A model based on total cost and manufacturer performance to evaluate a product as well as possible cost reductions

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ABSTRACT

Omega Pharma is a distributor of over the counter products, selling thousands of products produced at more than 200 manufacturers and sold in most European countries. The company was founded in Belgium in 1987 and has since then had a high market focus and expanded through acquisitions of brands and products. The company has in recent years started working towards centralization and supplier base management. A project team has been set up to work strategically by choosing key manufacturers and by reducing the supplier base. A first step in this is to look more closely at products with a low turnover and that are not strategically important in order to evaluate if the product is profitable and which products that could be moved to other manufacturers or cancelled from the portfolio. Therefore the purpose of the study is to:

Create an evaluation model based on revenue, total cost and manufacturer performance to evaluate a product and if cost reductions can be achieved by ending the production of the product or moving the product to a different manufacturer.

A four step approach for analyzing total cost was followed in order to, in a structured way, create the model and identify the relevant elements related to revenue, total cost and manufacturer performance that were to be present in the model. The four steps were:

1. In a first step elements and costs were identified that might be relevant for the model. This was done based on previous research, holding interviews at the company and reviewing documents.
2. The second step was to adapt the elements to the model.
3. In the third step, it was decided how the elements and costs that were to be in the model would be calculated and presented as well as looking into how the model would be built.
4. The fourth step consisted of doing test runs and a sensitivity analysis to test the robustness of the model.

The result handed over to the company is in the form of the evaluation model created based on the above stated purpose. Within the model, there are 4 manufacturer performance parameters and 1 for revenue. When it comes to costs, the amount varies depending on the case analyzed. To evaluate product profitability there are 7 cost elements containing 20 identified costs. When evaluating moving a product to another manufacturer there are the same costs, however an additional element for transfer is added containing 5 costs. For the situation ending a production, there are 2 costs. In order to facilitate the use of the model, estimations were done to the costs to the extent possible. From test runs the model was further adapted to the company as it was identified what values connected to a product where possible for the user to find in the system and in what units of measure. The sensitivity analyses showed that none of the estimated values would, if the estimation was not accurate, affect the evaluation of the product. They could however affect the cost element of that cost.

KEY WORDS: SUPPLIER BASE REDUCTION, EVALUATION MODEL, TOTAL COST ANALYSIS.
This study, our master thesis, is the final step of our Master of Science in Industrial Engineering and Management at Linköping’s University. We have both chosen to specialize in logistics and have therefore completed this study with the aim to develop an evaluation model for Omega Pharma to use with the purpose to evaluate a product and to reduce costs.

We would like to express our gratitude to all the positive energy and the enthusiasm towards our project at Omega Pharma, it has helped us on the way and made the study even more interesting to perform. We would like to say thank you to our supervisor at Omega Pharma, Veronica Söder, for help guiding us in the right direction when needed. We would also like to thank all employees at Omega Pharma for answering our questions and taking their time to participate in interviews, even when having busy work schedules.

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CONTENT

1 Introduction ................................................................................................................................. 1
  1.1 Background ........................................................................................................................... 1
  1.2 Purpose ................................................................................................................................ 1
  1.3 Clarification of purpose ......................................................................................................... 2
  1.4 Directives .............................................................................................................................. 2
  1.5 Delimitations ......................................................................................................................... 2
2 Company presentation ............................................................................................................... 4
  2.1 Omega Pharma ..................................................................................................................... 4
    2.1.1 Products .......................................................................................................................... 5
    2.1.2 Quality .......................................................................................................................... 5
    2.1.3 Supply chain ................................................................................................................... 5
  2.2 Perrigo .................................................................................................................................... 7
  2.3 Collaboration and project ....................................................................................................... 7
3 Frame of reference .................................................................................................................... 9
  3.1 Revenue and costs ................................................................................................................ 9
    3.1.1 Total cost analysis ......................................................................................................... 9
    3.1.2 Cost of quality .............................................................................................................. 16
  3.2 Manufacturer performance ................................................................................................. 19
4 Problem specification .............................................................................................................. 21
  4.1 Step 1 - Identify .................................................................................................................. 23
  4.2 Step 2 - Adapt ...................................................................................................................... 26
  4.3 Step 3 - Plan the calculations ............................................................................................ 27
  4.4 Step 4 – Test runs ............................................................................................................... 27
  4.5 Studied system ..................................................................................................................... 27
5 Method ....................................................................................................................................... 29
  5.1 Type of study ....................................................................................................................... 29
  5.2 Overall approach ................................................................................................................ 29
    5.2.1 Step 1 - Identify ............................................................................................................ 30
    5.2.2 Step 2 - Adapt ............................................................................................................... 34
    5.2.3 Step 3 - Plan the calculations ...................................................................................... 35
    5.2.4 Step 4 – Test runs ....................................................................................................... 37
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3</td>
<td>Credibility</td>
<td>37</td>
</tr>
<tr>
<td>5.4</td>
<td>Method criticism</td>
<td>39</td>
</tr>
<tr>
<td>6</td>
<td>Collected information and analysis</td>
<td>41</td>
</tr>
<tr>
<td>6.1</td>
<td>Step 1 - Identify</td>
<td>41</td>
</tr>
<tr>
<td>6.2</td>
<td>Step 2 – Adapt</td>
<td>50</td>
</tr>
<tr>
<td>6.3</td>
<td>Step 3 – Plan the calculations</td>
<td>52</td>
</tr>
<tr>
<td>6.3.1</td>
<td>Created model</td>
<td>63</td>
</tr>
<tr>
<td>6.4</td>
<td>Step 4 – Test runs</td>
<td>65</td>
</tr>
<tr>
<td>6.4.1</td>
<td>Test runs</td>
<td>65</td>
</tr>
<tr>
<td>6.4.2</td>
<td>Sensitivity analysis</td>
<td>67</td>
</tr>
<tr>
<td>7</td>
<td>Conclusion</td>
<td>71</td>
</tr>
<tr>
<td>8</td>
<td>Reflections</td>
<td>73</td>
</tr>
<tr>
<td>References</td>
<td></td>
<td>74</td>
</tr>
<tr>
<td>Company references</td>
<td></td>
<td>75</td>
</tr>
<tr>
<td>Appendix</td>
<td></td>
<td>77</td>
</tr>
<tr>
<td>Appendix 1 - Interview questions</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>Appendix 2 - Illustrations of the model</td>
<td>78</td>
<td></td>
</tr>
</tbody>
</table>
INTRODUCTION

1 INTRODUCTION

The following chapter describes the project's background, which leads to the purpose of the study. Finally, the company's directives and delimitations are presented.

1.1 BACKGROUND

Omega Pharma is a pharmaceutics and cosmetics company selling over the counter products. They are a part of the American company Perrigo since March 2015. However, Omega Pharma mostly operates in Europe. Omega Pharma's strategy for expansion is by acquiring several companies every year to gain access to new brands, products and market segments. Today Omega Pharma's products are produced at over 200 manufacturers as well as seven of their own factories. The company plans to keep augmenting their product portfolio by further purchases of brands and companies. (Söder, 2016)

The company is entirely focused on over the counter products, which includes products from the categories pharmaceuticals, medical devices, cosmetic products, biocides and nutritional supplements. The different categories of products have different regulations. The regulations are among others set by the European Union, the country of production and by the country of distribution. (Söder, 2016) Because of the singular nature of supply and demand for drugs, the pharmaceutical market is heavily regulated in many countries. The pharmaceutical supply chain is to ensure that the distribution of pharmaceuticals to end users is the right quality, arrive on time and at the right place. Quality is considered to be a vital factor for pharmaceutical manufacturing. (Mehralian & Zarenezhad & Ghatari, 2015)

When Perrigo bought Omega Pharma the two companies began the process of merging. Omega Pharma and Perrigo have started a project together with the aim to reduce the number of products and manufacturers that Omega Pharma has in its portfolio, and consequently reducing the total cost and the risks of having many manufacturers. (Patterson, 2016).

Before reducing the number of products and manufacturers, they have to be further analysed. Both the revenue and the total cost are important parameters when evaluating a product. Omega Pharma also evaluates if they should cancel the production of the product or move it to a different manufacturer. The evaluation also takes into consideration factors of manufacturer performance of the current manufacturer. (Söder, 2016) Today when looking at the products' cost only the purchase price of the product is compared with the revenue. However, there are several hidden costs as well that are important to consider. (Bruhn, 2016) The purpose of the study is based on the above mentioned needs that Omega must take into consideration when evaluating a product.

1.2 PURPOSE

Create an evaluation model based on revenue, total cost and manufacturer performance to evaluate a product and if cost reductions can be achieved by ending the production of the product or moving the product to a different manufacturer.
INTRODUCTION

1.3 CLARIFICATION OF PURPOSE
The model is focused on evaluating individual products. In a broader perspective, the model could be used to move or cancel all products from a manufacturer and thereby cancel the collaboration with that manufacturer. This would, in the long term, lead to reduction of the supplier base and also a more extensive cost reduction. The user of the model will enter costs and revenue for a selected product as well as the manufacturers’ performance into the model. The model can be used in order to evaluate three different cases presented in Table 1 below, of which Case 1 is the base of the model.

Table 1: The three different cases that can be evaluated with the model.

<table>
<thead>
<tr>
<th>Case</th>
<th>Explication</th>
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</thead>
<tbody>
<tr>
<td>Case 1</td>
<td><strong>Product profitability:</strong> Evaluate if a product is profitable by comparing the total cost with the revenue of the product.</td>
</tr>
<tr>
<td>Case 2</td>
<td><strong>Stop production of product:</strong> Evaluate what happens to the costs if Omega Pharma decides to stop producing the product.</td>
</tr>
<tr>
<td>Case 3</td>
<td><strong>Move production of product:</strong> Compare the total cost of a product with the total cost if the product was moved to another manufacturer.</td>
</tr>
</tbody>
</table>

1.4 DIRECTIVES
- Since there are different regulations and course of actions for the different categories of products, the model needs to consider the differences between pharmaceuticals, medical devices and cosmetics. The other two categories of products at Omega Pharma, biocides and nutritional supplements, will not be taken into consideration since they represent a small percentage of the volume of the total products.
- Manufacturer performance is more of a supplement in the model in order to discover if there is anything other than cost that is important to consider when evaluating different manufacturers.
- The model should be created in Excel, which is a tool already used at Omega Pharma. It will therefore, be easier for the user to understand the model.
- For Case 1, costs that occur initially, that is to say in the startup of a product and that are non-recurring, are not to be included in the model. This is since the model is to evaluate products that are already being sold by Omega. In Case 2 there are both recurring and non-recurring costs. While in Case 3, the costs that appear initially due to the transfer are to be included in order to be able to calculate the needed investment and the time until the cost for transfer reaches break even.

1.5 DELIMITATIONS
- The study is only to include manufacturers, transports and warehouses that are inside the European Union and countries that are members of the Schengen agreement.
- The model is to consider products at Omega Pharma with a low turnover and that are manufactured externally at manufacturers that only produce a few products for Omega Pharma.
INTRODUCTION

Normally no marketing campaigns nor extra activities or expenditures are spent on these products. These products will hereafter be referred to as products in the tail.

- Omega Pharma markets their products in 35 different countries and have about 30 local affiliates. The purpose is to create a general model that still contains some estimated values. A delimitation has been made to make estimations and identify elements based on the Corporate office and the Nordic affiliate. The Nordic affiliate is among the top four affiliates and it should therefore be possible to identify the necessary costs there. The Corporate office was used to gather overall information and to get examples from other affiliates considering the costs that needed to be estimated. The study took place at the Nordic affiliate and a visit was made to the Corporate office, which made collecting data easier at those locations. To the extent possible the model should be able to handle products from all different affiliates. In other words, to be flexible and easy for the user to make changes with affiliate specific data.
2 Company Presentation

This chapter presents the company, for instance different functions at the company related to the study as well as a brief description of the parent company Perrigo and its involvement in the project. If nothing is mentioned about Perrigo it is to be assumed that "the company" refers to Omega Pharma.

2.1 Omega Pharma

Omega Pharma (hereafter referred to as Omega) was founded in 1987 in Nazareth, Belgium, by Marc Coucke. When Coucke started the company, the focus was on a close contact with pharmacists and he began to build a consumer health organization. (Omega Pharma n.d. a) The company started off with a buy-and-build strategy, which means that it focused on growing through acquisitions. (Omega Pharma n.d. b) The first acquisition was made in Belgium in 1998 and since then the acquisitions have continued throughout Europe. (Omega Pharma n.d. a)

The company has had a clear focus on over the counter (hereafter referred to as OTC) products from the start. When Omega started, not many companies focused on this market segment, which made it possible for Omega to grow from a small local business to a business established in 35 countries. (Omega Pharma n.d. b) The headquarter (hereafter referred to as Corporate) is located in Belgium. The corporate function was created in 2013 and is still under development (Nord, 2016). At Corporate, strategy and general decisions for the entire company are made and there is an internal procurement company OPI, Omega Pharma International. OPI was created in order to centralize some of the logistics functions, for example planning for products ordered by several countries. Locally, Omega has affiliates that normally represent one country each. The affiliates operate as rather independent entities deciding what is to be sold in their area. There are, however, some areas where the market for several countries are gathered at one entity, for instance the Nordic affiliate, which includes Sweden, Norway, Finland, Denmark and Iceland. The affiliate is however situated in Sweden, with sales departments in Norway and Finland. The four largest affiliates are the Nordics, Belgium, United Kingdom and Germany. (Söder, 2016) About 10 affiliates are at the moment linked to the same SAP system, a software system used to manage business operations and customer relations. The other affiliates use other systems or SAP that is not linked. The introduction of SAP is still quite new and more affiliates are expected to change their systems so that they all use the same system in the future. The purpose is to simplify the communication and coordination. (Bellanger, 2016)

Today, Omega's strategy is focused on organizing, working towards excellence in the OTC market and optimizing its geographical coverage. The company wants to focus on its top 20 brands, selected based on their growth potential, in order to grow and develop. (Omega Pharma n.d. b) However Omega still makes three to four acquisitions per year, which leads to a steady growth. (Söder, 2016) Employees from different departments analyse the acquisition. After reviewing the analyses from all departments, a decision is made whether to buy the company/brand or not. When making acquisitions Omega buys either a product, a brand or an entire company, for several markets or only for a specific market or country. When Omega has acquired a new product it strives to integrate it into their own system as fast as possible. That is to say, negotiating the transportation and moving the storage of the product to their warehouse. (Söder, 2016)
2.1.1 Products
Omega has products within the categories cosmetics, medical devices, pharmaceuticals, biocides and nutritional supplements (the focus in this study is on the first three categories, biocides and nutritional supplements will therefore not be further explained). Together, all manufacturers in all categories produce about 6 000 different products (De Nil, 2016) and there are 150 brands (Bellanger, 2016). Cosmetic products are for instance face cream and soap, an example of an Omega brand is ACO. A medical device is a product, such as Wartner that removes warts, that requires a certain technology A pharmaceutical product is a product that in a way will improve the consumers’ health or ease symptoms, for instance pain killers like Panodil. (Söder, 2016)

Bruhn (2016) and Chornyi (2016) state that most of the products are local products marketed at the belonging affiliate. OPI handles approximately 23 brands (1500 products) of the total of approximately 150 brands. (Bellanger, 2016) Bruhn (2016) also states that products in the tail exist both at OPI and at the affiliates. At OPI all brands contain several products. However, on a local level there might be some brands that only consist of one product. (Bellanger, 2016) In the Nordics, 500 of Omega's 6000 products are marketed. Of these 500 products, 100 are pharmaceuticals, 70 medical devices and 330 cosmetics. (Söder, 2016)

2.1.2 Quality
The level of complexity, regulations, documentation and evaluation of products differ within the different categories, where cosmetics need the least amount of documentation followed by medical devices and last pharmaceuticals. Pharmaceuticals are more complex and harder to get out onto the market and need more supervision in order to ensure quality. To produce a product from the different categories, the manufacturer needs to fulfil different legislations. This means that just because a certain manufacturer can produce pharmaceuticals, it cannot necessarily produce cosmetics. Even though there are fewer rules for cosmetics than for pharmaceuticals the legislations have become stricter. Legislation does not only differ depending on the product and its category, but also depending on the country. In the European Union, all countries have their own legislations. In addition, there is legislation from the European Union to consider. (Söder, 2016)

At Omega there is a continuous control of regulatory changes for the different product categories and audits are done for manufacturers and the entities in the distribution system. (Söder, 2016) At Corporate, Omega has a quality department whilst each affiliate has at least one person working with regulatory affairs in the county/countries of the affiliate. (Hoengenaert, 2016)

2.1.3 Supply chain
At Omega, the supply chain consists of Omega’s manufacturers, warehouses, different transportation companies and customers.

