A PACKING PROCESS FOR DUMMIES

A study towards optimisation of the non-standard production process

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MANAGEMENT SUMMARY

Philips Consumer Lifestyle in Drachten is mainly responsible for the production of shavers, but in order to promote these shavers Philips also produces dummies. Dummies are non-working shavers that can be found in stores as sample products. However, since Philips has some troubles with the dummy process, the goal of this study is to improve the dummy process at Philips. In particular the scheduling and additional operational processes, such as the gluing and packing process, should be improved. This research evaluates the current process and compares it with literature and other service order processes in order to recommend some adjustments that will lead to optimisation of the dummy process.

During the analysis of the current situation at Philips, we received insight in multiple bottlenecks of different stakeholders, including the logistic department, the service department, the financial department, and the customer. The main activities that this research indicates as drawbacks to the dummy process are:

- The employees have to deal with devious tasks, which unnecessary costs time and money.
- Currently, there is overproduction and too much inventory, which causes obsolete dummies and costs money.
- There is no financial overview of the dummy process, because there is no clear insight in the cost price of dummies and production hours are not registered.

Based on these bottlenecks, this research shows a literature review and lays out the comparison with other service order processes in order to find improvements for the dummy process. During this research we found the following changes that improve the dummy process, ranked on their benefits and costs.

1. Saving the rejected Key Modules from the production run for dummies
   Saving the rejected Key Modules from the first production runs saves a lot of money, because they are already in the project budget and there are no extra production costs involved. Besides the low costs, another advantage of keeping these Key Modules on stock is the short lead time. The service department has enough capacity for the dummy process and therefore the dummies can be completed right after the order is received.

2. Gluing process at the service department.
   Keeping the gluing process at the service department, instead of gluing the dummies in the Model Shop, reduces the number of mistakes and saves money.

3. Processing the dummies by integrating a BOM in the SAP system.
   Using SAP to transfer the orders between departments and appropriately designing a BOM, will save time and effort, as it takes away some devious tasks, but it also contributes to better insight in inventory. Finally, this reduces the total operational cost of dummies.

4. Calculating the cost price and create separate routings
   A separate routing for the gluing and packing process of dummies will increase the insight in total costs. A more reliable price improves the customer satisfaction.

5. Ordering the packing material by the Material Support Group.
   The Material Support Group has to order the packing material based on an inventory level. This is more efficient and prevents devious jobs, as it is not the task of a project manager to order packing material. Furthermore, in this way the service department never runs out of packing material.

6. Scheduling service department tasks in SAP
   Scheduling the tasks of the service department in SAP by using the capacity and task restrictions of employees, provides insight in the backlog of this department and it gives a better overview in the work efficiency.

Most of these implementations are single investments that will benefit in time, money, and effort on the long term, however, a more extensive data study should explore the exact costs and the magnitude of benefit of these different modifications. Besides these improvements, we also recommend a few subjects that require further research in order to decide whether or not these interventions can contribute to improvement.

- Using single unit packing material
  During the analysis of the dummy orders and the use of packing material, it became clear that over 70% of the orders is not optimal packed. Therefore, it might save money when a different size of packing material is used, so less than 24 shavers per box.

- Using obsolete intermediates for the dummy Key Module
  Instead of using the standard shaver parts for the production of dummies, the obsolete intermediates can be used for the production process as long as the shaver has the same presents. However, it is not certain if this is a better solution and saves more money that saving the rejected dummies from the first production run.

- Improve communication between different departments and customer for clear specifications
  Better communication about the dummy specifications may reduce the number of faults and customer know what to expect so the complaints may reduce.

- Schedule gluing process or the production of Key Modules in a low demand season
  It is interested to investigate the possibility of scheduling the gluing process of the dummies at low demand periods, because it will save money but this is only possible when a certain pattern can be found in the demand for service orders and so this requires further investigation.

PREFACE

This thesis is the result of a graduation project in order to receive the Bachelor Degree in Industrial Engineering & Management at the University of Twente. This research is carried out from March untill June at Philips Consumer Lifestyle in Drachten.

After I finished almost all my bachelor courses, I started searching for a bachelor assignment. During the past years, my interest in the logistic sector had grown, but without a specific subject. Therefore, I decided that this bachelor research was a good opportunity to get more insight in the different fields of logistic processes. I knew I wanted to do my research in an inspiring environment, preferable a large organization, but I had no specific preference for which company. However, during another project with Mark Schut, he told me about his connections at Philips Drachten and that is when I became interested and enthusiastic about Philips. Eventually, Mark helped me to get in contact with my current supervisor at Philips Drachten and I got the internship. Therefore, I thank Mark Schut for introducing me at Philips and my supervisor mrs. Lubina de Leeuw-Spronk.

During my stay at Philips, I spoke with many people who were involved in my research. Not only talking with the management was inspiring, but also the discussions with the operators and other employees were very useful. In the past few months, I learned a lot about different logistic processes, but also I learned about the more organizational problems and dilemmas within a company. For all the inspiring conversations and tips, I thank my supervisor Lubina de Leeuw-Spronk. Also I thank all the other employees for their input and pro-active attitude towards my research and presence.

I thank my supervisor at the University, Dr. ir. J.M.J Schutten, for his critical feedback and useful advice to structure my research and this report. Finally I thank my family, who made it possible for me to stay in Groningen during the past few months.

Dianne Essers

Enschede, August 2012

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1 RESEARCH DESIGN

This first chapter provides a framework for the research, starting with Section 1.1, which gives an introduction to the company. Next, Section 1.2 describes the research environment and it identifies the problem. Section 1.3 outlines the research goal and corresponding questions and Section 1.4 discusses the scope of this research. Finally, Section 1.5 explains the research approach and the setup of the rest of this report.

1.1 INTRODUCTION TO THE RESEARCH ENVIRONMENT

Philips & Co is founded in 1891 in Eindhoven, the Netherlands, where the first production started with carbon-filament lamps. Throughout the years, the Philips Light-bulbs Factories Inc. expanded rapidly, and in the 1920s, the company started to manufacture other products besides light-bulbs. In 1939, Philips introduced the electric shaver and by building another factory in Drachten in 1950, over 50% of the entire market share of electric shavers became of Philips. In 1997, the headquarters of the company moved from Eindhoven to Amsterdam, along with the corporate name change to Royal Philips Electronics N.V. (Philips History)

With 1500 employees, Philips Consumer Lifestyle Drachten is one of the largest divisions that produces and develops consumer goods. Located in Drachten, Philips has one of the biggest research and development centres, which includes the following departments: The Advanced Technology Centre, Development Shaving & Beauty, Lead Innovation Site Small Household Appliances, and Innovation Water & Air. All these departments contribute to the development of many products, but the most important department for this research is the production of shavers, which is also located in Drachten. (Philips Drachten)

1.1.1 SHAVERS

Currently, Philips produces around 28 million shavers a year. In Drachten, the high segment shavers for the whole world are produced, which means a production of about 8 million *Key Modules* a year. Key Modules are the finished goods of Drachten; it is a complete shaver, without its package. The packing process of the high-end shavers is outsourced and since a couple of months in the hands of Modus Link, Czech Republic. Appendix A shows an overview of the different shavers that Philips Drachten produces. The following three ranges represent these high-end shavers: the Thor, the Mpire, and the SR 3. Each of these ranges has multiple shaver types, depending on the specifications formulated by the selling countries. The biggest distinction made by Philips are the Norelco shavers for the United States of America, and the shavers for the rest of the world. To get an idea of how the shavers look like, see Appendix B for an overview of the newest Key Module.

Since 2003, the production of the low-end shavers moved to a sister company in Zhuhai, China. Although Zhuhai produces the low-end shavers, the production of their shaving heads is also located at Philips Drachten, because of the advanced technology in this process. Not only does the shaving heads for the production of shavers are made in Drachten, but they also sell the shaving heads for commercial use. In order to make enough shaving heads for the total production of shavers and the commercial heads, around 85 million heads are produced a year.

1.1.2 NON-STANDARD PRODUCTS

Besides the Key Modules and shaving heads, Philips Drachten also produces non-standard products. These products are service orders from Philips Eindhoven, several parts for Argentine, and dummies. Dummies are demo shavers that stores use as a marketing product. It is a shaver that looks exactly like the original shaver and consists of the same parts, but these parts are glued to each other in order to disable the shavers for usage

and prevent them for theft or damage. The assembly lines at Drachten produce all these non-standard products, but in contrast to the Key Modules, the service department needs to edit and pack the dummies.

1.2 PROBLEM IDENTIFICATION

During the past years, Philips had quite some changes throughout the entire production process. 'Simply Philips' is a project that is set up to encourage everyone at Philips to constantly continue to improve. With this project Philips also focuses on lean manufacturing; Kaizen events became important, the packing process is outsourced, and furthermore Kanban is introduced throughout the entire factory. Although there are still a few struggles with the new packing factory in Czech Republic, many positive developments made the production of shaving heads, shaving units, and the Key Modules very efficient.

Nevertheless, there are still non-standard product processes that can be improved. One of these processes is the production of dummies. Until now, the dummies did not have the highest priority at Philips Drachten. However, during the years, Philips became more aware of the importance of this product. There is not only an interference between the dummy and the standard production process, which costs Philips a lot of money, but dummies are also important products for the marketing of shavers. So after some conversations with multiple people within Philips, it became clear that the dummy process should be improved. Therefore, we formulate the following problem statement:

"Philips does not know how the ordering, the production, the packing, and the financial processes of dummies should be managed."

1.3 RESEARCH GOAL AND QUESTION

As already stated in Section 1.2, this research focuses on finding the bottlenecks in the dummy process. These bottlenecks vary from order processing to packing the dummies. The goal of this research is to analyse the bottlenecks regarding the dummy process, which results in recommendations for Philips of how to make the dummy process more efficient and less cost driving. To find these recommendations, we formulate the following main research question:

"What are the characteristics of the current dummy process and how can this process be improved?"

1.4 RESEARCH SCOPE AND ASSUMPTIONS

At the start of this research, it became clear that a research towards the entire dummy process would be too broad. Therefore, this section defines the research scope.

The production of the dummy Key Modules happens according the standard production process. After some conversations at Philips, it was obvious that the Key Module production for a dummy could be improved. For example, it would be more efficient, and therefore cheaper, to use obsolete material for the production of a dummy. Damaged production materials are now thrown away or sometimes stored somewhere in the factory, with the purpose of using them, but in the end they got lost and are not re-used. Another alternative would be to remain the original look and weight, but without the use of original parts for a dummy. For example, using a weight instead of a real battery, which means that it is also not necessary to disable the battery. This would mean, however, that the standard basic bodies cannot be used and an additional production process is needed, which would probably make the production of dummies more complex.

Although it would be possible to improve the production process of dummies, the use of different materials and damaged intermediates, and the production process at the customize production lines are out of scope.

The scope of this research therefore focusses on the planning process and the additional operational processes of a dummy.

One assumption that is made for this research is based on the packages of the dummies. Until now customers could choose whether they wanted an additional package with their dummy order and whether the dummies should be packed in single or multiple unit packages. However, since this caused a lot of extra effort and money for Philips, it is assumed that from now on the delivery of dummies is done in one standard package.

1.5 RESEARCH FRAMEWORK

This section gives an overview of the approach that this research uses in order to find an answer to the main research question. First, Section 1.5.1 describes the research method for finding possible solutions and Section 1.5.2 shows how this method is used in practice. In order to answer the main research question, different chapters gain insight in the formulated subquestions.

1.5.1 RESEARCH METHOD

There are many different methods to solve a problem. The approach of this research is based on the Management Problem Solving Method (MPSM) (Heerkens, 1998). This method uses a checklist that is quite similar to the five steps of the model of Verschuren and Doorewaard (1999). The focus of this research is to come up with a solution for the dummy process. Therefore, this report treats the first five steps of the problem solving method (shown in Figure 1). The sixth stage, implementation of the solution, and the evaluation process of the solution are not part of this research.

Figure 1. Seven phases of the MPSM

De Vaus (2001) distinguishes different types of research: descriptive and explanatory. Since this research focusses on describing the current situation and finding possible solutions to the problems, this research is primarily a descriptive research.

1.5.2 RESEARCH APPROACH

This section discusses the approach of this research. Therefore, Figure 2 presents the structure of this report with the different stages of the MPSM that is used for this research.

As the figure shows, this chapter describes Stage 1 and 2 of the MPSM (see list of abbreviations on page 33). Chapter 2 and 3 emphasize the third stage of this research, focussing on the current normal production and the current dummy process. The literature review in Chapter 4 helps to find alternative solutions, after which Chapter 5 describes these solutions. So together Chapter 4 and 5 contain Stage 4 of the MPSM. Finally, Chapter 6 contains the fifth stage and it gives the conclusion and recommendations for further research. To find an answer to the research question (see Section 1.3), we formulate a series of subquestions that divides this research over the five stages that Figure 2 shows.

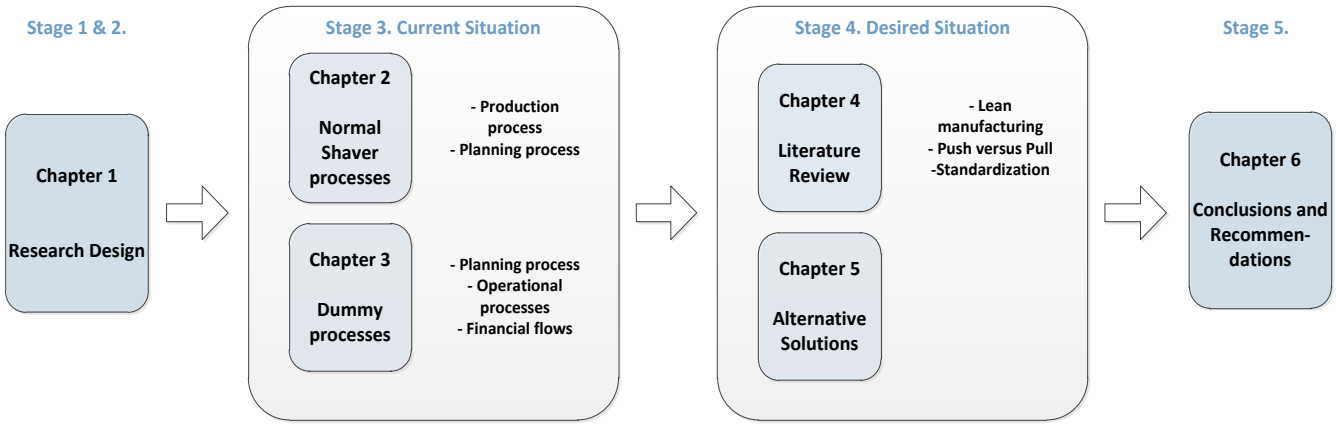

Figure 2. The research structure

By using the questions below, the third stage of this research gains a deeper understanding of the current situation at Philips Drachten. First, this stage considers the production process of shavers, but according to the research scope, it is also important to consider the planning process of shavers.

