an in-depth picture of routines
and the situation in Pune yet, which might have affected their answers. On the other hand, these interviewees might have seen everything with “fresh eyes”.

**No Recording or Transcription**

The interviews in this thesis work were not recorded nor fully transcribed, and therefore some of the details from the interviews might have been lost. However, both authors were attending all the interviews, the information was discussed and summarised immediately after each interview and there was an opportunity for follow-up questions in the second set of interviews. Therefore, the information from the interviews can be considered to have been collected in a valid way.

**No Private Room**

Many of the interviews in Pune were not accomplished in a separate and private room, which can have affected the validity and reliability of the study since the interviewees might have avoided talking freely, in order to not criticize or offend someone or something openly. If interviewing managers, they had their own rooms, but the other interviews took place in the open workplace, at the desk of the authors, or in the factory, where the latter provided some privacy. The space constraints were a limitation.

**Discussion of the Progresses and Findings**

There were a few occasions for discussing the findings and suggestions for improvements with the stakeholders in Pune and Antwerp, but there was no continuous dialogue, which would have been desirable. The authors’ weekly briefings were one approach for Antwerp to keep a regular contact. The authors are convinced that if there had been more interaction with the supervisors in Pune and the stakeholders in Antwerp, these persons could have expressed their thoughts of the direction of the study. It had been valuable for the authors to give and receive more feedback of the findings made during the study. However, no one is to be blamed.

**The Openness of the Respondents**

The importance of the researchers’ role became clear when performing the interviews since it seemed vital to establish a personal contact to make the respondents feeling comfortable enough to talk freely. The appearance of this phenomenon varied for the respondents in Pune, some could talk very openly about everything, including problems, while others did not want to criticize anything in front of unfamiliar visitors. The personal relationship may not have been the only factor; it could have been other reasons, such as being low in the hierarchy. The respondents’ openness or non-openness is a factor that can have affected the results in a negative way, so that a less correct picture of the situation has been received. An approach to facilitate anonymous answers from the respondents could have been to carry out a questionnaire, which was considered by the authors, but it was not possible to accomplish within the timeframe of this thesis work. Anyhow, it was the authors’ intention to reduce the feeling of unfamiliarity by establishing a first personal contact during the first set of interviews and the attendance to some informal occasions.

**10.1.3 Fulfilment of the Objective and Purpose of the Study**

There has been one main objective for this thesis work, which was formulated by the authors after discussions with stakeholders in Antwerp and Pune. The objective of the thesis work was to “study and evaluate the localisation process including the main activities and involved functions, which was to be visualised by creating a process chart”. The information about the current executed procedures was visualised together with what should be executed, since it
was requested by stakeholders in Pune. A work breakdown structure and flowcharts were created, which were similar to the layout of the process used in Antwerp. Another part of the objective was to “present suggestions for areas of improvement”, which is fulfilled through the suggestions presented in chapter eight.

There were two purposes formulated in the thesis work, one regarded the process, and the other purpose regarded the interaction. The first can be regarded as fulfilled, see the discussion above. The latter is also regarded as fulfilled since the interaction has been discussed in this report and the process charts consider the interaction between functions as well as the presented suggestions.

10.1.4 Verification of Reliability and Validity
By identifying the strengths and weaknesses of the study, a reflection of the reliability and validity of the study has been made. The study can be regarded to measure what it was intended to measure, in accordance to how validity is defined. The discussion above about fulfilment of the purpose and objective further confirms the validity.

Regarding the reliability it is believed that some of the findings from this thesis work would be similar if the study was performed again, referring to the definition of reliability. For instance, the results regarding the functional interaction as well as the handling of cultural differences has been proven to house difficulties, both theoretically as empirically in this thesis work. Because of the fact that some of the empirical results were similar to the collected theoretical data, it can be concluded that some of the results are generalisable and applicable to other circumstances than in this thesis work. There would though be hard to make an exact copy of a qualitative study like this, when so much information from the interviewees is subjective which, in addition, has been interpreted in a certain way by the authors.

10.2 Additional Reflections
It is unclear how this thesis work was initiated in the beginning within Atlas Copco, but there were much iteration between many persons before the authors could go to Antwerp and Pune. There was no declared and responsible initiator for the assignment, neither in Sweden, Antwerp nor in Pune, although Antwerp was the most interested part and gave some directions of what the assignment should include. Therefore, the authors, to a certain degree, decided the content of the thesis work by themselves, for good and for bad. Maybe the authors should have asked for more guidance regarding the direction and focus of the study.

