Considering non-supported information on logistics costs when self-developing ERP-systems

A case study in a manufacturing organization

David Da Silva Sampaio
Considering non-supported information on logistics costs when self-developing ERP-systems - a case study in a manufacturing organization


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Härmed intygas att allt material i denna rapport, vilket inte är mitt eget, har blivit tydligt identifierat och att inget material är inkluderat som tidigare använts för erhållande av annan examen.

Signerat: _______________________________
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Abstract

Logistics and Information System Development are hot topics in today’s business world. Although many studies have been conducted on these two areas, information about logistics costs is still lacking in many companies. Information Systems are tools that, if properly developed, aid organizations in processing data and providing information with speed, accuracy and quality to its intended users. A lacking in the relation between the business world and the Information System’s world was apparent in a studied company’s self-developed Enterprise Resource Planning system, where information about logistics costs was neglected. A case study made in this same studied company, show the importance of seven different logistics costs types and its related information. Using the analysis of the material gathered from both literary work and this case study, it was determined what information about logistics costs is neglected by the manufacturing organization’s self-developed ERP-system. Finally, it was concluded what information on these logistics costs that should be considered by manufacturing organizations for facilitating the understanding of total product cost of specific products and which may not be supported by these systems.

Key words: Information Systems, Information Systems Development, Logistics, Enterprise Resource Planning systems, Logistics costs
List of Abbreviations

CEO………………….Chief Executive Officer
ERP-system…………Enterprise Resource Planning System
IS…………………….Information System
ISD…………………….Information System Development
IT…………………….Information Technology
UML…………………….Unified Modeling Language
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1 Introduction

In this first chapter, the problem area for this thesis is introduced (section 1.1). The aim and objectives are presented in section 1.2 and the purpose of this thesis is stated. In section 1.3, the intended target groups for this thesis are listed. Finally, the delimitations of this thesis are presented (section 1.4).

1.1 Problem area

Understanding the total costs of a product is a difficult task since many costs are difficult to understand and store. It can for example be hidden costs which take much time and effort to determine, such as handling costs or transportation costs, among others. That is why many companies choose not to analyze all costs existing in a company (Oskarsson et al. 2006). Although not all costs are easy to understand, it is still better to try to gain an understanding of those which can easily be understood.

Around fifty percent of the total product cost consists of logistics costs (Fredholm, 2004). Bjornland et al. (2003) actually mean that up to eighty percent of the total costs of an industrial organization are logistics costs. In the United States of America alone, the logistics costs rose eleven percent from the year 2005 to 2006 (Blanchard, 2007). These logistics costs continue to rise at a fast pace. A company which has no information on its logistics costs cannot understand the whole logistics picture and consequently analyze the economical situation of the company (Oskarsson et al. 2006). Unfortunately, this situation occurs often in today’s organizations (Ibid). To understand the calculation involved in defining total product cost, reliable information is needed by organizations, mean Oskarsson et al. (2006).

To facilitate the reliability, as well as accuracy and speed of information being sent and received in organizations, Information Systems (IS) may be used. A type of IS used in many business companies is the Enterprise Resource Planning system. These systems can be bought as a standard or be self-developed for the specific company. Although standardized ERP-systems are becoming considerably less expensive to buy, more common and flexible, many companies still see them as expensive to maintain and adjust to fit the organization’s goals (Fredholm, 2006). Additionally, a successful self-developed ERP-system that can in fact support a company’s organizational goals can prove to be a great competitive factor for the company that uses it (Ibid). Therefore, some companies rather choose to build their own ERP-systems because it is more customized to fit the company (Fredholm, 2006).

A problem with developing customized systems is that certain parameters and functions are neglected because the coupling between business and Information System Development needs to be further analyzed and strengthened (Beynon-Davies, 2002).

1.2 Research aim and objectives

As can be seen in the previous section, this thesis deals with the areas of Logistics and Information System Development. Based upon the problem area, stated in the previous section, the aim of this thesis is to answer the following question:

What information about logistics costs, not supported by manufacturing companies’ self-developed ERP-systems, should be considered by these organizations and
included in these systems for facilitating the understanding of the total cost of specific products?

In order to help answering the main question, two objectives have been stated:

1. What information about logistics costs should be taken into account by manufacturing companies for understanding the total cost of specific products?
2. How well prepared are manufacturing companies’ self-developed ERP-systems for supporting information about logistics costs, so that the understanding of the total cost of specific products can be facilitated?

Figure 1. Problem area (own creation).

As can be observed in figure 1, and based upon the objectives and research aim mentioned above, an interrelation exists between the Logistics and Information Systems Development areas, to achieve the goal of facilitating the understanding of total product cost in organizations. Circle number 1 involves logistics costs and coincides with the first stated objective. The circle with the number 2 engraved, represents ERP-systems’ development, which correspond to the second objective. Together, these two objectives will answer the research aim, stated above.

Appendix 1 shows a more detailed picture of the entire problem area determined in section 1.1. It also includes where in this process this thesis’ objectives and research aim lie. The problem area starts out with an ERP-system user who wishes to find out what the cost of a determinate product is. To acquire such information, the user can utilize the ERP-system in which this information should be supported. But this is only possible if the ERP-system is developed in a way that the information concerning logistics costs is included in the system. Some information about logistics costs may not be supported by the systems and is especially important for manufacturing organizations to consider when self-developing their ERP-systems. It is in this process that the research aim of this thesis lies.

The IS developer will first need to understand whether the organization’s currently used ERP-system supports this information on logistics costs. This is the second objective defined in this thesis.

For being able to understand the requirements needed by the system, it is important to first understand what information concerning logistics costs should be taken into account by the organization in the first place. The organization can for example be business managers which hold that information and understand both how the
organization works and where costs may exist. This process is therefore the first objective stated in this thesis.

Being able to self-develop ERP-systems which support commonly neglected information on logistics costs will hopefully, let organizations gain a better understanding of these costs and make better decisions based upon this information. This is thus the purpose of this thesis.

1.3 Target groups

This thesis addresses those who work, directly or indirectly, with logistics costs and would like to understand how information about these costs is supported by the used ERP-systems. This thesis also addresses those who understand the importance of making these logistics costs visible and wish to make them noticeable in an organization. Sales representatives, Logistics managers and CEOs are examples of target groups within an organization, which would benefit from this thesis.

IS analysts are also a target group for this thesis because it is vital, in the development of an Information System, to understand the connection between the business world and the world of Information Technology. It is important to understand the organization’s goals and opportunities, as well as understanding the existing Information Systems used and how these can be used to aid the organization achieving these goals (Stair & Reynolds, 2005). This implies understanding how the business world works and transforming its true needs into requirements for the Information Systems (Fredholm, 2004).

Another target group are fellow colleagues in the areas of Logistics and Information Systems Development, which are interested in a further study of the problem domain. Finally, this thesis intends to hopefully help these target groups gain a better understanding of the problem area and develop new insights and knowledge.

1.4 Delimitations

The two chosen areas of study in this thesis are the Logistics and Information Systems Development areas. These are considered to be fairly extensive study areas with many processes, concepts and ideas. The Logistics area deals with the entire material and information flow of a product or service from the point of origin until the point of consumption (Bjornland et al. 2003). This thesis will only focus upon the costs which are related and which derive from these logistics activities, i.e. the logistics costs. Logistics costs can also be associated to Industrial Economics where numbers and calculations are predominant. This thesis, on the other hand, does not focus on numbers or calculations. It focuses on the information needed to understand these logistics costs. Although different types of logistics costs affect each other in some way (Aronsson et al. 2003), this relation will not be focused upon in this thesis.

Information Systems Development involves the entire process of analyzing, designing, implementing, testing and maintaining an Information System. There are many iterative steps during this process. Although all different steps ultimately will have an impact on the reliability and usage of the system, this thesis only concentrates on analyzing a self-developed ERP-system and how it supports information about logistics costs. It also concentrates on analyzing what information about logistics costs, which may not be supported by self-developed ERP-systems, should be considered when developing the actual system.
While Logistics and Information System Development are a part of every kind of organization, in this study, the focus will lie only on manufacturing organizations. This is mainly because, based upon a personal opinion, manufacturing companies have a more traditional and detailed view on logistics than service companies. This because of the production and storage costs, as well as the short product cycle in some organizations, which makes an understanding of their logistics costs all the more important for determining total product cost of their products and gaining competitive advantage in the marketplace.

As later can be viewed in section 3.1.2, this thesis has its focus on a manufacturing organization that has a traditional view on logistics and which self-develop its ERP-system, in accordance with the delimitations of this thesis. The proximity and size of this organization is also a delimitation to consider. It is an advantage in an economic aspect that the organization is not far so as to be able to study the organization on several occasions. Having the time limitation for this thesis in mind, it is also an advantage that the organization is small with no more than thirty employees. This in order to facilitate its study.
2 Background

This thesis involves two large areas, namely the area of Logistics and the area of Information System development. This chapter is therefore divided into two large sections. Section 2.1 explains concepts dealt in this thesis in the area of Logistics. Section 2.2 explains and deals with concepts found in the Information Systems Development area. There is also an additional section that summarizes this chapter (section 2.3).

2.1 Logistics

This section explains different concepts in the area of Logistics, associated with this thesis’ problem area. The term total product cost is explained in section 2.1.1, together with a justification as how this cost can be viewed and divided. In section 2.1.2, the wide concept of Logistics will be explained, where it will also include the vision on Logistics from this thesis’ point of view.

Section 2.1.3, explains the different types of logistics costs. It illustrates how different literary works describe the existing types of logistics costs in manufacturing companies and the related information needed to understand these costs. As will be explained in the chapter 3 (Method), this section functions as the first step to answer this thesis’ research aim. It also functions as an input for when gathering material in the studied company, for determining the logistics costs information to take into account by the organization, and thus answering the first objective stated in this thesis.

2.1.1 Total product cost

Not many companies understand their true costs, and those who think they do, often forget supplementary costs such as for example services or system costs (Anderson & Naurus, 2004). There are different ways of dividing and viewing costs.

One way of viewing and dividing costs is by separating them into fixed costs and variable costs. The fixed costs are costs which are costs of being in business and which do not change, like product design, advertising (Ibid).

One more way of dividing costs is, as stated by Olsson (2005), by dividing them into direct and indirect costs. Direct costs are costs which can be found easily such as machine costs, facility rent and personnel wages. Indirect costs are those that are not easily gathered identified and gathered.