MANUFACTURERS
Omega has seven internal manufacturers and over 200 external manufacturers. Some of the external manufacturers have one production site, while others have several sites. At the different production sites there are different amounts of products and brands being produced for Omega (Wickberg, 2016). Depending on the product, the local affiliates orders the product from the manufacturer or from OPI. Products that many affiliates market, are coordinated by OPI and therefore the affiliates then order those products through OPI. (Söder, 2016) See Figure 1 below for a visualization of the order process.
When ordering products, MOQ (minimum order quantity) is used to determine the minimum amount of products per order. For products in the tail, the amount per order is usually the MOQ. (Söder, 2016) When ordering products, the estimated lead time is normally set to three months. The manufacturer confirms the order within seven days and informs about the delivery date. (Chornyi, 2016) Omega treats both internal and external manufacturers the same way when it comes to the purchase price per product. (Söder, 2016)

Omega does not order the packaging or the raw material. This is done by the manufacturer. However, Omega decides what packaging should be used. Omega has contracts with suppliers of packaging and raw material that the manufacturers can use to get better prices, which Omega can normally achieve through economics of scale. When it comes to raw material, the manufacturer does not have to use Omega's contracts as long as they achieve product specifications. (Wickberg, 2016)

WAREHOUSES

Omega uses central warehouses and has approximately one warehouse connected to each affiliate. In addition, there is one warehouse in Poland that belongs to OPI. All warehouses are owned and run by third party logistic companies. (Chornyi, 2016) Inventory costs for keeping a product with low demand can sometimes be significant since the manufacturer wants to create a full batch of the product, which could sometimes represent the demand for 2-3 years. (Bellanger, 2016) Safety stock is used to avoid out of stock situations and Omega is currently working on finding a way to lower their safety stock levels. Internally, it has proven difficult to decide on a strategy for setting the safety stock level for all products, since it depends both on the variance in lead time from the manufacturer and the variance in demand. The lead time for producing products is quite long and it can, therefore, be difficult to change the planning for a product in time to avoid running out of stock and therefore Omega uses high stock levels to ensure that they are not going to run out of stock. (Stoop, 2016)

TRANSPORTATION
When a manufacturer has produced products for Omega, the products are transported to the warehouse of the affiliate that ordered the products. Every market is different from one another and requires their own transport solutions. Transport to Omega's warehouses are negotiated by Omega but ordered by the manufacturer. The transport is ordered 48 hours in advance for shipment to the warehouse. (Chornyi, 2016) Distribution to Omega's customers are made from the central warehouse. The transport is always performed by a third party, both to the central warehouses, inbound transport, and to the customers, outbound transport. In the transport from the manufacturer to the warehouses there are usually one or a few different products while the transportation from the warehouse to the customers consists of smaller quantities of a larger selection of products. The inbound transport could be either national or international, depending on whether the manufacturer is situated in the same country as the market or not. However, the outbound transport is usually national, since the market is in the same country as the warehouse. (Söder, 2016)

2.2 Perrigo
Perrigo was founded in 1881 in the United States (Perrigo n.d. a). The company supplies the market with both OTC products and generic prescription pharmaceuticals. Perrigo is mostly present on the North American, European and Australian markets. (Perrigo n.d. b) In 2015, Perrigo made an acquisition of Omega and the two companies are today merging and finding synergies. Perrigo can be seen as a production company, producing 80 % in-house. Whereas Omega is a marketing and sales company, with 20 % of the production in-house. (Söder, 2016) Before acquiring Omega, 80 % of Perrigo's sales and profits came from the United States. With the acquisition of Omega, 55 % of Perrigo’s sales and profits are now from the United States and 45 % represent sales and profits from the rest of the world. (Patterson, 2016)

2.3 Collaboration and project
Omega has earlier been focusing on current issues and not as much on maintenance and strategic factors regarding the acquisitions. This is the reason why they the company has a wide variety of different manufacturers and products. An important factor for the long term strategic work is to continuously evaluate the manufacturers and products. Omega has earlier had the ambition to do so but focused on the evaluation process to a higher extent when they were purchased by Perrigo. When Perrigo acquired Omega they visited Omega's internal manufacturers and found unexploited resources. As a result, Omega investigated what products that were being produced externally could be produced in-house instead. They then executed production transfers of some suitable products to internal manufacturers where they had excess capacity. Perrigo also set up a goal for Omega to reduce costs in different areas, one being the supply chain. (Söder, 2016) In order to reduce costs, Perrigo wants to reduce the number of external manufacturers that Omega uses, which is also in line with Omega’s goals. Therefore the project mentioned in 1.1 Background was started. The project group is to evaluate what products are in the tail and that would be interesting to evaluate further in the model that was created in this study. Since Omega has a high number of manufacturers that have a low spend, Perrigo hopes that Omega, by reducing its supplier base, improves profitability of outsourced products and reduces the complexity and risks associated with having a large amount of manufacturers. (Patterson, 2016)

At the same time as the model was being created in this study, a project group at Omega was evaluating manufacturers by choosing preferred manufacturers and products within the different categories and galenic forms (pills, creams, et cetera). The project group also looked at what products and manufacturers
should be further evaluated with the model. The group chose products and manufacturers based on several aspects: turnover, quality, ability to produce according to regulation et cetera. One of the most important aspects is turnover, the lower the turnover is, the more likely it is that the company's costs would be reduced by making the product at another manufacturer or stop producing the product. Therefore the model will mostly be used to evaluate products with a low turnover, products in the tail, in order to maximize the possible cost reduction. It is this project group that will pick products in the tail to be further evaluated in the model created in this study. (Söder, 2016)

STOP PRODUCTION OR MOVE PRODUCTION OF A PRODUCT

Omega is working to reduce the supplier base by cancelling products or moving products with the same galenic type to the same manufacturer. If Omega choses to stop producing a product at a manufacturer, it normally has to do with the fact that the manufacturer might be producing for a competitor or because the manufacturer does not meet the requirements regarding quality, cost, cooperation or communication. When using fewer manufacturers Omega will save costs. For instance economies of scale could be used to lower the purchase price of the products by making larger batches. Administrative work could be lowered internally for Omega since fewer manufacturers means fewer internal tasks. (Bellanger, 2016)

When choosing a new production, site there are important aspects to take into consideration. For instance, available equipment at a manufacturer, regulatory approval by the government for the manufacturer to produce products in a certain category, et cetera. In some rare occasions one manufacturer is the only one that has the technology, knowhow or equipment for producing a product. It is then necessary to take this into consideration and either move the production and make an investment, discontinue the product or keep the product at the manufacturer, even though it may not be profitable. (Bellanger, 2016) Another important aspect to have in mind when evaluating the transfer of a product is that when changing production site it is crucial that the customers get the same service as before the move. The customers should not be affected by the move in any negative way. (Söder, 2016)
3 FRAME OF REFERENCE

The literature used in this study is presented in the chapter below. The first part is revenue and costs, with a focus on total cost models. Thereafter, there is a part that further describes the different product categories in the model, regarding regulations and quality standards. This is an important aspect that needs to be taken into consideration in the model since there are several costs that arise due to the industry and regulations related to the categories of products produced by Omega. Lastly, a part about manufacturer performance is presented.

3.1 REVENUE AND COSTS

The model that is created in this study will compare the total costs and revenue of a product. This is similar to the cost to sales ratio proposed by Stock & Lambert (2001), which is used extensively by businesses to evaluate organizational effectiveness. The ratio compares the logistics costs needed with the revenue from sales. (Stock & Lambert, 2001) The revenue of the company is the income from all sales of goods and/or services of a company. The revenue is the sum of sales before any costs or expenses are deducted. (Business Dictionary, n.d. a) Costs will be discussed further below.

3.1.1 Total cost analysis

The total cost analysis is the key to managing the company’s logistics functions. It implies focusing on the total cost from all logistics activities, rather than focusing on every function by itself. (Stock & Lambert, 2001) In most decisions a company makes, costs will in some way be affected. One decision can lead to higher costs in some areas, while other costs in other areas will be reduced. (Oskarsson & Aronsson & Ekdahl, 2013) For instance, even though it might be cheaper to use the railway instead of an airplane, this might increase the need for storing products and therefore increase the storage cost. (Bloomberg & LeMay & Hanna, 2002) When deciding between several decisions, to determine what choice to make, total cost can be used. The total cost of different decisions are compared with the total cost of the current situation, in order to have a reference value. All costs that are going to change due to a decision need to be included, whereas the costs that will be indifferent in all situations do not need to be included. (Oskarsson et al., 2013) More than just the cost, it is important to consider how the activities affect each other when a change is made to an activity. (Bloomberg et al., 2002)

According to Oskarsson et al. (2013) the base of cost elements to be included in a total cost analysis are warehouse keeping, inventory, transport, administrative and other costs. However the costs that need to be included for different companies and decisions vary. The cost elements and costs according to Oskarsson et al. (2013) can be found in Table 2 below.

Warehouse keeping costs are the costs for having products in stock. The cost includes both the cost of tied up capital and the risk of having products in stock. The cost of tied up capital is the costs for not using the capital in a more profitable way. The risk of having products in stock includes the cost of products becoming obsolete and the cost for insurance.

The cost of tied up capital is calculated as the inventory carrying charge in percent times the average stock level:

\[ \text{Cost of tied up capital} = \text{Inventory carrying charge} \times \text{average stock level} \]
Where the inventory carrying charge is calculated as:

\[
\text{Inventory carrying charge} = \text{Weighted average cost of capital (\%)} + \frac{\sum \text{cost of risk/year}}{\text{average stock level}} \times 100
\]

The average stock level is calculated:

\[
\text{Average stock level} = \text{product value} \times (\text{Safety stock} + \frac{\text{The order quantity}}{2})
\]

In order to calculate the cost of tied up capital, the stock level is needed. The stock level includes the safety stock, which is used as a safety level not to run out of stock. To decide a safety stock level, the variance in lead time and the variance in demand is used. These two parameters both have an effect on the number of units needed in the stock in order to meet the demand even if an unexpected event occurs. (Oskarsson et al., 2013)

Inventory costs contain the cost for running a warehouse. These are costs for the warehouse building, the equipment used in the warehouse, transports inside of the site and the costs for the employees working at the warehouse. (Oskarsson et al., 2013)

Transport costs include the costs for the actual transportations as well as the costs for administrating the transport. The transports included are both internal, between different sites owned by the company, and external to other companies. (Oskarsson et al., 2013) Transportation can account for 50% or more of the total logistics costs and is therefore the most expensive part of the integrated logistics activities. (Bloomberg et al., 2002)

Administrative costs are costs for administrating the logistics at the company. Costs for planning activities such as picking goods, receiving incoming goods and outgoing goods. (Oskarsson et al., 2013)

When considering other costs there, are many different costs that can be included, depending on the situation. Some examples of costs that can be included are information costs, packaging costs and material costs. (Oskarsson et al., 2013)

Finally, Oskarsson et al. (2013) recommends that if production costs are needed in the model that they should be placed into their own element.

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**Table 2: Cost elements and associated costs, according to Oskarsson et al. (2013).**

<table>
<thead>
<tr>
<th>Cost elements</th>
<th>Costs included</th>
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<tr>
<td>Warehouse keeping</td>
<td>• Opportunity&lt;br&gt; • Risk of having products in stock, including:&lt;br&gt; o Products becoming obsolete&lt;br&gt; o Insurance</td>
</tr>
<tr>
<td>Inventory</td>
<td>• Warehouse building&lt;br&gt; • Transports within site&lt;br&gt; • Equipment in warehouse&lt;br&gt; • Employees in warehouse</td>
</tr>
<tr>
<td>Transport</td>
<td>• Internally between different sites&lt;br&gt; • Externally to different companies</td>
</tr>
</tbody>
</table>
According to Stock & Lambert (2001) there are six major cost drivers, where a cost driver is an activity that leads to a cost; warehousing, order processing and information, transport, lot quantity, inventory and customer service levels. (Stock & Lambert, 2001) In Table 3 below, the cost elements are illustrated with their associated costs.

<table>
<thead>
<tr>
<th>Cost elements</th>
<th>Costs included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warehouse keeping</td>
<td>• Warehousing&lt;br&gt;• Storage activities</td>
</tr>
<tr>
<td>Order processing and information</td>
<td>• Order processing&lt;br&gt;• Logistics communication&lt;br&gt;• Demand planning</td>
</tr>
<tr>
<td>Transport</td>
<td>• Traffic&lt;br&gt;• Transportation</td>
</tr>
<tr>
<td>Lot quantity</td>
<td>• Production setup cost&lt;br&gt;• Time required setting up a line&lt;br&gt;• Locating a manufacturer&lt;br&gt;• Operating inefficiency in the beginning&lt;br&gt;• Capacity loss due to downtime during changeover of line or a new manufacturer&lt;br&gt;• Material handling&lt;br&gt;• Scheduling&lt;br&gt;• Expediting&lt;br&gt;• Price differentials when buying different quantities</td>
</tr>
<tr>
<td>Inventory</td>
<td>• Opportunity&lt;br&gt;• Inventory service&lt;br&gt;• Storage space&lt;br&gt;• Inventory risk</td>
</tr>
<tr>
<td>Customer service levels</td>
<td>• Costs related to lost sales</td>
</tr>
</tbody>
</table>

Bloomberg et al. (2002) includes transportation, facility structure, inventory management, material handling and communication as elements in the total cost model. The elements as well as costs are presented in Table 4.
Table 4: Cost elements from total cost analysis by Bloomberg et al. (2002).

<table>
<thead>
<tr>
<th>Cost elements</th>
<th>Costs included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td>• Investment in for example railway</td>
</tr>
<tr>
<td></td>
<td>• Number of travelled miles: Internally and externally into, through and out of</td>
</tr>
<tr>
<td></td>
<td>factories and warehouses</td>
</tr>
<tr>
<td></td>
<td>• Maintenance</td>
</tr>
<tr>
<td>Facility structure</td>
<td>• Storage space in warehouses, plants and service centres:</td>
</tr>
<tr>
<td></td>
<td>o Rent</td>
</tr>
<tr>
<td></td>
<td>o Utilities</td>
</tr>
<tr>
<td></td>
<td>• If company owns its own storage space it becomes a warehousing cost</td>
</tr>
<tr>
<td>Inventory management</td>
<td>• Inventory risk</td>
</tr>
<tr>
<td></td>
<td>• Ordering</td>
</tr>
<tr>
<td></td>
<td>• Opportunity</td>
</tr>
<tr>
<td></td>
<td>• Storage space</td>
</tr>
<tr>
<td></td>
<td>• Inventory space</td>
</tr>
<tr>
<td>Material handling</td>
<td>• Packaging</td>
</tr>
<tr>
<td></td>
<td>• Material handling systems</td>
</tr>
<tr>
<td>Communication</td>
<td>• Order processing</td>
</tr>
<tr>
<td></td>
<td>• Demand forecasting</td>
</tr>
<tr>
<td></td>
<td>• Production scheduling</td>
</tr>
</tbody>
</table>

3.1.1.1 Total cost analysis approach

When doing a total cost analysis there are a couple of steps to follow in order to perform the analysis in a structured way. However, sometimes the steps might be too rigid for a certain situation and it is then possible to adapt the steps. It can sometimes be difficult to identify and retrieve the right costs for the project and it is therefore important to do a sensitivity analysis to evaluate what uncertainty there is in the results. The approach consists of the four steps presented below. (Oskarsson et al., 2013)

**STEP 1 - IDENTIFY RELEVANT COST ELEMENTS AND COSTS**

All situations are more or less different from each other. For every new decision the cost elements and associated costs that will be affected and changed need to be identified. Because of the change, some of the identified elements might no longer be of interest, whereas some other new elements might be of interest.

**STEP 2 - ADAPT THE TOTAL COST MODEL TO THE SPECIFIC SITUATION**

An extensive amount of work might be needed in order to calculate some of the costs. If these costs do not have a large impact on the total cost, it is possible to eliminate them from the model and to look at them as constant. This will be timesaving and will make it possible to reach a result in a more efficient and effective way.

**STEP 3 - PLAN THE CALCULATIONS**
In this step, it is to be decided how the calculations are going to be made and what data will be needed. If the needed data is not available a decision has to be made as to whether the calculation can be made with some other data that is available. If the calculation is not crucial for the total cost, the cost could be eliminated.

**STEP 4 - MAKE THE CALCULATIONS**

Collect the needed data and calculate the total cost based on the chosen cost elements and collected data.

A summary of the four steps are presented in Figure 2 below.

![Figure 2: The four steps of the total cost analysis approach by Oskarsson et al. (2013).](image)

### 3.1.1.2 Approach to manage costs through the supply chain

Anklesaria (2008) presents an eight step process in order to manage costs through the supply chain. The steps presented are:

**STEP 1: AGREEING ON THE NEED TO MANAGE COSTS THROUGH THE SUPPLY CHAIN**

In this first step, the people who will be involved in making changes in order to manage costs need to agree that they want to do it. Then a cross-functional team needs to be put together, including key manufacturers, and goals need to be decided.

**STEP 2: IDENTIFYING CRITICAL COSTS IN THE SUPPLY CHAIN**

First, the cash flow of the supply chain needs to be understood and the costs that are critical need to be identified. The first step is, therefore, to map the process and to list activities. Thereafter, list the cost elements associated with the activities in a process map. There is then a need to obtain cost data and
organize it into the different cost activities. In order to identify critical costs, costs are to be broken down into different levels. The cost elements and future cash flows are to be determined and the top two or three most important future costs selected for further analysis.

**STEP 3: MEASURE SECONDARY AND TERTIARY COSTS**

Here, a measurement process is to be applied to each major cost. This step is the most difficult but a critical one since measuring a cost means managing it. For each selected cost a list is generated with the cost drivers. For each selected cost, a formula should be written down on how to calculate it.

**STEP 4: DEFINE THE KEY COST DRIVERS AND DEVELOP STRATEGIC OPTIONS**

The cost drivers thereafter have to be reviewed to remove replicas. Each cost element should then be given a weight based on its impact on the total cost. The next step is then to calculate the weighted impact score of each cost driver, determine the cost drivers value, the potential future value and if the team can impact the future value. From that, three or four cost drivers should be chosen as well as factors that affect their value. The factors are then ranked based on importance for strategic development and are then brought to the next step.

**STEP 5-8**

Because of the delimitations of the study the last steps in the approach will not be presented further. They deal with taking strategic actions to reduce, change and eliminate activities that cause costs, that is to say the implementation. Implementation is however not a part of this study but the next step for Omega to take after using the model.

A summary of the steps are shown in Figure 3 below.
A model to analyse manufacturer performance and efficiency is the total cost of ownership (hereafter referred to as TCO). It evaluates the total quantity of resources (input) needed to obtain a given quantity of services or goods (output) from a manufacturer. Within TCO, all activities carried out by a company to manage a supply relationship are taken into consideration. TCO looks at the total cost of ownership meaning purchase price, cost of tasks required to do business such as supplier selection and evaluation, order and quality management, inbound logistics and administrative processes. (Visani & Barbieri & Di Lascio & Raffoni & Vigo, 2015)

A common approach to estimating TCO is by activity based costing (hereafter ABC). An advantage with ABC is that it yields more objective cost measures since costs are traced to the activities performed when dealing with a manufacturer. With ABC it is possible to, for example, calculate the cost impact of
alternative manufacturer choices. ABC can estimate the consequence of manufacturer performance improvement and ABC helps evaluate a changing number of manufacturers. (Visani et al., 2015)

ABC usually consists of four main steps. To start with, all the resources in a firm related to the object of investigation, for example a manufacturer, are to be identified. Secondly, the resources are to be divided into activities that are performed in the company by using resource drivers. The activities should thereafter be divided on a product level (or other object that is investigated) using activity drivers. To get a total cost per product all costs allocated to that product are summarized. (Gerdin, 1994)

To supply managers, TCO is a potential utility. However TCO is still not used to a wide extent since there are major barriers to its implementation, such as data availability and a complex ABC procedure that is needed in order to quantify resources. (Visani et al., 2015)

The four main steps of ABC are visualized below in Figure 4:

![Figure 4: The approach in calculating the TCO by using ABC.](image)

3.1.2 Cost of quality

The cost of quality is the costs resulting from preventing poor quality, evaluating and ensuring that the quality requirements are being met, and any other costs resulting from poor quality. There are different rules of thumb to quantify the cost of poor supplier quality and to measure its subsets. The cost of poor quality for a company has been estimated to be 10 to 25 % of sales. (Gordon, 2008) There are four categories of costs described by Srivastava (2008) and Gordon (2008) as the classical view of cost of quality. These are prevention costs, appraisal costs, internal failure costs and external failure costs. Srivastava (2008) identified costs of quality when doing a study of selected third party contract manufacturing sites of a world leading research based pharmaceutical company with headquarters in Europe. The company's products where within the domains pharmaceuticals, vaccines, OTC medicines and oral care products. To calculate the costs ABC was used, but to categorize the cost elements the four categories (prevention, appraisal, internal failure and external failure) were used. (Srivastava, 2008) Many of the costs found during his study were related to the time spent performing a task. Below the categories are explained further as well as the costs found for each category in his study.

Table 5 represents the four categories with related costs. The third column presents quality costs that Srivastava (2008) identified for his cost of quality study.