Stage 3. What is the current situation at Philips?

- How are shavers produced?
- In what way is the production of shavers scheduled by the logistic department?

As Chapter 2 describes the processes of the standard shaver, Chapter 3 focusses on the current dummy process. In order to get a complete overview of the entire process, Chapter 3 looks at the production, the planning, and the financial processes of a dummy. Therefore, we use the following subquestions:

- How are dummies scheduled?
- How are the dummies produced currently?
- What are the costs and profits of the dummy production process?
- What are the bottlenecks in the dummy process?

To gather the information given in Chapter 2 and 3, we observe the production process, analyse data, and have some interviews. During the entire period of this research, observations are made to understand the entire dummy process and possible bottlenecks. The interaction with the stakeholders during the observations leads to involvement of the actors. Also interviewing the employees of different departments at Philips Drachten creates an understanding of the current processes and bottlenecks of the dummies. With the insight in the current situation, we make flow charts that create clear overviews of the different processes.

After obtaining an overview of the current situation, this research provides a literature review in order to formulate the alternative solutions for the dummy process. Besides the literature review, data, which is gathered from the information system (SAP) at Philips Drachten, helps to find alternatives for the dummy process. Examples of data from SAP are: overview of the scheduling process, demand patterns, bills of material (BOM), and certain production steps.

In Stage 4 of the MPSP model, Chapter 4 first outlines the literature review by the subquestions below. Searching for improvements for the dummy process requires a better understanding of the lean principle that Philips uses. Another subject that is important for the scheduling process of dummies is the push and pull strategy. Finally, Chapter 4 also gives some background information about non-standard production processes.

Stage 4. How can the dummy process be improved?

- What does lean manufacturing contribute?
- Should dummies be produced based on push or pull strategy?
- What are the characteristics of standardised production processes?
- How can production processes be standardized?

Chapter 5 of this research focuses on finding alternative solutions in order to optimize the dummy process. Again we formulated some subquestions which are answered in Chapter 5.

- To what extent is there a correspondence between the dummy process and the standard service order process?
- What alternative ways are there to manage the dummy process?

Finally, Chapter 6 contains Stage 5 of this research, which is the last used stage of the MPSP model. It describes the chosen solutions and recommendations for some further research.

2 SHAVER PRODUCTION AT PHILIPS CONSUMER LIFESTYLE

This chapter gives more insight in the current situation at Philips Drachten, regarding the commercial shavers. Although this research focusses on the dummy process, it is important to have an overview of the entire shaver production process, to see whether there are any similarities or interferences. Therefore, Section 2.1 answers the first subquestion: "How are shavers produced?" After the production process, Section 2.2 enlightens the planning process at Philips Drachten by answering the question: "In what way are the shavers scheduled by the logistic department?"

2.1 THE PRODUCTION PROCESS

As already described in Section 1.1.1, the packing process of the High-End shavers is outsourced. Although Philips Drachten produces the shavers for the United States, in North America there are two factories (Roselle and Missouri Valley) where the shavers for America are packed. Therefore, the production at Philips Drachten focuses on the Key Modules.

The factory of Philips Drachten consists of two different parts, respectively the Process Driven Factory (PDF) and the Order Driven Factory (ODF). These two parts of the factory are both responsible for a different part of the shaver. Figure 3 shows a schematic view of the two parts of the factory.

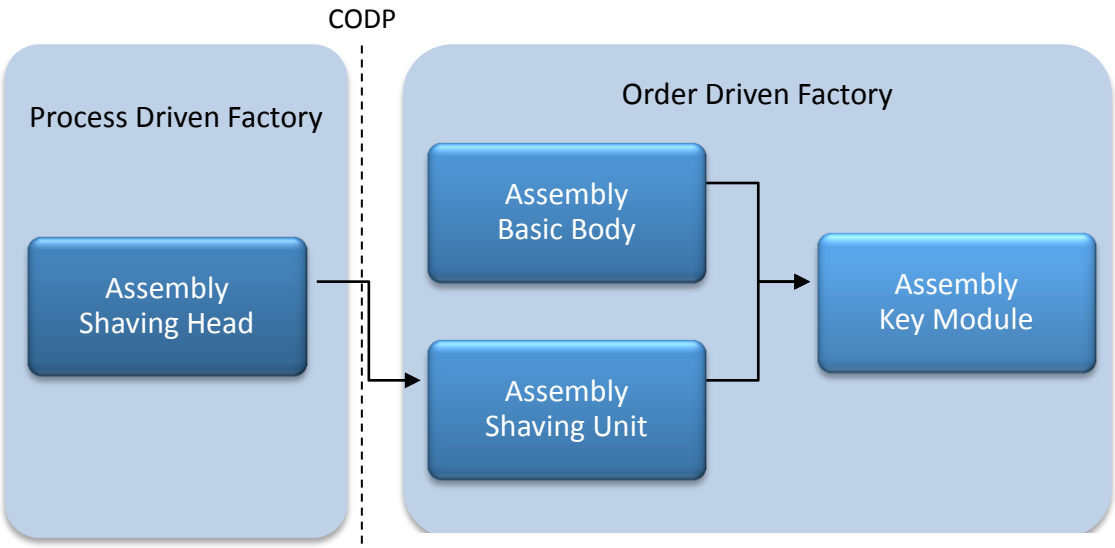

Figure 3. The Customer Order Decoupling Point

As Figure 3 shows, the separation between the PDF and the ODF is also the Customer Order Decoupling Point (CODP). The CODP is the point from where the customer has influence on the product and the production becomes customer specific. So in this case the CODP makes the difference between the process driven part of the production and the order driven part. Since the PDF is responsible for the production of shaving heads, which are used in the assembling of Key Modules but also for commercial sales, this production process is partially based on assembly-to-order but also based on a make-to-order strategy. (Naylor et al., 1999)

In 2010, Philips made the first steps towards the lean manufacturing principle by implementing the Simple Philips program. The principle of lean manufacturing is based on the idea of developing an operation that is faster, produces higher-quality products, and operates at low cost. To ensure that this can be achieved, the Simple Philips program contains the key issues of the lean philosophy namely: Eliminate waste, involve everyone, and continuous improvement. (Slack et al., 2007) Since standardization is part of the 5-S methodology, one of the key points of lean manufacturing, in order to eliminate waste, the Simply Philips

program also introduced the use of Standard Operating Procedures (SOP). A SOP includes diagrams, pictures and other techniques that describe certain tasks and steps, but highlight specifically how to do a job. (Roughton & Crutchfield, 2008).

Section 2.1.1 explains the production process of the shaving heads and Section 2.1.2 describes the assembling process of the Basic Body and the production of the Key Module. Appendix C shows an overview of these operational processes.

2.1.1 THE PROCESS DRIVEN FACTORY

As Appendix B shows, the Key Modules are made from the housing, the basic body, and the shaving unit. This shaving unit is the top of the shaver and contains among others the shaving heads. Most of the shavers have three shaving heads, and since Philips Drachten and Zhuhai together make 28 million shavers each year, this means that over 80 million shaving heads a year are produced in the Process Driven Factory.

From steel, the cutters and caps are made, and together with the spring and the spindle these form the shaving head. Since every shaving head needs a different treatment and because of the long changeover times, the shaving heads are produced in high volumes and low variety. Slack et al. (2007) describe multiple types of production processes (see Figure 4). Looking at the different characteristics of the process types, the production at the Process Driven Factory can be seen as a mass process, which means that the process flow should be almost continuous and the tasks are repeatedly executed. This is also the case in the PDF of Philips.

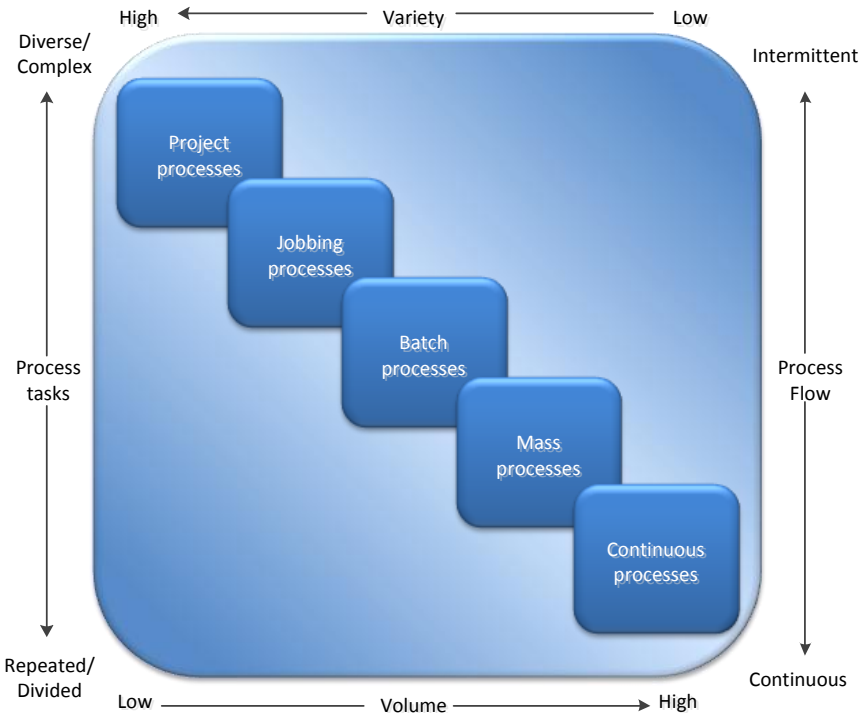

Figure 4. The process types (Slack et al., 2007)

2.1.2 THE ORDER DRIVEN FACTORY

The Order Driven Factory is responsible for the production of the different types of shavers, based on the different housing, trimmers, and electronic components. Therefore, the Customer Order Decoupling Point (CODP) is positioned at the beginning of ODF, when the Printed Circuit Board (PCB) is assembled and the moulding process starts.

Because of the variety in products and the lower production volumes, the order driven process is a batch process. (Slack et al., 2007) The size of these batches is based on the size of the Key Modules that are shipped towards Czech Republic for packing. This transportation is done by pallets on which 720 shavers are stored. Based on these numbers, the batch size and the size of the Kanban inventories is 1440 units. Kanban control is one of the techniques for the Just-In-Time method of planning and control, which is closely connected to the Lean principle, see Section 4.1.

Looking at the Order Driven Factory, Figure 5 shows that the production process can be divided in different parts. The first part, which is not included in Figure 5 however, is the moulding and printing process of the different parts. The next part of the Order Driven Factory is the production of the PCB and the attachment of the battery. The third part is the assembly of the basic body and the assembly the shaving units. The PCB and the battery is connected to the driving unit and the shaving heads are placed in the shaving unit. These two parts are passed on to customizing, which is the last step in the production cycle. Here, the right housing parts are placed on the basic body and each shaver is printed with its own characteristic number.

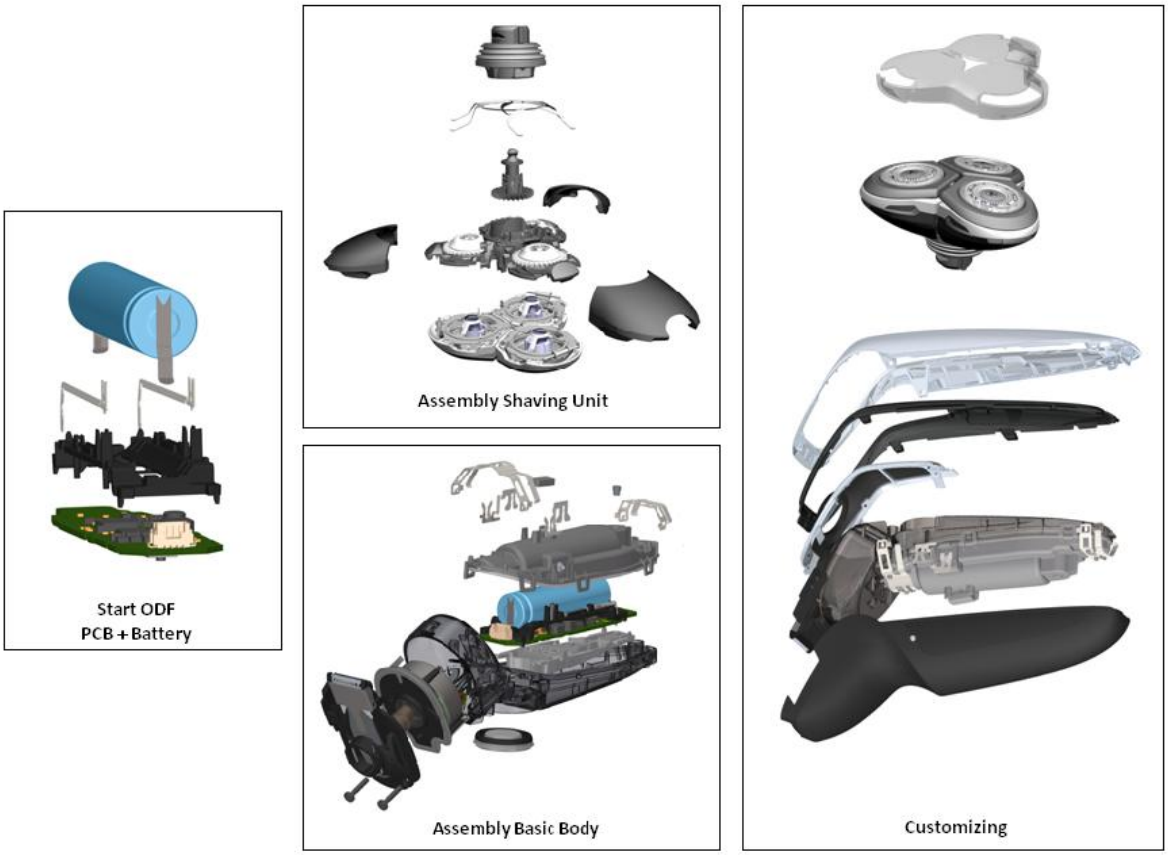

Figure 5. The ODF production lay-out of a Key Module

2.1.3 THE LOGISTIC CENTRE

The Logistic Centre of Philips (LoCe) is responsible for the storage of the inventory and for the shipment of all goods towards Modus Link, America, Zhuhai, and all other connections. Focusing on the Key Modules of the 'standard' shavers of Philips, about 90% of the entire production is sent to Modus Link for packing. The other 10% is shipped to America, where they pack their own shavers in two different factories.