10.2.1 The Theoretical Frame of Reference
The theoretical frame of reference is to a great extent based on management theories that originate from the westerns world, which are quite common to practise all over the world. The question is whether it is suitable for all cultures. Researchers like Hofstede et al (2005) have indicated that management theories are culture specific, and mean that the presumption of universalism should be proven. The authors actually tried to find relevant theory that emanated from for example Asia and India in particular, but it was difficult. Theories and practices for the software industry in Asia were considered, as well as theories like Lean Production from Japan. These could maybe have been included, which though would have led to a different perspective of the study.
10.2.2 The Empirical Study

During the empirical study, the authors observed the execution of several projects, which were in the later phases of the process. From the beginning though, the idea was that the authors would follow a project in the early phases, i.e. that recently had started in Pune, and study the project activities in real action. However, that was not possible since that project was put on hold. Perhaps the findings from the study could have been different if execution of projects in early stages had been observed. As it was, the interviewees had to talk about how they used to work in projects instead of taking one ongoing project as an example, where the authors could follow the actual project work and the resulting project performance.

The interviews in Pune were often delayed some hours up to weeks, which clearly was a disturbance in the plan for the thesis work, and there was a continuously re-planning of the interviews throughout the empirical study. The reason for these delays could have been the fact that the personnel resources were limited so persons did not have enough time to participate in an interview; another reason may have been hierarchical aspects where an interview with the authors was not prioritised.

10.3 Future Work

The developed work breakdown structure and flow-charts, which visualise the basic activities and involved actors, are to be used as a ground for further discussion about the process and the involved parts. The suggestions for improvements, which illuminate parts of the process in Pune, and some of the procedures when interacting, need to be further investigated and discussed.

It can be discussed whether a more efficient process and interaction can be received after this thesis work, and if the development time can be shortened to become more competitive on the market. It is the authors’ belief that these kinds of improvements cannot be achieved immediately since the findings of this study require further work by the involved persons in Antwerp and Pune. It is though the authors’ hope that Atlas Copco can benefit from this study, even though the results are not completely new for the involved persons in Pune and Antwerp. Maybe some of the findings clarify the current situation at the investigated division in Pune. It can be concluded that the findings from the thesis work just have scratched the surface, and that future work is needed to gather more in-depth information. Moreover, it is believed that by having someone from the outside, who have investigated, evaluated and presented the findings verbally and in writing, the situation are brought up to surface and made visible in another way than it would have been under normal circumstances.

If this thesis work would continue, it would of course be interesting to study the phases and gates in the product development process even more. However, some other areas would also be interesting to investigate more in-depth, such as:

- How to make the procedures and processes in Antwerp and Pune similar, and how it should be implemented
- The definition of non-standard and standard variants in Pune, how to implement it in the MS, and clarify the difference between what work tasks that belongs to custom design and standard engineering respectively
- The Field Follow-up phase and project closure, and which activities and actors that are included
- Compare the thoughts about quality in Pune and Antwerp, and for example how the Qualification of the prototypes should be executed as well as the PQM’s
10 Reflections

- Evaluate how the customer requirements are documented, how complaints are followed-up and how the functions interact during these activities
- Evaluate the design notification process that involves a lot of interaction and communication between functions, and compare the procedures in Pune and Antwerp
- Evaluate the tools used for project work, and which tools that could be added to make the execution of projects more effective
- The structuring of project information in maps and databases in Pune and compare to how it works in Antwerp, in order to make the transfer and exchange of information more effective
- Evaluate the communication modes used for the interaction between Pune and Antwerp
- Evaluate the documents and formularies used to report the project status and to exchange information between Pune and Antwerp
- Compare the procedures at the Product Companies in India, China and Brazil within the same division
- Compare the processes within the Atlas Copco Group

The authors are grateful for the opportunity to perform this thesis work at Atlas Copco CT in Pune and Antwerp. It has been a great chance to learn about a product development process in reality, and to study the interaction, cross-functional as well as cross-national within a multinational company.
List of References