**PREVENTION COST**
Prevention cost is any cost related to investigating, preventing or reducing the risk of defect or non-conformity. The cost drivers identified during Srivastava's study were for validation of a part of the production to ensure consistent product results, internal audits meaning the review and documentation of quality in the operations area and doing an area line clearance before starting a new production line. When changes needed to be made, costs were also found for generating standard operating procedures to meet new quality requirements, for raising and approving the change control reform, meaning getting the approval to make changes to the standard operating procedures, and finally implementing the changes. (Srivastava, 2008)

**APPRAISAL COST**

Appraisal cost is the cost of evaluating the achievement of quality requirements. This includes the cost of verification and control that are performed at any stage. The costs found in Srivastava's (2008) study were retest costs if the first analysed sample of a product did not yield correct results and dealing with the management information system. (Srivastava, 2008)

**INTERNAL FAILURE**

Internal failure costs arise within an organization due to non-conformities or defects, such as costs for reworking, retesting or re-inspecting. From the study, the cost drivers were rework in the production, dealing with a deviation from the standard operations procedures and handing over a concessional approval to the head of quality before implementing an intentional deviation. (Srivastava, 2008)

**EXTERNAL FAILURE**

External failure costs arise from non-conformities or defects discovered and claimed by a customer. These costs are for instance claims against warranty, consequential losses, replacements, penalties and evaluation. During his study the costs found were costs for customer complaints handling, rodent damage, and pouch bursting that is to say products that get destroyed in transit and expired products. (Srivastava, 2008)

*Table 5: The cost elements included in total cost of quality (Srivastava, 2008).*

<table>
<thead>
<tr>
<th>Cost elements</th>
<th>Costs</th>
<th>Srivastava's case study</th>
</tr>
</thead>
</table>
| Prevention    | • Investigating non-conformity  
                • Preventing non-conformity  
                • Reducing the risk of non-conformity  
                • Validations  
                • Internal audit  
                • Area line clearances  
                • Education & training  
                • Standard operations procedure generation  
                • Raising & approval of the change control form  
                • Implementing changes |
| Appraisal     | • Evaluating the achievement of quality requirements:  
                • Verification and control at any stage  
                • Retests  
                • Management information systems |
3.1.2.1 Product categories regulation
The medical products agency in every European country is responsible to ensure that market surveillance of medical products is done in its own country. Market surveillance is the activity conducted to ensure that medical products meet regulations. The oversight of medical products is done to ensure quality and safety for the consumer. The medical products agency also acts to ensure that quality and safety of products are continuously developed. (Läkemedelsverket, 2015a)

PHARMACEUTICALS
Pharmaceuticals are to be approved by the medical products agency before they can be sold. Thereafter market surveillance is applied regularly depending on the level of risk of the product. The approval is based both on the agency's examination of documentation and by testing the product in a laboratory. The pharmaceutical products have to be produced by a manufacturer that has been approved by the agency. Even the distribution channel is subject to possible examination by the agency. When a product is approved, a document is sent to the market authorization holder describing analyses that have been made and also that the results are consistent with the company's own authorized specifications. (Läkemedelsverket, 2015a) Other than a registration fee there is also an annual fee for each product that the distributing company pays to receive permission to sell the product. (Läkemedelsverket, 2015b)

MEDICAL DEVICES
Market surveillance of these products is done as supervision, participation in investigations regarding accidents caused by medical devices, inspections of the manufacturer or distributor, administrative control directed towards a specific product, product type or a company and by controlling the medical product in a laboratory. Market surveillance is done to a higher extent for products that are considered a higher risk since the manufacturer then needs to have an approved quality system. A European database, Eudamed, is under further development and will enable European countries to have better knowledge about what medical devices are being sold in their countries. (Läkemedelsverket, 2015c)

COSMETICS
When it comes to cosmetics, market surveillance is done when products are already on the market to ensure that any products that do not meet regulations are discovered. An inspection can be done at the production site, chemical analysis of product samples or by control of documentation. An inspection is normally done if the medical product agency has been informed about product defects, a new product requirement has been enforced or because few previous controls have been made. For cosmetics there
is an annual fee to be paid if the product was manufactured in the country. The regulations for cosmetics includes rules such as the necessity for the responsible to have detailed product information, some substances are illegal to use and the products are to be registered in the database CPNC. (Läkemedelsverket, 2015d)

A summary of the costs found from Läkemedelsverket (2015a, 2015b, 2015c, 2015d) is found in Table 6 below.

Table 6: The costs found from Läkemedelsverket (2015 a, b, c and d).

<table>
<thead>
<tr>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration (pharmaceuticals and medical devices)</td>
</tr>
<tr>
<td>Annual fee (pharmaceuticals and cosmetics)</td>
</tr>
<tr>
<td>Registration in databases (cosmetics)</td>
</tr>
<tr>
<td>Laboratory tests (pharmaceuticals)</td>
</tr>
<tr>
<td>Audits of both manufacturer and distribution system (pharmaceuticals- regularly, medical devices and cosmetics – only if needed)</td>
</tr>
</tbody>
</table>

3.2 MANUFACTURER PERFORMANCE

Manufacturer performance management is the process of measuring, monitoring and evaluating a manufacturer to be able to reduce costs, mitigate risk and drive improvements. By using manufacturer performance management to reduce the number of manufacturers, a company can focus resources on value-adding activities instead of having to react to problems induced by poor manufacturer performance. (Gordon, 2008) By reducing the number of suppliers in a company's supplier base the company can generally save significant amounts of corporate expenditures. Fewer suppliers enables focus on long term strategic issues, for instance developing or sharing technologies. This also reduces transaction costs, which are costs related to contracting with suppliers, monitoring and enforcing agreements. (Choi & Krause, 2005)

Often within a company the same product is manufactured in several locations. By reallocating production, it is possible to improve the current machine utilization. (Hill, 2000) Synergies from merging manufacturers by moving products can be related to economies of scope, which is defined as the cost saving that can be realized by combining the production of several production lines at one factory. Less capacity is then needed for the total production since the same machines, support functions and IT-systems can be used for the different products. (Panzar & Willig, 1981)

Good manufacturer performance is the ability to meet requirements of the buyer such as cost, ability to meet deliveries, consistent deliveries, management sensitivity to buyer's requirements, after sales support, positive attitudes towards complaints and quality. These factors can be used to evaluate a manufacturer and develop a strategy to deal with and compare different manufacturers' performance. (Sarkar & Mohapatra, 2006) By working to avoid the cost of poor manufacturer performance it is sometimes possible to get a higher return on investment than when working with price reduction. The difficulty lies in that costs of poor manufacturer performance are less visible and transparent than the variance in purchased price. If there are inefficiencies at the manufacturer this can lead to inefficiencies and waste for the customer as well for instance warranty returns, customer complaints, quality problems, excess inventory and long cycle times. (Gordon, 2008)
Parameters of manufacturer performance that were found in the literature above are summarized in Table 7 below.

*Table 7: Parameters of manufacturer performance.*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Price</td>
<td>• Warranty returns</td>
</tr>
<tr>
<td></td>
<td>• Quality</td>
<td>• Customer complaints</td>
</tr>
<tr>
<td></td>
<td>• Ability to meet delivery</td>
<td>• Quality problems</td>
</tr>
<tr>
<td></td>
<td>• Consistent delivery</td>
<td>• Excess inventory</td>
</tr>
<tr>
<td></td>
<td>• Management sensitivity to buyer’s requirements</td>
<td>• Long cycle time</td>
</tr>
<tr>
<td></td>
<td>• After sales support</td>
<td>• Cost of poor quality</td>
</tr>
<tr>
<td></td>
<td>• Positive attitudes toward complaints</td>
<td>• Supplier disruption</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Logistics failures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Strategic failures</td>
</tr>
</tbody>
</table>
PROBLEM SPECIFICATION

4 PROBLEM SPECIFICATION

This chapter aims to break down the purpose of the study and to, together with the found literature, find questions that are to be answered in the study. The purpose of the study is, as stated earlier:

Create an evaluation model based on revenue, total cost and manufacturer performance to evaluate a product and if cost reductions can be achieved by ending the production of the product or moving the product to a different manufacturer.

The main purpose of the study, and the base of the model, is to create an evaluation model based on revenue, total cost and manufacturer performance. Since Omega has many manufacturers and products this will be a tool to evaluate the products in order to determine how to proceed with a product and longer term to lower the number of manufacturers. This will lead to cost savings and Omega will be able focus more on the products and manufacturers that are strategically important. Further, the model will enable the evaluation of the alternatives ending the production of the product or moving the product to a different manufacturer. Since the model can be used to evaluate three different alternatives these alternatives have been named cases, which are summarized in Table 8.

Table 8: A short summary of the different cases of the study.

<table>
<thead>
<tr>
<th>Case</th>
<th>Explication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>Product profitability</td>
</tr>
<tr>
<td>Case 2</td>
<td>Stop production of a product</td>
</tr>
<tr>
<td>Case 3</td>
<td>Move production of a product</td>
</tr>
</tbody>
</table>

During the study, the focus was mostly on the costs since there are more cost elements to consider than revenue. The manufacturer performance part of the model was a supplement for costs in order to represent costs that are very difficult to calculate or estimate. For revenue there is only one element and according to the Business Dictionary (n.d a) the revenue is the sum of sales before any costs or expenses are deducted, which makes it quite simple to bring forth. Manufacturer performance is an important supplement, since poor manufacturer performance can lead to high costs. For instance, according to Gordon (2008) by working with manufacturer performance, a company can avoid the costs of dealing with poor manufacturer performance and instead focus resources on value adding activities.

Since costs require most focus and most work in the study, when reviewing what approach to follow in order to create the model, three approaches regarding how to calculate the costs related to a product were used. The approaches found were: the one from Oskarsson et al. (2013), which presents a four step approach for calculating the total cost, the approach by Anklesaria (2008) that focuses on how to manage the costs through the supply chain and the third approach by Gerdin (1994) describing how to calculate the total cost of ownership using ABC.

The ABC method was as a whole not deemed fit as the approach to use in the study. However the way to allocate costs on a product level will be used in a simpler way in some parts of the study. Because Omega
uses third parties for different activities, ABC is not needed in order to allocate the costs for those elements since Omega does not own the resources. However, ABC is a good method to use when it comes to the internal costs and could be used internally on the resources that Omega has.

The approach by Anklesaria (2008) includes several steps that lay beyond the scope of this study and that fall upon the project group at Omega. For instance the first step is agreeing on the need to manage costs through the supply chain which they already had done internally within Omega. The steps 5 to 8 in the approach are the steps Omega will have to take after the completion of the model. Therefore they are not part of the scope of the study. The steps of interest from Anklsaria (2008) are therefore steps 2 through step 4. The approach by Oskarsson et al. (2013) includes only the four steps that will be performed in this study. It is therefore a better fit and is the main approach chosen for this study.

To include revenue and manufacturer performance, the approach presented by Oskarsson et al. (2013) has been slightly modified. To modify the approach is something that Oskarsson et al. (2013) approves of, if it makes a better fit with the studied situation. This has led to a change of names for Step 1 and Step 2, which can be seen in Figure 5 below. Within Step 1, the two parts: identify relevant revenue elements and identify relevant parameters of manufacturer performance have been added. Step 1 by Oskarsson et al. (2013) has a part that is identify relevant costs that will change. However, since Case 1 in this study is focused on finding the total cost for a product and comparing it with the revenue, all costs that can be associated with a product is to be found and therefore the name has been changed to identify. In Step 2 the part about identify what costs will change in the different cases has been added and modified to include the cases of this study. In Step 3 a part to identify how manufacturer performance is going to be presented in the model was added. Step 4, according to Oskarsson et al. (2013), is to make the calculations and has therefore also been modified, since the purpose of the study is to create a model that can be used by Omega, not to make calculations. The focus in Step 4 will instead be to make test runs and sensitivity analyses.

The changes and additions of the approach are visualized in Figure 5 below, where all new parts and parts that have changed compared to the original approach have been written in red.
4.1 **Step 1 - Identify**

The first step includes identifying the revenue, relevant cost elements and costs. This leads to question 1 and 2 below. Question 2 has been divided into two sub questions to facilitate the evaluation of elements and costs separately.

*Question 1: What is the revenue?*

*Question 2: What are the relevant cost elements and costs?*

*Sub question 2.1: What cost elements should be in the study?*

*Sub question 2.2: What costs are applicable in the study?*

The cost elements to be in the model were first identified from three different models of total cost analysis from the literature. Since the names of the cost elements in the three different total cost models in the literature are slightly different from each other, it was important in this step to study the cost elements and the costs within each element at the same time to make sure that the model of the study did not have elements and costs overlapping. The total cost by Oskarsson et al. (2013) was chosen as the starting point and thereafter the costs and cost elements from the other two authors, Stock & Lambert (2001) and Bloomberg et al. (2002), that were not represented in the model by Oskarsson et al. (2013) were added. The result of this comparison and creation of the model can be seen in Table 9.
The cost elements from Oskarsson et al. (2013) are warehouse keeping, inventory, transport, administrative and other. The only cost element that was found in the two other cost models that could not be incorporated into the cost elements by Oskarsson et al. (2013) was lot quantity from the model by Stock & Lambert (2001). Oskarsson et al. (2013) mentions that in situations where the production cost affects the total cost, production cost should be included in the model as a separate element, which is what is needed in this situation. The costs by Stock & Lambert (2001) are costs for internally producing products. However, most of Omega’s products are bought from external manufacturers and even when the product is produced internally Omega treats that manufacturer as external. Since Omega treats all manufacturers as external the only cost in this element that they pay is a purchase price per unit. The production cost can therefore only include what the manufacturer charges Omega for the product and is therefore renamed product cost.

In 2 Company presentation, Chornyi (2016) states that all warehouses and all transports are run by third parties, meaning that the costs found in the literature, that are costs related to owning warehouses and having an own transport system are not relevant. In the study’s model, the costs for those two elements were instead set as the costs related to using a third party.

In addition to the elements from the three total cost models, the element cost of quality was identified as an important aspect for the model. This since quality has an impact on the total cost when it comes to pharmaceutical manufacturing where Mehralian et al. (2015) states quality is a vital factor and quality was mentioned several times at the company. Cost of quality will therefore be added as its own cost element. Costs of quality were identified in the literature from Srivastava (2008) and Läkemedelsverket (2015). The costs from the literature related to quality factors that are not predictable in the future, that is to say that vary and it is not known beforehand how often they will appear, are not to be included in the study. The removed costs from the ones identified in the literature about Srivastava (2008) are: raising & approval of the change control form, implementing changes, retests, rework, concessional approval and deviations. Other costs that were removed were the costs related to owning a manufacturer. This is never the case for Omega since they treat all manufacturers as external. Therefore, costs removed and not of interest are: education & training, area line clearance and standard operations procedure generation.

In Table 9 below, the chosen elements and costs from the literature are presented.

*Table 9: Total cost analysis according to Oskarsson et al. (2013) with additional elements, the chosen elements for the study.*

<table>
<thead>
<tr>
<th>Cost elements</th>
<th>Costs included</th>
</tr>
</thead>
</table>
| Warehouse keeping | • Opportunity  
| | • Risk of having products in stock:  
| | o Products becoming obsolete  
| | o Insurance  
| Inventory | • Costs related to third party  
| Transport | • Costs related to third party  
| Product | • Purchase price  

24
One of the directives for the study is that the model needs to consider three categories of products that Omega markets and distributes. Since there are different regulations for the different categories, costs related to the different categories need to be identified.

**Sub question 2.3: Are there any category specific costs?**

The model should also cover the costs for the three cases and the focus so far has been on Case 1. It is therefore necessary to find other costs related to the other two cases. A difference in Case 3 compared to Case 1 is that costs that appear initially when transferring a product are to be taken into consideration. For Case 2, the costs to be included are the ones that occur when closing the production, but there could also be some recurring costs.

**Sub question 2.4: What are the specific costs for Case 2 and Case 3?**

Parameters regarding manufacturer performance need to be found. Such parameters are important to include into the model since it is not always possible to estimate a cost for all factors that are important when evaluating a model. For instance, Gordon (2008) states that the cost of poor quality can be estimated to 10 to 25% of sales. The cost of poor quality is however difficult to predict for a product and may vary depending on the year or because of a factor that is not the manufacturer’s fault. It is therefore important to include parameters on manufacturer performance, where employees will be able to give their opinion about a manufacturer which might, in the long term, lead to cost savings. For instance, a
manufacturer that does not make an effort to better faults might lead to a cost of poor quality, and would, therefore, not be worth keeping.

**Question 3: What parameters of manufacturer performance are relevant to take into consideration?**

From the literature Sarkar & Mohapatra (2006) and Gordon (2008) have suggested parameters that can evaluate and compare manufacturer performance. The parameters found from the literature were analysed and parameters with the same meaning were merged. The parameters of manufacturer performance for this study are shown in Table 10 below.

<table>
<thead>
<tr>
<th>Parameters of manufacturer performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality (Sarkar &amp; Mohapatra, 2006)</td>
</tr>
<tr>
<td>Ability to meet delivery (Sarkar &amp; Mohapatra, 2006)</td>
</tr>
<tr>
<td>Consistent delivery (Sarkar &amp; Mohapatra, 2006)</td>
</tr>
<tr>
<td>Management sensitivity to buyer’s requirements (Sarkar &amp; Mohapatra, 2006)</td>
</tr>
<tr>
<td>After sales support (Sarkar &amp; Mohapatra, 2006)</td>
</tr>
<tr>
<td>Positive attitudes toward complaints (Sarkar &amp; Mohapatra, 2006)</td>
</tr>
<tr>
<td>Excess inventory (Gordon, 2008)</td>
</tr>
<tr>
<td>Long cycle time (Gordon, 2008)</td>
</tr>
<tr>
<td>Supplier disruption (Gordon, 2008)</td>
</tr>
<tr>
<td>Logistics failures (Gordon, 2008)</td>
</tr>
<tr>
<td>Strategic failures (Gordon, 2008)</td>
</tr>
</tbody>
</table>

**4.2 Step 2 - Adapt**

In order to adapt the model to the study, the first thing that had to be done was to identify what costs are important and might change in the three cases, which leads to the question:

**Question 4: What costs change in the three different cases?**

Beyond the costs that change in each case, the costs can be either direct or indirect. Direct means that the cost driver is related to the product and indirect means that the cost driver is allocated to the manufacturer. In the situations where the cost is direct there is no need for further allocation whereas in the situations where the cost is indirect an allocation with a simpler form of ABC will be used. In Case 2 and Case 3 this could have an impact on the costs for remaining products at the manufacturer, which will then carry a larger part of the indirect costs.

**Sub question 4.1: Which costs are direct versus indirect?**

Beyond looking at what costs are relevant to have in the evaluation model, it is also important to recognize the costs that require a lot of effort to calculate but that have a small impact on the result and that are therefore not worth considering.

**Question 5: What costs can be eliminated because they are difficult to calculate and do not have a noticeable impact on the result?**
4.3 Step 3 - Plan the Calculations

According to Oskarsson et al. (2013) in this step it is to be decided how the calculations are going to be made and what data will be needed.

Question 6: How are the calculations going to be made?

In order to determine how each calculation is going to be made, the first step in order to ensure uniformity is to decide for what unit of measure the result should be presented. The first sub question is therefore:

Sub question 6.1: For what unit of measure should the calculations be made?

In order to calculate the costs, data will be needed, since the form and amount of the data necessary are not known beforehand the next question is:

Sub question 6.2: What data will be needed?