Another responsibility of the LoCe is the shipment of service orders, dummies, and parts that are sent to China, such as the shaving heads. Furthermore the LoCe also distributes products that need to be sent towards organisation responsible for testing, such as KEMA.

2.2 THE PLANNING PROCESS

In order to manage the entire production process, there is a team of about 25 people responsible for all the logistic flows within Drachten. To get a better insight in the organization and how the production flow of shavers is managed, this section describes the planning process.

The logistic department consist of the following departments: The International Support Group Shavers (ISGS), the Material Support Group (MSG) (a MPS planning officer and procurement officers), and the Logistic Engineers. Together, these departments are responsible for the scheduling process of the Key Modules. Appendix D gives an overview of this process. The Logistic Engineers support the production process directly in the factory, while the following sections describe the functions of the other departments.

2.2.1 THE INTERNATIONAL SUPPORT GROUP SHAVERS

Based on the average demand, the production scheduler makes a capacity plan for all weeks and enters this in the information system, SAP. Once the Commercial Organisations (CO) passed on their demand on Tuesday, the International Support Group Shavers can make a Key Module plan. This plan specifies the amount of each product type that needs to be produced in the next week; therefore, it is also called a week+1 plan.

The next step, for the ISGS planner, is to check whether or not this schedule exceeds the capacity plan. When this Key Module plan is made, one of the constraints is that Philips Drachten does not have any finished goods inventory, but after production the shavers are immediately sent to Modus Link, in Czech Republic. APO, a special function in the SAP system, generates a temporary production schedule when the Key Module plan is processed.

After the production plan is made and the production scheduler has approved the production numbers for next week Master Production Schedule (MPS), the production plan is confirmed to the Commercial Organisations in SAP. Section 2.2.2 clarifies the Master Production Schedule in further detail. In order to make a plan that is satisfactory, good communication is important; therefore, this department verifies every Tuesday with the CO whether there are any additional requirements to their demand.

Each of the support group planners is responsible for a different shaver range. But since the United States has its own packing centre, one of the planners is responsible for all the products that need to be scheduled for America.

2.2.2 THE MATERIAL SUPPORT GROUP - MPS

At Philips, the logistic department has to deal with a long- and a short term demand. So each month the MPS officer receives an expected demand for all the months of the year in the Goods Movement Survey (GMS). This demand is not specified for the different shaver types, but it gives an overview of the demand of each range. Based on this given expected demand, the production scheduler makes a capacity plan for each week. As already mentioned before, this capacity plan is then sent to ISGS were they can make a Key Module plan.

Every Wednesday, the production scheduler receives the Key Module plan from ISGS and again checks this plan with the available capacity. Afterwards the Master Production Schedule can be made for the next week. The MPS is an important schedule on which the Material Requirements Planning (MRP) is based. It contains the exact volumes and schedule of the end products that are made. (Slack et al., 2007)

First, SAP makes a levelled schedule by equally dividing the production of each shaver type over five days. This levelled scheduling, also called Heijunka, is based on the idea that the mix and volume of products are equally divided over time to stimulate routine and a regular outcome. (Slack et al., 2007) Figure 6 shows an example of Heijunka scheduling with respect to the traditional way of production scheduling.

Figure 6. Heijunka scheduling

For the MPS, however, the schedule needs to be adjusted in such a way that the production can only be done in batches of 1440 pieces. But there are also multiple other constraints that need to be taken into account. This means that some of the products, with a small demand, cannot be divided over the week and they are produced in one batch.

2.2.3 THE MATERIAL SUPPORT GROUP - PROCUREMENT

Another part of the MSG is responsible for the procurement of raw materials. Once the MPS is complete, every Wednesday midnight, the SAP system composes a list of all the materials needed, based on the Bill of Material (BOM) for all the scheduled products that need to be produced. A BOM is a list that contains all the component parts required to make the end product, together with their level in the component structure and quantity of components. (Slack et al., 2007)

With this list, SAP makes a Material Requirement Planning (MRP) for the different commodities of raw materials for the procurement department. Also a MRP is created about the different intermediates for the Logistic Engineers. Every Thursday, these MRPs are analysed and if they are approved, the raw materials are ordered by the Material Support Group.

3 THE CURRENT DUMMY PROCESS

Using the explanation of the production and planning process of the standard products in Chapter 2, this chapter defines all processes that involve the dummies. Section 3.1 looks at the planning process of dummies and compares this process with the production of the standard Key Module by answering the following research question: 'How are dummies scheduled?'. Then Section 3.2 explains the operational processes of a dummy with the next question: 'How are the dummies produced currently?' Section 3.3 answers the sub research question: 'What are the costs and profits of the dummy production process?' These different sections all contain information about the bottlenecks in the dummy process. Finally, Section 3.4 gives a summary of all these bottlenecks and the involved stakeholders.

3.1 THE DUMMY PLANNING PROCESS

Most of the time, when a new shaver type is being launched, dummies are produced to promote the new product. Since two years, however, it is also possible to order dummies to replace old or damaged dummies in stores. With the introduction of this new ordering process, the dummy demand became even less predictable and therefore the planning process became rather complex.

When a new shaver type is released, an initial product sheet (IPS) is sent to the customers. This initial product sheet contains information about the new shaver and is made by the project manager and the Customer Marketing Manager (CMM) from the head office in Amsterdam. The CMM sends this IPS to the Customer Organisations (CO) of the different countries, which will send it to all the stores that sell Philips shavers.

If a store has an interest in dummies, ISGS receives an initial request from the COs. Based on this initial request, the price information is sent. When the customer wants to confirm, he sends a final Purchase Order to Philips. Because the demand for dummies is usually not very large and unpredictable, and since the production of the dummy Key Modules is done at the same machines as where the normal shaver are produced, this production is seen as extra. Therefore, the overall lead time that is communicated to the customer is 8 weeks from the moment when the final purchase order is received. Section 2.2.1 mentioned that ISGS receives a capacity plan for the next week in order to make a Key module plan. However, for the dummies this is not the case, because these are produced on top of the standard shaver production plan.

After receiving the initial request, ISGS sends an email to the production planner, who estimates the actual lead time based on the total available production capacity and the demand for the coming weeks. The actual production of the dummies mostly takes about 3 weeks. When there is enough space, the production planner schedules the dummies in the MPS of the production lines. In this case, an email is sent to the service department to let them know that they can expect dummies for the packing process. Although the other service products are scheduled in a week plan through SAP, the dummies are not scheduled because the demand is unpredictable and there is no time pressure because of the long lead time that is given to the customers. Figure 7 shows a summary of the dummy planning process.

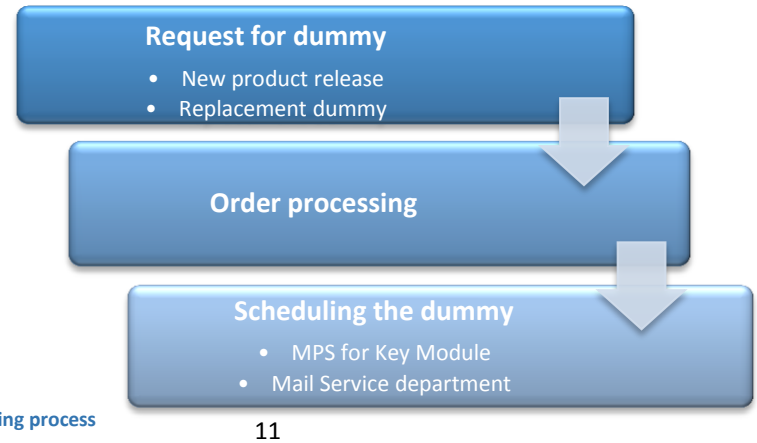

Figure 7. Overview of the dummy planning process

3.1.1 PROBLEMS

Although we mentioned before that, since a few weeks, the production of dummies should only be started when the official PO is received, it still happens that the production of the dummies is already scheduled based on the initial request. The reason for this is that Philips has to respond to the demand of the normal shavers. This means that high standard demand reduces the capacity for dummy production, since dummies have less priority and can be considered as extra production. When the production of dummies is started before the final PO is received, multiple problems can arise. For instance when this happens, it occurs that the dummies are produced and ready for shipment, but the Purchase Order is still missing or incomplete. The reason for this is that the communication with the customer, about for instance the delivery address (FunLoc code), is indirect. In this case the LoCe is not able to send the dummies, which means that dummies should temporarily be stored in the warehouse.

Another disadvantage that is caused by this way of planning is that sometimes the final Purchase Order (PO) of the customer has a demand for less dummies than initially thought. Not only because the customer can change his mind, but also because it is rather hard to estimate the final demand. If this happens, an overproduction of dummies arises and there will be obsolete inventory. Appendix E shows the flow chart of this planning process, including scheduling before the official PO.

As discussed earlier in this section, the planning of the Key Module production happens in SAP, but the other part of the dummy planning process is not done according this official method. Even though this is not considered to be a very difficult and important problem by the logistic department, it is inefficient and it will cause a problem for the service department as Section 3.2 will explain. Currently, there is not a Bill of Material (BOM) of the dummy, which means that it is necessary that the communication about the dummy is performed by other ways than the SAP system, for instance by email. The reason for this is that the system recognizes only one type of dummy and that is the Key Module, mentioned in Section 3.2.

3.2 THE OPERATIONAL PROCESSES OF A DUMMY

As already mentioned in Chapter 1, a dummy is a shaver that is used for demonstration in stores. Since the dummy should give the customer a touch and feel experience, the dummy should have the same weight and look as the normal shaver. Therefore, the first part of the production is done according the standard production process of the Key Module. The only difference in the production of the dummy Key Module is the customization process. Since every shaver has its own laser inscription, the dummy has an inscription that says ‘Not for commercial use – sample only’.

Since it is not necessary, or even wanted, that the dummies are working shavers, the battery of a dummy is disabled. In order to make sure that the dummies can no longer be used, the specifications of the Thor dummy, one of the shaver types showed in Appendix A, recommend that the battery should be charged with 40 Volt. This should blow up the battery and therefore the shaver cannot be charged again. However, since practice showed that the batteries were quite hard to blow up with a high voltage, the new high-end shavers will be disabled by disconnecting a contact cable during the customization process. For the old model, Philips decided that is enough to turn the shavers on at the end, until the battery is empty and finally deliver the dummy without a charger.

After the customizing process, the dummies are sent to the Model Shop or service desk where they are glued and packed. Finally, when the dummies are ready, the LoCe sends the orders to the customers. These next sections describe these different processes, shown in Figure 8.

Figure 8. Overview of the operational processes of a dummy

3.2.1 GLUING THE KEY MODULE

After the production of the Key Modules, the dummies need to be glued according to the specifications. Although it is important that customers can experience a shaver, they should not be able to steal or break certain parts of the shaver. For example: A customer should be able to know how the trimmer looks like, however, the external trimmer of the Thor can easily be broken and therefore it should be glued. On the other hand, the Mpire and the SR 3 have an internal trimmer that can be extended and does not need to be glued. These different specifications for each shaver type are made by the project manager and the marketing director that are responsible for the specific shaver.

At the factory of Philips Drachten, the Model Shop is part of the Research and Design department and is responsible for the production of newly released products. Until now, most of the dummies were produced during the project launch and afterwards they were glued in the Model Shop. However, not all those dummies satisfied the required specifications. A reason for the wrong glued dummies is that multiple people were working on the same product and not everyone was aware of the specifications. Another problem with this old gluing process is that it happened that the dummies got lost somewhere in the LoCe. The Key module of a dummy, is stored in the LoCe after production. When the dummies are moved to the model shop for the gluing process, they also disappear in SAP. But when the dummies are glued and sent back to the LoCe, they are not registered in SAP again which causes lost dummies. Therefore, Philips Drachten is trying to implement this gluing process at the service department instead of the Model Shop.

3.2.2 THE PACKING PROCESS

When the gluing process of the dummy is finished, the dummies should dry for 24 hours, before they can be packed at the service department. The service department consists of three women, who are responsible for the packing of service orders, spare parts, and dummies.

As described in Section 3.2, the service department receives an email with the upcoming dummies. Then, based on the schedule of the service orders, the dummies are planned. The head of the service department checks whether there is enough packing material stored in the warehouse and if this is not the case, this material is ordered by a project manager.

Currently, there are two types of dummies that can arrive at the service department: the first type are the dummies that are leftover from the Thor project and are already glued in the Model Shop and the second kind of dummy is the one that is produced according to the new procedure, after the Purchase Order is received. These older dummies should be checked on their specifications first, before they can be packed. When the dummies are approved, the dummy is placed in a protection bag, which is set on a pulp tray of 12 units. Then the tray is placed in a cardboard A-box and when the order is ready, it is sent to the Logistic Centre. Appendix F shows an overview of this gluing and packing process.

3.2.3 SHIPMENT OF DUMMIES

As already mentioned in Section 2.1.3, the Logistic Centre is responsible for the distribution of all orders. If a Service Document is received, the order is picked and sent to the customer. A service document consists of a

destination address, the required material, the total number of units, and the price. When this service document is received by the LoCe, an invoice and a packing list are made, to send the order towards the customer. COs send dummies towards the smaller stores and if the demand is for a bigger store, the customer receives the dummy order in their own warehouse. Depending on the costs, an appropriate way of delivery is chosen based on volume, weight and packages.