Yet another way of dividing and viewing costs is through logistics costs. These are all costs which are associated with the material and information flow of a product from its origin until it gets to the customer. Bjornland et al. (2003) explain, as previously stated, that around eighty percent of organizations’ total cost, are logistics costs. Since logistics costs stand for such a big part of the total cost of organizations and since they are, as previously mentioned by Oskarsson et al. (2006), often difficult to understand by organizations, they will be the costs focused in this thesis. Another reason for choosing to focus on these costs is because of the short product life cycle in many manufacturing organizations. Since the life cycle of products is becoming shorter, it is crucial that manufacturing organizations understand their logistics costs for gaining competitive advantage in the marketplace (Christopher, 2005).
Logistics costs can be divided into different types (Jonsson & Mattsson, 2005). These different types of logistics costs are shown and explained in section 2.1.3. They are also summarized and illustrated in Appendix 2. For understanding what logistics costs are, it is necessary to first get an understanding of the concept of Logistics. This concept is described in the following section (section 2.1.2).

### 2.1.2 Logistics - definition

When talking about logistics, many people often associate the term with distribution and transportation. This is only a part of the logistics process. Initially, Logistics involved the transportation of troops, as well as the transportation and storage of weapons and other military materials. The outcome of a war can very much be determined by how well logistics is employed (Bjornland et al. 2003). Nowadays, and in times of military peace, there is still another war going on, namely the war between companies. This war is actually a survival war where companies compete in order to gain competitive advantage (Christopher, 2005).

Logistics is the science of efficient material flows. It is the planning, organization and control of all activities involved in the materials flow, from the acquisition of raw materials to the final consumer. The objective is that end-consumers’ needs and wishes should be satisfied in form of providing low costs, good customer service, and ecological solutions (Mattsson & Jonsson, 2003). Fredholm (2006) means that the flow of information is as important as material flow in logistics in today’s world. Logistics can even be defined as all the activities involved in making a product or a service available for the right customer, in the right quantity, right quality, in the right place, at the right time and at the right cost (Bjornland et. al, 2003).

*Logistics* in the business world is divided in three different logistics areas (Fredholm, 2006; Oskarsson et al. 2006). The first area is called *Inbound Logistics*, which deals with the flow of materials and information from the suppliers to the company’s own warehouse and/or production. The second area of logistics is entitled *Production Logistics* and it deals with the planning and control of the production and stock inside the company. The third and final logistics area is the *Outbound Logistics* also know as *Distribution*. In today’s business world, it is popular to outsource a part of its Logistics to a third-party logistics company. Some companies do not deal with Production or Distribution Logistics themselves and choose to outsource it instead (Fredholm, 2004). This thesis shares the view of Fredholm (2004) and Oskarsson et al. (2006) in that logistics it is divided into three logistics areas. It does however take into account that all these three logistics areas, i.e. Inbound-, Production- and Outbound logistics, are dealt with by the company in a more traditional way, and not outsourced as stated by Fredholm (2004). This “traditional” logistics view of this thesis is thus demonstrated in figure 2.
Figure 2. Personal figure demonstrating this thesis view on logistics (own creation).

Associated to an organization’s logistics activities, are of course also several costs, which Bjornland et al. (2003) entitle logistics costs. Christopher (2005) claims though that logistics activities not only generate costs but also revenue if managed correctly.

2.1.3 Logistics costs

Logistics costs are all costs which are associated with the material and information flow. This section will be divided into the seven types of logistics costs mentioned by Jonsson and Mattsson (2005). Jonsson and Mattsson’s (2005) view was chosen because they have a complete and wide view of these costs, compared to the other literary work, examined for this study. For example, Oskarsson et al. (2006) divide logistics costs only in five types. Two of these types deal with Handling and Warehousing costs, one type deals with Transportations costs, another one with Administration costs, and finally a fifth one which are miscellaneous costs. Although this is a division which surely includes information of all Logistics costs, the view of Jonsson & Mattsson (2005), with their division of seven types of Logistics costs, was considered more detailed and was therefore chosen for this thesis.

To facilitate for the reader, the relevant information which should be gathered for the respective logistics cost type will be marked in bold in the text below. It can also be visualized in a summarized manner, in Appendix 2.

Transportation costs

Transportation costs involve, according to Jonsson and Mattsson (2005) and Sahlin et al. (2009), all costs related to internal and external transportation. Internal transportation is the flow inside the company whereas external is the transportation to or from suppliers and customers (Jonsson & Mattsson, 2005).

Because of globalization, transportation costs have increased largely during the last decades. Sahlin et al. (2009) claim that keeping the transportation costs low will increase competitive advantage in the marketplace. They also mean that organizations should understand that the costs of a product increases per route length.

Important information to take into account when dealing with transportation costs are the vehicle’s purchase cost and costs of fuel and lubricants per mile. Repair costs as well as insurance costs of the vehicle is equally interesting information for understanding transportation costs in case of malfunction. Sahlin et al. (2009) also
mention that yet another important aspect to analyze is the **vehicle’s capacity**. This is to determine how many product units or/and people the vehicle can transport. The **infrastructure investment**, like for example building roads, is also included as transportation costs. **Accidents** done during transportation are also seen as transportation costs. These can be accidents for the vehicle and for the personnel. Yet another piece of information which is good to have is the **vehicle’s route length**, to easier understand the total transportation costs for a single unit (Sahlin et al., 2009).

Jonsson and Mattsson (2005) are in agreement with Sahlin et al. (2009) that **product damages** during transportation should be categorized as transportation costs. Moreover, the actual **handling of the products** during transportation are also part of this category, this, in turn also include the **personnel costs** during transportation (Jonsson & Mattsson, 2005). Lumsden (2006) add that in understanding the **type of container and/or loading pallet** in transporting the product, it can also be included as a transportation cost. According to Sahlin et al. (2009), the **type of vehicle** is also information which is needed to know because it easier helps determining lubricant, fuel, insurance and repair necessity as well as how it affects the infrastructure negatively, by tearing the roads for example.

**Packaging costs**

Jonsson and Mattsson (2005) describe packaging costs as being costs which are related to the **material needed for packaging and tagging**. It is also the activities of the actual packaging and tagging of products (*Ibid*). Lumsden (2006) and Johnsson (1998) write that packaging was not always seen as a logistics process, but rather an independent activity for merely protecting the product. It has become more than that and it not only serves the function of protecting the product, but it also provides better handling, give information about the products to end-users as well as inside the organization (Lumsden, 2006).

Lumsden (2006) explains that it is important to have information on the **package type**, whether it is metal, paper, glass, etc. Different types must be handled differently and also have different costs. Similarly, the **package size** is also important due to product cost but also to warehousing costs (*Ibid*). Lambert et al. (1998) state that, depending on the amount of space it takes, the warehouse costs are affected and affect packaging costs. **Package size, (height, weight, length, width)** are important information to have because not only for the warehouse costs, but also because of transport regulations and customer requirements (Coyle et al., 2002).

Many companies change their packages often, which implies great costs on the printing and layout design, and printing material (Johnsson, 1998). Like Jonsson and Mattsson (2005), Johnsson (1998) and Lumsden (2006) agree that **administrative costs** are highly related to packaging costs because it involves solution development. Other costs which are affected and affect packaging costs are **personnel costs**, **machine costs** and **transportation costs**, when packaging and tagging activities occur (Jonsson & Mattsson, 2005; Johnsson, 1998).

**Setup and capacity loss costs**

Setup costs are the costs associated with the **time it takes to adjust the machines** from one manufacturing order process to another (Bjornland et al., 2003 ; Jonsson and Mattsson, 2005). Jonsson and Mattsson (2005) add that also machine break-down or the time it takes to repair, test or get a tool, for example are consider setup-costs.
Coyle et al. (2002) claim that setup costs involve personnel costs, the fixed costs of machines and facility costs for this setup time. Vollmann et al. (2005) mean that setup-time can be measured by using video cameras and analyzing the processes and diminishing setup-time by counting the time it takes to change a machine.

Costs from capacity loss are the costs that derive from the time that takes to prepare an order. The more number of orders that must be dealt with in a specific time, the bigger the risks of capacity loss costs. If the capacity is low, then there are no capacity loss costs, but if the capacity is full in some part of the logistics process and this same capacity could be used for other value-added activities instead, then these costs appear. It is therefore important to have information about the actual capacity level when dealing with the intended order. It is also important to understand the capacity related costs, which will be further discussed. (Jonsson & Mattsson, 2005)

**Capacity related costs**

Capacity is, according to Olsson (2005) the reflection of how an organization is built up and composed. Capacity is what is used for operating the entire organization. Facility costs are seen as capacity related (Jonsson & Mattsson 2005). Jonsson and Mattsson (2005) mean that personnel costs, vehicle costs and machine costs are also capacity related. Even maintenance costs as well as provision costs for the facility, vehicles and machines are associated to this type of costs. Ahl and Johansson (2002) also add that cleaning costs are part of the maintenance costs of the locale.

Mattsson and Jonsson (2003) add that to calculate the capacity costs of a specific product, information about the product’s operation groups for producing the product. The number of machines and workers in that group should be known. To understand the total cost of the capacity employed in the organization information concerning the number of shifts per day, number of hours per shift and number of working days per chosen period should equally be known (Ibid). Additionally, to better understand and measure capacity it is important to time the operations at their normal pace, and by using the same measurement unit and same time interval, like for example product/hour (Oden et al., 1993).

**Shortage or delay costs**

Shortage or delay costs is a type of logistics cost that occur when an order is not delivered to the customer according to requirements (Jonsson & Mattsson, 2005). Shortage costs exist due to the fact that demand is higher than the supply and these are costs which are very difficult to measure but which can be subjectively estimated, according to Oden et al. (1993).

First the company might lose income or worse, the actual customer. If they do not lose the customer, then there can be additional costs in order to repair the delay in the order, so that it meets the customer’s requirements. These costs can be costs for faster transportation or on weekends when transportation is usually more expensive. Even compensations to the customer is associated to this type of cost. It can also involve delay costs in production, due to the non-existence of materials for production because of the delay from the supplier or bad planning (Jonsson & Mattsson, 2005). If only a component of a product is delayed or in shortage, then the entire product can not be delivered, which involves a loss for the company (Oden et al., 1993).