It is of interest to look closer at how the model will be created and within the model to look more closely at how the revenue and the costs will be calculated. There are also certain costs that can be generalised and for those costs, estimations will be used in the model. These will have to be identified and calculated, some of these costs may differ depending on the category of product, and in these cases several estimations for the same cost will be needed.

Sub question 6.3: How is the revenue calculated?

Sub question 6.4: How are the costs calculated?

The parameters of manufacturer performance also need to be taken into consideration regarding how they are going to be presented and evaluated in the model.

Sub question 6.5: How are the parameters of manufacturer performance going to be presented?

4.4 Step 4—Test Runs

Test runs will be used in order to adjust the model to the different products tested. The products will be chosen by the project group at Omega that represent products in the tail. The sensitivity analysis will evaluate if the estimated costs in the model are stable and to what extent they affect the result if the estimation is not fully accurate. To evaluate how the model would need to be further developed in order for it to fulfil its purpose the next question is:

Question 7: Does the model need to be further developed?

4.5 Studied System

To clarify what is included in the study, a mapping has been done over the studied system where Omega includes the Corporate and the affiliates. The mapping also includes the manufacturers, both internal and external, transportation, warehouses and customers. The studied system is illustrated in Figure 6 below.
Since the model is to take both cost and revenue into consideration, the material flow, the information flow and the transaction flow are included in the studied system. The material flow appears within the transport of the products. The information flow goes both to and from Omega to all entities. The transaction flow goes from Omega to the entities, except for the transaction flow between Omega and its customers, which is the revenue and goes from the customers to Omega.

The studied system consists only of factors where costs related to owning a product occur. The limits of the studied system is set partly by the cost elements that were gathered in 4.1 Step 1 - Identify. The elements warehouse keeping and inventory are represented in the warehouse in Figure 6. The element transport is represented by the transportation from the manufacturer to the warehouse, inbound, and the transport from the warehouse to the customer, outbound. The production of the products is represented in the manufacturer. The red squares in Figure 6 made in the manufacturer, warehouse and transportation is due to that the entities are run or managed as third parties and the only costs that are to be considered for these elements are costs Omega are charged by the third party. Both the elements quality and administration are represented by the information flows shown in the figure. However quality is to some extent also represented by the transaction flow. In order to find the administrative costs, the studied system will be further developed in Step 1 to map who does what internally connected to a product in the tail.

Since Omega is to be able to use the model for any of their three categories pharmaceuticals, medical devices, and cosmetics the studied system includes all of the external production sites that produce those types of products. However, the internal manufacturers do not today produce products that will be included in this study. The only case where the internal manufacturers will be of interest is in Case 3 where a product could be transferred to an internal manufacturer.
5 METHOD

This section will begin with a discussion regarding the type of study that has been done. The method will thereafter follow the somewhat modified approach by Oskarsson et al. (2013), to finish with the credibility of the study.

5.1 TYPE OF STUDY

The amount of knowledge within an area is an important factor when determining the type of study. The types of studies are explorative, descriptive, explanatory, and normative. The explorative study is used when there is little previous knowledge within an area and a basic knowledgebase is to be created. The descriptive study is used when there is already a basic knowledgebase within the area and that knowledge is to be described. The explanatory study is used when deeper knowledge and understanding is sought after and when the aim of the study is to describe and explain a knowledge area. The normative study is used when the area is understood, there is existing knowledge and the goal of the study is to give guidance and suggest actions. (Björklund & Paulsson, 2012) Since the purpose of this study was to create a model to give guidance and to take actions within an area where there is already an extensive amount of knowledge, the type of study was of normative characteristics. However, at the beginning of the study it would be considered explorative. This is based on the fact that when collecting data to use as a base to create the model a knowledgebase about the studied area had to be created.

The type of study can also be categorized depending on if it is a quantitative or a qualitative study. A quantitative study is the type of study where the information can be measured or valued numerically. In this type of study mathematical models or surveys would normally be used. A qualitative study is when the goal of the study is to use observations or interviews to gather information. The possibility to generalize a study is higher when a study is of quantitative character. (Björklund & Paulsson, 2012) Since the purpose of this study was to create a model mostly based on numbers, the study is somewhat quantitative. However, the focus of the study mostly evolved around identifying costs and parameters that would be put into the model by the user. Therefore, it was of importance to create a deeper understanding of a specific problem, which is more of a qualitative study. To summarize, the study is mostly qualitative but contains some elements of a quantitative study as well.

5.2 OVERALL APPROACH

Björklund & Paulsson (2012) has put together an approach for an academic study regarding what parts should be included in the study and in what order the parts should be done. The approach was customized for this study and is presented in Figure 7 below. The first row represents the first half of the study, which were gathered and already represent in a half time report. During the second part of the study, the steps of the approach by Oskarsson et al (2013) were used in order to achieve the specified purpose of the study.
The study started with the problem definition and company presentation to get an idea of the context of the study, how the model was going to be created and its purpose. Interviews were held in order to gather enough information about the company and the purpose of the study. The problem was thereafter widely discussed within the company with focus on the end product and how it would benefit the company. Interviews were held with the supervisor at the company as well as employees selected from different areas of the company in order to build a knowledgebase of the company and of the current situation from more than one person.

Once the problem definition had been further understood and developed, the study was planned in further detail by making sure that the necessary steps would be present in the study. Literature was reviewed in order to take advantage of prior knowledge within the scope of the study and to create a basic understanding of what should be included. The problem specification was, based on findings from the literature, developed in order to have a substantiated approach that added credibility to the report. The last part of the half time report was the method, which was developed for a normative type of study. In order to gather deeper knowledge the focus was on the different types of methods for collecting data.

Thereafter the approach developed in the problem specification was followed, in a methodical way, to find costs, ways to calculate them and to create the model. Regarding the study's approach, it can be described as iterative since it was sometimes necessary to go back from one part to another amongst the parts represented in Figure 7. For instance, when in Step 3, it was discovered that literature was needed for a certain calculation, which led to the literature gathering being further developed.

The steps then led to the conclusion of the study. The four steps are presented more in depth below.

5.2.1 Step 1 - Identify

In the first step, it was important to identify what elements and costs should be a part of the model. Thereafter the relevant parameters of manufacturer performance had to be found. To do so, data had to be collected in order to get a further understanding of the problem and to identify the elements. Data was collected from literature, by holding interviews, an observation and by going through documents. Methods for the collection of data are presented below. After the data had been collected the information
was analysed in order to determine what elements, costs and parameters of manufacturer performance where relevant for the study.

5.2.1.1  **Collection of data**

When collecting data, there are two main types; primary data and secondary data. Secondary data implies that the data has already been collected and was not necessarily collected for a similar study to the one being performed, for instance literature. When data is collected from secondary data, it is important to be aware that the data gathered does not necessarily contain all the information about a certain area and that the data might be subjective. Primary data is data collected to be used in the actual study. (Björklund & Paulsson, 2012) The primary data is collected from people, groups or by doing a survey. (Lekvall & Wahlbin, 2001)

**LITERATURE**

Literature refers to all types of written material, it can for instance be books, brochures or periodicals. The advantage of gathering data from literature is that with bare economical resources and in relatively short time it is possible to gather a lot of information. Often literature studies help map already existing knowledge within an area. (Björklund & Paulsson, 2012) Literature was collected from books, scientific articles and web pages. As far as possible the literature was collected from several different authors in order to ensure credibility. In the study the literature was gathered as a first step to have a base and guidance for the primary data that was going to be collected.

In order to find scientific articles and web pages, searches were made using search engines, such as Unisearch and Primo. To give an example, a search was made in Unisearch on "synergistic effect" which gave over 770 000 hits. In order to find something useful for this specific study, the search was narrowed to "synergistic effect acquisition". This gave 73 hits, of which only one was a source of useful information. The words used were kept track of in order to be able to look back at what had been done, to avoid doing the same search twice and also to be able to analyze what might be a better search alternative in case of difficulty with finding useful information.

**OBSERVATION**

Observation means that the observer personally witnesses how the current process of interest works. A limitation is that the observer can only witness ongoing behavior and occurrences. It is not possible to study knowledge, opinions, what has and what will be. There is also a risk that the observer, by being present, changes the course of action. (Lekvall & Wahlbin, 2001) Observations need to be structured, well thought through and registered. A positive aspect of observations is that little attention is needed from those being observed. A negative aspect is that observations are time-consuming and costly. (Patel & Davidson, 2011) Observation was used to collect data within a manufacturer’s factory in Belgium and led to a deeper understanding of the products and what costs arise from producing them. The focus was on finding costs related to a specific manufacturer. In preparation for the visit, three questions formulated by Patel & Davidson (2011) were answered:

1. What is going to be observed? The process of a product at the manufacturer. In other words, the steps of the production, packaging and storage until the product is shipped.

2. How is the observation going to be registered? The observation was supposed to be registered by taking notes. However due to the production area being a sterile environment no belongings
could be brought into the area. Therefore, notes were written down directly after the observation. The observation was discussed by the two observers to make sure everything was noted. There was also an interview held with the manager of the factory after the observation, to clarify certain parts of the information.

3. How are we, as observers, going to behave during the observation? During the observation the observers were mostly taking in information by visual observation of the production, when needed questions were asked to the manager of the factory.

INTERVIEWS

There are several types of interviews that can be held, such as group interviews, interviews over the telephone or by meeting in person.

A group interview is most suitable for explorative research and has the advantage that the group dynamic during discussions might lead to views that would otherwise not have been thought of or expressed by an individual. Lekvall & Wahlbin (2001). However, since this is not an explorative study but a normative study group interviews were not used.

The types of interviews that are over the telephone or in person are rather similar to each other. Having an interview in person is advantageous if the interviewee’s point of view is of interest. Holding interviews in person is a costly and time consuming form of interview and is therefore not used that often. A telephone interview is a cheaper and less time consuming method. (Lekvall & Wahlbin, 2001) A positive aspect of the personal interview is that the interviewee’s body language can be observed. (Björklund & Paulsson, 2012) Even though telephone interviews are less expensive and a more efficient method for interviewing, it was decided to hold interviews in person to the extent possible. The reason for this decision was that it was not difficult to arrange personal meetings. Therefore it was neither more expensive nor more time-consuming than a telephone interview. Because of these reasons, it was the preferred alternative. In addition, it is easier to communicate with someone you have never met before if you meet in person. This enables studying the interviewed person’s reaction to different questions through body language. In the study, interviews over the phone were held a few times as a quick follow up interview.

There are three types of interviews. The open interview is informal and based on a couple of areas to discuss. The semi-structured interview is used to receive explanatory answers when the opinions and knowledge of the person being interviewed is sought after. Although, the questions are written before the interview, the interviewer can change the sequence and ask supplementary questions. The structured interview is used for collecting quantitative data and the exact same questions are then asked in the exact same order in all interviews without room for supplementary questions. (Lewis & Saunders & Thornhill, 2007)

During the study, interviews where used for two reasons, to gather information about the purpose of the model and to find information to create the model. Therefore, explanatory answers were needed and the interviews conducted where semi-structured to be able to collect specific data and at the same time leave room for the interviewee to come with their own thoughts and opinions about what was important in the discussed area. The interviews were based on models from the literature and since it was not certain that
the literature covered all aspects of the study the interviewee’s knowledge and opinion about the discussed area was important.

By interviewing one person and finding out more it could be discovered who possessed what role and what information and, therefore, with whom it would be of interest to have the next interview. The gathering of information resembled how Lekvall & Wahlbin (2001) describes the analysis as being a puzzle, where the different puzzle pieces are the data collected from interviews. Difficulties that occur when gathering information from interviews are according to Lekvall & Wahlbin (2001) that a puzzle piece might be missing or some puzzle pieces do not belong. These difficulties where encountered in the study, since it sometimes was difficult to identify what was relevant information and also since the company structure was complex.

**INTERVIEW SETUP**

Interview subjects were chosen together with the supervisor at Omega, to ensure that the employees with relevant knowledge where identified and interviewed. This ensured that the costs for all elements were taken into account. For the purpose of identifying what departments and employees would be relevant to interview, a mapping of the company was done and compared with the findings from the literature. In total about 17 interviews were held throughout the study.

To ensure that the necessary information for each cost would be retrieved, Excel was used during the interviews. The rows in the Excel file contained information about cost elements and costs, whereas each column was to be filled in for each relevant cost in order to retrieve the necessary information. See Table 11 below. Since Excel was used during the interviews, it made it more important to conduct interviews in person to be able to fill in the Excel together with the interviewee.

<table>
<thead>
<tr>
<th>Which costs can you identify in each element?</th>
<th>Costs Included</th>
<th>Relevance</th>
<th>Difficult to estimate, low impact on total cost</th>
<th>Costs related to a specific product category</th>
<th>Value (data/estimation)</th>
<th>Unit of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warehouse keeping costs:</td>
<td>- Opportunity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Products becoming obsolete</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Insurance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

At the beginning of the interview, the purpose of the study and model was explained on a general level for the interviewee to understand what type of information was relevant to convey. Thereafter the interviewee was asked to explain more in depth what their position involved. Based on their position and knowledge, the interviewee was asked questions about different elements of the model. The interviewee did from start not see the different costs in the elements. This was done to ensure that the interviewee would mention the costs they found important on their own without being influenced by the content of the Excel file. Afterwards, the costs from the literature were shown to the interviewee to see which costs were relevant for the model, according to them. Thereafter, the columns were completed for each relevant cost. The interview questions can be found in Appendix 1 - Interview questions.
**METHOD**

**DOCUMENTS**

In order to identify the values to be entered into the model, several documents about manufacturers, products and factories where used to gather information. Documents regarding contracts with third parties, as well as documents regarding previous invoices were reviewed. Most of the data collected was of quantitative aspect and it was necessary to look at several values of each measure to ensure that the model could be made general and would cover variations between different manufacturers, products and factories.

5.2.2 Step 2 - Adapt

In this step, the costs that change and the costs that do not change for each of the three cases were identified, as well as what costs were indirect versus direct. A decision was then made whether the costs had a large impact on the total cost or not and how difficult they were to calculate. When the cost did not have a large impact on the end result and would be difficult to calculate, the cost was not included in the model. To complete this step, data was collected from interviews and documents were reviewed. The methods for the collection of data was done similarly as for Step 1 and can, therefore, be viewed there.

By completing Step 2, costs have been removed and only the costs relevant to this study have been included in Step 3. The factors used to determine which identified costs that where not to be in the model from Step 1 and Step 2, are presented in Figure 8. In Step 1, the costs that occurs initially, in the startup of the product, was not included for Case 1. In Case 3 the costs that occurs during the transfer was however included.

![Figure 8: Factors that have determined what costs should be in the model.](image-url)
5.2.3 Step 3 – Plan the calculations

This step focuses on how the model will be built. To start with it had to be decided how costs and the revenue were to be calculated based on what data was available. The data presented in this step is fictive, but shows the relations between different costs. Thereafter, it was looked at how the parameters of manufacturer performance would be presented. This was done by going through documents and holding interviews. The model was created after several tests due to a trial and error approach whilst building it. It was created in Excel and an important factor was for the model to be user friendly. The model is created for the employees at the department Supply, who are the primary users of the model. The employees are going to be able to make changes in the model in order for the evaluations to be as accurate as possible. Estimations will be used when possible, since it enables employees to complete the model more easily. In the end this will also enable Omega to make faster decisions.

5.2.3.1 Techniques for estimating costs

Once it is known what data is needed, there is a need for determining the degree of accuracy necessary for the values to be estimated. The more accuracy needed, the more investigation, collection of data and calculations are necessary. Estimating data is a very important, but difficult, task since it has to do with an uncertain future. (Hartman, 2007) When determining the degree of accuracy needed the process used was inspired by Anklesaria’s (2008) advice on dividing the costs into tertiary and secondary. There was no actual grouping of the costs into tertiary and secondary, but the mindset was used. Therefore, not as much effort was spent to ensure accuracy in the estimations for costs that represented a smaller percentage of the total cost. Instead, the main focus was on costs representing a higher percentage of the total cost.

Hartman (2007) suggests that one estimation technique is to produce a range of estimates. This was not done whilst estimating. However, in order to test the estimation and how it affected the total cost, a range of estimations were tested in the sensitivity analysis done in Step 4.

One way to estimate costs, is to break down manufacturing processes into different costs. The cost estimation is then based on historical cost data and estimations on the similarity of products. (Sajadfar & Ma, 2015) This type of estimation is what the total cost analysis and the study is about since the entire process from manufacturing until the product reaches the customer has been broken down into different costs. What should be noted however is that certain processes have not been looked deeper into, for instance the manufacturing process, since it is not done by Omega, but externally.

Another estimation technique is the unit method. It yields a rough estimate of the project’s cost and assumes that data is defined per unit. For example, the construction cost per square foot of a factory. This type of information is often available from sources at the company and from trade journals. The method works best when the units repeat, which is the case for pieces of equipment in a production line.
When estimating different values, the unit method was used. For instance, important values in the model were how many units sold per year and how many pallets are sold per year. Even though the costs were not always presented under these forms it was the simplest way to make sure that the different costs were set for the same unit.

Estimations where preferred for costs of smaller magnitude. Since they would not have a high impact on the total cost, it was not worth for Omega to spend time on them. Sometimes the entire cost was not estimated but only one of the variables necessary for the calculation. For instance, regarding transports, the cost for transporting a pallet varies depending on distance, country, transport company and the amount of Omega pallets in the transport. This is a complex problem, since Omega's system did not show the cost per product but per transport and each transport could contain several different products. In order to simplify the model for the user, an average cost per pallet was calculated and the user would then only need to enter the amount of pallets that were being produced per year. This value is easily found in Omega's system. There will also always be the possibility for Omega to change the estimates to more accurately calculated values for the product being evaluated.

5.2.3.2 Creation of model
The model was created in Excel and consists of a number of steps and factors. Excel was chosen since the program is widely used at Omega. According to Hartman (2007) Excel is the bestselling spreadsheet software and spreadsheets' value has become immeasurable.

To start off, a simple, first draft of the model was created in Excel in order to get to know the tool better and to have something to further develop. This first draft was based on Case 1 where the different costs were in one column and the revenue in another and a comparison was made between the sum of the costs and the revenue. The model was thereafter developed with necessary calculations for costs in order for them to be in the correct format in Case 1. The model was then further developed for Case 2 and Case 3. In order for the user to get a quick overview, a sheet was created called the result where the results from the cases were gathered. The questions regarding manufacturer performance were to be answered in the sheet result. The questions were open questions where the user had the possibility to fill in the answer freely. It could have been done differently, for example a scale for the user to fill in could have been used. However, it was argued that even though a value could lead to a faster evaluation and a result that was easier to evaluate and draw conclusions from, it was important for the user to fill in the answers with their own words in order to give a better picture of the situation.

To ensure that the model would be useful and easy to use, focus was put on making it user-friendly. This was done by working with the layout of the model and integrating a user guide into it. The integrated user guided enabled long term usage of the model. For instance, for estimated costs and inserted costs, it was written when the user should update them. It also specified that employees could make changes in the model, for instance that they could add a cost. This was important, since all costs for all of Omega's products might not have been identified in the study otherwise.
5.2.4 Step 4 – Test runs

Test runs and sensitivity analysis were done to test the reliability of the model and to discover factors that had to be changed, for instance to make it more user friendly or because the value asked for proved to be difficult to extract from Omega’s systems. Step 4 tests the model’s validity since the information collected is reviewed. Several test runs were done to ensure the model could be used for a number of different products.