3.2.4 PROBLEMS

For the gluing and packing process of the dummies, there was not yet a Standard Operation Procedure, which caused inconsistency in the products. So in order to perform these tasks in the right and standard way, a SOP for the gluing and packing process is introduced. Appendix G gives an example of such a SOP.

Section 3.2.1 describes the gluing process of the dummies and it discusses that the gluing process is currently being done by the service department, since the dummies did not meet the specifications and quality when they were glued in the Model Shop. This is mainly caused by the lack of good communication. At the Model Shop, there are multiple people responsible for the gluing of dummies and in the end there is no one who has the main responsibility of checking the dummies. However, it is not only necessary that the employees know exactly how the dummy should look like; the customers (stores in this case) should also know what they can expect from a dummy. It is decided by the project manager and the marketing director that the specifications of a dummy type are the same for each customer. However, the customers have different expectations of the dummies whether they are working or which parts are glued, therefore Philips receives complaints from the customers. Therefore, the dummy process currently lacks good communication about the specifications of the dummies towards personnel, but also towards the customers.

For the gluing process of the Thor dummies, a special coating needs to be used and therefore a fume hood is needed for the extraction of noxious smells. However, such a hood is not available in the service department and it is too expensive to buy an extra hood. On the other hand there is a fume hood available at the Model Shop, so the employees of the service department have to go to the Model Shop for the gluing process. Chapter 5 considers the consequences of this decision.

Dummies are not scheduled in the SAP system, which causes that the service department is not able to report the dummies when they are ready. Therefore, it is not only necessary that all information is sent by email, but it is also more difficult to keep control over the hours that are made for the different processes at the service department. Sometimes it is also possible that there is any delay or backlog in the dummy process and if this happens it is not possible to check the status of the dummies in the SAP system. One more disadvantage of using email instead of SAP for placing the dummy order is that occasionally emails are forgotten or numbers are misread. Until now this is not considered a big problem for the logistic department, since they have always been able to change the lead time and produce the dummies. However, it may bring the MPS officer in a difficult position when the forgotten dummies need to be produced with high priority.

Another part of the process that is not optimal is the inventory of packing material. Packing material is not registered in SAP which means that there is no overview of the inventory level of this packing material. Therefore it could happen that the service department runs out of material and the dummies cannot be shipped on time. One of the reasons why the packing material is not registered in SAP is that the packing material of the dummies is not the same as the usual packing material for service orders. Originally the trays that are used for the dummies belong to the standard packing material of Zhuhai. When the first dummies were launched, the project manager ordered a certain amount of material and from this point on he was responsible for ordering the packing material.

As discussed in Section 3.1.1, it still happens that the products are made before the final Purchase Order is received and the production is done based on an earlier request. Without a complete Purchase Order,

however, ISGS is not able to forward the Service Document to the LoCe and when this happens there will be an inventory in the LoCe. On the other hand, sometimes the actual demand of dummies is much lower than the initial production which causes that dummies need to be stored in the LoCe for a long time. So it is very important that the information in the Service Document is complete and correct, because if for instance the FunLoc code is wrong, the order is sent to the wrong delivery address.

3.3 FINANCIAL CONTROL

During this research it became clear that the ambiguities in the dummy process are the main cause of this research. However, the following research question describes another purpose of this research: 'What are the costs and profits of the dummy production process?'

Currently, the department Finance and Accounting has no structured overview of the costs that are made for dummies. Therefore, it is not known whether the dummies are profitable or not. Normally, the Industrial Cost Engineers (ICE) calculate the cost price for every product that is made by Philips. This means that not only the costs of raw materials, but also the production and the depreciation costs of machines are calculated. However, when the pricelist of the dummies was initialized, the prices of the dummies were estimated based on the production of the Key Modules plus an additional margin. Since the demand of dummies is rather small and the current pricelist seems to cover the costs, there is no real calculation of the cost price of the dummies.

3.3.1 PROBLEMS

As this section mentioned before, the biggest problem is that there is no insight in the dummy costs. This is not only caused by the lack of a cost price, but it is also caused by the fact that there are multiple stakeholders involved in the dummy process.

First of all the gluing process used to be done at the Model Shop and since the Model Shop belongs to the Research and Design (R&D) department, the gluing costs for each dummy were booked on the R&D budget of the project it belongs to which caused no insight for the financial control of the supply chain. Although Philips decided that from now on the gluing process will be done at the service department, there is not yet a separate routing or an estimation of the operation hours for the gluing process.

Another part of which the costs disappear on the budget of different projects, are the costs of packing materials. When the first dummies were made, the packing material from Zhuhai was used. This material was not ordered by the procurement department or delivered by the general suppliers for service order packing materials, but as described in Section 3.2.2, these materials are ordered by the project manager. By now this packing material is used for all dummy orders and therefore the same project manager is asked to order these materials, if there is no packing material left. This way of ordering is rather devious. Not only does this not belong to the project managers job, but currently dummies are also ordered to replace the old dummies, while in the meantime the project of this manager is closed, and therefore the costs cannot be booked on his budget anymore. Another reason is that dummies will be packed with material that is bought from the budget of a wrong project.

Because the demand for dummies is hard to predict and most of the time the orders are small, there is no separate routing for the packing process of the dummies. How long it takes for the service department to pack one dummy, is not officially calculated yet. Therefore, it is not possible to book the hours at a certain dummy order.

The different points that this section discusses, are not only necessary for the calculation of a cost price, but it is also important that the final hours and used materials can be checked, in order to see whether a certain order gains profit or costs.

3.4 SUMMARY OF THE BOTTLENECKS

Based on Sections 3.1 to 3.3, this section gives a conclusion to the following research question: 'What are the bottlenecks in the dummy process?' So this section gives a summary of the bottlenecks.

Multiple stakeholders are dealing with different drawbacks in the dummy process. The stakeholders that have to deal with the difficulties in the dummy process are the logistic department, the service department, the Industrial Cost Engineers, the customers, and the project managers that are involved. The effects of the dummy process on the logistic department are rather big, because it affects multiple parts such as the ISGS, the MSG, the MPS officer, and the LoCe among which the employees in the warehouse but also its forwarding team. Figure 9 shows the causal relationships between all the bottlenecks that are discovered in the dummy process and the stakeholders that have to deal with the problems.

From Figure 9 we conclude that the biggest bottlenecks that are responsible for the inefficient dummy process are:

1. The employees cannot operate according to standardized work
   Because of devious tasks some of the employees encounter haziness which causes irritations, but mostly it costs time and money.

2. Long/ High inventory
   The inventory leftovers from dummy orders that misfit the initial production numbers costs money and space. Sometimes the dummies even got lost in the LoCe because they cannot be registered in SAP.

3. There is no financial overview of the dummy process
   The lack of a clear cost price causes makes it hard to remain overview in the efficiency of different departments and to see whether a dummy is profitable.

Next, Chapter 4 describes the literature review in order to find improvements and alternative solutions for the dummy process. This chapter focusses mostly on the first two bottlenecks from this section.

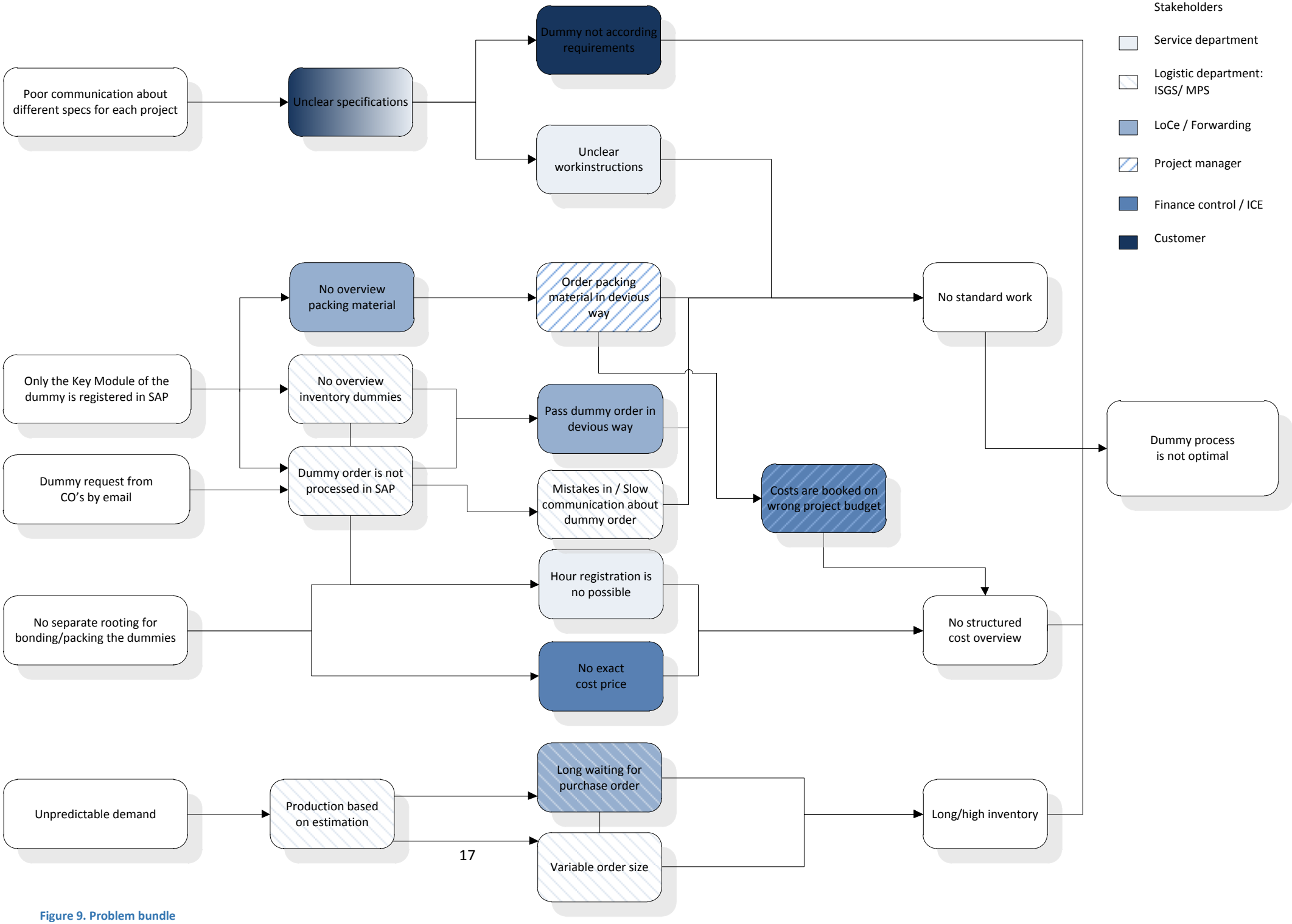

Figure 9. Problem bundle

4 LITERATURE REVIEW

As Chapter 1 describes, Stage 4 of this research is to find alternative solutions to the dummy process, which is stimulated by a literature review. Section 4.1 gives insight in an important part of the production process at Philips: Lean manufacturing. Section 4.2 describes the advantages of a pull production process versus a push process. After the literature about the general production processes, this chapter focusses on the relevant theory about non-standard production processes. Section 4.3 deals with the standardisation process of non-standard products.

4.1 LEAN MANUFACTURING

Section 2.1 describes the implementation process of lean manufacturing at Philips. In order to look for improvements in the dummy process we compare the current dummy process with the lean manufacturing principle.

Lean manufacturing is an approach that should create a streamlined, high quality process that produces finished goods based on the demand of customers with little or no waste. (Shah & Ward, 2003) This principle is introduced by Toyota and it combines multiple management practices, such as just-in-time production, Kanban inventory, work teams, and quality systems. (Villa & Watanabe, 1993) Kanban uses a physical plate or card to show the requirement of parts; it is a device to control the release of materials in pull control systems. There are two ways in which Kanban can be used. One is looped between processes for pulling parts from the forward process; in this case the Kanban between PDF and ODF. The other kind of Kanban is used to order the manufacturing of the parts in a process (Villa & Watanabe, 1993), which in this case is done within the order driven process, for instance the moulding process. The practice of lean manufacturing is measured on a three-point scale depending on the extent to which it is implemented.

To ensure the implementation of lean manufacturing in a company, it is important to stimulate lean thinking throughout the entire company by focussing on the identification of value, the generation of flow, and by elimination of waste. Melton (2005) stated that lean manufacturing benefits in shorter lead times, smaller inventory levels, more knowledge management, and better working processes with less errors or rework needed.

As discussed above, one of the characteristics of lean production is the elimination of waste. There are seven types of waste that can be indicated. (Melton, 2005) Table 1 enlightens the seven types of waste and it also shows to which extent those types of waste can be detected in the dummy process.

Waste	The dummy process
Overproduction	If there is too much production, these products only cost money. In this case this happens when the production is started based on an estimation of the order size.
Waiting	When equipment or products wait to be processed, they are not adding any value to the product. In this case when the products are ready and waiting in the LoCe for the Service Document to be finally shipped.
Waiting transport	While a product is in motion it is not being processed and therefore it receives no extra value. The packing material is spread throughout the LoCe and since this is not registered dummies sometimes get lost. This causes unnecessary transport.
Inventory	Storage of products, intermediates, and so on, all costs money. Inventory occurs when the first production run Key Modules are stored to be used as dummies. Therefore the question is how much money does it cost? Chapter 5 considers the differences between new production and the storage of obsolete shavers.

Over processing	When a particular process step is done twice, it does not add value to the product. For example at Philips this is the packing process of dummies; dummies are packed in boxes of 24 pieces, but some of the COs undo this and place the dummies in a package of 1.
Motion	Unnecessary movement of employees that should operate the manufacturing process is wasteful, because when they are in motion they do not support the processing of the product. This could refer to the process of moving the dummies to the LoCe by hand or checking the inventory of packing material physically rather than looking in the SAP system.
Defects	Defects in a product of production process, will not add value to the customer. In the dummy process wrong communication causes defects or faults in the gluing process.