Bjornland et al. (2003) and Christopher (2005) write about how customer satisfaction can be analyzed by companies, by measuring the service level via the so called perfect
order concept. This concept can for example be measured by determining the number of completed orders, the number of completed orders in time, the number of completed orders without any faults (the right product to the right customer) and, finally, the number of completed orders without any faults which were completed in time. These ratios should, independently, be displayed in percentage by first being divided by the total number of orders and finally multiplied by a hundred. (Ibid)

**Warehousing costs**

Lambert et al. (1998) define warehousing costs as the costs which appear from warehousing and storage activities. Jonsson and Mattsson (2005) write that in many companies, warehousing costs is the most important and biggest type of costs. These warehousing costs can be divided, among others, into three categories: warehousing financial costs, warehousing storage costs and contingency costs. (Ibid)

Warehousing financial costs have to do with how big the return rate is set on the bonded capital in warehousing. Banc interest is the lowest required return rate of the bonded capital for companies who want to be profitable. Warehousing storage costs involve the costs on the warehouse locale, personnel wages, warehousing and management equipment, administrative costs and internal transportation costs. Contingency costs are all costs which imply uncertainty. The bigger amount of products, the more likely there is to be mishaps and damaged goods because handling becomes more difficult. Other uncertainties which imply more costs, is whether the products a company sells have short product life cycle. If a product is not sold and no customer demands it, then the product in question must be sold at a cheaper price or thrown away, which means that the company loses valuable resources. Articles can even disappear from the warehouse if products are robbed. Yet another uncertainty is if incorrect amounts have been delivered to a customer or between warehouses (regional and central for example), then there will be additional warehousing storage costs. Inventory insurance is also a part of contingency costs. (Jonsson & Mattsson, 2005)

Vollmann et al. (2005) divides warehousing costs into order preparation costs, inventory carrying costs and shortage and customer service costs. Order preparation costs basically involve the administrative costs of working with the paperwork involved in receiving an order. It also entails transportation between warehouses and distribution centers, as well as verification of the available stock and quality control of the products before distribution. (Ibid)

Vollmann et al. (2005) also mention that the relation between the return rate and the capital invested, such as bank loans and insurances should be information that must be monitored. Facility costs and personnel and machine costs are seen as inventory carrying costs, which are, in agreement to Jonsson and Mattsson (2005), warehousing costs (Vollmann et al., 2005).

The shortage and customer service costs stated by Vollmann et al. (2005), largely coincide with the logistics costs type shortage or delay costs as seen by Jonsson and Mattsson (2005), Christopher (2005), Bjornland et al. (2003) and Oden et al. (1993), as previously mentioned. Vollmann et al. (2005) also state that shortage of a product in stock affects customer service and therefore, the costs involved of losing a customer. The difference is that Vollmann et al. (2005) see these costs as being warehousing costs.
Administrative costs

Jonsson and Mattsson (2005) write that administrative costs are all costs which involve long-term planning and operative management of the material flow. **Wages for administrative personnel** who works with for example planning, warehouse accounting, order management is also an example of this type of costs *(Ibid)*. Yet another cost is the cost of **purchasing and maintaining information systems** for the company to use (Jonsson and Mattsson, 2005). Johansson and Samuelson (1997) declare that **office material, office machines, telephone and fax bills** and **postage expenses** are also included in this type of logistics costs.

Bjornland et al. (2003) and Aronsson et al. (2003) actually see information costs as an own type of logistics costs, instead of merely being a part of the administrative costs. Information costs can, for example be, according to Aronsson et al. (2003) the **investment costs** for the system and the **maintenance costs**. As Mattsson and Jonsson (2003) state, the administrative costs involved in, either a purchase order or a production order for the customers, are also seen as administrative costs.

In general, Mattsson and Jonsson (2003) mean that there also is a difference in the costs depending on the order type. Whether if it is a purchase order or a production order to the customer. If it is a **purchase order**, administrative costs will be present such as making a bid, negotiation with the suppliers and choice of supplier. Making the actual order and following up on the order are also considered to be administrative costs, when purchasing an order. Controlling the invoice and finally, making the payment are also administrative costs.

When dealing with a **production order** to the customer, there are equally administrative costs, such as order handling, production planning, customer specification’s control, instruct the workers to produce the intended products for the order. There also exist costs in following that the order arrived safely to the intended customer, making a report when the order has reached the customer, and making the calculations when the payment has been done (Mattsson & Jonsson, 2003).

### 2.2 Information Systems Development

This section aims to give a better understanding of concepts in the area of Information Systems Development, used in this thesis. The concepts of **Information, Data and Databases** are determined in section 2.2.1. Section 2.2.2 explains what Information Systems are and how they support information. The next section (section 2.2.3) involves ERP-systems, which is a type of Information Systems and which is focused in this thesis. After determining the preceding terms, it is time to determine how these systems can be developed, and thus the concept of **Information Systems Development** is explained in section 2.2.4. Finally, section 2.2.5 defines UML, a modeling language often used when working with the process of developing information systems and which will equally be used in this thesis.

#### 2.2.1 Information, data and databases

This thesis deals with the **understanding of information about logistics costs**. The terms **Logistics** and **Logistics costs**, were explained in section 2.1. But how can the term **Information** be explained?

Before trying to explain the concept of **Information**, this thesis will aim to explain the term **Data**. **Data** symbolizes raw unstructured facts about people, events or objects.
(Avison & Fitzgerald, 2006). Data can consist of numbers and letters (alphanumeric data); graphic images and pictures (image data); sounds, noises and tunes (audio data); or moving images or pictures (video data). Stair and Reynolds (2005) mean that data must always symbolize something which exists in the real world. It can for example be a product’s name, or a number symbolizing a determinate cost in an organization. What is important to understand is that data alone has no real value and it will always remain raw facts (Stair & Reynolds, 2005).

Why the concept of Data was previously explained is for facilitating the understanding of the different views on the concept of Information. There are several ways of viewing and describing Information. Beynon-Davies (2002) means that information is the interpretation of data in a meaningful context. Information is when data is placed together in a way that it gets meaning. When information is used, it implies that a group of people are interpreting data.

Avison and Fitzgerald (2006) agree that information comes from interpreting data, summarizing it and presenting it in a way that it is useful to the recipient. Information can after being interpreted by a particular recipient, be used for different types of decisions.

According to Stair and Reynolds (2005), information is considered one the most important assets for organizations today. When data is assembled and put together in a meaningful way, information is created. This relationship can be seen as railroad tracks. Data are the actual tracks while information is the railroad. Adding more data, can greatly increase the value of the information.

This thesis agrees with the above mentioned views on the concept of Information. Data can be numbers representing a certain cost existing in an organization, or a text displaying the name of a specific product. If alone, the data will have no meaning. However, if put together in a context, it will provide information to a receiver that, for example, this particular product has that particular cost.

This thesis shares the view of Stair and Reynolds (2005) that adding more data may greatly increase the value of information, but only if the data is put in the right context and if the data is accurate. Like Avison and Fitzgerald (2006), this thesis is also of the opinion that after this information is interpreted by the intended receiver, it can be used for facilitating decisions. An example of such decisions that could be facilitated is the determination of total costs of specific products, which is, as earlier stated in section 1.2, the ultimate purpose of this thesis’s research aim.

But where can this data be found and stored? Elsmari & Navarthe (2003) discuss that data can be stored in databases. It cannot be random data though, because it has to have a meaning while put together in an intended way. The data inside a database must be related in some way. Databases are often seen as reflections of the real world and if something changes in the real world it should be changed in the database as well. They are designed to serve a specific purpose and they can be of all sizes and complexity levels. Databases can be manual, like a phone book, which have phone numbers and names, or computerized. When databases are referred in this thesis, it is merely the computerized databases which will be included.
Stair and Reynolds (2005) state that most managers and CEO’s in today’s organizations see databases as one of the most valuable parts of their computer-based IS, since it is in these that the data and information on the organization lie. It is this thesis’s interpretation that if information is lacking from, for example logistics costs, it is in these databases and computerized Information Systems that this information should be included. A new term has now been introduced: Information Systems. This term will be presented in the following section (section 2.2.2)

2.2.2 Information Systems

Information Systems (IS) are systems that gather and manipulate data, which is then transformed into useful information and presented to the users. Many Information Systems even give feedback to the user if information is wrong and needs to be altered. The gathered data is called input data. The data that is being manipulated is called processed data and finally, the presented information is called output (Stair & Reynolds, 2005).

Andersen (1994) agrees with Stair & Reynolds (2005) in that an Information System exists in order to collect, process, store, distribute and present information. He adds that an Information System alone is nothing without a meaning for its existence. An Information System both serves and is a part of an organization. An Information System has the function of collecting and distributing the information inside the organization and its surrounding (Andersen, 1994).

This thesis agrees with Andersen (1994) in that, an Information System is a part of an organization. This is because it is this thesis’s opinion that great part of the information concerning the entire organization is gathered and can be acquired by the organization’s employees, in these systems. Due to the importance of valuable and fast information in today’s competitive business world, Information Systems can be of great help for aiding organizations acquire fast and accurate information, thus helping organizations in achieving their goals.

This thesis agrees with Stair and Reynolds’ (2005) definition of Information Systems due to their simple yet clear way of describing the term. Figure 3 illustrates how this thesis views the term Information Systems. An Information System must have a user and a reason or intention for being used. For example the user may wish to calculate the total cost of a specific product or save information concerning a determinate logistic cost in the system. The user will first input the data which can be for example a product number and the button “Search” on the screen (input or step 1 in figure 3). The data will then be processed by the system (Data processing or step 2 in figure 3). This is when for example the actual calculation of a product cost can be made, when different data on logistics costs are processed. When the data has been processed, something will come out from the system. This is the output, which will be information (step 3 in figure 3). This information can for example be the actual calculated product cost, or an error message. Finally, the information will be presented to the user (step 4 in figure 3). The presented information can need to be altered if it does not meet with the user’s intention and thus becomes input again and the cycle begins again until the information presented meets the user’s intention.
Information Systems can be either manual or computerized. Manual Information Systems can consist of a person, a piece of paper and a pen. Computerized information systems involve people or users, the actual hardware, the software, the Internet or other networks; procedures and databases (Stair & Reynolds, 2005).

According to Avison and Fitzgerald (2006), computerized Information Systems can most often process more data, in shorter time and with more accuracy than manual Information Systems. On the other hand can sometimes manual Information Systems be better to use, especially if it is crucial that human judgment is required. Because this thesis involves facilitating the understanding of determining the total cost of products, much data concerning different costs is to be processed. Computerized Information Systems would make these processes faster and with greater accuracy than manual Information Systems. Therefore this thesis only focuses on computerized Information Systems. From now on, when the term Information Systems is used in this thesis, it will only refer to computerized Information Systems.