## Appendix 1 - Feasibility Phase

In this appendix, a proposal is presented for what main activities the Feasibility phase in Pune should include, where some of these activities are performed today. It should be mentioned that this is a first version, which needs to be evaluated, discussed, and worked out in detail by the involved persons. On the next page, a flowchart of these activities can be seen.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Responsible</th>
<th>Description</th>
<th>Deliverable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main objectives for the new</td>
<td>Marketing</td>
<td>Pricing, technical characteristics, serviceability, reliability, variants and options, legal requirements. Rank the objectives and define the variants and options for the product</td>
<td>Preliminary Master Specification</td>
</tr>
<tr>
<td>product</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product Description</td>
<td></td>
<td>Reference BOM and drawings from design lead product company and Master Specification from marketing are inputs to decide which parts to buy locally/global.</td>
<td></td>
</tr>
<tr>
<td>Evaluate localization feasibility</td>
<td>Engineering</td>
<td>Reviewing the factory's operations, identifying potential areas for improvement, and ensuring compliance with regulatory standards</td>
<td>Preliminary Product Description</td>
</tr>
<tr>
<td>Identify suppliers</td>
<td>Sourcing</td>
<td>Source of material, labor, and facilities, ensuring the project is feasible and sustainable</td>
<td>New BOM for India</td>
</tr>
<tr>
<td>Define product features</td>
<td>Engineering</td>
<td>Review the product design, identify improvements, ensure compliance with standards</td>
<td></td>
</tr>
<tr>
<td>Product cost estimation</td>
<td>Sourcing</td>
<td>Review the cost estimation, identify cost centers, ensure compliance with budget</td>
<td></td>
</tr>
<tr>
<td>Process Evaluation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluate production feasibility</td>
<td>Methods</td>
<td>Receive drawings and plan layout, location and tooling for production</td>
<td></td>
</tr>
<tr>
<td>Define project</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Define prototype and PIBa</td>
<td>Project Team</td>
<td>The project team plans and decides variants and options for the prototype and PIBa, which also is related to customers requirements</td>
<td>Prototype and PIBa definition document</td>
</tr>
<tr>
<td>Project budget</td>
<td>Project Team</td>
<td>Allocate costs for marketing, engineering, production, purchasing and after-market</td>
<td>Project Budget</td>
</tr>
<tr>
<td>Time plan</td>
<td>Project Team</td>
<td>Define time for different projects phases, ensuring the project is feasible and sustainable</td>
<td>Project Plan</td>
</tr>
<tr>
<td>Return Calculation</td>
<td>Marketing</td>
<td>Cost &amp; sales price, sales forecast, IRR, pay-back time, ROI</td>
<td></td>
</tr>
<tr>
<td>Complete Master Specification</td>
<td></td>
<td></td>
<td>Final Master Specification</td>
</tr>
<tr>
<td>Review of Master Specification</td>
<td></td>
<td></td>
<td>Action list</td>
</tr>
<tr>
<td>Follow-up action list</td>
<td>Project Leader</td>
<td>All involved functions in the project team should execute the listed actions. The Master Specification must be updated if changed inputs</td>
<td>Cleared action list</td>
</tr>
<tr>
<td>Local PCM</td>
<td>Project Team &amp; Management India</td>
<td>Go/Stay for Prototype Phase</td>
<td>Signed Master Spec</td>
</tr>
<tr>
<td>PSM</td>
<td>Marketing, Management, India and Division at Airpower</td>
<td>Master Specification is presented and approved/not approved by divisional management (if not approved the activities are iterated)</td>
<td>Signed off Master Spec</td>
</tr>
<tr>
<td>Evaluate the Phase</td>
<td>Project Leader</td>
<td>The project team evaluates the activities in the phase and list what was good and what could have been done better</td>
<td>Lessons Learned</td>
</tr>
</tbody>
</table>