Table 1. Seven types of waste in the dummy process

4.2 PUSH VERSUS PULL PRODUCTION

A similarity between the production of dummies and spare parts is that demand is often extremely sporadic and difficult to forecast. Since material and time buffers in production systems and supply chains are decreasing, there is a pressure for streamlining the logistic systems of spare parts and so it is for the dummies in this case. Based on the criticality of service products, suppliers need to choose between material and time buffers. Since the dummies are not critical there is no time pressure and a buffer in time will be logical to choose. (Huiskonen, 2001) Therefore Philips decided that they only produce on demand from now as discussed in Section 3.1.1. The section considers both options, to find an answer to the following research question: 'Should dummies be produced based on push or pull strategy?'

A pull system holds that actions in the production chain are taken based on request. It could happen that activities at the process station are triggered by a output of Kanban stock at the process stations, which is also the case at the ODF, as Section 2.1.2 describes. On the other hand a push system takes action in anticipation of a need and pushes the products forward. However, for this push policy it is important that this need is known and the future, in terms of demand, should be clear or the company should at least be able to estimate. (Villa & Watanabe, 1993)

As already stated before, the dummy demand is rather hard to estimate since orders are small and inconsistent. Therefore a push policy would be difficult to implement or it would cause inventory of finished goods. Section 4.1 describes that inventory can be seen as waste, besides Slack et al. (2007) also mention that there are multiple disadvantages of holding inventory:

- Inventory may become obsolete.
- Inventory can be damaged or deteriorate.
- Inventory could be lost, or be expensive to retrieve.
- Inventory uses space that could be used to add value.
- Inventory incurs storage costs.
- Inventory involves administrative and insurance costs.
- Inventory ties up money, in the form of working capital, which is therefore unavailable for other uses.

Although, based on the lean manufacturing principle, inventory should be seen as waste (Villa & Watanabe, 1993) and according to the lean philosophy products should be produced when the customer 'pulls' for it (Melton, 2005), there is a solid reason why the push policy should be considered. However, it is important to consider the total costs and benefits when a decision between both options, which Chapter 5 defines. (Beullens & Janssens, 2011)

4.3 STANDARDISATION

One of the bottlenecks that Chapter 3 outlines, was that the dummy process is not standardized and that it causes devious work for employees. In order to get an overview of the consequences of non-standardized work and standardization of production processes, the following research questions support in finding information in existing literature.

- What are the characteristics of standardised production processes?
- How can processes be standardized?

Standardization is the degree to which processes and products are prevented from varying over time and therefore it can be implemented in multiple ways. (Slack et al., 2007) First, there is the standardization of products and materials. Most of the time, this is focussed on the output of a manufacturer, but it can also include the use of standardized components. In this case, standardization of the end product can be achieved by setting one type of specifications for each dummy order of a specific shaver type. When Philips takes the requirements of each customer into account, this would mean that the gluing process cannot be standardised and it would be a lot more complex.

However, the more common components there are used for the production, the less complex the process becomes. Although the dummies already consist of the same components as a normal Key Modules, the packing material is unique. In order to make the packing process easier for the service department, the packing material can be standardized and the same material for service orders can be used for the packing of dummies. This would mean that it is not more efficient to use obsolete intermediates for the production of dummies, but as mentioned before, this is not considered within the scope of this research.

Looking at the standardization of the production process, this could mean that tasks and jobs can be standardized by using Standard Operating Procedures. Section 2.1 describes that Philips started to implement SOPs throughout the factory. As can be seen in Appendix G, a SOP contains not only the scope and tasks of a certain job, but it also details the quality control requirements. (Roughton & Crutchfield, 2008). A SOP can function as a checklist, which causes less mistakes or errors. Tasks will be executed more efficient and it is possible for others to execute the job since there are clear instructions.

5 DESIRED SITUATION IN THE DUMMY PROCES

Since it became clear in Chapter 3 that the dummy process has multiple bottlenecks, we want to influence these parts of the dummy process in order to get the desired, optimized dummy process. With the use of the following research questions, we consider different opportunities for improving the dummy process.

1. To what extent is there a correspondence between the dummy process and the standard service order process?
2. What alternative ways are there to manage the dummy process?

Section 5.1 compares the dummy process with the service order processes in order to find possible improvements. Next, Section 5.2 focuses on finding more improvements for the dummy process as a result of the literature review that Chapter 4 gives.

5.1 THE DUMMY PROCESS COMPARED TO THE SERVICE ORDER PROCESS

Section 5.1.1 describes the planning process as well as the packing process of service orders, in order to compare these processes with the dummy process. After comparing the two processes, Section 5.1.2 provides possible alternatives for different aspects of the dummy process.

5.1.1 THE SERVICE ORDER PROCESS

Since the demand for Service Orders is variable and hard to predict, it is not possible to make a reliable capacity week plan. Therefore the demand of the Service Orders, which comes from Philips Eindhoven instead of the COs, is processed directly by ISGS. Depending on the urgency of the Service Order, the orders are mostly planned on a week+2 schedule in SAP. This planning is made for the packing process at the service department and additional production cards are placed in the Order Driven Factory.

Once the service department receives the Service Document from ISGS and the products are ready, a more detailed packing planning can be made. After the products are packed, the orders should be reported as ready in SAP. For service orders, the inventory level of packing material is also registered in SAP and the purchasing department orders packing material based on a certain reorder level. After registering the service orders, SAP adjusts the inventory level with the use of the BOM. If the amount of inventory falls below a certain level, the reorder point, the purchasing department orders an amount of material. Together with the Service Document, the orders are sent to the LoCe, which sends the different products to Eindhoven. Appendix H shows an overview of the service order process.

5.1.2 IMPROVEMENTS FOR THE DUMMY PROCESS

In order to find improvements for the dummy process, this section elaborates on the comparison between the dummy and service order process. This section distinguishes multiple modifications for the dummy process that are improvements for the bottlenecks that are found Chapter 3.

DUMMIES IN SAP

Looking at the service order process, the most important difference with the dummy process is that the planning process of service orders is executed through SAP. Since the dummies are not processed using the SAP system, multiple negative consequences occur in the dummy process (see Section 3.2.4.) Therefore, registration of the dummies in SAP would be an improvement for the dummy process. For instance, it would be better if the COs insert their Purchase Order by SAP or at least use direct contact with ISGS instead of sending

an email to the Marketing director. However, Philips has no influence on the activities of the COs, so it is not possible to change the incoming request. Although ISGS receives the dummy request by email, the dummies should be placed in SAP as soon as the order is received by ISGS. However, this does not prevent that the production is already started before the final PO is complete as mentioned before. Therefore, it is important to make clear and strict agreements. On the other hand, when Philips decides to make use of a push system and dummies are produced in advance, implementing the different stages of the dummy in SAP gives a clear overview of the different dummies that are still in stock. Register the dummies in SAP should be done, by giving the dummies after each different production stadia (Key Module, glued, or packed) a different 12 NC number in the Bill of Material, Table 3 shows an example of this BOM.

When the production planner receives the dummy orders through SAP, not only is it possible to make a production plan for the Key Modules, but the orders can also be integrated in the planning for the service department. Activities such as informing the Service Department about the dummy order and transferring the dummies from the service department towards the LoCe, will no longer take more time than necessary. When the orders are scheduled in SAP, the system provides a clear overview of the planned and backlog orders of the service department. Another advantage of the use of SAP is that the Service Document is automatically passed on to the next department when a product is registered as completed. Moreover, this would mean that emails or information cannot be forgotten and all stakeholders in the factory are up to date.

ORDERING THE PACKING MATERIAL

Combined with the implementation of dummies in SAP, another relevant modification that can be made in the dummy process is the ordering of packing material. As Chapter 3 describes, currently the ordering of packing material is done by the project manager, but it is also done merely when the service department notices that there is insufficient packing material. Therefore, this part of the process is very inefficient. However, when the purchasing department orders the packing material it would save a lot of time and effort. Not only does it prevent that the services department has to wait for packing material, but it also saves the dummy process from the waste motion as Section 4.1 describes.

When a Bill of Material is connected to the dummy in SAP, the packing material can be attached to the dummy. In this way the system registers the inventory level of packing material automatically and it shows when new packing material needs to be ordered. This would mean that the packing material of dummies will be ordered based on an inventory level including a safety stock, which is the same way as it is done for service orders. In this way the physical control of inventory is no longer necessary, and packing material can be ordered by the purchasing department. The most important benefit of designing an appropriate BOM is that it will reduce the

Bill of material of a dummy			
Component	**Component description**	**Quantity**	**Un**
» 8222-217-***	Dummy shaver	1	PC
4222-018-46511	Stretch foil 17 mu	…	G
4222-034-17191	Pallet 120x100 Germfree	…	APC
4222-016-97082	Sticker blanco 48x23	…	PC
» 8222-217-***	Packed dummy shaver	1	PC
8222-*-*****	Foam bag	1	PC
8222-*-*****	Pulp tray	0,083333	APC
8222-*-*****	A-box	0,041667	APC
4222-016-***	Sticker blanco ..x..	…	PC
» 8222-217-***	Glued dummy shaver	1	PC
8222-*-*****	Glue	…	G
» 8222-217-***	KM dummy shaver	1	PC

Table 2. Example BOM of a dummy

total operational costs of a dummy, because for example when the right amount of products is ordered this will reduce the inventory costs. (Wu & Hsu, 2008) On the other hand, there is a restriction for this solution, because it is not possible to integrate a BOM of the dummy when the gluing process is customer specific or obsolete intermediates are used for the production of dummies. However, since the use of obsolete intermediates or a using a customized gluing process is out of the scope of this research, for now the best solution would be to make a BOM of which Table 2 shows how it should look like.

However, when the ordering of packing material is done by the purchasing department, they should get in contact with the new deliverers. Since there is no difference between the project manager and the employee of the Material Support Group, it is rather easy to change the purchase tasks from one to another. Still it seems inefficient to have a separate deliverer for the packing material of dummies; this is why Section 5.2.2 discusses the possibility of using different packing material.

FINANCIAL OVERVIEW

Detached from the service order process, another advantage of implementing the dummies in SAP is the improvement of the financial overview. Philips is currently uncertain about the profitability of the dummies, because there is no insight in the production hours of the service department and therefore in the production costs of a dummy (see Section 3.3).

It is important that the Industrial Cost Engineers of the supply chain department make a separate routing for the gluing and the packing process of dummies. With these routings the service department is able to write-off the hours that they spend on the gluing and packing of a dummy. In this way, all the hours of the service department will be covered, but it is also possible to keep track of backlog and the work efficiency of the service department. Therefore, Philips should first measure the average hours that are made for gluing and packing dummies by timing the process a few times. Finally the actual productivity can be compared with the measured production capacity.

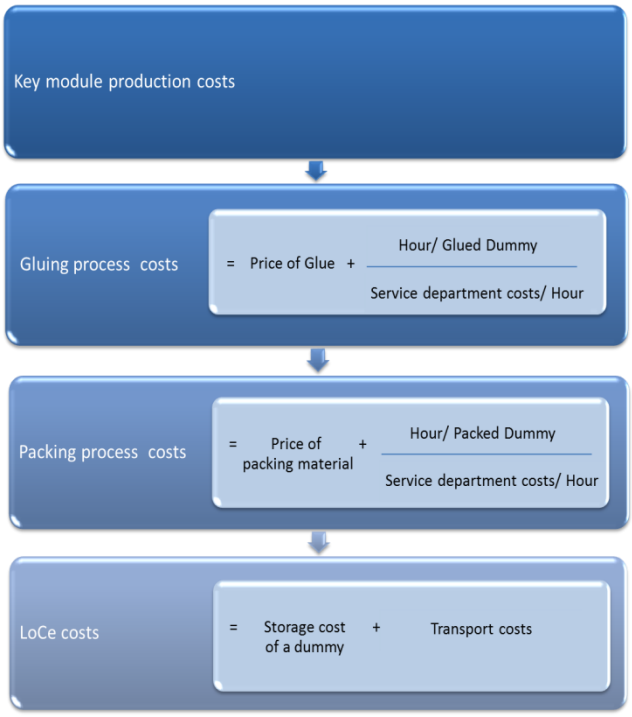

Figure 10. Cost price calculation

With these measurements, it is also possible for ICE to calculate a more precise cost price. Figure 10 shows an example of the cost price calculation, using the costs of the additional processes. Although it costs some effort to implement the extra routings and calculate the cost price, it will create a clear cost overview, which eventually will pay back in efficiency and it will result in more satisfied customers because the price is more reliable.

5.2 ALTERNATIVES

Section 5.1 discusses the improvements for the dummy process based on the production and planning processes of non-dummy products. This section focusses on alternatives for the dummy process as a result of the bottlenecks in Chapter 3 and the additional information that Chapter 4 describes.

Section 5.2.1 and 5.2.2 look at the preferred planning process for the dummies. Following, Section 5.2.3 considers the gluing process of dummies and finally, in Section 5.2.4, we consider an alternative for the packing material.

5.2.1 PRODUCTION OF DUMMIES; BASED ON PUSH OR PULL?

Chapter 4 discusses some advantages of a pull system compared to a push system, although we described that, according to the lean principle, it would be better when Philips would use a pull strategy for the dummies. In this section we compare the different strategies for the production process of the Key Modules.

Pull

With a pull production system, the dummies are produced when the customer 'pulls' for it. As Chapter 4 describes, there should not be any inventory since inventory is considered as waste and costs money. So it is important to prevent dummies on stock, which is caused by an incomplete Purchase Order. Therefore, once the purchase request is received, this should be checked and be complete, before the production of the Key Modules for dummies is started. This prevents the dummies from having an unknown destination, and it also means that the production scheduler is up to date on the upcoming demand which means that there is enough time to produce the dummies within an acceptable lead time. However, since dummies are extra and standard shaver demand has more priority, a pull strategy will always cause a pretty long lead time.

Push

Producing the dummies with a push strategy, the products are 'pushed' towards the customer based on an estimated demand. However, because of the fluctuating demand, the risk of overproduction becomes high and so is the risk of obsolete inventory. The biggest advantages of a push system, is a shorter lead time, because there is enough capacity calculated based on a demand pattern. The production can be scheduled in such a way that it has the least effect on the standard Key Module production process. Still, as this report describes earlier, the demand pattern is really hard to predict.