Different types of Information Systems exist for different levels of an organization, because different organizational levels have different information needs or problems which must be solved (Andersen, 1994; Stair & Reynolds, 2005). Stairs and Reynolds (2005) describe Transaction Processing Systems as systems used at an operative level of a company and which involve everyday functions such as payroll systems or customer billing. There are even Management Systems and Decision Making Systems which collect data from the Transaction Processing Systems and are used by managers to support decision making so that the company’s goals are met (Ibid). Yet another type of Information Systems is ERP-systems, which is the type of Information System focused in this thesis and which is discussed in next section.

2.2.3 ERP-systems

Enterprise Resource Planning is considered to be a type of Information System which is most adequate for today’s business organizations, due to the increasingly more complex business world and more demanding market. By using an ERP-system, the user gains total control of all the processes in a company. The ERP-system can be divided into several modules, which are different functionalities which correspond to different processes involved in business organization. Different ERP-systems may have different modules, depending on the type of business which the company drives (Beynon-Davies, 2002).

An ERP may have a Transportation module, a Purchase module, a module for Sales, Production, Customer Service, Warehousing, Human Resources. Companies today may buy only the modules they want or develop their own modules (Stair & Reynolds, 2005). For example, if a transportation company, which does not deal with producing products, were to develop or buy an ERP-system, there would be no

Figure 3. Personal figure of the IS function (own creation)
interest in working with a Production module. Magnusson and Olsson (2005) mean that Information Systems exist in every organization but that many organizations use different Information Systems for different functionalities in an organization. Thus a different IS for each module. Choosing to use an ERP-system organizations get all these IS into one single system, giving better data and also process control in organizations (Magnusson & Olsson, 2005).

That which gives ERP-systems its strength, is that different modules can reach and interact with each other, which gives the system a great flexibility and structure. Instead of having small independent systems designed for controlling and supporting different departments of a company, an ERP system can be used which function as all these systems in one. The data stored in one independent system can not be directly reached by another, whereas using an ERP system, for example, data concerning an order can be viewed and which only store data inside the different systems. This is because an ERP-system has a centralized database of the organization’s data (Beynon-Davies, 2002).

ERP-systems were the type of IS chosen to be focused on this thesis. This because this thesis shares the view of Beynon-Davies (2002) that it is the type of IS that is most adequate for all types of business organizations today, because of the today’s increasing complex and more demanding business world. The ERP-systems’ centralized database as stated by Magnusson and Olsson (2005) is also a reason for this choice, since it increases data control in organizations and thus the organizational processes. ERP-systems can thus aid its users in getting the information required from all processes of the organization. In the case of this thesis, it can aid users in determining the total product cost of a specific product by also getting data on logistics costs from different modules in the ERP-system’s centralized database, assuming that this data is supported by the system when it was developed.

Magnusson and Olsson (2005) state that there are organizations which choose to buy standardized ERP-systems, whereas other organizations choose to self-develop their ERP-systems instead. This thesis is interested in focusing on self-developed ERP-systems as since as stated by Magnusson and Olsson (2005) they are customized systems that are developed to fit the specific organization’s needs. Its development reflects how the relation between the business world and the Information System’s world is in organizations. Whereas in standardized ERP-systems this reflection is not obvious since the system is not developed specifically for the intended organization (Ibid). How Information Systems can be developed can be seen in the next section (section 2.2.4).

2.2.4 Information Systems Development

The goal with Information Systems Development (ISD) is to have developers build Information Systems which can be used by organization members to facilitate the information flow in the organization (Beynon-Davies, 2002). Avison and Fitzgerald (2006) state that ISD is when Information Systems developers use Information Technology (IT) to achieve a determinate goal. According to Avison and Shah (1997), Information Technology is the technology used that makes information flow possible, when using the help of Information Systems.

Andersen (1994) adds that the need for developing Information Systems is born when an organization has a problem, wish, or new ideas. A problem or wish can for example be as part of this thesis’s research aim, namely when an organization has a
wish to facilitate the determination of total cost of a product by understanding its logistics costs. If it is analyzed that these ideas, problems and wishes can be solved through Information Systems or if the problem is related to the organization’s present Information Systems, then Information System Development is required (Ibid).

Beynon-Davies (2002) mean that there are steps in which the development of an Information System takes place. The first step is the Requirements, when the organization determines the risks of implementing an IS and develop a strategy of implementation and the system’s feasibility. The second step is the Analysis, where requirements for the system are represented and analyzed. The next step is Design and this is when the technical planning takes place to meet the requirements made in the analysis. The Construction step is when the system is programmed and tested. Then comes the Implementation step, which is where the system is delivered to its users and education of its usage takes place. Finally, the last step is Maintenance and this is when the system is monitored over time in, tested and changes are made to the system due to the revelation of new requirements or if the system was badly developed in the first place.

Avison and Fitzgerald (2006) have a similar view to Beynon-Davies (2002), regarding the steps used in the development of Information Systems. Avison and Fitzgerald (2006) mention that there are many variant views but that most views have the same basic structure. The structure consists of six different steps called the Information Systems development life cycle. Being a more recent and generalized view of the processes involved in Information Systems Development and because of its detailed yet simple and easy to understand explanation, the view of Avison and Fitzgerald (2006), is the view shared by this thesis. This view is illustrated further below in figure 4, where the steps in focus in this thesis is highlighted.

According to Avison and Fitzgerald (2006), the first step is the Feasibility Study, which determines the current system’s problems, and takes a gross view of the requirements for the system and whether these requirements are met. It takes this in account and views the human, organizational, technical and economic costs and benefits of developing the system. This is when managers decide issues like if developing a new system will be affordable or economically justifiable. It also determines if there is the technology available to support the usage of the system which is planned to be developed. It also involves determining whether developing the system will be accepted by the organization and its employees, considering the fact that too many changes in the system might in turn change the organizational processes to a large extent.

If managers decided to proceed with the development after the Feasibility study, the next step according to Avison and Fitzgerald (2006) is the Systems Investigation. This is a more detailed investigation of the organizational requirements and if these are being met by the current system. It also investigates if there are problems with the working methods of the system. In this investigation step, it is important to gather information by interviewing personnel (managers as well as system users) or by using questionnaires, viewing documentation or by direct observation so that the system and the organizational requirements are thoroughly investigated (Ibid). In this thesis, the focus is on this step of Information Systems development, as stated in this thesis’s second objective (section 1.2). System Investigation is the step to use when, for example, understanding if information about logistics costs which should be taken
into account by manufacturing organizations for total cost of specific products, is being supported by these organizations’ self-developed ERP-systems.

The next step in the Information Systems Development life cycle is, according to Avison and Fitzgerald (2006), the **Systems Analysis**. After the system has been investigated, it is now time for developers to try and understand all aspects of the current system and why it was developed in that particular way. It is also in the System Analysis that a developer starts inquiring and analyzing whether there are alternative ways of improving the system so that the organizational requirements are met by the system. This is also a focus of this thesis, since the research aim deals with determining what information about logistics costs can be neglected when these systems are developed and should be included in these systems for facilitating the determination of total cost of products.

![Information Systems Development Cycle](image)

**Figure 4. Information Systems development cycle according to Avison and Fitzgerald (2006) and view shared by this thesis (own creation)**

Avison and Fitzgerald (2006) mean that **Systems Design** is the next step. From the improvement pointers derived from the Systems Analysis, the Systems Design step is when system developers design computer and manual parts for the new system. It shows for example what data is input to what process and how this input is to be entered in the system. It shows what processes convert input to output and also shows what the output is supposed to be. It also involves the structure of computer files in the system as well as the security and back-up plans to be made in the system. This step also involves creating the plans for systems testing and for the implementation.

After the Systems Design comes the **Implementation** step (Avison and Fitzgerald, 2006). This is when the system developers program the code from the implementation plan stated in the design step. It is also when the purchasing of new software and hardware takes place. The testing of the code, software and hardware of the system is also done in this step. Done in this step is also the education and training of the employees to use the system so that they become familiar with it. Security procedures like the access to different functionalities by the users are also tested in this step. It is
also in this step that documentation is carried out like code documentation and user manuals and for the system.

Finally, the last step according to Avison and Fitzgerald (2006) is the Review and Maintenance of the system. This step happens after the system has become operational. It ensures that the system continues to run effectively, where errors are continuously corrected. As time goes by, new organizational requirements can appear and it is important to then go back to the Feasibility Study, thus going back to the first step of the Information Systems Development life cycle.

When working with Information Systems development, there exist tools which can be used for aiding developers in this process. One of these tools is UML or Unified Modeling Language (Jacobson et al. 1999; Fowler, 2004). UML is a tool that will be used in this thesis (as can be seen in section 3.2.4) and will be described in the next section (2.2.5).

2.2.5 UML

Unified Modeling Language (UML) is defined by Fowler (2004) as being a tool for using models which will aid when describing, analyzing, designing and implementing Information Systems. The most common type of UML models are class diagrams. They describe tables which exist in an IS database. They can also describe the attributes existing in each table, associations between these tables and attributes. This is done so that the database can be connected together with the tables in it and its attributes (Ibid).

Many technical terms are being used, so figure 5 demonstrates how UML class diagrams can look like, together with the terms tables, attributes and associations. A table can have a name, which in turns is a representation, in a system, of something in the real world (Skansholm, 2005). For example it can be a table called Article, representing a specific manufacturing organization’s article. An article may have some attributes like description, name or price. Attributes describe information concerning status or condition. A table also has a unique attribute which is unique. In the case of the table Article, the unique attribute could for example be article number, since it is the best way to identify the specific article in question. It is the same if the table would have been called Person, the unique attribute would have been personal number and not name, since many people may share the same name and are therefore difficult to identify in that manner.

![Figure 5. Example of a UML class diagram (own creation).](image)

There also exist associations in UML class diagrams. An association is a link between two tables and its attributes (Skansholm, 2005). Associations make it possible for
attributes from different tables to connect and share information (Jacobson et al. 1999). For example, the table Article can have an association to the table Vehicle (which in its turn is connected to the table Company Car by generalization). This implies that the attribute article price in the class Article can be changed by for example the fuel per mile in the Company Car table and the attribute capacity in the table Vehicle. The information which can exist from this association and generalization is that for example, the article’s transportation cost based upon capacity and fuel cost of a specific vehicle.