Most calculations contain uncertainties of some sort. For instance, it is difficult to know beforehand what quantity of goods will be ordered. Another uncertainty is that an even consumption often is used to calculate inventory levels even though the consumption normally varies during a year. Sometimes there can be a significant difference between the result from the estimated value and the actual value. Therefore, it is important to do a sensitivity analysis in order to discover to what extent the result diverges from reality. (Oskarsson et al., 2013) It was, therefore, decided to test the values entered into the model through sensitivity analysis and the steps presented below by Oscarsson et al. (2013) were followed:

1. **Identify all possible sources of error** which includes all parameters connected to uncertainty, for instance the expected sales numbers or the purchase price of a product.
2. **Choose the most critical sources of error** and limit the sensitivity analysis to these
3. **Choose alternative values** for instance change value for the inventory carrying cost with 10%, 15% and 20%.
4. **Test how the alternative values affect the result** for a specific value or for several.

After all possible sources of error were identified, the most critical sources of error where chosen as the ones with the highest impact on the total cost. The chosen values were + 20 %, + 100 % and – 20 %. This way, both what would happen if the error was of more important magnitude and if it was a minor error in the estimation could be overseen. Both the change of the estimation and the percentage change of the total cost were analyzed.

5.3 Credibility

There are three parameters used to measure the credibility of research. These parameters are validity, reliability and objectivity.

**VALIDITY**

Validity refers to how well the chosen method used for measuring actually measures what it is supposed to. (Björklund & Paulsson, 2012; Patel & Davidson, 2011) Validity in a study can be achieved by doing a logical analysis of the content in the used instrument, making sure that the theories used are accurate for the purpose and that the right questions are being answered. One way to make sure that the used instrument is accurate and validate the content is by letting someone that understands the area of the
instrument try it and evaluate if it works as it should. Validity can also be tested by comparing the outcome of the instrument with the outcome from another method or instrument used within the same area. (Patel & Davidson, 2011) Therefore, whilst creating the model, advice was sought several times from the supervisor and from employees at Omega with good insight into the areas covered by the model to ensure that nothing was missing.

Björklund & Paulsson (2012) suggests that to augment validity several sources should be used to collect data, for instance several interviewees and books. This has been done throughout the study. For instance, when creating the total cost analysis for the study, the total cost models from three different authors were used as well as literature regarding total cost of ownership and cost of quality to ensure that the total cost model of the study would cover as many areas as possible and be as valid as possible.

**RELIABILITY**

Reliability refers to how accurate and trustworthy the measurement is. For instance, if the same measurement is done several times and always leads to the same answer, then the method is reliable. (Björklund & Paulsson, 2012) Patel & Davidson (2011) states that reliability is that the method should be robust to random influences. Beyond the reliability of the model itself, focus was put into making the method for executing the study reliable. This was done by explaining in detail how things had been done and by discussing different choices in order for the reader to be able to create their own opinion regarding how accurate and trustworthy the study and the result from the study were. By describing more in depth how the study had been performed it enabled that the study could be done again. For the results from the study to be reliable, it would mean that the same result would be obtained at a different time. However, since a company is a dynamic environment different factors are constantly changing, which then might affect the result if the study was done again.

As for validity, a way to augment reliability is to use several sources when collecting data, to use different methods on the same data and to let several people evaluate the material and result. (Björklund & Paulsson, 2012) This was therefore done in the same way as was described in validity. When it comes to reliability, an area in the report where it is important to strengthen the reliability further was when collecting data. This is because collection of data is subject to the subjectivity of the person collecting data.

In order to reach high reliability, more than one person should be present during an interview or observation. After the session of collecting information, they can make sure that they perceived the information in the same way. This minimizes the risk of misunderstanding and the interviewers' own interpretation becomes less impacting. (Patel & Davidson, 2011) This was taken into consideration and two people were always present at interviews and at the observation.

Another way to work with reliability is to record interviews in order to be able to listen to them again and thereby reducing the risk of misunderstandings. (Patel & Davidson, 2011) This has however not been done. Instead, to augment the reliability, one or both of the interviewers wrote down the answers. This was seen as a similar approach. After the interview the transcribed document was read by both interviewers to make sure the data had been understood in the same way and that nothing had been missed. This also ensured that the interviewees own subjectivity would not affect the collected data. When uncertainties arose, the interviewee was asked to clarify and in the end all data collected was checked in order to ensure the correct conclusions had been drawn. In this way it was also made sure that
the interviewer and interviewee were unanimous about collected data, which was important for reliability according to Lantz (2013).

When it comes to interviews, to ensure that the collected data is reliable, it is important that the person being interviewed has had the possibility to express all thoughts they have regarding the area discussed. The interview should therefore end with the possibility for the interviewee to add information. (Lantz, 2013) These suggestions were followed in order to ensure higher reliability.

**OBJECTIVITY**

The objectivity defines to what extent personal opinions affect a study. The fewer personal opinions that affect the study the more objective the study. Augmenting objectivity of the study can be done by explaining and motivating the different choices made. When retelling what someone else has written, problems with objectivity can occur. In order to minimize the problems all content should be reproduced not only the arguments and facts that reflect one’s own point of view and no emotionally charged words should be used. (Björklund & Paulsson, 2012) To make sure that the data collected during interviews is objective, the one interviewed should control it. (Brinkmann & Kvale, 2015)

Throughout the report, different choices were motivated to make it easier for the reader to determine to what extent the collected data was objective. For instance, when presenting literature about collecting data several different ways to collect data were presented and thereafter motivations to why certain methods were used and others were not presented. As suggested by Björklund & Paulsson (2012) charged words were not used in the report unless it was to express an interviewee’s opinion. In addition, the supervisor of the company read through information about the company to make sure that nothing had been misunderstood. It would perhaps have been even better if every interviewee read through the information gathered from that interview, but due to many employees having little time to spare and that the supervisor was well informed in all parts of the company this was deemed a satisfactory solution.

5.4 **METHOD CRITICISM**

When conducting a study, different parts could always be done differently and possibly lead to different results. For example, a factor that probably affected the outcome of this study was that the literature study was done as a first step and was mostly collected for there to be a knowledge base and to create an approach. It might be argued that doing the literature study first led the study into a certain direction and that if interviews regarding what the model should contain was done first, other costs might have been found. However, going through literature was the preferred first step in order to have some guidance as to where costs and elements appear for a product since the company has a complex structure with many departments and affiliates.

In order to decide whom to interview, the elements discovered from the literature were used when mapping the positions and departments at the company and when choosing the relevant departments and people to interview. The risk with this approach was that if there was another element that should have been added to the model it would not have been discovered because the expertise of the people interviewed would only be within their element. A way around this would have been to conduct a survey at the company asking everyone if there was a missing element. However, time is money for employees and the company and the survey would have taken more time from more employees and from the interviewers than what it was considered worth. Considering that 17 employees were interviewed it was
METHOD

decided that at least the most important elements would be discovered since employees often work with people from other departments.

A factor of uncertainty within the study was regarding the estimations and their accuracy. For instance, the cost related to the time employees need for different tasks is difficult to estimate since it varies depending on the individual and between times it is done. When estimating time, the task was not clocked but estimated by the employee. Clocking might have led to a more accurate result. However, that needn't necessarily be the case and it would have been more time consuming. In addition, it might not always have been possible to clock all activities since they might not have been performed during the time frame of the study and at the same place. An alternative could have been to not account for the cost of time and instead use additional parameters on manufacturer performance in the model. This alternative was discussed but it was decided that costs would have a greater impact on the evaluation of the result of the model and that the parameters of manufacturer performance in the model would suffice.

Some estimations have been made from the Nordic affiliate and some from Corporate. It would have been better with an average for all affiliates, but this would have been time consuming seeing as there are about 30 affiliates. The estimations can be seen as a quick way for the company to evaluate a product and if the company would need more exact values for the product, they could be calculated.

It was also discussed whether the cost of risk should be estimated or not. Within manufacturer performance an important factor was poor performance which could lead to risks and high costs. It was therefore considered to put costs on risks. However as there are many different products and manufacturers the risk and its importance would have been different from case to case and difficult to generalize.
6 COLLECTED INFORMATION AND ANALYSIS

In the chapter below the four steps are analyzed with information found from collecting data. To structure the chapter, the questions of the study from the 4 Problem specification are answered.

6.1 STEP 1 - IDENTIFY

Question 1: What is the revenue?

At Omega, the purchasing company OPI and the local affiliates are seen as separate when it comes to ordering, the sales of products and revenue. If an affiliate orders a product through OPI, OPI buys the product from the manufacturer and sells it to the affiliate who will then sell it either directly to customers or to the local market of a country. For example, this happens at the Nordic affiliate. The affiliate sells the product to, for example, the market of Sweden who will then sell the product to external customers, such as pharmacies. If instead, the affiliate orders the product from the manufacturer the product is directly sold to the affiliate without any involvement of OPI. For each time a product is sold to another entity a profit margin is added to the price. However, Corporate gives a recommendation for the final selling price to the external customers. The selling price of a product could differ depending on market and the market status. (Söder, 2016) The revenue of the products is gathered on a product level and the affiliates report the revenue to Corporate. (De Nil, 2016) In Figure 9 below the different steps that can occur for the selling price within Omega are illustrated.
The revenue that will be used in this study is the revenue from the selling price that Omega uses towards their external customers. In that way an evaluation can be made of a product for Omega as one entity. Which part of Omega that will get different quantities of the profit margin is not as relevant since the study is made for the entire company.

**Question 2: What are the relevant cost elements and costs?**

The elements and the costs that were identified, based on the literature study, were used as the base when interviewing employees at Omega as was shown in 5. Method. Through interviews, several more costs in the identified elements were identified as can be seen in the sub questions below.

**Sub question 2.1: What cost elements should be in the study?**

The elements chosen in the 4. Problem specification are warehouse keeping, inventory, transport, manufacturer, quality, administrative and other costs. These elements were shown at each interview and no additional element was found. The elements are all relevant to have in the model and no other element should be needed to make a complete analysis of the total cost (Bruhn, 2016; Söder, 2016).

**Sub question 2.2: What costs are applicable in the study? & Sub question 2.3: Are there any category specific costs?**

Below, the costs, both from literature and collection of data, are analysed for each element, when there is a category specific cost it will be mentioned. If the cost is not delimited in this step it is to be further analysed in the next step and possibly be a part of the model. In this sub question, costs for Case 1 are identified. Since Case 1 is the base of the model, some of these costs also occur in the two other cases.

**CASE 1: PRODUCT PROFITABILITY**

**WAREHOUSE KEEPING**

Warehouse keeping costs in the literature include cost for tied up capital, costs for obsolete products and insurance. Insurance is, according to Söder (2016) difficult to estimate on a product level since the insurance is paid for the total value of Omega's products in a warehouse. Since products in the tail generally represent a small amount of the products in the warehouse and since they were not identified through the interviews, the cost will not be a part of the model. The other two costs from the literature were identified as important for the model.

- **Cost for tied up capital:** The cost differs depending on the product value. This is something that the company could try to lower by having a lower stock level. (Söder, 2016; Tytgat, 2016)
- **Obsolete products:** The costs of obsolete products are measured today and could be used to show if a product causes extra costs due to lack of quality or other problems (Bruhn, 2016). If the stock turnover of a product is high and the shelf life of the product is long there is a low risk that the products become obsolete, and the opposite, if the turnover of the product is low and the shelf life is short there is a high risk that the product becomes obsolete. (Söder, 2016)

**INVENTORY COST**

The inventory cost includes the costs that appear from having a third party, since Omega uses third party logistic companies to handle their warehouses. The costs are negotiated with each company and can differ
for different companies. Usually every country has their own set up and cost drivers, even though it sometimes can be the same company running the warehouses in several countries. (Söder, 2016) The costs found are:

- **Handling incoming goods:** Each time Omega has a delivery to a warehouse, a cost for putting the goods into the storage appear. The cost could either be for each order and order line (Cook, 2016) or per pallet or carton that is going to be stored. (Chornyi, 2016)
- **Picking goods:** When the warehouse picks the goods for consolidating orders to different customers, there is a cost that appears for each pallet, carton or order. (Chornyi, 2016)
- **Handling outgoing goods:** In the same way as for putting goods into the warehouse, there is a fee for picking goods and exiting them from the warehouse. This cost could also either be per order and order line (Cook, 2016) or per pallet or carton. (Chornyi, 2016)
- **Storage cost:** The storage cost of products is paid per pallet in the storage and differ depending on the characteristics of the product. Products could be either ambient, flammable or in need of temperature controlled storage. The cost for cold storage is the highest and the cost for ambient storage is the least expensive. (Cook, 2016; Chornyi, 2016)
- **Fixed administrative and IT fee:** These costs are fixed, paid regularly and they cover the fixed costs for the warehouses. (Chornyi, 2016; Cook, 2016)
- **Cycle count cost:** This is the cost for doing an inventory of the warehouse, which is done on a regular basis, for example once every year. (Chornyi, 2016).
- **Value added services cost:** The cost is for different displays et cetera that are used for example in stores and fairs to display a product in a different way than on a shelf. (Chornyi, 2016) Since the products in the tail are normally not marketed, this means that the cost normally does not occur and, therefore, will not be looked into further.
- **Packaging material:** The packaging material is used for the displays explained in the cost for value added services. (Cook, 2016) Since value added service cost will not be looked at further, there is no need to look at costs regarding packaging material either.
- **Investments at warehouse:** The cost appears when the warehouse makes investments for the purpose of the agreement with Omega. This cost will not be looked further into since it is an initial cost when beginning to work with a warehouse.
- **Education of Warehouse staff:** Omega is to provide an appropriate amount of resources for education of the staff at the warehouse regarding the products, handling routines et cetera. (Chornyi, 2016) The education of warehouse staff will not be looked further into since it mainly occurs initially when Omega starts using a warehouse. This will not change in the different cases since warehouses are bound to affiliates and not products.

**TRANSPORT COSTS**

In this element the costs that occur are all related to having third party transportation companies managing all the transports. The transport is divided between inbound transport and outbound transport. The inbound transport is the transport for finished products from the manufacturer to central warehouses in the countries in which the product is sold. The outbound transport is from the warehouse to different customers on the market. (Söder, 2016) The costs identified at the company were:

- **Transportation cost per pallet:** This cost depends on how many pallets that are to be sent in the same transport, the more pallets the lower the price per pallet. The cost also differs depending
on the distance of the route, if the products need to be temperature controlled, if the transport is by truck, flight or sea and if it is a pharmaceutical or non-pharmaceutical product. (Chornyi, 2016) When it comes to costs, the more regulations regarding a product, the more expensive the product becomes. For instance, pharmaceuticals can sometimes have a higher price than cosmetics for transports because the transport company must obtain the rights to transport the pharmaceuticals and the transports need to be validated. (Söder, 2016) The cost per pallet differs depending on if it is an inbound transport or an outbound transport. Inbound transport could either be national or international depending on the location of the manufacturer in relation to the markets. Outbound transport is mostly national since there is a warehouse connected to each affiliate. (Chornyi, 2016)

- **Customs clearance and import:** In some situations, this cost is included in the transport price but mostly Omega has to pay for tolls. However, within the Schengen agreement there are normally no costs for import at customs. (Wistedt, 2016) Since this study will only include countries within the Schengen agreement this cost will not be a part of the model.

- Every transportation system is unique and every transport company has their own system. A unique contract is negotiated between Omega and each one of the transport companies, since they all have their own cost drivers and costs. There are many extra costs that could appear depending on country and company. Therefore, it was decided to show a few of these costs as examples, but since Omega is present in 35 countries it would not have been possible to find and evaluate every single cost within the scope of this study.
  - **Document fee:** The document fee is paid for each document that the transport company handles. The cost is sometimes included in the administration fee and sometimes paid separately. (Chornyi, 2016)
  - **Waiting time:** The transport company can charge Omega for extra waiting time at the warehouse if the warehouse is not ready on time to handle the incoming goods. (Chornyi, 2016)
  - **Second driver:** Sometimes a second driver could be needed in the transportation of certain goods, Omega will then pay extra for this. (Chornyi, 2016)
  - **Road tax:** In some countries there could be a tax for transporting goods on all or certain roads in the country. (Chornyi, 2016)

**PRODUCT COST**

The only cost found within this element was:

- **Purchase price:** This is the cost per unit that the manufacturer charges Omega, when selling their products to them. The cost is paid in the same way regardless if the manufacturer is external or internal. This cost includes the costs for raw material, packaging, production and can also include the cost for investments done for the product by the manufacturer. (Söder, 2016)

**OTHER COSTS**

From the interviews, the only cost identified as being of interest within other costs was artwork. In the literature cost related to lost sales was identified. The general opinion during interviews, about cost of lost sales, was that it would be too difficult to estimate since there is no certainty of how the cost will change in the future. Therefore, artwork is the only identified cost within other costs.
• **Artwork:** Artwork is done when creating a new product or when changing a product. It implies creating printing plates and developing designs for products or brands. (Limrell, 2016) For pharmaceuticals, artwork is done on the leaflet as well as on the inner and outer packaging. Cosmetics have a simpler packaging and so only one artwork needs to be done. Artwork might imply scrapping of the old material. For almost all products, artwork has to be done every two or three years. For instance, this could be due to changing regulations. (Bruhn, 2016)

**QUALITY**

If not otherwise indicated, it is assumed that the cost for quality exists for all three categories: pharmaceuticals, medical devices and cosmetics. In the element quality many of the costs identified were related to the time spent which conforms to what Srivastava (2008) discovered in his study.

• **Regulatory department:** Some of their tasks are filling and updating internal and external databases and keeping track of changing regulations. All costs regarding regulations are administrative overhead costs, measured in time for the employees working with medical devices and pharmaceuticals. Their time can be allocated onto each product. As cosmetic products are not as heavily regulated, work related to regulations of cosmetics is under the responsibility of the manager of cosmetic innovation. (Limrell, 2016) These costs were identified in the literature as well, for instance for filling in the management information system and for registrations in databases.

• **Annual fees:** For all categories there is an annual fee to pay. For pharmaceuticals, this fee is paid to the agency in each country it is present in or to the European Union. In the Nordics, there are only nationally approved pharmaceuticals, which means a fee is paid for each country it is sold in. For cosmetics and medical devices, the fee is only paid to the country where it is being produced. (Limrell, 2016) The cost for pharmaceuticals and cosmetics had been identified in the literature. However, from the interviews a cost for medical devices was discovered as well.

• **Variation fees:** When changes are made to pharmaceuticals, for example to the production process or to the product’s packaging, a variation fee is paid to the medical products agency. (Limrell, 2016) However, according to Limrell (2016), it is not possible to say how many times a year a variation fee occurs in general per product. It could be a couple of times per year or never. Since the amount of variation fees that would have to be paid for a product would be difficult to predict since it varies, the variation fee will not be looked at further.