Both production strategies contain the same disadvantage of causing the total production cost of a Key Module, but with a push strategy there are also some costs involved for the short inventory. Table 3 shows an overview of the production costs for the three different dummy ranges. Another disadvantage of producing the Key Modules is that it takes some time for the operators to adjust the production lines. However, there is a solution for both these shortcomings.

When a new project is launched, all machines should be adjusted and tested. In order to do this, the first production run is scheduled and considered as a test run. During this test run, multiple errors occur and the number of rejected Key Modules is very large. Therefore, this production run is now seen as waste. However, since dummies are non-working shavers, it is possible to use these test run shavers as a dummy, if they have the correct look. So an advantage of this inventory of rejected dummies is that there are no production costs for dummies, because these test runs are budgeted within a project. The only costs involved in this case, are the inventory costs, which is about 7% of the costs price of a standard Key Module.

Nevertheless, there are so many first production run shavers that if all the rejected Key Modules are saved on stock, the inventory will be too large and becomes obsolete in the end. In this case the dummies will not only have inventory costs, but the obsolete dummies should be demolished, which costs extra money. Normally, the demolishing of rejected Key Modules is booked in the project budget. However, this budget is already closed and this is not possible after they have been stored for a few years. In the past, Philips already considered this option but it appeared that there was a large gap between this number of production run shavers and the demand of dummies. Based on the demand patterns of the most recent dummies, that Appendix I shows, it is

quite hard to calculate the best inventory level. Nevertheless, looking at the end-to-end process, the rejected Key Modules are not used anyway and the costs are already budgeted in the project, so it makes no difference which department within Philips is responsible for the costs. We think that the total costs are more important and so all rejected Key Modules from the first production run can be saved, which saves a lot of money in the end.

Table 3 shows the different consequences of all three production strategies. The advantage in lead time, the comparison between production scheduling and inventory, but also the costs from the industrial cost engineers are given. Since all strategies need the extra costs for packing an gluing the dummies, Table 3 does not show these costs.

	Push	**Pull**	**First production-run inventory**
Compare production and inventory costs	Thor: 6.96-17.76 Mpire: 17.15-17.98 SR 3: 31.24-44.73	Thor: 6.5-16.6 Mpire: 16.4-16.8 SR 3: 29.2-41.8	Thor: 0.46-1.16 Mpire: 1.15-1.18 SR 3: 2.04-2.93
Comparison of lead time	Average	Long	Short
Disadvantages of strategy	Difficult scheduling on predicted demand	Capacity and planning is depending on standard shaver orders	Too much inventory causes obsolete dummies

Table 3. Consequences of the different production strategies

Considering the different consequences that are caused by all production strategies, it is the best solution to keep the rejected Key Modules from the first production run on stock and sell these as dummies. This saves a lot of time, production capacity, but mostly it saves a lot of money.

5.2.2 DESIGN OF PACKING MATERIAL

Since it became clear in Chapter 3 that the ordering of packing material is not optimal, we conclude in Section 5.1. that from now on the ordering should be done by the procurement department. However, in order to make sure that this is possible, this section considers the background information for using the current packing material.

The packing material that is currently used is introduced by a project manager when he received this packages for another product from Zhuhai. This packing material, foam bags and pulp trays for 12 shavers, appeared to be cheap and easy to use. Therefore, this material was introduced as the packing material for dummies. During the past years, this packing material is used for different projects and became the standard packing material for all dummies.

One point of attention, at the packing process, is that every order for each country is packed separately. But since dummies can be ordered in all kind of amounts, it appears that over the 70 % of the boxes are not completely filled. Based on the dummy demand of the past five years, Figure 11 shows the actual usage of the packing material.

While the packing material is very cheap, it is not only ordered in a devious way, but also half empty packages are shipped towards the COs. Since the transport costs of dummies is defined by the number of products, volume and weight, this means that unnecessary costs are made. Therefore, it could be more efficient to use other packing material. Looking at the volume of the orders during the past years, it seems that these are very fluctuating and that it is rather hard to decide what would be the best size package for the dummies. However, in order to decide what package should be used, we first look at the purpose of the dummies.

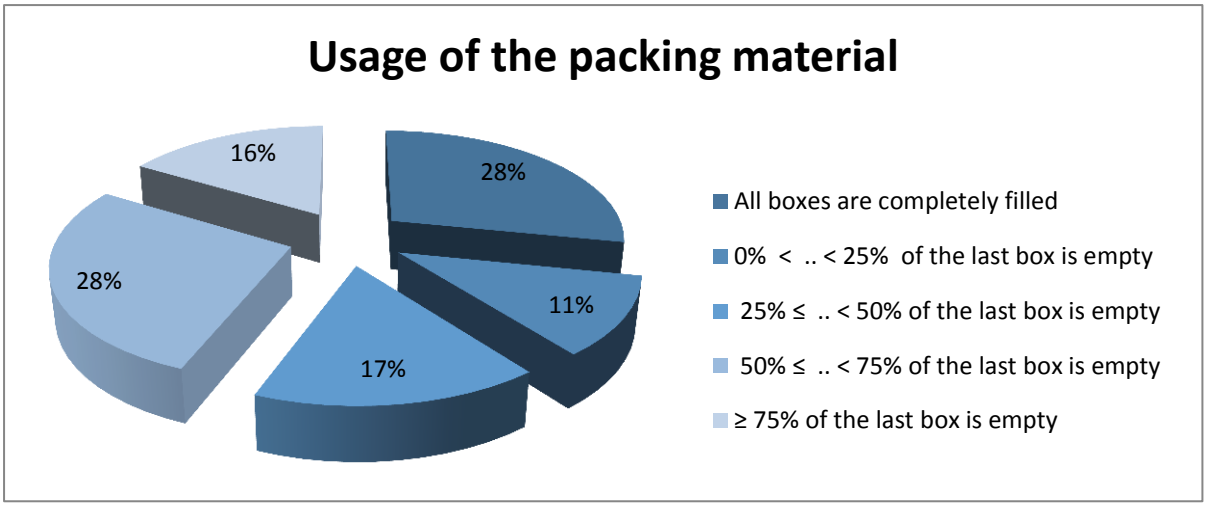

Figure 11. Usage of packing material

Once the dummies are sent from the Logistic Centre towards the Commercial Organisations, the COs make sure the dummies are sent to the different stores. This can be done by installing the dummies on a display and sending the entire display to the store, or sometimes a representative drives by the different stores and unpack the dummies there, or the dummies are unpacked and each dummy is sent to the stores in a different package. Therefore, some Commercial Organisations have no preference of how to receive the dummy, while in other cases it would save time and money if the dummies have one piece packages.

Although Philips decided, a few years ago, to remove their one piece packages, because they were more expensive, it would be better to use smaller packages than boxes of 24. Eventually the low cost, 24 pieces, packages will probably not save enough money to cover the costs of shipping the packing material from Zhuhai to Drachten plus the costs of shipping half empty boxes, and the costs for unwrapping the packages. Therefore, it would be wise to choose another packages that is suitable for only one dummy. However, in order to decide what the best size of dummy package is, the actual packaging and shipment costs should be considered. Therefore, Chapter 6 gives a recommendation for further research on this improvement.

5.2.3 GLUING OF THE DUMMIES

One of the latest changes in the dummy process is the movement of the gluing process of dummies from the Model Shop towards the service department. As Section 3.2.1 deliberates, there are multiple reasons for this decision, such as it would be easier to keep the products within one department and less mistakes in the gluing process are made. On the other hand, a disadvantage of this decision is that the Model Shop has its own hood for the gluing process, which saves time.

Nevertheless, one thing that Philips did not take into account, is the comparison between the costs of both gluing processes. A small comparison of both options is given in Table 5, where the numbers of capacity of the service department are based on an estimation since this is not exactly calculated yet. The production costs are given by the responsible Industrial Cost Engineers. Although the service department has no fume hood, and placing a new hood would be too expensive, this will not cause more costs because the employees of the service department have free access to the hood and currently the hood is not used most of the time.

	Model Shop	Service department
Costs per hour	63,50 euro	30 euro
Dummies per hour	+/- 56 dummies	+/- 40 dummies
Costs per dummy	1,13 euro (inclusive glue)	0,75 euro (exclusive glue)

Table 4. Cost overview gluing processes

Another criteria that is important for this decision is the work capacity of both processes. However, in this case there is no difference in the capacity because both departments are able to hire extra personnel from the agency. So with the costs taken into account, we conclude that the best applicable gluing process is indeed to execute the gluing process at the service department of the supply chain.

5.2.4 SCHEDULING IN SAP

As Section 5.1 discusses, it could be an improvement to make a routing for the different tasks of the service department and to calculate the capacity of this department. This would give better insight in the costs and backlog of the dummy process, but moreover it could also be used to make a more realistic schedule for the service department.

Now and then, a new calculation of the capacity of service orders is made in order to keep track of the work efficiency. Though, when a planning for gluing and packing dummies in the service department is made by the ISGS, this happens on a rough estimation of the capacity. On the other hand, the Master Production Schedule is made based on the capacity restrictions in SAP. This could also be an alternative for the current planning process of the service department. Each of the employees gets its own restrictions about which tasks they are able to do or what task is preferred, but also the capacity can be a restriction. Therefore, if the capacities for the dummy process are identified, SAP can be used to make a realistic planning for each week. So if the dummies are scheduled in SAP, the backlog is registered and the available capacity will lead to a better plan for the service department.

5.3 SUMMARY OF IMPROVEMENTS

This chapter discusses multiple improvements for the bottlenecks of the current dummies process, such as using a BOM in SAP, ordering the packing material through the MSG, or create a financial overview by calculating the cost price. Furthermore, this chapter also elaborates on possible alternatives for the dummy process. Alternative improvements of the dummy process are for example: the use of rejected Key Modules from the first production run or different packing material. Chapter 6 concludes all the possible enhancements and recommendations for Philips.

6 CONCLUSIONS AND FURTHER RECOMMENDATIONS

This chapter gives an answer to the main research question: **"What are the characteristics of the current dummy process and how can this process be improved?"**.

First, Section 6.1 concludes the results of this research that are found in order to reach the desired situation. In Section 6.2, we give a few supplementary recommendations which may contribute to the optimisation of the dummy process but require further analysis.

6.1 CONCLUSION

The purpose of this research was to find improvements for the dummy process, because multiple problems occurred during the analysis of the current dummy process. No financial overview, no standard work, and obsolete inventory cause drawbacks in the current way of scheduling and operating the dummy process. As mentioned before, different stakeholders such as the logistic department, customers, and the service department have to deal with the following bottlenecks in the current situation:

- There is no clear overview of the dummy cost price
- It is not possible for the service department to register the working hours
- Ordering the packing material is done in a devious way
- Passing the dummy order between departments happens laborious
- Large inventory leftovers because of too much production
- Unclear specifications that causes lack of work instructions and wrong glued dummies.

Based on the literature review and the comparison with other service order processes, we found the following interventions that will improve the dummy process. These improvements for the dummy process are ranked based on their impact and effort.

1. Saving the rejected Key Modules from the production run for dummies
   Currently, it is not efficient to produce the Key Modules at a push or pull strategy because there is too much haziness in the prediction of demand. Most of all both strategies are much more expensive than saving the rejected Key Modules from the first production runs. Besides the low costs, another advantage of keeping these Key Modules on stock is the short lead time. Therefore, the benefits of this change are very high and the effort is low. The production run shavers only require a storage space in the LoCe and a registration of the amount and types that are on stock.

2. Gluing process at the service department
   The biggest advantage for gluing the dummies at the service department is that it is easier to keep track of new specifications and that there are clear work instructions which cause less errors. Also it appeared that gluing the dummies at the service department takes a little more time, but it saves a lot of money.

3. Processing the dummies by integrating a BOM in the SAP system.
   By using SAP, a Bill of Material can be registered, which would lead to a better overview of the inventory of dummies. Another benefit of using SAP, is that orders can be automatically send to another department. In this case, time and effort are saved. Finally, using SAP would improve the communication about dummies, which means that, when an order is received, it should immediately be placed in SAP so the production scheduler and service department are aware of the upcoming order.

4. Calculating the cost price and create separate routings
   A separate routing for the gluing process and packing of dummies will provide insight in the total costs of dummies. Furthermore, it offers awareness of the work efficiency of the service department. Since the current cost price is estimated based on the production costs of the standard Key Modules with an additional margin, it might be that the cost price of a dummy is too high. Although this is an important change in the dummy process, it has not the highest priority because it takes some time for ICE to implement this change. However, we think that the benefits are bigger than the costs.

5. Ordering the packing material by the Material Support Group
   Since it does not belong to the job of a project manager to order packing material, it would be better if the packing material is ordered based on an inventory level by the Material Support Group.. This is more efficient and prevents devious jobs, as it is not the task of a project manager to order packing material. Furthermore, in this way the service department never runs out of packing material.

6. Scheduling service department tasks in SAP
   Scheduling the tasks of the service department in SAP by using capacity restrictions of employees, provides insight in the backlog of this department and it gives a better overview in the work efficiency.

This chapter describes multiple suggestions for improving the dummy process. Most of the implementations are single investments that will benefit in time, money, and effort on the long term, however, a more extensive data study should explore the exact costs and the magnitude of benefit of these different modifications.

6.2 RECOMMENDATIONS

Besides the improvements stated in Section 6.1 we recommend a few subjects that require further research in order to decide whether or not these interventions can contribute to improvement.

6.2.1 USING SINGLE PACKING MATERIAL

Since there is not enough data and the research period was too short for a deeper investigation in the use of the packing material, we recommend to take a closer look at the use of different packing material. Based on the research we concluded that it would be probably more efficient to use different packing material, since part of the packages are currently shipped empty and the commercial organisations have no clear opinion about the packing material.

In order to decide what size the alternative material should have, it is important to look at the transport costs of the different packages. But also the costs of the material should be considered. We think that using packing material of a smaller size will economizes the shipment of unused packing material, which saves money. Furthermore a different supplier, not from China, can save the transport costs and make the ordering process more easy.

6.2.2 USING OBSOLETE MATERIAL FOR DUMMY PRODUCTION

The research scope, defined in Section 1.4, describes that Philips currently produces dummies based on the standard production, while using exactly the same material as for a retail shaver. Besides saving rejected Key Modules from the first production run, we recommend to investigate the use of obsolete intermediates for the production of dummies. Although this requires that the obsolete materials should be listed in SAP and that production lines need to be adjusted, it would save production costs. However, depending on these costs compared to saving rejected Key Modules from the first production run, the outcome of this investigation may be that a pull strategy, which is more suitable for lean thinking, eventually gives a better result.