2.3 Background summary

Total product cost is difficult to define for many organizations since many costs are forgotten or neglected by organizations (Anderson & Naurus, 2004). There are many views and ways of dividing costs for understanding organization’s total cost. This thesis chose to focus on logistics costs. The reason for this choice is because logistics costs consist of more than fifty percent of the total costs of organizations and are very difficult to understand and therefore often neglected by organizations (Oskarsson et al., 2006).

Logistics is according to Bjornland et al. (2003), all activities involved in making a product or a service available to the right customer, at the right time, to the right price, at the right place and in the right quantity and quality. In the business world, there are three different Logistics areas (Fredholm, 2006; Oskarsson et al., 2006). It can be Inbound Logistics, Production Logistics or Outbound Logistics. Not all organizations deal with all three areas. Many organizations nowadays tend to outsource some part of their Logistics. This thesis’ has a traditional view on Logistics. It sees Logistics as business Logistics where all three areas are dealt by organizations, not outsourced.

Logistics activities also imply logistics costs. Jonsson and Mattsson (2005) divide Logistics costs into seven types: Transportation-, Packaging-, Setup and capacity loss-, Capacity related-, Shortage or delay-, Warehousing-, and finally, Administrative costs. Transportation costs involve all costs related to an organization’s internal or external transportation. These are costs like vehicle costs, infrastructure or personnel costs during transportation. Packaging costs are all costs related to the packaging and tagging of products. Setup and capacity loss costs are costs associated with the time it takes to adjust machines and the time it takes to prepare an order, respectively. Capacity related costs are costs connected to capacity, which according to Olsson (2005) is what is used for operating the entire organization. Facility costs, machine costs and the entire personnel costs are examples of capacity related costs. Shortage or delay costs are the costs associated with not delivering an order to a customer according to requirements (Jonsson & Mattsson (2005).

Warehousing costs are costs related to warehousing and storage activities and are divided into three categories: warehousing financial costs dealing with the return rate of the warehouse; warehousing storage costs dealing with costs like warehouse locale, warehousing equipment, internal transportation and personnel costs inside the warehouse; and finally contingency costs which are costs implying uncertainty like for example when organizations deal with products with short life cycle (Jonsson and Mattsson, 2005). The last type of administrative cost named by Mattsson and Jonsson (2005) is the Administrative costs type, which involve all long-term operative management and planning of the material flow.
This thesis deals with the understanding of information about these logistics costs. Information is the interpretation of data put together in a meaningful way (Stairs and Reynolds, 2005). Data are raw unstructured facts about people, events or objects. Data can be stored in databases, where it is grouped in a related manner. Databases reflect something in the real world and are designed to serve a specific purpose. They can be computerized or non-computerized. However, only the computerized databases are focused in this thesis. Most managers and CEO’s see their organization’s databases as one of the most valuable assets, since it is in them that most information about the organization lies (Stair & Reynolds, 2005). This thesis interprets therefore that if information concerning, for example, logistics costs is lacking in organizations, it is in databases and Information Systems that this information should be included.

Information Systems are systems that gather and manipulate data, which is transformed into useful information and presented to the intended user (Stair & Reynolds, 2005). IS both serve and are a part of organizations (Andersen, 1994). Information concerning the entire organization is gathered and can be acquired by its employees in these systems. IS can be computerized and non-computerized, according to Stair and Reynolds (2005). This thesis only focuses on computerized IS due to its greater accuracy, shorter process time and because they are able to process larger amounts of data. A type of IS focused in this thesis is ERP-systems.

Today’s increasingly complex and demanding business world makes it adequate for organizations to use ERP-systems (Beynon-Davies, 2002). These are used by most organizations today and give better data and process control due to its centralized database and its possibility to use the interactive modules (Magnusson & Olsson, 2005). This process control and better data control could also aid users in getting organizational information such as determining the total cost of products by using the interaction of different modules in the ERP-system and its centralized database.

Companies today can choose to buy standardized ERP-systems or self-develop their ERP-systems. With standardized ERP-systems, organizations may run the risk of having to change its business logic and organizational processes to adapt to the system. When self-developing an ERP-system, it is the system that is customized to the specific organization and its business logic. When self-developing an ERP-system it is important that there is an understanding of the organizational processes and business logic when developing the system (Magnusson & Olsson, 2005).

Information Systems Development arises when a company has a wish, new ideas or a problem (Andersen, 1994). It is when developers build IS for facilitating the flow of information in organizations (Beynon-Davies, 2002). The wish or problem can for example be to facilitate the understanding of the total cost of products by understanding what information on logistics costs which is not supported by the used ERP-systems and which should be considered when organization self-develop these systems. This is, as previously stated, what this thesis ultimately aims to do. This thesis focuses on Systems Investigation and Systems Analysis, two steps of the Information Systems Development life cycle, according to Avison and Fitzgerald (2006). Systems Investigation deals with the detailed analysis of organizational requirements and if these are met by the organization’s current system. This corresponds with this thesis second objective, which is understanding how well prepared the manufacturing companies self-developed ERP-systems are for supporting information about logistics costs.
Systems analysis deals with how the current system can be improved for meeting the stated organizational requirements (Avison & Fitzgerald, 2006). This corresponds with this thesis research aim which is to find out what information about logistics costs not commonly supported by ERP-systems should be considered and included in these systems for facilitating the understanding of the total cost of products. A tool for aiding in the Information Systems Development is UML, which uses models that help in describing, analyzing and implementing IS (Fowler, 2004). The most common type of UML model is the class diagram, which can be used for describing databases. As can be seen in section 3.2.4 will be used as a tool for presenting the material gathered for this thesis’ second objective (section 4.3.2).
3 Method

A method is, as explained by Berndtsson et al. (2002), a systematic approach to try and solve a determinate problem. This thesis research aim is as earlier stated to determine what information about logistics costs, not supported by manufacturing companies’ self-developed ERP-systems, should be considered by these organizations and included in these systems for facilitating the understanding of the total cost of specific products. In order to achieve the research aim, objectives must be stated and worked with by using methods (Ibid). The objectives for this thesis are, as stated in section 1.2, to determine what information about logistics costs should be taken into account by manufacturing companies for understanding the total cost of specific products (objective one). Objective two is to understand how well prepared manufacturing companies’ self-developed ERP-systems are for supporting information about logistics costs, so that the understanding of the total cost of specific products can be facilitated.

This chapter deals with the method used in this thesis. Section 3.1 explains the chosen method, where the qualitative approach (3.1.1) and case study (3.1.2) are in focus. In section 3.2, the five steps used to answer this thesis’ research aim, are presented.

3.1 Chosen method

This section explains the chosen method used in this thesis. The qualitative approach and why it was chosen is determined in section 3.1.1. Section 3.1.2 explains the concept of a case study and also explains why it was chosen for this thesis.

3.1.1 Qualitative approach

This thesis uses a qualitative approach. This indicates that the quality of processes, entities and different meanings will not be measured or examined, through amounts, frequency, intensify or quantity, which describes the quantitative approach (Denzin & Lincoln, 2000). Instead, the qualitative approach is chosen because the thesis will focus on trying to examine information from sources, interviews, motives and social processes of a studied reality. Whereas, quantitative research processes information into numbers and carry out statistic analysis (Holme & Solvang, 1997). Thus, the qualitative approach was selected because, despite working with logistics costs, it is the quality of the information obtained by developed ERP-systems which is in focus. Because no actual calculations, statistical data or numbers will be in focus, the quantitative approach was not chosen.

Holme and Solvang (1997) mean that when using the qualitative approach, it is very common to employ some sort of case study strategy. The case study concept can be viewed in the next section.

3.1.2 Case study

A case study is when a specific phenomenon, in a limited number of cases, sometimes only one, is analyzed and explained in detail (Berndtsson et al. 2002). The case can for example be an individual, group or organization and is a good method of choice when working with phenomena which are not yet fully comprehended (Ibid). The case study is chosen in this thesis, because one specific organization will be analyzed and studied in depth, so as to answer the two objectives for this thesis and, consequently, the research aim.
A single studied organization is chosen in this step since it is a good way of going in-depth and understanding the problem at hand. The chosen organization is considered relevant for this thesis since it both employs and fits with this thesis’s view of traditional logistics, as discussed in section 1.4. Additionally, this same organization has a self-developed ERP-system which the organization’s current CEO considers being in need of changes so as to better support the understanding the total cost of the organization’s products. The proximity and size of the chosen organization is also an advantage to consider.

The second and final objective of this thesis is to identify how well prepared today’s manufacturing companies’ developed ERP-systems are for supporting information about logistics costs to take into account when determining the total costs of specific products. Since only one ERP-system shall be studied in detail and in only one case, i.e. the empirically studied company, the case study method will be used for achieving this objective. The conclusions which derive from this objective (i.e. this thesis’s research aim) will also be relevant for other organizations, regardless of the fact that it was only tested in a single organization. By viewing what information about logistics costs analyzed in this thesis, is not supported by the self-developed ERP-system of the studied organization, it is my purpose that other organizations can test their own systems. These organizations could verify if their ERP-systems support the information not supported by this thesis’s ERP-system and if not, that it is information that should be taken into consideration when manufacturing organizations want to self-develop their ERP-systems.

3.2 Steps used for achieving the research aim

This thesis’s first objective is to be the first to be answered and is to be composed of three steps. The first step, which will involve the gathering of logistics costs information from literary works, is explained in section 3.2.1. The second step, displayed in section 3.2.2, will deal with the gathering of material concerning logistics costs information to be taken into account by the studied organization. The third and final step for answering the first objective is to analyze the material gathered in the two previous steps. Step three is further explained in section 3.2.3.

The second objective can thereafter be answered and is to be composed of two steps, namely this thesis’s fourth and fifth steps. Step four should gather material from how the studied ERP-system is currently developed to determine logistics costs of products. This step is explained in section 3.2.4. The last step (step five), which is explained in section 3.2.5, should analyze how well prepared the studied organization’s self-developed ERP-system is for supporting information about logistics costs. Once step five and thus the second objective is answered, also the research aim can finally be answered.

3.2.1 Step 1 - Logistics costs background information

The first objective to be reached is to determine what information about logistics costs, not supported by manufacturing companies’ self-developed ERP-systems, should be considered by these organizations and included in these systems for facilitating the understanding of the total cost of specific products. Having this objective in mind, the first step to answering the thesis’s research aim can be made.