• **Renewal fees:** When a product is reregistered, a renewal fee is paid. (Limrell, 2016) This will, however, never be of interest within the delimitations of this study since it is based on products already in the system.

• **Registration of product:** All products must be registered on the markets where they are marketed and distributed. There is also a possibility to have a registered product, but not have it on the market, this is however only possible for a short period of time. (Limrell, 2016) Since, the registration of the product is an initial cost, it will not be looked at further.

• **Audit:** When audits are performed a site is visited and the production lines and products of a manufacturer are inspected. (Hoengenaert, 2016) There are employees responsible for auditing pharmaceuticals and medical devices, which is done every third year. The regulations for cosmetics are less strict and their audits are only done when the auditors have time to spare and are estimated to being done every four to five years. Most affiliates audit their local suppliers of
warehousing and transports. The manufacturers are responsible for auditing their own suppliers, for example the suppliers of raw materials. (Nord, 2016) These different audits were discovered in the literature as well. The audits that will be looked at further are the ones for the manufacturers. The cost for auditing manufacturers can be allocated to the product indirectly by estimating it per manufacturer, whereas the audits of warehousing and transport are done for all of the products at the affiliates. These audits are part of a bigger system, where it becomes too difficult to allocate the cost onto the product.

- **Creation of standard operation procedures:** For every activity in the manufacturing and distribution process of each product, there needs to be a standard operation procedure with the steps to take. (Nord, 2016) This cost was identified in the literature. However, since it is a cost that only occurs initially or when there is a change it will not be examined further.

- **Product quality review (pharmaceuticals):** Every year Omega gets an annual report from the manufacturer that has to be reviewed. (Nord, 2016; Hoengenaert, 2016)

- **Review license from authorities:** Every three years Omega needs to see the license from the authorities that the manufacturer has the right to produce the products. (Hoengenaert, 2016)

- **Review quality agreement:** The quality agreements for the products have to be reviewed every three years. (Hoengenaert, 2016)

- **Batch release (pharmaceuticals):** When a batch of products is produced a batch release is done before sending the products to the warehouse. This means that the batches are controlled to make sure quality is met. (Tytgat, 2016; Chorny, 2016; Hoengenaert, 2016) The batch release is included in the cost of the product. However, internally, for the quality department, it takes time as well, which is to be included as a cost. (Nordin, 2016)

- **Stability studies (pharmaceuticals):** Each year that the product is produced a batch is removed to perform stability studies on. The batch is placed in a chamber with the right environment for the period representing the end of shelf life and analyzed. (Hoengenaert, 2016)

- **Concessional approval (pharmaceuticals):** Every change and deviation for a pharmaceutical product is looked over to ensure that the quality is met. (Hoengenaert, 2016; Nord, 2016) However, the amount of changes varies depending on product and situation according to Limrell (2016). Since it varies it is not certain how often the cost will arise in the future and the cost will, therefore, not be further examined. The cost was identified in the literature and was delimited there also.

- **Withdrawal of product:** Costs appear if the quality is not met and the affected product needs to be withdrawn from the market. (Söder, 2016) This cost will not be used in the model since it is not something that happens on a regular basis and cannot be foreseen.

- **Reclamation:** The customer service employee enters reclamations into a database. (Nord, 2016) In the literature this is called customer complaints handling.

**ADMINISTRATIVE COSTS**

In order to map the administrative roles, where the employees’ tasks are of relevance to managing a product in the tail, the organizational structure for the Nordic affiliate was analyzed. The departments represented in the Nordic affiliate are presented in Figure 10 below.
Figure 10: Organizational structure of Omega Pharma Nordics.

Since the products that will be entered into the model will be products in the tail that most often do not receive any attention internally and where the minimal amount of work necessary for it to simply keep being a part of the system is done, this means that there are many roles and departments that do not work with the product. The costs of management charges, head office and corporate indirect found in the literature are therefore not taken into consideration. The departments that are not involved in the products in tail or that work indirectly with all products are Innovation, Nordic Marketing, CSI (Customer Sales Information), Finance and Sales departments for Sweden, Norway and Finland. These departments will therefore not to be considered in the model. The departments of interest were therefore Supply and Regulatory. The costs arising from Regulatory are described further in the element of quality. In the administrative element only Supply was investigated further. This conforms with the costs for administration identified in the literature since they are costs related to logistic activities such as ordering products, order processing and logistics communication. These costs were found within different roles at Supply.

- **Supply Manager:** All of the products at an affiliate are divided between the Supply Managers. In the Nordics, there are five supply managers. Their tasks include planning, ordering products, communicating with manufacturers and making sure deliveries arrive on time. Normally their time spent on each product and manufacturer depends on whether the product or the manufacturer is strategically important. However, if problems occur with a manufacturer of products in the tail the supply manager might have to spend more time on that manufacturer. (Wickberg, 2016) Making sure deliveries arrive on time was associated with order processing from the literature.

- **Demand Planning Manager:** For each product there is a forecast developed for the coming year. The forecast is updated continuously to give a more exact forecast three months ahead. (Tytgat, 2016) Every affiliate has at least one local demand planner working with forecasts. When making a forecast for the coming year the market has to be analyzed together with information about upcoming marketing campaigns and other parameters that affect the demand. (Stoop, 2016)

- **Warehouse and Distribution Manager:** Communicates continuously with warehouse and transport companies. However, since this study will neither change the structure of the central
warehouses nor the transportation, this role will not be allocated on the products. Even if products were to be taken out of the portfolio, there will be neither a cost reduction nor time saved internally for this role.

**Sub question 2.4: What are the specific costs for Case 2 and Case 3?**

**CASE 2: STOP PRODUCTION OF PRODUCT**

- **Scrap:** When ending the production of a product, there could potentially be costs due to scrapping packaging material and raw material. This can be avoided to the extent possible by making sure that the product is produced until the end of the contracted time and not ending it in advance. Ending a contract with one manufacturer normally has to be announced 9-12 months in advance, according to contract. The manufacturer then has the possibility to plan its production in order to have as little scrap as possible left. (Wickberg, 2016)

- **Keeping a product registered:** It can sometimes be difficult to reregister a pharmaceutical if it was first registered a long time ago. This is due to the changes in regulation over time. Therefore, it can sometimes be better to keep a product registered even though it is cancelled. This will enable putting the product on the market again. To unregister a product is a simple procedure with no additional fees. (Limrell, 2016) If the product is not unregistered, there will still be annual costs paid to the medical products agency. However, in this study, the products evaluated are products that are not strategic for Omega and, therefore, there is a low risk that they would keep the product registered. Therefore, this cost will not be examined further.

- **Stability studies (pharmaceuticals):** Even if the production of a product is cancelled there needs to be continuous stability studies of the product until the end of shelf life, to ensure the quality of the sold units. Usually, the manufacturer is paid to continue the stability studies. (Hoengenaert, 2016)

- **Internal cost:** If a product is cancelled there are still some costs internally until the production is fully cancelled and the last batch has expired. For example, the product quality review is still reviewed until the end of shelf life for pharmaceutical products (Hoengenaert, 2016).

**CASE 3: MOVE PRODUCTION OF PRODUCT**

- **Scrap:** When moving the production of a product there could potentially be costs due to packaging material and raw material that were not used at the previous manufacturer. In some situations when the production is moved, the new manufacturer buys the raw material. In other situations, Omega pays the manufacturer for the raw material that was not used. However, when it comes to packaging material, the supplies cannot be transferred to the new manufacturer if they are marked with manufacturer specific information. (Wickberg, 2016)

- **Artwork:** Sometimes new artwork needs to be done when there is a change of manufacturer. For example the name of the manufacturer on the package has to be changed when it is a pharmaceutical product. (Limrell, 2016)

- **Taxes, sanctions and tolls:** These costs may occur if the manufacturing is moved to another country. (Bellanger, 2016) Since the studied system is within the European Union, these costs are not to be considered.

- **Transfer offer from manufacturer:** The manufacturer sends as an offer for the transfer costs that arise when moving a product to a different manufacturer. A lot of these costs arise within
Regulatory and mostly for pharmaceutical products (Limrell, 2016). For example, the transfer cost could include stability studies for the product, which has to be done before the product can be released on the market (Hoengenaert, 2016).

- **Stability studies (pharmaceuticals):** There is a need for the previous manufacturer to continue the stability studies for pharmaceutical products they have produced until the end of the shelf life. (Hoengenaert, 2016)
- **Audit:** When a pharmaceutical product is transferred the quality needs to be secured for the new production. During a transfer of one or several products to a new manufacturer, audits can be executed up to once a year in order to make sure that every aspect of the transfer is quality secured. In other situations an audit is not needed. (Nord, 2016)
- **Variation fee (pharmaceuticals):** For pharmaceutical products, a variation fee is paid when a product is transferred. (Limrell, 2016)
- **Internal costs:** When the decision to transfer is taken, a project group is set up internally. Together with the manufacturer, discussions and negotiations are held in order to agree on contract, quality agreement, transfer cost et cetera. (Limrell, 2016) The positions that are included in this process are, among others, Value Chain Manager, Technical Transfer, Quality Assurance Manager and someone from Regulatory (Bellanger, 2016). Technical Transfer is responsible for making sure that a transfer is possible from a technical point of view and working with the transfer from beginning to end to make sure that every step goes as planned. The employees working with these questions are the only ones working full time with transfers. (Söder, 2016)

**Question 3: What parameters of manufacturer performance are relevant to take into consideration?**

Parameters of manufacturer performance found at Omega that were taken into consideration include quality, flexibility, delays and communication. These parameters will visualize other aspects than costs that are important to consider when evaluating a manufacturer.

- **Quality:** One parameter that was identified both in the literature and at Omega is quality. There is an agreed level of quality that the manufacturer should perform. The quality department calculates a level of risk for each manufacturer based on quality parameters and how well they follow the quality agreement. The parameters that they take into consideration are, among others, deviations in the production, complaints from customer and status of auditing. (Hoengenaert, 2016) According to the literature, poor quality performance could lead to customer complaints, excess inventory and costs of the magnitude 10 to 25 % of sales. It is, therefore, an important parameter to consider within the model. Since it is difficult to calculate the cost for poor quality, it is better to visualize the costs as a parameter of manufacturer performance.
- **Delays:** The lead time for products ordered by Omega is usually three to four months. It is important that the manufacturer is ready to deliver the ordered goods on the agreed day. The parameter was also found in the literature and was then referred to as the ability to meet delivery. The parameters excess inventory and long cycle time could also be related to the lead time. When a manufacturer is late with the delivery on a continuous basis Omega will most likely raise the safety stock level (Wickberg, 2016) since it is crucial that Omega does not run out of stock as it could lead to lost customers and sales. (Nordin, 2016) Costs related to lost sales were identified in the literature. However, since it is difficult to get a good estimate the cost is instead represented through the parameter delays. If a higher safety stock is needed because of delays, this would
lead to higher costs in tied up capital and inventory costs for Omega. Since the safety stock level depends both on the variance in lead time and the variance in demand, it is not possible to state the reason for a high safety stock level without further investigation.

- **Communication**: The easier the communication and transparency with the manufacturer is, the easier it is for Omega to develop a good relationship with the manufacturer. Communication was not found as a parameter in the literature within manufacturer performance. Instead it was found as a cost in the element administrative. Communication is also included in the model as a cost, as the time spent by the employees in Supply, but this parameter will be used by the employees to further explain if there are any difficulties in the communication. It was decided to represent communication as a manufacturer performance parameter as well, since it would be difficult to predict a cost for the communication with a manufacturer in the future. There is also no connection between a lot of communication, which would imply a higher cost, and poor manufacturer performance. In many situations, it is a good thing that Omega puts a lot of time to communicate with a manufacturer, since it gives a closer relation and deeper understanding for each other. A risk, if the manufacturer does not communicate well, is also that they may not inform Omega about deviations or if problems occurs. (Hoengenaert, 2016)

- **Flexibility**: Flexibility was found as a parameter of manufacturer performance. In the literature this could be related to management sensitivity to buyer's requirements. Flexibility is important when it comes to the aspect of changing activities in the production. The more flexible the manufacturer is, the easier it is for Omega to adapt their production to changes in the demand and to modify the production in terms of equipment and methods used (Söder, 2016).

### 6.2 **STEP 2 – ADAPT**

**Question 4: What costs change in the three different cases? & Sub question 4.1: Which costs are direct versus indirect?**

Question 4 and sub question 4.1 have been answered together in Table 12 that can be found below question 5. In the situations where the product evaluated is the only product that is being produced at the manufacturer all indirect costs that appear at a manufacturer level will be direct. In the table however, a cost is always stated as an indirect cost if it has to do with a manufacturer and not a product.

**Question 5: What costs can be eliminated because they are difficult to calculate and do not have a noticeable impact on the result?**

The costs identified in Step 1 could be difficult to calculate, if the cost would also have a low impact on the total cost the cost could be eliminated from the study. Below, the elements where there has been eliminations of costs are presented, in the other elements the costs are to be included in the model. Only the costs that are to be included in the model are shown in Table 12 below.

**INVENTORY**

- **Picking goods**: The larger costs for inventory are putting goods into storage and shipping them off, the picking cost is small compared to these other two. It would also be too difficult to calculate the exact cost for the picking of a product since there could be different cost drivers used at the same storage, for example one cost for full pallet and another cost for mixed pallets. It has
therefore been decided that the cost would be too difficult to calculate and have to low an impact on the result for it to be considered in the model.

- **Fixed administrative fee, fixed IT cost and cycle count cost:** These are all indirect costs that are constant and do not change due to the number of products. Seeing as a product in the tail would have a very small amount of that cost allocated to it these costs would not have a noticeable impact on the result, since they are also difficult to calculate and allocate they will not be looked further at.

**TRANSPORT**

- **Document fee, waiting time, second driver and road tax:** These costs differ depending on the transport company and the country, they seldom occur and therefore represent an insignificant cost in the total cost model. It was from documents not possible to identify these costs related to a product only to the transportation company as a whole. To allocate these costs onto a product will therefore be difficult and not worth doing.

**QUALITY**

- **Regulatory department (cosmetic):** Regulatory time spent on cosmetics will not be a part of the model since there is only one person working with it, who is at the same time working as the manager of cosmetics development. The time spent by that employee on each product for regulations would therefore hardly have an impact and would be difficult to estimate. The cost for Regulatory on the other two categories are however a part of the model.

- **Review license from authorities:** Reviewing licenses from authorities is done once every three years for each manufacturer and takes one hour according to Hoegenaert (2016) the cost therefore becomes too small to be taken into consideration.

- **Batch release:** One batch release takes about 45 minutes and is done every time for pharmaceutical products before the pallets are shipped. Since little time is spent on this activity and it would be difficult to calculate the cost per product it will not be further looked into, nor for Case 2 or 3.

- **Concessional approval (Pharmaceuticals):** It was decided that this would not be a part of the model since the time spent varies greatly depending on the product according to Limrell (2016). It would be difficult for the user to calculate this cost and it would neither be possible to estimate it since it varies. Seeing as well as the cost has a small impact on the result it will not be a part of the model.

- **Reclamations:** There is only one person working 60% with reclamations in the Nordics for all of the 500 products and the amount of reclamations vary significantly depending on the product. It is therefore not a cost that is easily generalized on a product level and a cost with little impact per product. This cost will therefore not be looked into further.

**Case 2: Stop production of product**

- **Internal cost:** This cost is not worth looking further into since there are few internal costs once the product is no longer being produced. A mapping would have to be done to estimate this cost better and that does not seem to be necessary considering that the costs that have been discovered so far are minor costs that occur for pharmaceutical products and are for looking over
the stability studies and the product quality review. It is therefore assumed that other costs that might be discovered would be minor ones as well.

Table 12: All costs that will be included in the model are presented as well as information regarding if they are category specific, case specific, in what cases they change and if they are direct or indirect.

<table>
<thead>
<tr>
<th>Cost</th>
<th>Category specific</th>
<th>Case specific</th>
<th>Change in case</th>
<th>Direct / Indirect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warehouse keeping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tied up capital</td>
<td></td>
<td>Case 2</td>
<td></td>
<td>Direct</td>
</tr>
<tr>
<td>Products becoming obsolete</td>
<td></td>
<td>Case 2</td>
<td></td>
<td>Direct</td>
</tr>
<tr>
<td>Inventory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handling incoming goods</td>
<td></td>
<td>Case 2</td>
<td></td>
<td>Direct</td>
</tr>
<tr>
<td>Handling outgoing goods</td>
<td></td>
<td>Case 2</td>
<td></td>
<td>Direct</td>
</tr>
<tr>
<td>Storage cost</td>
<td></td>
<td>Case 2</td>
<td></td>
<td>Direct</td>
</tr>
<tr>
<td>Transport</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inbound</td>
<td></td>
<td>Case 2</td>
<td></td>
<td>Direct</td>
</tr>
<tr>
<td>Outbound</td>
<td></td>
<td>Case 2</td>
<td></td>
<td>Direct</td>
</tr>
<tr>
<td>Manufacturer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase price</td>
<td></td>
<td>Case 2 &amp; 3</td>
<td></td>
<td>Direct</td>
</tr>
<tr>
<td>Transfer offer</td>
<td></td>
<td>Case 3</td>
<td></td>
<td>Direct</td>
</tr>
<tr>
<td>Scrap</td>
<td></td>
<td>Case 2 &amp; 3</td>
<td></td>
<td>Direct</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artwork</td>
<td></td>
<td>Case 2</td>
<td></td>
<td>Direct</td>
</tr>
<tr>
<td>Quality</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulatory department</td>
<td></td>
<td>Pharmaceutical and medical device</td>
<td>Case 2</td>
<td>Direct</td>
</tr>
<tr>
<td>Annual fees</td>
<td></td>
<td>Case 2</td>
<td></td>
<td>Direct</td>
</tr>
<tr>
<td>Audit</td>
<td></td>
<td>Case 2 &amp; 3</td>
<td></td>
<td>Indirect</td>
</tr>
<tr>
<td>Product quality review</td>
<td></td>
<td>Pharmaceuticals</td>
<td>Case 2</td>
<td>Direct</td>
</tr>
<tr>
<td>Review quality agreement</td>
<td></td>
<td>Case 2</td>
<td></td>
<td>Direct</td>
</tr>
<tr>
<td>Stability studies</td>
<td></td>
<td>Pharmaceuticals</td>
<td>Case 3</td>
<td>Case 2 until end of shelf life</td>
</tr>
<tr>
<td>Administrative</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply manager</td>
<td></td>
<td>Case 2 &amp; 3</td>
<td></td>
<td>Indirect</td>
</tr>
<tr>
<td>Demand planning manager</td>
<td></td>
<td>Case 2</td>
<td></td>
<td>Direct</td>
</tr>
<tr>
<td>Technical transfer</td>
<td></td>
<td>Case 3</td>
<td></td>
<td>Direct</td>
</tr>
</tbody>
</table>

6.3 **STEP 3 — PLAN THE CALCULATIONS**

Because of confidentiality, the numbers presented in this chapter are fictive. This was done in order to be able to present the calculations that could not have been presented otherwise.