**Appendix 1:1**
Appendix 2 - Prototype Phase

In this appendix, a proposal is presented for what main activities the Prototype phase in Pune should include, where some of these activities are performed today. It should be mentioned that this is a first version, which needs to be evaluated, discussed, and worked out in detail by the involved persons. On the next page, a flowchart of these activities can be seen.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Responsible</th>
<th>Description</th>
<th>Deliverable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Preview</td>
<td>Design Reviewer</td>
<td>Design reviewer and project leader decide what should be reviewed in the end of prototype phase. All functions should look at this.</td>
<td>Design preview report</td>
</tr>
<tr>
<td>Make Product Design</td>
<td>Engineering</td>
<td>A-, B- and C-parts. Prototype drawings</td>
<td></td>
</tr>
<tr>
<td>Calculation of critical parts</td>
<td>Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare prototype BOM</td>
<td>Engineering</td>
<td></td>
<td>Prototype BOM</td>
</tr>
<tr>
<td>Review of drawings and BOMs</td>
<td>Project Leader</td>
<td></td>
<td>New Prototype BOM and drawings</td>
</tr>
<tr>
<td>Propose design modifications</td>
<td>Engineering</td>
<td>Design iterations if needed</td>
<td></td>
</tr>
<tr>
<td>Supplier Process Evaluation</td>
<td>SQA</td>
<td>Start planning suppliers processes</td>
<td></td>
</tr>
<tr>
<td>Introduce first part approval</td>
<td>SQA</td>
<td>Approval from Engineering</td>
<td></td>
</tr>
<tr>
<td>Procurement</td>
<td>Sourcing &amp; Engineering</td>
<td>Procurement of both local and global parts</td>
<td>Material and performance test report</td>
</tr>
<tr>
<td>Part inspection</td>
<td>QC</td>
<td>Dimension inspection, material test, performance test</td>
<td></td>
</tr>
<tr>
<td>Finalee first part approval</td>
<td>SQA</td>
<td>Evaluation of parts, definition of parts as critical or non-critical</td>
<td>Approval from Engineering</td>
</tr>
<tr>
<td>Assemble Prototype</td>
<td>Engineering</td>
<td>Engineering and two operators build the prototype together. It is though very important to involve production since only one prototype is built. Small prototypes are built in the lab, big prototypes on the production line.</td>
<td>Prototype</td>
</tr>
<tr>
<td>Study the assembly procedure</td>
<td>Methods</td>
<td>Methods should follow the assembly procedure of the prototype to be able to prepare for PIBa and serial production</td>
<td></td>
</tr>
<tr>
<td>List assembly problems</td>
<td>Engineering &amp; Methods</td>
<td>Problems listed during the assembly, photos are taken, this is concluded in the same document</td>
<td>List of assembly problems with photos</td>
</tr>
<tr>
<td>Remarks of prototype</td>
<td>Project Team</td>
<td>All functions in the project team give remarks on the prototype, photos are taken and it is summarized in the same document where the problems are listed</td>
<td>List of remarks with photos</td>
</tr>
<tr>
<td>Conclude problems and remarks</td>
<td>Project Leader</td>
<td>Conclude problems and remarks in an action list with photos and responsible persons</td>
<td>Action list</td>
</tr>
<tr>
<td>Test Prototype</td>
<td>Project Leader</td>
<td>Define what should be tested in consultation with test engineer (and design lead product company when needed)</td>
<td>Test program</td>
</tr>
<tr>
<td>Define test program</td>
<td>Project Leader</td>
<td>Test prototype and clarify problems. Test motor, noise, vibration, transportation, temperature, cold start etc.</td>
<td>Test report</td>
</tr>
<tr>
<td>In house tests</td>
<td>Test Engineer</td>
<td>Tests at suppliers</td>
<td>Test report</td>
</tr>
<tr>
<td>External tests</td>
<td>SQA &amp; Engineering</td>
<td>Tests at suppliers</td>
<td></td>
</tr>
<tr>
<td>Propose design modifications</td>
<td>Engineering</td>
<td>Propose and summarize needed design modifications and add to the action list from the assembly of the prototype</td>
<td>Action list</td>
</tr>
<tr>
<td>Internal Reviews</td>
<td>Project Leader</td>
<td>Compare test results and design preview before final design review in an internal design review report that is sent to Airpower</td>
<td>Internal design review report</td>
</tr>
<tr>
<td>Service Review</td>
<td>Aftermarket</td>
<td>Perform a service review of the prototype</td>
<td>Service Review Report</td>
</tr>
<tr>
<td>Design Review</td>
<td>Design Reviewer from parent company</td>
<td>Identify defects. Recommend future design changes</td>
<td>Design review report</td>
</tr>
<tr>
<td>Finalize action list</td>
<td>Design Reviewer &amp; Project Leader</td>
<td>It is checked that all functions have executed their part of the action list from the prototype phase</td>
<td>Final action list</td>
</tr>
<tr>
<td>Follow-up Action List</td>
<td>Project Leader</td>
<td></td>
<td>Cleared action list</td>
</tr>
<tr>
<td>Local PCM</td>
<td>Project Team &amp; Management India</td>
<td>Go/Hold for PIBa Phase</td>
<td></td>
</tr>
<tr>
<td>Report to Airpower/PSM</td>
<td>Management India</td>
<td>Present status of the project on next PSM</td>
<td></td>
</tr>
<tr>
<td>Evaluate the Phase</td>
<td>Project Leader</td>
<td>The project team evaluates the activities in the phase and list what was good and what could have been done</td>
<td>Lessons Learned</td>
</tr>
</tbody>
</table>