The first step will focus on collecting data for answering this thesis’s first objective. Background information on the subject concerning logistics costs information will be
gathered in this step. This will be done by examining previous literary works written on this specific subject. Berndtsson et al. (2002) state that it is important that the literature used is in accordance with a specific purpose and that it supplies an argument for an interpretation or idea. In this case, the specific purpose is the first two objectives of this thesis.

Since step one is considered mostly background data, textbooks can be considered as ideal sources for gathering material on logistics costs. These textbooks can deal on the topics of Logistics and Financial Economics. Financial Economics is a subject which also describes costs related to Logistics.

Since the area of Logistics and information concerning its costs is vast and detailed, the first step should be to gather information concerning how these logistics costs can be divided into different types. This division shall be made by reviewing how different literary works divide logistics costs and in turn by finding the division which is most complete. Once the chosen division of the types of logistics costs is determined for this thesis, it is time to find the information connected to each of the different logistics types.

Because a great amount of data concerning information on costs related to logistics can be found, a delimitation must be made. Only costs which are considered relevant for organizations working with the traditional logistics view (see section 2.1.2), should be gathered in this step. Costs which are too specific for individual companies should not be gathered. This is because of two reasons. The first reason is that even though organizations may have the same logistics view, there are still logistics costs which may differ. For instance, consider a company which sells clothes and one which sells automobiles. Their views on logistics may be the same, but the costs may differ. Packing costs for example, are considered as a type of logistics costs, as seen in section 2.1.3. Packing clothes items and packing car parts are not done in the same way, thus the costs will also differ. Therefore not too much detail and not too specific costs should be gathered in this step. Another reason for not gathering all the specific and detailed costs is the fact that it can be very difficult to include information on all minor costs found in literature works, just because they may be considered logistics costs.

The information gathered in this first step is to be presented in section 2.1.3 and in Appendix 2 for a more summarized view.

3.2.2 Step 2 - Material gathering: Relevant logistics costs information

The purpose with this step is to collect data on what the studied organization believes to be information considered important to have on logistics costs in order to determine a specific product’s total cost.

Step one serves as an input for the second step, for answering this thesis’s research aim. Based upon the data collected from literature work (step one), this step focuses on what the Sales manager (and the company’s former CEO) and Logistics manager, of the studied organization, believes to be information on logistics costs which affect the company’s cost of a specific product.

Structured interviews are to be made with the studied organization’s Logistics manager and Sales manager. These are chosen interviewees because they have the knowledge necessary about information on logistics costs needed, which can be associated to the total product cost, of the specific studied company. They are also
chosen interviewees because Sales managers and Logistics managers often comprehend and deal with the logistics activities. They also follow the product from the acquisition of raw materials, until the distribution of the sold material to the customer, as stated in the definition of logistics in section 2.1.2. Logistics managers comprehend the logistics activities of the company and its related costs, whereas the Sales manager, understands the logistics activities and the costs which should be involved in a selling product.

Structured interviews can be compared to questionnaires or check lists where it is the interviewer and not the interviewees who write down the answers (Bell, 2000). Data gathered from these types of interviews are considered easy to arrange and qualify and are suggested for inexperienced interviewers (Ibid). The chosen interviewees for this objective are to be asked to look at the list of information on logistics costs, considered critical from the literature study (i.e. the material gathered from step one). They shall thereafter be asked to add or remove information to that list, also concerning critical information of logistics costs which affect the total costs of the company. As they add or remove data to the list, an enquiry is to be made as to understand the cause of their choices.

Instead of merely asking questions with no concrete examples from earlier studies done on the area of Logistics this enables the interviewees to analyze this data. It also decreases the possibility of the interviewees of forgetting a specific logistics cost which they considered important for determining a specific product’s cost. Equally, it is a good way of having control over the interviews, in agreement with Jensen (1991) not letting the interview drift to other off-topic subjects and a way of giving feedback to the interviewees through these lists shown to them.

All interviews should additionally be recorded using a dictaphone, to ensure that no vital information is lost. Berndtsson et al. (2002) believe that recording interviews may in fact help in the process of gathering data but it is also important to make sure that it does not give the reverse effect. If the interviewees are not comfortable being recorded, the information gotten from the interviews may not have the best quality since it can be hiding information in fear of it being recorded (Ibid).

The interviews in this step are to be made by using a group interview which may last up to six hours. The conduction of the structured group interview can be viewed in figure 6. Both the Sales manager and Logistics manager are to be present during the same interview, which is important for the organization and interviewer from an economic point of view. The economic aspect is one of the benefits of group interviewing, agree Jensen (1991). Jensen (1991) also mean that group interviewing is a positive method because it creates an atmosphere of brainstorming and creativity, whereas in individual interviews, maybe the interviewee only thinks on his/her own interests. This is another reason for the choice of making a group interview in this case.
Jensen (1991) means on the other hand that the greater the group, the worse the quality of the data gathered. Therefore only two interviewees are to be chosen; the two people in the company that have most knowledge in the studied organization’s logistics costs. The group is then small enough to still have both the strength of brainstorming and the quality of not being too large so that some interviewees cannot speak their minds. Another negative part of group interviews is that if used in organizations where people know each other, and there is a hierarchy, then maybe one of the interviewees talk less or do not want to say what is really on his/her mind (Ibid).

Two unstructured interviews should also be done with the studied organization’s current CEO since the CEO is the one who currently uses the ERP-system for the purpose of understanding the product’s real cost. It must not take more than one hour for each interview due to time limitation from the CEO. The conduction of these interviews is also displayed in figure 6. These interviews will serve merely to gain an understanding of the manufacturing organization, its background, history and current problem with the determination of total product cost using the organization’s current ERP-system. Why these interviews should be done individually is because it is the easiest way of understanding the system’s problem CEO can transfer this information freely and with a personal tone. The material gathered from these two interviews can be seen in section 4.1.

The information which will be provided by the interviews with the Sales manager and Logistics manager will then become the material included in section 4.2. A more summarized view of the material from section 4.2 together with which interviewee/s that conveyed this information, is to be illustrated in Appendix 4.

3.2.3 Step 3 - Material analysis (Objective 1) – Logistics costs information to take into account

The purpose of this step is to analyze both the literature and the interviewed managers of the studied company believe to be the information needed on logistics costs, so that the total product cost is understood. The material gathered from step one will therefore be compared with the material from step two and its agreements and
differences are to be shown and explained in this analysis. This analysis will provide an answer to the first objective of this thesis, which is what information about logistics costs should be taken into account by manufacturing companies for understanding the total cost of specific products?

Material analysis is when collected material is structured, ordered and finally interpreted (Marshall & Rossman, 1999). It is when statements are done concerning the relations between different material categories. Holme and Solvang (1997) states that material analysis when doing qualitative studies (see section 3.1.1) do not usually have a guideline or a specific way of being accomplished. There are more guidelines and methods for doing analysis work in quantitative studies (*Ibid*). However, as stated in section 3.1.1, these studies are not to be done in this thesis.

Holme and Solvang (1997) also mean that when analyzing collected data, there is usually a great amount of information to be analyzed. It is therefore of great importance that this information is structured and grouped before the analysis takes place, so as to ensure that no material gathered is “forgotten” in the analysis. The material analysis in step three should be grouped and structured this way. It is to be based upon the logistics costs types divided already in steps one and two.

For example one section will deal with transportation costs (a type of Logistics cost). It will contain the analysis of the material collected from literature works concerning only transportation costs. It equally will contain the material gathered through structured interviews in the studied organization concerning what information on transportation costs that are important for understanding a specific product’s total cost. This way, the analysis will be made in a structured way and no material will be forgotten. How the actual material analysis is to be done in step three, is illustrated in figure 7.

![Figure 7. Step three - Material analysis – logistics costs information (own creation).](image-url)

Important to understand is that in this analysis, no prioritizing in order of importance is to be made regarding this information on logistics costs. This is because all logistics costs affect total cost in some way, since these costs are interrelated, as stated Oskarsson et al. (2006).
Chapter 5 is to contain what will be analyzed in this step. For a more summarized view, an illustration of this material analysis should be included in Appendix 5. The content that comes out from this analysis done in step three will serve as the answer to this thesis’s first objective.

3.2.4 Step 4 - Current ERP-system and logistics costs information support

Once this thesis’s first objective is reached, it is time to go forward and focus on gathering material for answering the second objective of this thesis. As previously mentioned, this thesis’s second objective is to determine how well prepared manufacturing companies’ self-developed ERP-systems are for supporting information about logistics costs, so that the understanding of the total cost of specific products can be facilitated. The purpose of this step is to gather material from the chosen studied organization’s current ERP-system, which is the Information System area of this thesis.

Marshall and Rossman (1999) discuss that material gathering techniques when studying a specific organization, are usually done through document analysis, interviews or observations. As previously stated in section 2.2.4, Avison and Fitzgerald’s (2006) also agree that when investigating systems, it is important to gather information by interviewing personnel, through using questionnaires, by viewing documentation or by direct observation. Similarly, material collection in this step is to be done by reviewing documentation of the currently used ERP-system and its developer is to be interviewed, having the data from the analysis from step three as an input. The simplest and most direct approach for gathering data in this step is to concentrate on how the system determines a specific product’s total cost, and in that way, to determine how the information on logistics costs, analyzed in step three, is supported by the studied organization’s current system.

Six unstructured interviews are to be done with the system’s developer where the analyzed data gathered in step three must be shown at the same time as an enquiry of how the system supported this data is also done. These unstructured interviews should not have any prepared questions before-hand (Bell, 2000). They are questioned as the system’s design documentation takes place. These interviews should take about six hours in total.

As in step two (material gathering for logistics costs information) all interviews in this step are also to be recorded with the help of a dictaphone, having in mind the cautions of Berndtsson et al. (2002) of making sure that the interviewees are comfortable with being recorded. This also ensures that vital information is recorded and decreases the possibility of losing important collected material. Like with the interview with the CEO in the second step, though, in step four, the interviews should also be done individually. Jensen (1991) believes this to be the most commonly used type of interviews because it gives the interviewee the freedom to talk freely without having to think about other people who might be present. A summarizing table showing how the interviews were conducted can be seen in figure 8.
Interviewee | Interview type | Interview topic | Number of interviews | Interview time  
--- | --- | --- | --- | ---  
ERP-system’s developer | Unstructured | Company X’s ERP-system’s explanation | 6 | 6 hours ERP-system explanation  

**Figure 8. Interviews with chosen studied company’s ERP-system’s developer (own creation).**

Another approach to gather material in step four is to review documentation of the system and to work with the system. These documents should consist of how the system is designed for calculating a specific product’s cost and which databases that are used in processing this calculation. Marshall and Rossman (1999) believe that documentation reviewing is a good method for gathering material since it can reveal rich material in terms of demonstrating the studied organization or individual ideas and values. In this case, the view of how the system’s developer chooses to design he’s system.