*Question 6: How are the calculations going to be made?*
**COLLECTED INFORMATION AND ANALYSIS**

**Sub question 6.1: For what unit of measure should the calculations be made?**

When Omega estimates and measures values for their products the unit of measure is most often per year. (Söder, 2016) When evaluating if it is worth moving a product, the time period looked at is how much is saved per year. (Toukal, 2016) A year being the standard time period when evaluating scenarios and estimating future values it is the time unit that will be used within the model. That is to say the costs that will occur in the model will be for the product during one year.

When looking at transferring a product, ROI (return on investment) is used in order to estimate the amount of years it will take before the transfer pays off. If the ROI is less than a year then it is often a profitable action to move the product. But if the ROI is a longer period than a year, then it first has to be secured that the product will be on the market long enough in order to invest in the move. (Söder, 2016; Toukal, 2016) ROI was therefore used when looking at the alternative to transfer a product and was seen as a good choice to use in the model to make it user friendly.

When it comes to the time spent on different internal activities related to a product, the time will also be presented as the time spent per year and an average cost per day and hour per employee has therefore been calculated. These averages are based upon the average cost per employee for Omega at its four largest affiliates. The averages are calculated by assuming that all employees work 40 hours a week and 47 weeks a year, since 5 weeks paid holiday is assumed. According to Nordin (2016) the largest affiliates are in Belgium, United Kingdom, Germany and the Nordics, where the main office is in Sweden which is the country that will therefore be used for the cost of employee in the Nordic affiliate. In order to use the right category of labour, business economy for 2014 has been chosen. The average cost per hour is in Belgium 41.1€, Germany 31.8€, United Kingdom 22.2€ and in Sweden 40.2€ (Eurostat, 2015). Making the average cost per hour:

\[
\text{Average cost per hour} = \frac{41.1 \, \text{€} + 31.8 \, \text{€} + 22.2 \, \text{€} + 40.2 \, \text{€}}{4} = 33.8 \, \text{€}
\]

and the average cost per year:

\[
\text{Average cost per year} = 33.8 \, \text{€} \times 52 \, \text{weeks} \times 40 \, \text{hours} = 70,300 \, \text{€}
\]

Which can be compared to the average in the European Union for business economy labour that is 24.5€ (Eurostat, 2015).

**Sub question 6.2: What data will be needed?**

This question will be answered in the following two questions for each element and for each cost.

**Sub question 6.3: How is the revenue calculated?**

The revenue is documented for each product. When the user is going to fill in the model the revenue of the product during a year is a parameter that needs to be entered for the product that is to be evaluated.

**Sub question 6.4: How are the costs calculated?**

**WAREHOUSE KEEPING**

- **Cost of tied up capital:** According to Oskarsson et al. (2013) to calculate the cost of tied up capital, both the inventory carrying charge and the value of the average stock level are needed. The way...
to calculate the inventory carrying charge suggested by Oskarsson et al. (2013) was slightly modified since it consists of both the average cost of capital and in addition the cost of risk per year divided by the value of the average stock level. In this study it has been chosen to take the cost of risk into consideration through the cost of products becoming obsolete and parameters of manufacturer performance. The inventory carrying charge in this study equals the weighted average cost of capital and the value of average stock level. The calculation of the tied up capital was done as:

$$\text{Cost of tied up capital} = \text{Weighted average cost of capital} \times \text{Average stock level} \times \text{purchase price}$$

The value of the average stock level is calculated in the model by looking at the MOQ (Minimum Order Quantity), demand per year as well as the safety stock. It is assumed that the demand is evenly distributed during the year. For products in the tail, only one MOQ at the time is ordered according to Liljedahl (2016). The average stock level is calculated:

$$\text{average stock level} = \frac{\text{MOQ}}{2} + \text{safety stock level}$$

- **Products becoming obsolete**: For each product at Omega, the number of units becoming obsolete per year is calculated by the Supply department (Söder, 2016), this number will be filled in by the user.

Below, in Figure 11, the costs in the element warehouse keeping are broken down into the components and values in the model, in order to calculate the element. In the model, the user fills in the values presented in the green boxes and then the other values presented in the orange boxes are calculated by the model.

- **Handling incoming goods**: This cost was generalized per pallet and a fee is paid per pallet put into storage. The amount of pallets per year was calculated by using the demand per year and number of units per pallet. These two variables have to be entered by the user. In addition to pallets, there are also mixed pallets and cartons being put into storage. Since pallets is the most common way of transportation at Omega, it was decided that only the cost per pallet would be used in the model.

To calculate the cost per pallet, the average cost per pallet in different European countries was used. In some countries the cost per pallet was stated in the contract with the third party. However, in the Nordics the cost was per order and per order line and in general there where 30 pallets per order. A calculation was, therefore, needed to get the cost per pallet in the Nordics.
The cost per pallet was calculated as:

\[ \text{Cost per pallet} = \frac{\text{cost per order} + \text{cost for order lines per order}}{\text{Pallets per order}} \]

Where the cost for order lines per order was calculated by taking the average amount of order lines per order for all of the orders during that year. The cost per pallet was in in euros 7 €.

- **Handling outgoing goods**: For handling outgoing goods, the calculations were made in the same way as for handling incoming goods and an average between the same countries was calculated. The average cost for handling outgoing goods was 6€ per pallet.

- **Storage cost**: The storage cost differs depending on the characteristics of a product; ambient, temperature controlled or flammable. A generalization of the costs at different warehouses was used. The average stock level for a product, including the safety stock, was used in order to calculate how many pallets there are on average in storage. The cost was then calculated as:

\[ \text{Storage cost} = \text{Storage cost per pallet} \times \text{average stock level} \]

The average price for each characteristic is found in Table 13 below.

### Table 13: Storage cost depending on characteristic of the product.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Average cost [€]/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient</td>
<td>100</td>
</tr>
<tr>
<td>Flammable</td>
<td>120</td>
</tr>
<tr>
<td>Cold</td>
<td>130</td>
</tr>
</tbody>
</table>

The costs in the element inventory are shown in Figure 12 below. There are estimated values for the cost per pallet for the different characteristics. However, the user is going to enter the characteristics of the product being evaluated.

*Figure 12: The element inventory and its costs broken down in the way they are entered in the model. The values marked in green are to be entered by the user and the other values are estimated.*
TRANSPORT

The transport is divided into two different parts, inbound and outbound. The cost for inbound transport is usually higher than outbound, since there are incoming goods from different countries, while the outbound transport is usually within the same country as the warehouse. Due to differing cost of transport, depending on the number of pallets in the transport, the distance and the type of transport, it would take time to calculate the exact cost per product. Instead, a generalization was made to get an average cost per pallet.

- **Inbound transport:** The cost for the inbound transport was calculated as an average from the cost per pallet in the countries that are members of the European Union. The cost per pallet for each country was already documented by the Logistic Coordinator at Corporate. As a verification, a calculation was made for the transportation costs in the Nordics. The average cost per pallet in the Nordics was calculated by taking the average cost for transporting more than five pallets per transport from all the manufacturers delivering to the Nordics. The cost per pallet in the Nordics was the same as the cost per pallet for the Nordic in the calculations from Corporate. The average cost per pallet in the European Union is 160€.

- **Outbound transport:** It would be even more difficult to find the exact cost for a product for the outbound transport, since many kinds of products are consolidated in the same transport to the same customer. It was, therefore, decided to use an estimate for this cost as well. However, there was no data from Corporate available and the average is based on figures from the Nordic affiliate. The cost per pallet for outbound transport was estimated to 22€ and calculated as:

\[
\text{Cost per pallet} = \frac{\text{Total cost transporting pallets in 2015}}{\text{Number of transports in 2015} \times \text{pallets per transport}}
\]

The calculations and allocations for inbound and outbound cost for transport are shown in Figure 13 below.

![Figure 13: A conceptual model of how the cost for transport is calculated. The green boxes in the figure represents the values entered by the user in the model, the other values are estimated and already a part of the model.](image-url)
**PRODUCT**

- **Purchase price**: This cost will be found as the unit cost charged by the manufacturer for the product, which the user will enter into the model.

The purchased price is shown below in Figure 14.

![Figure 14: The purchase price is entered by the user in the model.](image)

**OTHER**

- **Artwork**: Since the cost differs depending on the product and includes several costs, such as printing plates and scrap from old material, the user will fill in the cost for the product being evaluated.

The name of the element other cost was in the model changed to additional cost. The name was changed to give the user the possibility to fill in more costs as it was assumed that there might be a cost that had not yet been identified, since the model is to work for about 6000 different products.

Below, in Figure 15 the element other is visualized.

![Figure 15: Artwork was the only cost found in the element other, the cost per year for the evaluated product is to be entered by the user.](image)

**Quality**

- **Regulatory department (pharmaceuticals and medical devices)**: The time that the employees are working can be allocated to the products according to Limrell (2016). A simpler form of ABC was used to allocate the costs. As there is at least one employee working with regulations at each affiliate, the cost for the regulatory department in the Nordics could be used to determine the average cost for the regulatory department per product. In the Nordics there are two employees working with Regulatory affairs and one person working half time. Their time allocation is 60 % on pharmaceuticals, 20 % on medical devices, 10 % on foods and 10 % on biocides. By looking at the number of products per category in the Nordics and by seeing what percentage of their time was spent on each category of products, a cost for time spent on each product could be determined. As there are 2.5 employees working with regulations, spending 60 % of their time on pharmaceuticals and 20 % on medical devices, where the amount of pharmaceuticals in the Nordics are 100 and there are 70 within medical devices, this means that the cost per year is:

\[
\text{Cost per year for pharmaceuticals} = \frac{2.5 \times 0.6 \times 70300\text{€}}{100} = 1055\text{€}
\]

\[
\text{Cost per year for medical devices} = \frac{2.5 \times 0.2 \times 70300\text{€}}{70} = 502\text{€}
\]

- **Annual fees**: The cost for pharmaceuticals was calculated to 1981€ based on the average cost in the Nordic countries, since the cost occurs in each country where it is sold. Since the study has the Nordic affiliate as an example, this is the cost that will be used in the model. However, it will...
be possible for the user to change the value. For medical devices and cosmetics, the fee only appears in the country where the product was produced. For a medical device this cost is, according to Limrell (2016), 164 € per product in Sweden and should be similar in the other European countries. The cost for a cosmetic product was found to be 66 € (Läkemedelsverket, 2016c).

- **Audit**: An audit is normally done by two auditors. It takes about five work days per person, which includes several steps before, during and after the audit. Before the audit, one day is needed for planning and review of the documentation regarding the manufacturer. One day is necessary for travel back and forth to the manufacturer. Two days are needed for the audit. And then one day is spent writing a report. (Nord, 2016) Since the audit is normally done by two people this means that it takes ten work days to conduct an audit every three years for products belonging to the categories medical device and pharmaceuticals. For cosmetics, the audit was conducted on average every four to five years. It was decided to use every five years, since the audit is only conducted when the auditors for the two other categories have time left over and since Omega is not obliged to audit cosmetics for regulatory reasons. The cost of transport to and from the manufacturer, within Europe, can be estimated at 200€ per person for flights, the estimated cost for taxi rides during the visit is 100€ and a hotel night is estimated at 100€ per person. Therefore, the total cost for transport and hotel is:

\[
\text{Cost of travel} = 200 \times 2 + 100 \times 2 + 100 = 700 \, \text{€}
\]

The audits costs per year and manufacturer:

\[
\text{Audit (Pharmaceuticals and medical devices)} = (70300 \times \frac{2}{52} + 700) \times \frac{1}{3} = 1135 \, \text{€}
\]

\[
\text{Audit (Cosmetics)} = (70300 \times \frac{2}{52} + 700) \times \frac{1}{5} = 681 \, \text{€}
\]

- **Product quality review (pharmaceuticals)**: This is done once a year for pharmaceutical products and takes an hour. The cost is, therefore, 33.8€.

- **Review quality agreement**: To review the quality agreement takes about 24 hours per product and is done every three years. (Hoegenart, 2016) The cost is therefore:

\[
\text{Review quality agreement} = \frac{24 + 33.8}{3} = 270 \, \text{€}.
\]

- **Stability studies (pharmaceuticals)**: This cost is about 2000€ per year for each pharmaceutical product to be paid to the manufacturer. (Hoegenart, 2016)

All costs in this element are shown in Figure 16 below. The user has to fill in what category the product belongs to.
**Supply Manager:** In the Nordics there are five supply managers who in general spend 10% of their time on the manufacturers of products in the tail. ABC was used to allocate this cost. This means that the cost for the manufacturers of products in the tail was:

\[ \text{Supply manager (per manufacturer)} = 70300 \times 5 \times 10\% = 35150€ \]

The manufacturers of products in the tail represented 16% of the manufacturers used in the Nordics and it was assumed that the same percentage of the products would be products of the tail. As there are 500 products in the Nordics, this means that the products in the tail in the Nordics are:

\[ \text{Products in the tail} = 500 \times 16\% = 80 \]

The cost of 35150€ can therefore be allocated to those 80 products which leads to:

\[ \text{Cost per product in the tail} = \frac{35150}{80} = 439€ \]

**Demand Planning Manager:** In the Nordics there are three demand planners responsible for the 500 products, they need to spend time forecasting each product. Even though there is some difference regarding how much time is spent on different products, this time has not been
recorded and the same tasks are to be done for all products. Therefore, there is not a clear differentiation in time spent on products in the tail and it has been assumed that all products take the same time. The cost per year of the three employees was, therefore, allocated onto the 500 products. This means that the cost becomes:

\[
Demand \ planning \ manager \ cost \ per \ product = \frac{3 \times 70300}{500} = 422 \ €
\]

The administrative costs are allocated in the way shown below in Figure 17.

**CASE 2: STOP PRODUCTION OF PRODUCT**

The costs identified when cancelling the production of a product were; scrap and for pharmaceutical products stability studies. Since the costs vary depending on product, the values of the costs will be entered into the model by the user for the product that is being evaluated.

When a product is no longer being produced, costs related to time disappear for the product. For instance, the demand planner no longer needs to do forecasts for the product. However, costs related to time do not actually disappear for Omega when a product is canceled. This is because the employee performing the task that is no longer needed still has several other tasks to perform and still receives the same salary. The internal cost visualizes time that employees have to put into the product and when a product is cancelled, that time can be used differently, for instance to do more qualitative work towards the other projects or to work strategically.

It was decided that the main focus of Case 2 would be to make the user of the model aware of costs from Case 1 that would still exist when production of the product was stopped because the costs were indirect costs or cost of time. For the indirect costs related to a manufacturer, audit and supply manager, time and costs that would be saved would only be visualized if the product was the only product at the manufacturer. Even though the cost for the supply manager is calculated per product, it will be allocated onto the remaining products. In other cases, the costs will be allocated onto the products still being produced at the manufacturer.

The costs that was identified when cancelling a product are shown below in Figure 18.
CASE 3: MOVE PRODUCTION OF PRODUCT

The costs that appear when transferring a product to a different manufacturer are both costs for starting the production line at the new manufacturer but also some costs that remain due to the old manufacturer, at least for pharmaceutical products.

- **Transfer offer from manufacturer:** When Omega considers a different manufacturer for a product, the manufacturer sends them a cost for the transfer. This cost will have to be entered by the user in the model. For pharmaceutical products the transfer offer includes, amongst other costs, **stability studies**.

- **Internal costs:** There are costs arising internally at Omega when transferring a product. Since every transfer is unique, the time spent on a transfer varies. Therefore, the user could either enter an estimated value of the internal costs or investigate further which roles are included in the transfer and how much time a transfer takes internally. A role within the company, at Corporate, that is a hundred percent toward transfers is the role of the technical transfer. It was estimated by the head of the technical transfer team that 60-80 hours is spent by them on each transfer. In the model the 80 hours will be used since it will then also cover some of the job done by other employees. Therefore, the internal cost for the technical transfer employee will be:

  \[ \text{Cost of technical transfer for a transfer} = 80 \times 33.8 = 2704 \, \text{€} \]

  The cost of the technical transfer employee will be entered into the model beforehand. However, the user can fill in an estimation for the other internal costs as well.

- **Variation fee (pharmaceuticals):** The variation fee for the transfer of a pharmaceutical product is to be entered by the user.

- **Other costs arising at a transfer** are **artwork, scrap from material remaining at previous manufacturer** and **stability studies at the previous manufacturer**, which the user has to fill in.

All of the costs above are costs that arise due to the transfer of the product and the investment for the transfer. In order to evaluate the transfer, the breakeven of the transfer is used by calculating the ROI. Omega usually calculates ROI in the way shown below, in order to understand how many years it will take before the investment reaches breakeven. The same equation will be used in the model.

\[
\text{ROI} = \frac{\text{Investment}}{(\text{total cost at previous manufacturer} - \text{total cost new manufacturer})}
\]

The other costs that were identified for Case 1, remains when transferring a product. The only cost that will change from Case 1 is the purchase price. The other costs are estimated to remain the same even if a transfer is performed, although, for example, transport will change in reality. This is because the studied system is still considered the same, for instance, the same amount of pallets will be sent and the cost per
pallet is an average calculated for all of Europe. The indirect costs, audit and supply manager, are to be distributed on to the remaining products at that manufacturer, in the same way as for Case 2. If there is only one product produced at the manufacturer there is time saved for the supply manager, since the new manufacturer does already have a supply manager for the communication with the manufacturer.

The costs identified when transferring a product are summarized in Figure 19.

Sub question 6.5: How are the parameters of manufacturer performance going to be presented?

There are four parameters found to represent the manufacturer performance, they are quality, delays, communication and flexibility. The questions for these parameters are to be filled in openly by the user or by another employee that has more knowledge in the area, for example Quality.

- **Quality**: The parameter quality is to be answered in two steps. The question is to be answered at first with yes or no and secondly with an open answer. This gives the user the possibility to explain why the quality was not fulfilled and give a general opinion on the quality of the manufacturer. A recommendation for the user is to let an employee from the quality department answer the question since they often have better knowledge in the area.

  **QUESTION QUALITY: DOES THE MANUFACTURER MEET THE QUALITY REQUIREMENTS? EXPLAIN FURTHER**

- **Delays**: The user will enter if the manufacturer is late with their deliveries and also evaluate if this has had a negative effect on Omega in any way.

  **QUESTION DELAYS: DOES THE MANUFACTURER DELIVER THE PRODUCTS ON TIME, IF NOT WHAT ARE THE REASONS FOR THIS AND HAS IT AFFECTED OMEGA NEGATIVELY?**

- **Communication**: In order to evaluate communication, the user of the model will have the possibility to fill in how they perceive the communication with the manufacturer. The focus will
mainly be on whether it is easy to communicate with the manufacturer and if there is transparency between the two companies. It should also be answered if communication is an obstacle worth considering.

**Question Communication: How is the communication with the manufacturer, is it easy, transparent or complicated and how does it affect the relation?**

- **Flexibility:** The user will have to fill in their perception of the manufacturer’s flexibility and what it implies.