Output of Prototype Phase
Approved Master Specification

Appendix 2:1
Appendix 3 - Pilot Batch Phase

In this appendix, a proposal is presented for what main activities the Pilot Batch phase in Pune should include, where some of these activities are performed today. It should be mentioned that this is a first version, which needs to be evaluated, discussed, and worked out in detail by the involved persons. On the next page, a flowchart of these activities can be seen.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Responsible</th>
<th>Description</th>
<th>Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Release of Specifications</td>
<td>Engineering</td>
<td>Make sure that incoming parts are allocated, that assembly instructions are ready, that tooling and fixtures are ready and set up production line</td>
<td>Final drawings and BOM’s</td>
</tr>
<tr>
<td>Organise Production</td>
<td>Methods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procure PBA parts</td>
<td>Production</td>
<td>Parts are procured as if in serial production</td>
<td></td>
</tr>
<tr>
<td>Part inspection</td>
<td>QC</td>
<td>Dimension inspection, material verification, performance test, packaging control</td>
<td></td>
</tr>
<tr>
<td>First part approval</td>
<td>SQA</td>
<td>If new parts are introduced a Improvement first part approval is performed</td>
<td>Approval from Engineering</td>
</tr>
<tr>
<td>Process plan for suppliers</td>
<td>SQA</td>
<td>Process flow diagram, quality assurance and control plan</td>
<td></td>
</tr>
<tr>
<td>Assemble PBA units</td>
<td>Production</td>
<td></td>
<td>PBA units</td>
</tr>
<tr>
<td>Study the assembly procedure</td>
<td>Methods</td>
<td>Methods should follow the assembly procedure of the PBA units to be able to make necessary changes for serial production</td>
<td>List of assembly problems with photos</td>
</tr>
<tr>
<td>List assembly problems</td>
<td>Production</td>
<td>Production writes a list and hand it over to engineering</td>
<td></td>
</tr>
<tr>
<td>Remarks of prototype</td>
<td>Project Team</td>
<td>All functions in the project team give remarks on the PBA units</td>
<td></td>
</tr>
<tr>
<td>Conclude problems and remarks</td>
<td>Project Leader</td>
<td>Conclude problems and remarks in an action list with photos and responsible persons</td>
<td>Action list</td>
</tr>
<tr>
<td>Production Tests</td>
<td>Engineering</td>
<td>Define what should be tested in consultation with production</td>
<td></td>
</tr>
<tr>
<td>Define test program</td>
<td>Engineering</td>
<td></td>
<td>Test program</td>
</tr>
<tr>
<td>Production tests</td>
<td>Production</td>
<td>Units are tested by the line-inspector &amp; the test manager, if any remarks it is added to the action list</td>
<td>Test report</td>
</tr>
<tr>
<td>Follow-up action list and test results</td>
<td>Engineering</td>
<td>Make sure that all actions in the list are completed by the responsible persons</td>
<td>Cleared action list</td>
</tr>
<tr>
<td>Prepare Serial Production</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product Launch</td>
<td>Marketing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forecast Stop</td>
<td>Project Team</td>
<td>The project team plan the number of products, variants and options to be produced in serial production and inform suppliers</td>
<td></td>
</tr>
<tr>
<td>Qualification</td>
<td>Production</td>
<td>Production check that all processes, specifications, instructions are correct and make sure the project is ready for serial production including service review,</td>
<td>Qualification report</td>
</tr>
<tr>
<td>Qualification follow-up</td>
<td>Project Leader</td>
<td>Remarks from the qualification report are checked and solved by the responsible persons</td>
<td></td>
</tr>
<tr>
<td>Local PCM</td>
<td>Project Team &amp; Management India</td>
<td>Go/ Hold for serial production</td>
<td></td>
</tr>
<tr>
<td>PSM</td>
<td>Marketing &amp; Division at Airpower</td>
<td>PSM reporting of the project conclusions before serial production</td>
<td></td>
</tr>
<tr>
<td>Evaluate the Phase</td>
<td>Project Leader</td>
<td>The project team evaluates the activities in the phase and list what was good and what could have been done better</td>
<td>Lessons learned</td>
</tr>
</tbody>
</table>

Output of Pilot Batch Phase

Built and tested Pilot Batch units & an approved Qualification report