The content of these databases can then be gathered and shown in this thesis as UML-databases (Appendix 6). A more detailed view of the content of the material which will be gathered from these system documentation reviews and interviews is to be presented in chapter 6.

### 3.2.5 Step 5 - Material Analysis (Objective 2) - Current ERP-system preparedness for supporting logistics costs information

In step five, the purpose is to answer how well prepared manufacturing companies’ self-developed ERP-systems are for supporting information about logistics costs. This is this thesis’s second objective. To answer this thesis’s second objective, an analysis must be made. This analysis will consist of analyzing the material analysis from step three, which gives an answer to the first objective of this thesis, and the material gathered in step four, i.e. the data which is used by the studied organization’s ERP-system for calculating a specific product’s cost. How step five is to be done can be viewed in figure 9, in the next page.

This analysis is to be done in a similar way as the material analysis for the first objective, in step three. The analysis must also be divided into the seven types of logistics costs types. This is done to give the structure and grouping so that no gathered material is forgotten when a great amount of material is analyzed, as stated by Holme and Solvang (1997).

The analysis in this step should take every logistics cost type at a time and compare the material gathered from documentation of the system’s design for calculating the specific product’s cost and the interviews with the system developer and CEO of the studied organization, with the answer of objective one.

For example, the information on transportation costs, which has been analyzed as being information which manufacturing companies should take into account for understanding total product costs of a specific product, is to be compared to the data existing in the studied organization’s current ERP-system when calculating the specific product’s cost. It should be equally compared to the material gathered from the unstructured interviews done to the ERP-system’s developer. The main question
to answer in this analysis is whether this information is present in the ERP-system. This approach is to be done for every logistics costs type.

Figure 9. Material analysis - current ERP-system’s preparedness for supporting logistics costs information (own creation).

This way we can determine how well prepared the studied organization’s self-developed ERP-systems is for supporting information about logistics costs to its intended users and thus the second objective of this thesis can be answered. The content of this analysis done in this step for answering this thesis second objective is to be presented in chapter 7 and summarized in Appendix 7.
4 Material – Logistics costs information

In this chapter, the material gathered for this thesis can be viewed. A case study was made in a company which has chosen to be anonymous throughout this thesis. It will therefore be named the studied company, or merely the company. Similarly, the product which the company sells will be simply called the content, so that the company can not be identified by the product it sells. This is because the depth of this research and the fact that material gathered can be considered sensitive and may expose the company to competitors, jeopardizing its competitiveness advantage in the market.

The chapter starts by giving a background description of the company, based upon interviews with the organization’s CEO, where even its present issues are stated (section 4.1). Section 4.2 consists of gathered material from interviews made with the company’s Sales manager and Logistics manager. This section deals with the gathering of material to answer the first objective of this thesis, which is also stated in section 4.2.

4.1 Company background

The studied company is a Swedish manufacturing company. Besides the Swedish market, the company has also established itself in North European and the Baltic countries. It has a high level of automation, where the machines for producing the final product are specifically engineered for and by the company. Therefore, production can be very flexible. The company is also very customer-oriented and can produce in the quantities and labeling according to customer requirements. The company consists not only of a fabric, but two stores in Sweden as well, for individual customers. One store is bigger than the other and serves, not only as a selling point, but also as a central warehouse for the smaller store. It has around twenty employees and is situated not so far from the University of Skövde, thus having a good proximity, in accordance to this thesis’s delimitations (section 1.4).

Many other customers are enterprises that sell the products in their own name, which means, the actual product is from the studied company but the label has the customer’s name on it. This process is called private branding. The studied company also works hard with environmental friendly solutions. Today’s products are already in accordance to the environmental threshold values stated for 2010.

The company’s goal is to produce even more products according to customers’ requirement, and gain competitive advantage in a market where over-production is dominant. An issue which the company needs help with is to better understand its logistics costs, in order to get a better view of their products’ total cost, and make better decisions based on this understanding.

4.2 The studied company’s views on logistics costs information

The information about logistics costs, presented in this thesis’ Background (section 2.1.3) was shown to two employees of the studied company. These employees were the company’s Sales manager (the company’s former CEO) and the Logistics manager, who in turn gave their own opinion on the subject. This section, gathers data from these opinions and, together with the background information of the different logistics costs, done in section 2.1.3 (Background), will help to answer the first
objective, stated in section 1.2. This objective is to understand what information about logistics costs should be taken into account by manufacturing companies for understanding the total cost of specific products. Thus, this section corresponds with the second step for answering this thesis research aim (see section 3.2.2). In order to facilitate the reading of this section, the data collected from these two interviews will be divided in terms of the seven types of logistics costs, in accordance with the seven logistics costs types mentioned in this thesis’ Background (section (2.1.3). This gathered data, together with which interviewee/s that it was gathered from, is illustrated in Appendix 7.

4.2.1 Transportation costs

Transportation costs was a type of cost which was difficult for the interviewees to determine. According to the Sales manager and Logistics manager, the only type of transportation costs which were interesting for the company were the internal transportation costs. This means that the costs connected to the transportation to the company by the suppliers are not considered as vital logistics costs for the company. This because the costs of this type of transportation are embedded in the purchased order price that the company pays their suppliers. The studied company hires a transportation company, which in turn, sends the studied company’s finished products to their customers. This implies that studied company does not deal with the distribution to their customers themselves. These costs are well known and embedded in the price paid to these distribution companies, and therefore not considered vital information which must be identified in the company. Generally, it is the customers who pay for the cargo. Sometimes though, depending on the type of agreement the Sales manager has with the customers, it is the studied company that has to pay for the cargo.

Both the Sales manager and the Logistics manager agreed that the only interesting transportation costs were the ones which occur inside the fabric. The Logistics manager described in detail that the transportation costs worth mentioning was when the company’s employers unloaded the suppliers’ vehicles with raw materials or tins for the content, and transported it with the help of trucks to the warehouse for raw materials. There were also transportations when a production order arrived and raw materials and tins were needed to manufacture the end-product. The raw materials need then to be transported from its current warehouse, to the production area. When the product has been produced, then it needs to be transported to the warehouse for finished products. If the finished product already has an intended buyer, then it needs first to be transported another place inside the warehouse, for packaging. It will thereafter be transported to a smaller warehouse where the product will be placed and will await for the vehicle of the distribution company, which will deliver the products to the customer. It is also the company’s employees who need to transport and load the products to the vehicle. The Logistics manager also stated that, the company has its own vehicles though to transport their finished products to their two stores but that this cost were nothing they thought about, even though it could be a cost which should be interesting to understand and identify.

Since the Sales manager, and former CEO of the company, stated that only internal transportation costs inside the fabric were considered relevant for the company, only the costs of the trucks inside the fabric should be identified. The studied company only has electric trucks so electricity was an important cost, as well as the capital invested in the vehicles and insurance. The Sales manager and Logistics
manager also agreed that the time that takes to handle the loading pallets during transportation time should also be considered as critical information for understanding this type of logistics costs. The costs of loading pallets was also a cost which is associated to transportation costs.

Neither the Logistics manager nor the Sales manager agreed that the fuel costs and type of vehicle used was important information, because the trucks used inside the fabric were the same model and ran on electricity. Since distribution service is bought there is no need in having information about container costs. This since they are embedded in the distribution price. Both the logistics and Sales manager concurred that product damage or accidents done in connection to transportation were interesting information to acquire and which could influence transportation costs negatively. Therefore this information should be included in the ERP-system. The Sales manager also stated that logistics costs concerning transportation cannot be placed on one single product directly. The costs must be first associated to an entire loading pallet and thereafter divided into the number of products in that pallet. This because it is usually pallets that are transported and not single products.

4.2.2 Packaging costs

Concerning packaging costs, both the Logistics and the Sales manager stated that the most important information to gather for this type of cost was the time spent by the employees when creating the label customized for the specific customer, putting the products inside the pallet, with the base so that the tins will are stable in the pallet and not just on top of each other, tagging the pallet with the label and finally, taping it together with plastic around the pallet to ensure maximum stability and security. This taping process is done by a machine and therefore the machine costs are also relevant, also the creating the label is done by a printer. The item costs such as labels, pallets, cupboard bases and plastic are equally interesting and of course, also have an influence on packaging costs, stated the Logistics manager. There are two types of cupboard bases, those which go to the customer and those that stay in the warehouse and can be reused, and this information is equally important to distinguish for knowing the exact packaging expenses. The Sales manager also explained that the package size is also important to have in mind because, thirty 1 liter tins will imply thirsty times more packaging costs than a 30 liters tin.

4.2.3 Setup and capacity loss costs

The view of logistics in the studied company does not involve the production process. Therefore, setup-time costs are costs which are not considered vital for neither Logistics manager nor the Sales manager and thus do not affect logistics costs. These even though setup-time for vehicles or other machines connected to an order such as computers, printing machines, are also as considered setup-costs. Similarly, capacity loss costs derive from when a logistics activity cannot be performed due to many orders being handled at the same time and thus personnel and machinery must for example be used in production instead of warehousing due to priorities. Both the Logistics and Sales manager for the company believe that it is very difficult to store this information every time an employee or machine is used to do other tasks.
4.2.4 Capacity related costs

Both the Logistics manager and the Sales manager agree that capacity related costs is a very important type of logistics costs. Knowing how much the company has at their disposal and translating the capacity into costs should is a big step to understanding a company’s total cost. Both managers agree that the facility’s and total personnel costs are important capacity costs. It is also vital to know the machines’ and vehicles total cost as well as how many times per day, week, month and per year the capacity is used. Again, these are costs are not so difficult to store and are archived and stored by the administrative personnel.