**Question Flexibility: Is the manufacturer flexible and to what extent?**

### 6.3.1 Created model

The model was created in Excel with one sheet for each of the three different cases, as well as one sheet explaining all estimations in the model. To make the model user-friendly all fields where the user is to fill in a value is marked in green. In total there are 12 costs included in the seven cost elements. The revenue and other general product data is to be filled in to the left, SKU stands for Stock kept units at Omega, which is referred to as the product in the report. To get an overview, the result of the evaluation is shown on its own sheet where the parameters of manufacturer performance are presented as well. The sheet of Case 1 and the sheet for the result are illustrated below in Figure 20 and Figure 21. Illustrations for Case 2 and Case 3 can be found in Appendix 2 - Illustrations of the model.
### COLLECTED INFORMATION AND ANALYSIS

#### Figure 20: An illustration of the sheet for Case 1.

<table>
<thead>
<tr>
<th>SKU1</th>
<th>Fill in the green cells</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manufacturer information</strong></td>
<td><strong>Profitability [year]:</strong> 0,00</td>
</tr>
<tr>
<td>Name:</td>
<td></td>
</tr>
<tr>
<td>Number of SKUs:</td>
<td></td>
</tr>
<tr>
<td><strong>SKU information</strong></td>
<td><strong>Margin (1-cost/revenue):</strong></td>
</tr>
<tr>
<td>Name:</td>
<td></td>
</tr>
<tr>
<td>SKU number:</td>
<td><strong>Product cost % of total cost</strong></td>
</tr>
<tr>
<td>Demand per year [pcs]:</td>
<td></td>
</tr>
<tr>
<td>Revenue per year [l]:</td>
<td></td>
</tr>
<tr>
<td>MOQ [pcs]:</td>
<td><strong>Total cost [year]:</strong> 0,00</td>
</tr>
<tr>
<td>Units per pallet:</td>
<td></td>
</tr>
<tr>
<td>Safety stock [days]:</td>
<td></td>
</tr>
<tr>
<td>Average stock level [pallets]:</td>
<td></td>
</tr>
<tr>
<td>Pallets per year</td>
<td><strong>Warehousing cost:</strong> 0,00</td>
</tr>
<tr>
<td><strong>Inventory cost</strong></td>
<td>Handling incoming goods 0,00</td>
</tr>
<tr>
<td>Category of SKU</td>
<td>Handling outgoing goods 0,00</td>
</tr>
<tr>
<td>Mark with:</td>
<td>Storage 0,00</td>
</tr>
<tr>
<td>Pharmaceutical</td>
<td></td>
</tr>
<tr>
<td>Medical device</td>
<td></td>
</tr>
<tr>
<td>Cosmetic</td>
<td><strong>Transportation cost:</strong> 0,00</td>
</tr>
<tr>
<td>Characteristics of SKU</td>
<td>Inbound</td>
</tr>
<tr>
<td>Mark with:</td>
<td>Outbound</td>
</tr>
<tr>
<td>Cold</td>
<td></td>
</tr>
<tr>
<td>Flammable</td>
<td><strong>Quality cost:</strong> 0,00</td>
</tr>
<tr>
<td></td>
<td>Category specific 0,00</td>
</tr>
<tr>
<td>Audit</td>
<td>0,00</td>
</tr>
<tr>
<td>Annual fee</td>
<td>0,00</td>
</tr>
<tr>
<td>Hours spent</td>
<td><strong>Administrative cost:</strong> 0,00</td>
</tr>
<tr>
<td>Cost</td>
<td>Supply manager 0,00</td>
</tr>
<tr>
<td></td>
<td>Demand planner 0,00</td>
</tr>
<tr>
<td></td>
<td>0,0</td>
</tr>
<tr>
<td></td>
<td>0,0</td>
</tr>
<tr>
<td></td>
<td>0,0</td>
</tr>
<tr>
<td>Additional costs:</td>
<td>Artwork</td>
</tr>
</tbody>
</table>
6.4 **STEP 4—TEST RUNS**

*Question 7: Does the model need further development?*

In order to be able to evaluate if and in what areas the model needs further development, test runs and sensitivity analyses are performed as well as discussions with employees at Omega. The supervisor at Omega has reviewed the model in order to see to that it is user friendly and that nothing is wrong or missing. It is, however, difficult to fully ensure that the model fulfils its purpose since it was not possible to test it on all products in the tail. Test runs and sensitivity analysis are further explained below.

6.4.1 **Test runs**

In order to test the model, three different products were tested in it, one from each category. This resulted in fine tuning of what unit the different costs and parameters should be in. It was also a way to test if the model was user friendly and where explanations were needed. For example, the safety stock is now...
measured in days and not in units, as was first expected. The calculation was then changed so that the user could enter the number of days of safety stock and the model will convert it to the number of pallets and units in the warehouse, in order to calculate the cost of tied up capital and storage cost. Another example is the value of the average stock level, which is not documented by the company. Instead, the user will fill in the ordered quantity, the safety stock and the purchase price. With these values, the model will be able to calculate the value of the average stock level. It has also been made clear in which unit the values in the model are to be entered in, in order to avoid misunderstandings.

For all estimations, explanations were added in order for the user to know how they were calculated and when it is recommended that they should update them. The test runs are performed for Case 1 and data for all parameters that is needed in the model is gathered from Omega, except for the cost for artwork. This is a cost that the user of the model will be able to fill in when they are using the model, but it is not included here. For Case 2 and 3 there was no data documented for these situations in the past. That is why they were not tested. However they were reviewed by the supervisor at Omega in order to ensure that the cases was user friendly and that the units of measures are correct. For each product tested, a diagram was made to show the percentage of different costs of the total cost. A second diagram for the products was also made, where only the logistics costs are shown. See Figure 22, Figure 23, Figure 25, Figure 24, Figure 27 and Figure 26 below.
From the tables above it is clear that the product cost is the largest cost for all categories of products. All other costs are significantly smaller and does not affect the total cost as much. However, in the figures for the logistic costs the cost for transport and the cost for warehouse keeping are the highest. This could be related to what Bloomberg et al. (2002) states, that the transportation cost could account for 50 % or more of the total logistics cost. This could mean that the estimations of the transportation costs could be worth doing more exact in order to take more costs into consideration and to look more in detail on how the transportation cost depend on the characteristics of the product.

6.4.2 Sensitivity analysis

1. IDENTIFY ALL POSSIBLE SOURCES OF ERROR

Within the model there are several sources of error, for instance every time that an estimation has been made. The sensitivity analysis has been delimited to Case 1, since most of the estimations are found for Case 1 and it is the base of the model. The estimations are found in Figure 28, where the unit is cost per year or cost per pallet, depending on element.
Sources of error found in the estimations was the estimations of costs for inventory and transport as well as the internal costs for labor and time spent, which was used within the elements administrative and quality.

2. **CHOOSE THE MOST CRITICAL SOURCES OF ERROR**

From the estimations in Figure 28, the areas within which the sources of error appear are costs measured in cost per pallet, the costs related to time spent and the cost per hour.

The cost of inbound transport was chosen as the most critical source of error within the area cost per pallet. It was chosen as the cost to investigate further, since it was the cost connected to pallets with the highest impact on the total cost. The source of error within the inbound transport is that it is estimated using the averages of all inbound transports to European countries. It does neither take into consideration the percentage of the transport that is going to the different countries, nor that for some countries the cost is much higher than in others. For this cost to be truly accurate it would have to be calculated for
each route, since differences such as the amount of pallets transported and the distance also affect the price.

The cost with the highest impact on the total cost, within time, was the cost per audit and was therefore chosen for further analysis. The cost for audit varies depending on the person performing the audit and how far away the manufacturer is. The time spent could vary depending on how efficient the auditor was, as well as how easy the manufacturer was to audit and the traveled time. The cost also contains the sources of error cost for transport and for staying overnight, where different costs appear for different destinations.

When it comes to the hourly cost, this affects all the costs related to the time spent. Since it was estimated based on the four countries where the most amount of Omega products were sold, it could vary greatly in other countries.

3. **CHOOSE ALTERNATIVE VALUES**

All three chosen sources of error were changed by making them 20 % and 100 % larger. Since the costs are linear, the same percentage of change would occur for the same negative magnitudes. Making negative percentage changes will, therefore, not be done. This was decided in order to see how both a small and a bigger change would affect the value.

4. **TEST HOW THE ALTERNATIVE VALUES AFFECT THE RESULT FOR A SPECIFIC VALUE OR FOR SEVERAL**

The same product was chosen for doing all of the analysis, in order to be able to compare the results. The product chosen was within the category medical device. Below, in Table 14, Table 15 and Table 16, the results from the sensitivity analysis are shown.

<table>
<thead>
<tr>
<th>Table 14: The sensitivity analysis of the inbound transport.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inbound transport cost per pallet</strong></td>
</tr>
<tr>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Inbound transport cost per pallet</td>
</tr>
<tr>
<td>Cost for inbound transport</td>
</tr>
<tr>
<td>% change total cost</td>
</tr>
<tr>
<td>% change logistics costs</td>
</tr>
</tbody>
</table>

If the transport cost per pallet was to be double of the estimated value for a product, it could have a significant impact on the logistics cost that would augment by 17.20 %. When looking to cut logistics costs, it is a cost worth considering. The change on the total cost would on the other hand be small. Since an augmentation of the cost by a 100 % is a worst case scenario, it is not likely to happen and a change in the worst case of 1.24 % on the total cost is not significant. If the estimation is faulty, it would still not affect the overall result.
When it comes to audit of a medical device, the estimation could have an impact on the % change quality. This is because the audit represents about half of the quality cost for a medical device. The % change total cost if the cost for audit would augment with 100 % is of 1.8 %, which is of the same magnitude as for the impact of the inbound transport on the total cost. Therefore, following the reasoning for inbound transport a different plausible value for audit cost would not affect the overall result.

Within quality and admin, the only costs that are not affected by the hourly cost are the costs for the annual fee and the transport and hotel cost within audit. In other words, these two elements are significantly affected by the hourly cost. For instance, this can be seen as the % change quality and admin increased to 86.52 % when the hourly cost was augmented by 100 %. When the hourly cost increased by 20 %, the cost for the elements went up 17.3 %. This means that the cost for quality and administration will be affected and change with a similar magnitude to the change in hourly cost. When it comes to the hourly cost, this was estimated for the four countries where Omega have the largest affiliates and is rather high compared to the European average of 24.5 €. The risk of the hourly cost being higher at another affiliate is, therefore, low. However, the probability is higher that the hourly cost would be lower than what has been estimated. A lower value would mean that the category of product would have less impact on the total cost and therefore not mean that the evaluation of the product would be any different.

The conclusion from looking at the results of the three most important sources of error is that the model is rather robust and a change of reasonable magnitude of an estimated value does not affect the model and the evaluation of the model. The only time where the change of the total cost was somewhat significant was when the hourly cost was doubled. The change was then somewhat above 4 %. For the different elements changes in estimations could however have an effect.
7 CONCLUSION

The purpose of this study was to:

Create an evaluation model based on revenue, total cost and manufacturer performance to evaluate a product and if cost reductions can be achieved by ending the production of the product or moving the product to a different manufacturer.

To answer the purpose and in order to create an evaluation model, the modified steps by Oskarsson et al. (2013) were followed. The first step was to identify costs for the three cases, the revenue and parameters of manufacturer performance. The costs that were initial, could not be estimated in the future, or that were difficult to calculate and had a negligible impact on the total cost were delimited. In the model, some costs are to be entered by the user. The other costs are generalized and estimations have been calculated to be part of the model, in order to make the model easier to use. Finally, the model was tested and sensitivity analyses were made.

From the sensitivity analysis it was concluded that further development of estimations could be done, for example in the element transport. From the test runs, it can as well be seen that the transport cost represent more than 20% of the total cost of logistics. The transport cost could be further developed to vary depending on the distance of the transport instead of the number of pallets. In that way it would also be possible to see a difference in the transport when transferring a product. As the model was developed, the only change that occurs when transferring a product is the purchase price. However, in reality, there are several other costs that change as well such as the cost for the inbound transport. The cost for products becoming obsolete could also change if the new manufacturer has a higher manufacturer performance. However, it is not possible to calculate a new cost for products becoming obsolete at the moment that the product is evaluated. The annual fee could also change if the product is transferred to a different country with a different fee. Even though the result is not exact, the result of the model gives an approximate value for the product costs and also the possibility to evaluate what should be done strategically with a product. Therefore, the model fulfills its purpose.

The evaluation model works for calculating the profitability of a product, as well as calculating the difference in the total cost if the production is cancelled or moved for the product. The model is adapted to work for the categories pharmaceuticals, medical devices and cosmetics. It will make it possible for Omega to evaluate products and, in the long run, reduce the amount of products in the tail and their supplier base. By reducing the supplier base, Omega will not only save costs but also save time internally that could be spent on more strategically important products and manufacturers. By looking at the answers from the test runs, the conclusion can be drawn that Omega can reduce the largest amount of costs by reducing the purchase price of a product. This can be done either by negotiations with the current manufacturer or by moving the product to a cheaper manufacturer. The internal cost for transfer is to small to take into consideration, even though one must keep in mind that the estimated value does not include all employees working with transfers. In other words, it is more profitable for Omega to transfer products than to try to save costs internally. The internal costs for transfer could be further mapped by Omega, in order to further evaluate the model and to get a better estimation on the cost. This could be done by recording the time spent on future transfers of the different categories of products and to add the values in the model. The fact that the purchase price represented the largest cost shows that the
largest saving potential is in the purchase price. However, when looking at the logistics costs, both warehouse keeping and transport are important parameters. Therefore, it would be a good idea to further develop the cost for transport, in order to have a more exact estimation. The other estimations should be useful in order to get an easy evaluation and give an idea of the magnitude of the costs.

The evaluation model brought forth in this study can also work as a base for other companies working with pharmaceuticals, medical devices and cosmetics. This is possible, since the standard total cost analysis model has been adapted to work for this industry as the element of quality has been added. This could help similar companies to evaluate the total cost and revenue of their products and to also evaluate their products with the possibility of supplier base reduction.
When creating an evaluation model that can be used for all products of a complex company, cost estimations help the user since it enables simpler and faster decisions. The company should always consider to what extent time spent mapping and calculating costs give an advantage compared to just having the products in the system. By using the evaluation model created in this study, the company does not have to spend as much time evaluating each product since the estimations can be used. This will save time compared to calculating values each time. The risk with a time-consuming model, is that it will not be used at all or that only a few costs will be entered. From the sensitivity analysis it was well concluded that even if the estimations were significantly larger than calculated values, it would not have an impact on the evaluation of the product. The expectation is also that it will be easier for the company to use the model as more affiliates implement SAP. This will enable more affiliates to measure and document data in the same way and for one person to be able to access all information. Since Omega continues to make acquisitions every year, using the model could also give more time to the new products and less time allocation to products in the tail. Today, products in the tail take up unnecessary time even though they are not strategic.

In order to make generalizations, it was decided that estimations were to be done for products in the tail. That the estimations were delimited to that type of product was necessary in order for uniform estimations to be made and, for instance, to delimitate what administrative work should be a part of the model. However, it is said in the purpose that the model is created so that it can be used for all of Omega’s products and that the majority of the estimated costs could probably be used for other products as well. For instance, for inventory and transport costs no regard has been taken to the fact that the products are products in the tail. For internal costs, there would have been several additional costs if the delimitations to products in the tail had not been done. As an example, this would have been the case for the roles of marketing and sales. It could be of interest for future development of the model to map and generalize costs for another type of product as well. Since the focus of the company for now is to evaluate products in the tail and reduce their supplier base, it is sufficient that the estimations are calculated with focus on products in the tail. If the user wants to use the model for another type of product and feels that it would add value for the evaluation, they can continue to develop the model.

An alternative for how the administrative costs could have been identified and used for the model could have been by taking the overhead costs for all the administrative work at the company and allocating them onto the different products. However, this would not really give a just value since there is an enormous complexity to figure out what percentage of costs should be allocated to what product, doing a thorough ABC analysis would have been necessary. According to De Nil (2016) overhead costs are impossible to distribute per brand, instead it is done per department. Therefore, the focus of the study was exclusively on the roles at the company that could be directly linked to a product or manufacturer. In order to avoid distributing overhead costs in the element of quality, where Hoengenaert (2016) stated that breaking down costs onto product level, for the quality employees, is difficult since they often look at different categories and brands, this was done by identifying activities instead.
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REFERENCES


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REFERENCES

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Limrell, Karin, Senior Regulatory Affairs Manager at Omega Pharma Nordic, 2016.
Nord, Anneli, Head of Quality Assurance at Omega Pharma Nordic, 2016.
Nordin, Marie, Supply Director at Omega Pharma Nordic, 2016.
Patterson, Chris, Senior Director International External Operations & UK Procurement at Perrigo, 2016.
Stoop, Wim, Corporate Supply Manager at Omega Pharma, 2016.
Söder, Veronica, Group Supply Operations Director at Omega Pharma, 2016.
Toukal, Linda, Value Chain Manager at Omega Pharma, 2016.
Tytgat, Maureen, Plant Manager at Medgenix, 2016.
Wickberg, Mattias, Supply Manager at Omega Pharma Nordic, 2016.
Wistedt, Edward, Key Account Manager at Omega Pharma Nordic, 2016.
APPENDIX

APPENDIX 1 - INTERVIEW QUESTIONS
1. Ask questions about what they do, expertise!
2. (What elements do you have further knowledge about?)
3. What costs do you think about in this cost element? (the ones within their focus area, First generally and then one case at the time)
   4. Except for costs, are there any other important factors to consider when looking at the manufacturers performance?
5. Specifically for administrative costs, make sure to go through all other elements. And fill in question 8-13. Make sure the costs occur at Omega
6. (Are there other costs that do not fit into these cost elements that are important?)
7. Here are the costs from the literature, which ones do not apply in this case?
   8. With what words are these costs described at Omega?
9. Are there any product category specific costs?
10. Where can we find data about the different costs, Are the data available?
   11. What costs can be generalized and what costs need to be calculated for every specific case?
   12. How are the costs generalized or calculated? What amount of work would be needed?
   13. If not - How can the cost be estimated or calculated? The interviewee or other employer must help us to estimate the cost.
   14. What costs can be eliminated because they require a lot of work but do not have a noticeable impact on the result?
15. What is a good way to measure this unit, what is creating costs?
16. Are there any other costs to think about when moving the production to another manufacturer or when a production of a product is stopped?
17. (What costs do you think should be under each other element? (Not the one in their area))
### APPENDIX 2 - ILLUSTRATIONS OF THE MODEL

<table>
<thead>
<tr>
<th>SKU1</th>
<th>Fill in the green cells</th>
</tr>
</thead>
</table>

#### Manufacturer information
- **Profitability:**
  - **Total cost:**

#### SKU information
- **Remaining costs at manufacturer**
  - **Product cost:**
    - Purchase price
    - Scrap
  - **Warehousing cost:**
    - Tied up capital
    - Products becoming obsolete

#### Inventory cost
- **Category of SKU**
  - Mark with X:
    - Handling incoming goods
    - Handling outgoing goods
    - Storage
- **Characteristics of SKU**
  - Mark with X:
    - Transportation cost:
      - Inbound
      - Outbound

#### Quality cost:
- **Category specific**
- **Audit**
- **Annual fee**

#### Administrative cost:
- **Supply manager**
- **Internal cost for cancellation**

#### Additional costs:
- **Artwork**

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*Figure 29: Case 2 - ending the production of a product.*
Figure 30: Case 3 - move the production of a product.