6.2.3 IMPROVING COMMUNICATION ABOUT THE SPECIFICATIONS

One of the assumptions of this research was that for each type of shaver there is one dummy type, which is not customer specific. However, often the customer prefers different types to choose. Currently, the communication between the service department, the project manager, and the customer is not sufficient and this causes confusion for the different stakeholders. An improvement of the communication about the specifications would create more clarity on the work instructions, which could reduce the number of useless dummies. On the other hand, better communication with the customer makes sure that the customer is more aware of what to expect, which leads to less complaints, as mentioned before.

6.2.4 SCHEDULING ON A DEMAND PATTERN

Currently, the Service Department has enough capacity and flexibility for the packing and gluing process of dummies based on a pull strategy. If the Service Department lacks capacity, it is possible to hire temporarily employees at the agency. However, as stated in Chapter 3, the use of different people in these processes caused deviations in the dummies. Therefore, it is interested to investigate the possibility of scheduling the gluing process of the dummies at low demand periods. However, this is only possible when a certain pattern can be found in the demand for service orders and so this requires further investigation.

6.3 FINAL WORDS

With this report we demonstrate that the current dummy processes do not fit the desired way of working at Philips. Therefore, we propose to adjust the current scheduling and operating process. We are convinced that modifications in the dummy process will reduce costs and improve the efficiency.

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LIST OF INTERVIEWEES

- Kenneth Breidel — Logistic manager
- Agnes Lub — Innovation manager & manager supply planning
- Nynke de Jong — Logistic Engineer
- Klaas van der Ploeg — Operations manager- Supply
- Klaas Gruppen — Financial controller
- Astrid Wagenaar — All-round assembly worker, service department
- Dirk de Vries — MPS planning officer
- Linata Hilberink, — Availability manager; ISGS
- Martijn Huitema, — International master- and supply planner; ISGS
- Aalzen Tuinstra, — Procurement officer; MSG
- Arend Bakker — Sr. Engineer
- Tom Weersink — Industrial Cost Engineer

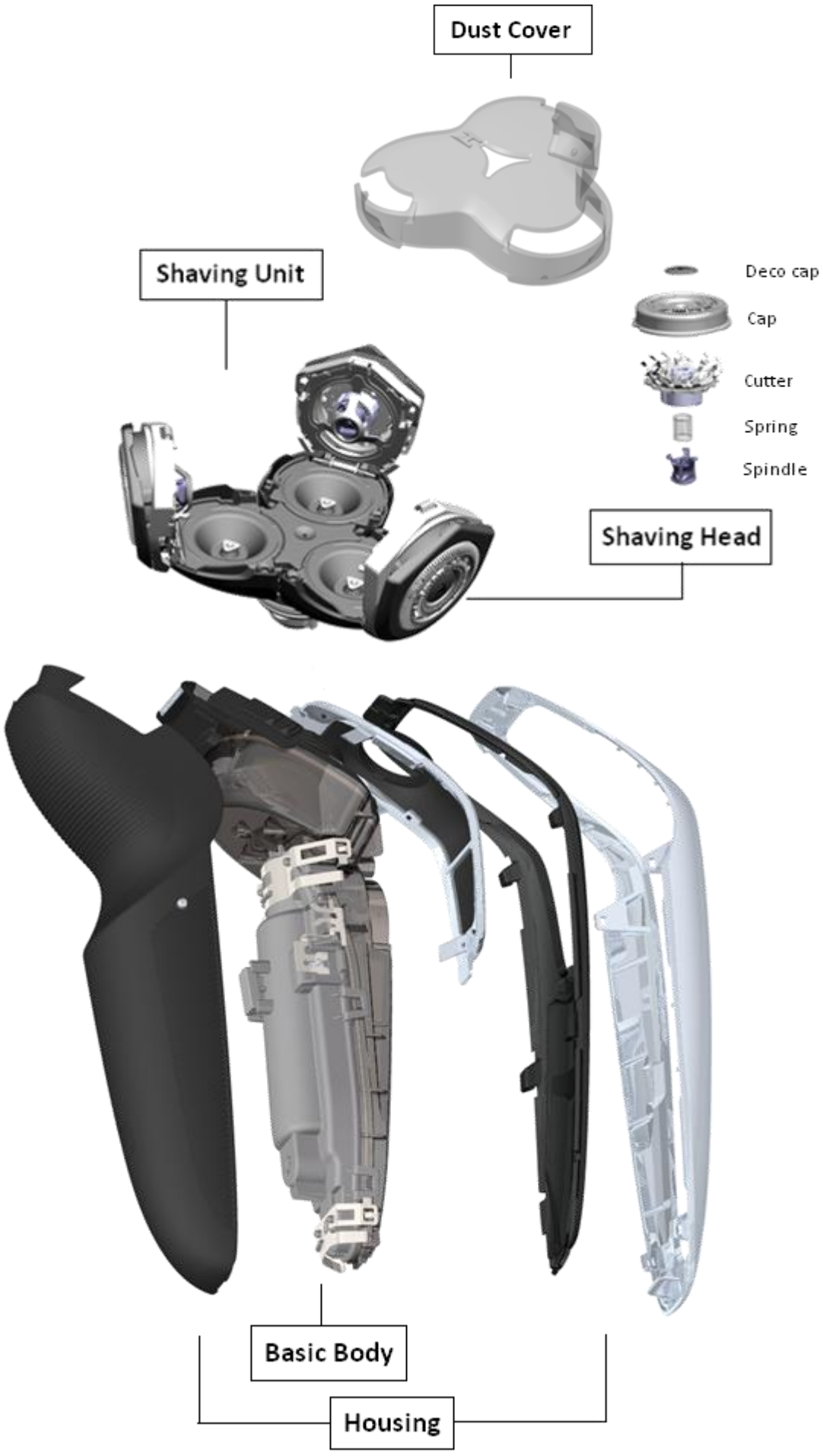
LIST OF ABBREVIATIONS

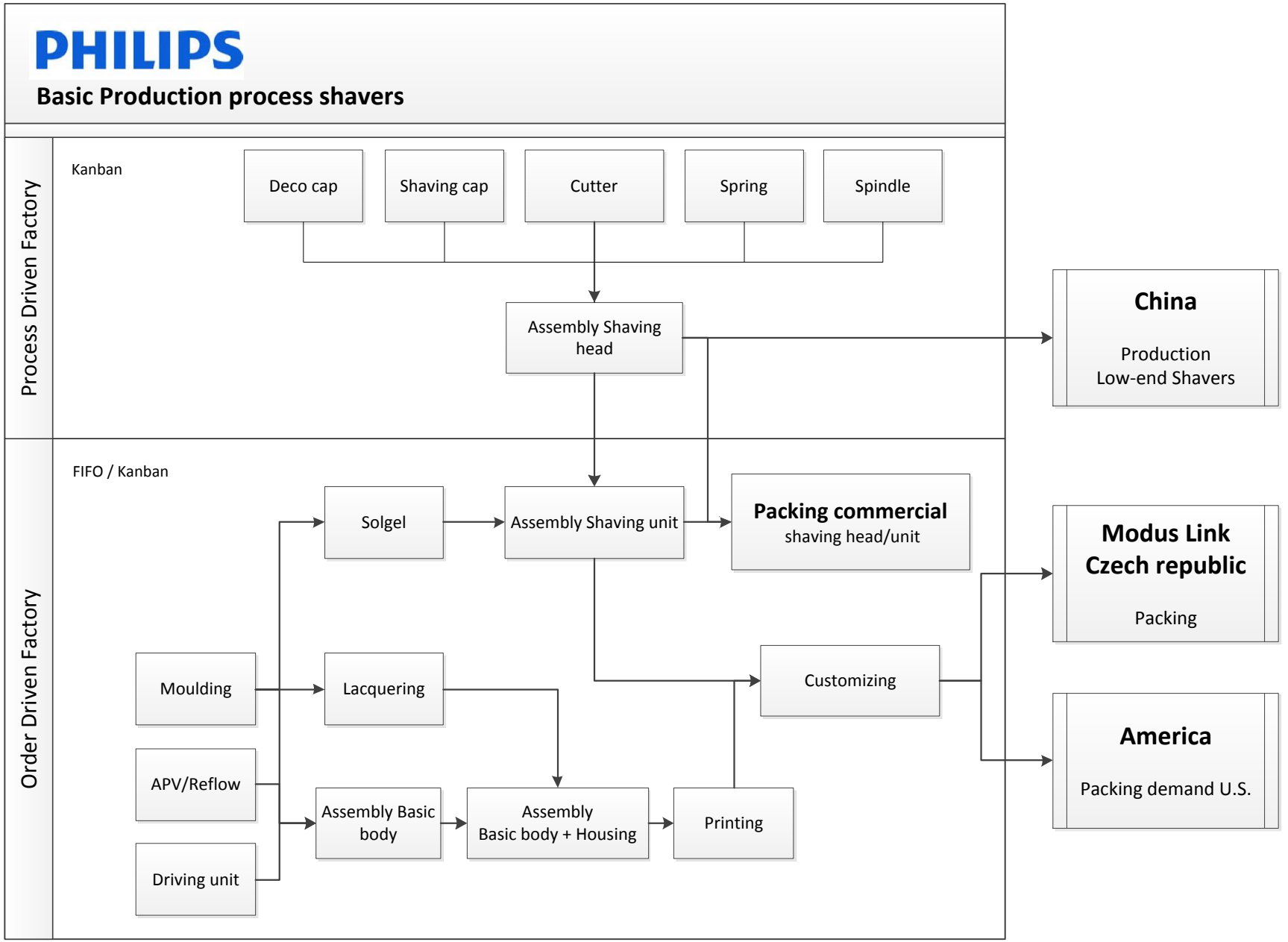
APO	Advanced Planner and Organizer
CMM	Consumer marketing manager
CO	Commercial Organisation
CODP	Customer Order Decoupling Point
ISGS	International Support Group Shavers
LoCe	Logistic Centre
MPS	Master Production Schedule
MPSM	Management Problem Solving Method
MRP	Material Requirements Planning
MSG	Material Support Group
SAP	Systems, Applications, and Products in Data Processing
SOP	Standard Operating Procedure

APPENDICES

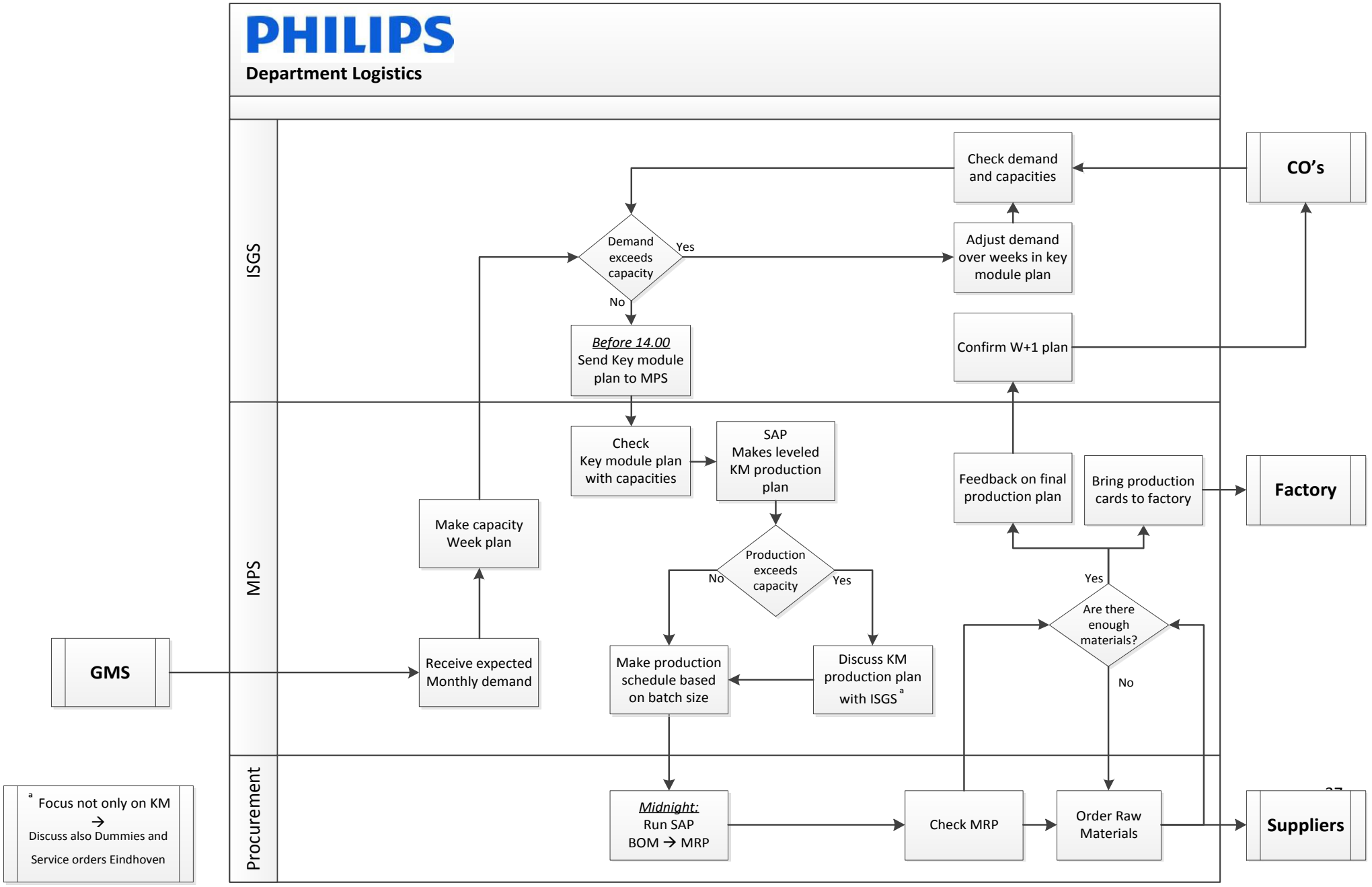
APPENDIX A KEY MODULES

APPENDIX B EXPLODED VIEW OF A (SR3) SHAVER

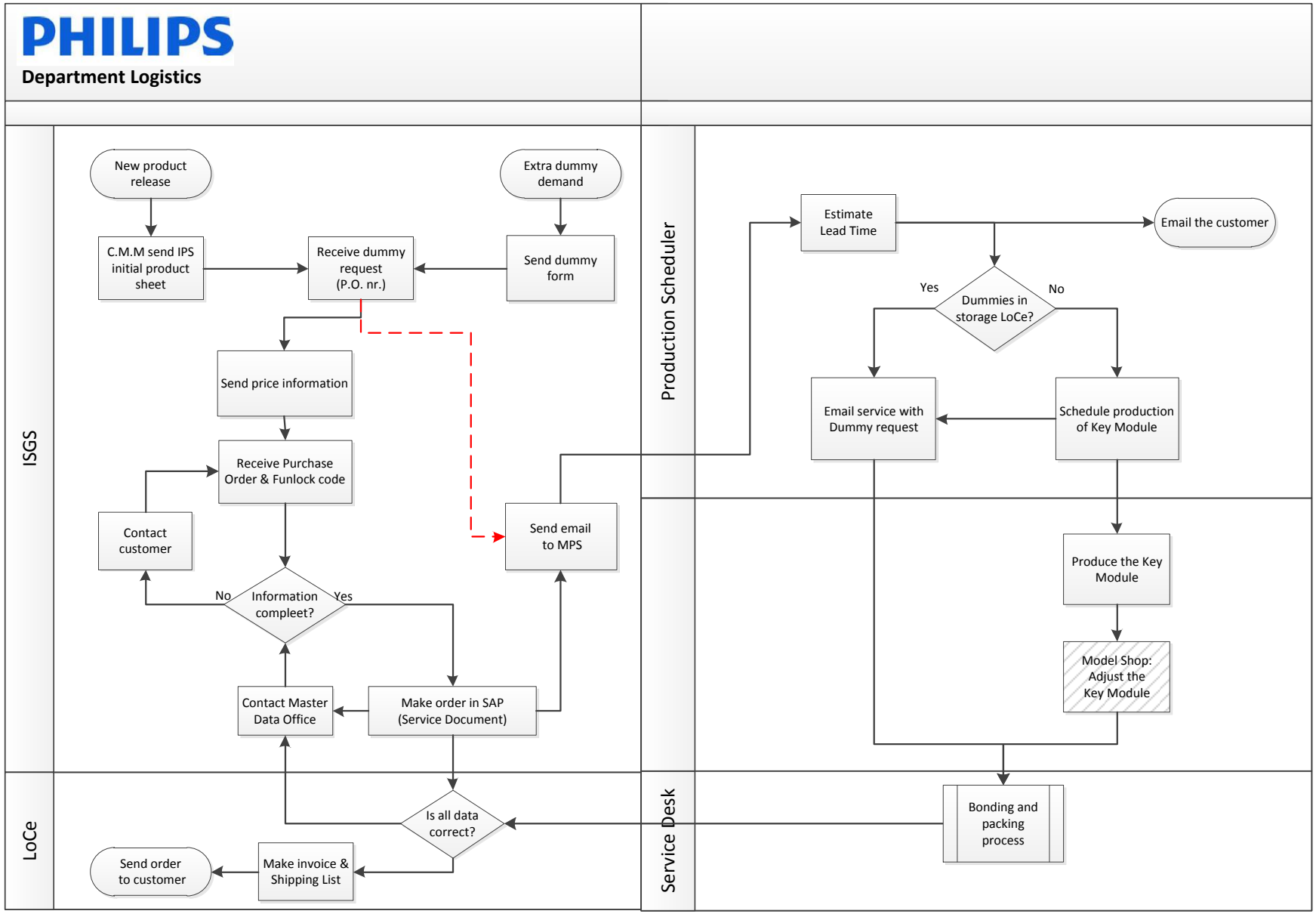



PHILIPS
Basic Production process shavers
Process Driven Factory
Kanban
Deco cap
Shaving cap
Cutter
Spring
Spindle
Assembly Shaving head
China
Production
Low-end Shavers
Order Driven Factory
FIFO / Kanban
Solgel
Assembly Shaving unit
Packing commercial
shaving head/unit
Modus Link
Czech republic
Packing
Moulding
Lacquering
Customizing
APV/Reflow
Assembly Basic body
Assembly
Basic body + Housing
Printing
America
Packing demand U.S.
Driving unit

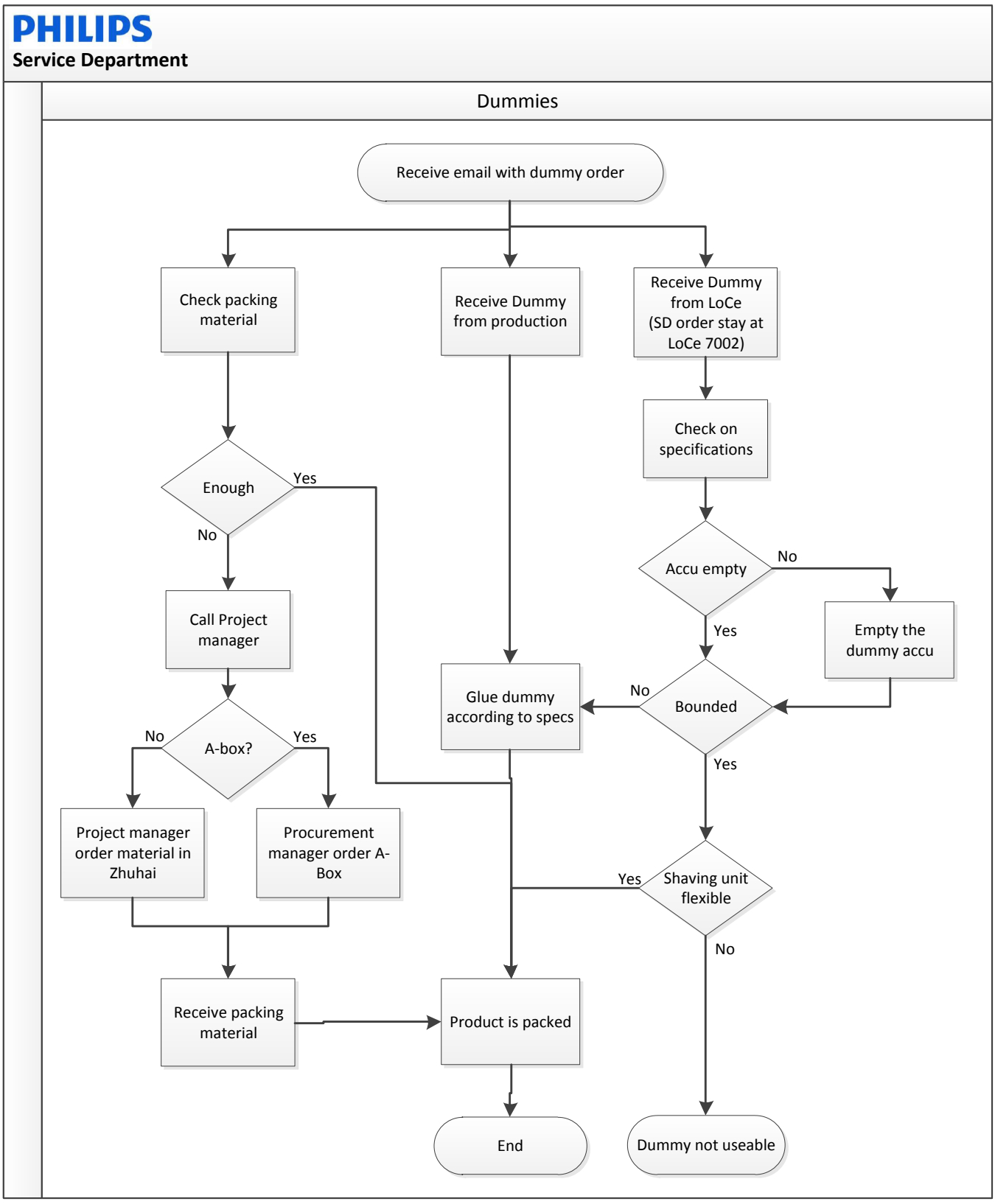
APPENDIX D OVERVIEW PLANNING PROCESS



APPENDIX E OVERVIEW OF THE DUMMY PROCESS



APPENDIX F GLUE PROCESS AND PACKING OF A DUMMY

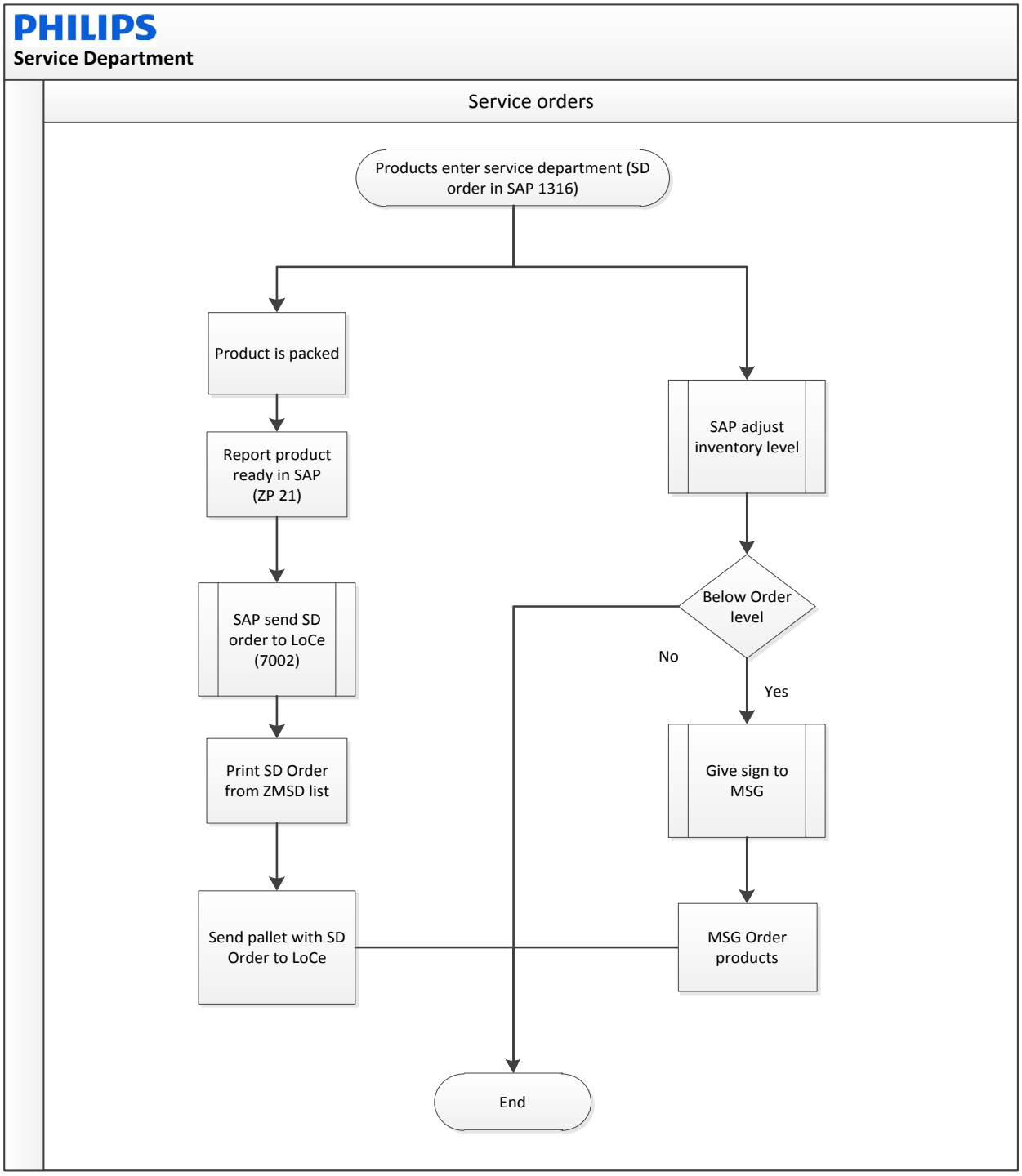


APPENDIX G SOP OF THE DUMMY GLUING AND PACKING PROCESS

Foto	1 	2 	3 	4 	5 
Beschrijving	Meng de 2-componenten-lijm in het bakje.	Breng de lijm aan rond de driver.	Plaats de scheerunit en open de scheerkappen	Lijm de nokjes van de haarkamer op beide aangegeven punten en sluit vervolgens de kap	Plaats na lijmen de shaver terug in de tray en laat deze 24 uur drogen.
Aandachts-Punt ⚠	***Uit beide tubes evenveel gebruiken***	***Lijm mag niet buiten de rand komen***	***3 Scheerkappen openen per scheerunit***	***Herhaal voor de overige 2 kappen***	
Reden	Juiste mengverhouding	Niet overmatig lijm gebruiken		Alle kappen dienen gelijmd te worden	

Foto	6 	7 	8 	9 	1 
Beschrijving	Vouw de A-doos in elkaar en plak deze dicht met de tapedispenser	Plaats de shaver in een schuimzakje met de scheerunit naar de open zijde gericht	Plaats de shaver in pulp tray	Plaats de volle pulp tray in de A-doos.	Plak de A-doos dicht met de tape dispenser en plaats op de korte zijde in de linker bovenhoek een sticker (2x). Zet doos op de pallet.
Aandachts-Punt ⚠	***Eerst de korte flappen en daarna de lange flappen naar binnen vouwen***	***Vouw het flapje erbij in***	***Let op de trimmer dient naar boven gericht te zijn***	***1. Er kunnen twee tray's (van 24 stuks) in een doos. 2. Het hangt af van de aantallen of de doos vol afgeleverd wordt.***	***Op het label staat type, aantal en 12nc vermeldt***
Reden		Anders valt de shaver mogelijk uit het zakje	Shaver ligt anders niet goed in pulp tray		

APPENDIX H COMPARISON WITH THE SERVICE ORDER PACKING PROCESS



APPENDIX I DUMMY DEMAND