4.2.5 Shortage or delay costs

A tremendous important logistics cost type which can have a deep negative impact of the company’s total cost and even in its competitive advantage is the shortage or delay logistics costs. The Logistics manager described the process of sending the wrong order to a customer as being something which involves doubling the logistics costs. For example, if a wrong order is sent, the order must be sent back to the studied company, the order must be transported and placed back in the company’s stock, possibly a new production order or even purchase order for new raw materials to manufacture the customer’s order once again, must be made. This new order must then be packed, taped, placed in the warehouse, loaded into the vehicle of the distribution company, and finally sent to the customer once again. It is therefore important to have a good visualization over the order and to follow it so as to have control over where and why the wrong order was sent.

The Sales manager agrees that these costs are important to understand and register. It is important to analyze the risk of a product shortage and consequently, on order delays. It is especially important to have information about those products which are expensive and have little demand. Since the products produced by the company is dependent of the weather, it is sometimes unpredictable when a specific product will be demanded. If a product, tin, raw material, pallet or plastic for taping is missing, then shortage and delays will occur. It equally important to have information on both the distributors and the customer which buy the delayed order. Information about service level in accordance to the perfect order concept is important to keep in mind. This information is vital to have about the distributor, to associate if the delays occur often, and the customer in order to ensure that these delays do not occur too often and that the company does not lose that customer.

4.2.6 Warehousing costs

Both Sales and Logistics managers agree that all transportations that occur inside the raw materials and tins warehouse, the finished product warehouse or the soon-to-be-distributed products warehouse are considered warehouse costs. So all transportation costs previously gathered in this case study (section 4.2.1) are also relevant for warehousing costs, as long as the transportation occurs inside the warehouses. The packaging costs, according to the Logistics manager are associated to warehouse costs, but only if it happens in the finished goods warehouse. In this warehouse, the product is produced and lies ther, waiting for a purchase order from a customer. When the order finally arrives, the product is packed, the tagging process is done to both the products and the loading pallets, according to customers requirements.
Capacity costs are also of course, a part of warehouse costs, according to the Logistics manager of the company. The trucks and machines used, personnel costs and facility costs are important costs to think about and that define the capacity involved when performing warehousing activities. The company’s view on capacity costs can be viewed, in detail, in section 4.2.4. As previously mentioned, it is vital to know the amount of products in the finished goods warehouse. This is true especially concerning those few products with little demand but which have great value and therefore, bring costs to the company as long as it is not sold, mean the Sales manager. The insurance for the stock that is in the warehouse is also seen as warehousing costs, state the Logistics manager. When it comes to products which may disappear from the warehouse, in case of robbery for example, the company should try to count the number of product in stock more often because product disappearance is, of course, seen as warehouse costs.

4.2.7 Administrative costs

The Sales manager of the studied company describes administrative costs as being the type of logistics costs which is the most difficult to distinguish. For him and for the Logistics manager, administrative costs are the costs which are involved in every decision done at an administrative level of the company, which have an influence on logistics activities. Making a purchase order for raw materials is considered as an administrative cost. The act of choosing a supplier and making offers are equally seen as administrative costs but, this is done very seldom, since most of the company’s suppliers have been their suppliers for many years. The act of controlling the raw materials on arrival (quantity as well as quality) is also considered an administrative cost for the studied company. In general, all communications done with the supplier about a purchase order is considered as an administrative order, according to the Logistics manager. The actual payment for the purchase order is similarly an administrative cost.

Equally, when dealing with a production order, all communications inside the company and with the customers are considered as administrative. Discussing and setting a price for a customer and noting down their requirements is the first cost. Secondly, if the products are already in stock and don’t need to be produced, the warehouse personnel are told to prepare this order. The act of making sure that the packaging and that the orders are done according to customers’ requirements is also an administrative cost. Even the communication with the distributors, which will transport the order to the company’s customers, is an administrative cost. This communication ensures that the distribution is done correctly, in a safe manner and in time. The act of payment for this distribution service can also be seen as administrative costs as well as receiving payment for the production order, from the studied company’s customers.

The Sales manager and the Logistics manager state that yet another big cost is taking care of reclamations. If the customer is not satisfied with the purchased order from the studied company, this implies added administrative costs such as contacting and paying the distribution company to retrieve the original order as well as instructing the warehouse personnel that an order is coming back to the company’s warehouse.

Logistics manager also mean that the act of payment involving facility costs and cleaning costs are equally administrative costs. Besides these costs, the Logistics manager also includes recycling costs for materials that must be disposed. The
payment of external transportation and recycling fees are also a significant for understanding logistics costs at an administrative level. Yet another cost to keep in mind is the environmental cost, which implies paying a sum for each product. The content of the selling product contain chemicals which are dangerous and which can damage the environment. These costs are known by the company, but the administrative costs of reporting these costs after the stated environmental rules, and of making the actual payment are considered administrative costs. The Sales manager considers IT costs such as usage, maintenance of IT systems and the developers cost as administrative costs. IT costs are very difficult to gather to understand total product costs, according to the Sales manager. The same can be said about office material, phone bills and other machine costs related to administrative activities.
5 Material analysis – Logistics costs information

The following chapter describes an analysis made between the literature written in section 2.1.3 (Background) about logistics costs information and of the material gathered in the case study, in the studied organization. Section 5.1 analyzes how literary work in section 2.1.3, as well as the Logistics manager and Sales manager of the studied company, perceive as important logistics costs and its related information. Section 5.2 analyzes how the company’s developed ERP-system presently supports the information on logistics costs which is analyzed in the precedent section (5.1).

5.1 Logistics costs information

This section is divided into eight sections. The first seven sections (sections 5.1.1 to 5.1.7) coincide with the seven types of logistics costs, found in section 2.1.3 (Background). These types of costs will then be analyzed with the information gathered from the studied company’s view of these types of costs. The material analysis done in this section will serve as the answer for the first objective stated in section 1.2. This analysis will determine what information about logistics costs should be taken into account by manufacturing companies for understanding the total cost of specific products. Thus, this section corresponds with the third step for answering this thesis’ research aim (see section 3.2.3).

The information analyzed as being the most relevant, from the studied company’s view, will be highlighted in bold type in this chapter. What is important to have in mind is that no real prioritizing in order of importance will be made concerning this information on logistics costs. This is due to the fact that, as stated by Oskarsson et al. (2006), all logistics costs affect total cost in some way, since these costs are interrelated. The summarized version of this analysis can be viewed in section 5.1.8, and Appendix 7 gives an illustration of this section.

5.1.1 Transportation costs

Jonsson and Mattsson (2005) and Sahlin et al. (2009) stated that both internal as well as external transportation impose costs to a company and are therefore considered as logistics costs. The Sales and Logistics managers of the studied company mean that only the internal transportation costs, i.e. the transportation that occurs inside the company, are relevant to understand and therefore, the trucks inside the company are the only vehicles needed for transportation. They state, on the other hand, that they sometimes use a company car to transport products to their stores, and that they sometimes pay the cargo costs when sending the goods to their customers, through distribution companies. This means that information on the type of vehicle needed is important, since both the trucks inside the company and the cars used for transportation to the stores are costs for the company. The cars can then be either the company’s or the distributors’. Consequently, the information, determined by Sahlin et al. (2009), concerning the vehicle such as purchase cost, costs of fuel and lubricants per mile, repair costs and insurance costs, is important to understand. Since the trucks used in the company run on electricity, according to the Sales manager, it is also important to have information on this cost in mind.

The costs of the infrastructure and its repair was not discussed by either the Sales or the Logistics manager but was considered as a part of transportation costs by Sahlin et al. (2009). Building and repairing the roads in the fabric for example is a cost which
should be of interest in the long run. Even understanding the capacity the vehicle has (i.e., how many pallets it can support) and the length the vehicle must travel when transporting a product was something which was not discussed in the company as relevant, which Sahlin et al. (2009) also consider of importance. Knowing this may for example give a better understanding of how to divide the costs for a single product, based upon fuel costs (for the car) or electricity costs (for the truck). Since both Lumsden (2006) and both the sales and Logistics manager are in agreement that the costs of the loading pallets are important, this information is also relevant to be understood.

The Sales and Logistics managers mentioned that container costs where only used by the distributors, and it was included in the price paid to the distributors, so it is not a relevant information for the company, despite Lumsden’s (2006) statement of the importance of understanding container costs. When transporting to their own stores, using their own cars, the company does not use containers at all.

One of the most important transportation costs are, according to both Jonsson and Mattsson (2005) and the company’s interviewed managers, the personnel costs. All handling and transportation inside the company is considered a transportation cost. So the required information about personnel wages is, of course, of importance to understand these costs. But overall, they also agree that transportation costs are difficult to determine and add to a single product. Yet another cost which both Sahlin et al. (2009) and the Sales and Logistics managers agree to include the transportation costs are the product damage costs and accidents derived from transportation. Damaged products and accidents done to personnel, vehicle or infrastructure are costs which should be comprehended by companies.

5.1.2 Packaging costs

Analyzing packaging costs, a general agreement existed between the material gathered by the literature found on the subject and the views of the company’s Sales and Logistics managers. Jonsson and Mattsson (2005), Johnsson (1998) as well as the two interviewed managers of the studied company mean that personnel costs, or wages in this case, and machine costs are important packaging costs to have information about. The machine costs are relevant in the company since they have a machine which is used for packaging the products in plastic, to ensure its safety and stability. Another machine used is the printer which prints out the labels for the tins. As mentioned, yet again it may be difficult to identify and distribute especially wages costs to a product, as well as gathering this information.

The cost of materials needed for the actual packaging was a cost evidently interesting and associated to packaging costs, as viewed by Jonsson and Mattsson (2005) and shared by the both the Logistics and Sales manager of the company. The packaging material costs relevant for the studied company was the printed labels, and again, the actual loading pallets which are also associated to packaging costs. Other material costs for this type of logistics cost, relevant for the company is the security plastic and the cupboard bases used as a support for the tins so that remain stable on the pallet. Since it was explained by the Logistics manager, that some cupboards are reused, whereas others are included in the orders to customers, it is important to have information on what type of cupboard it is used. Similarly, Lumsden (2006) means that the type of package is an information important to know because it has an effect on the costs. Similarly, Coyle et al. (2002) state that information on the package’s
**size and weight** is also vital and has an influence on the transportation as well as warehousing costs. If the package takes too much space and weighs more than usual, distributors’ costs and the space used in the warehouse will increase.

### 5.1.3 Setup and capacity loss costs

Although not seen as relevant logistics information by the company’s Logistics and Sales manager, Bjornland et al. (2003) and Jonsson and Mattsson (2005) state that it is of great importance to determine the costs involved in the time that takes to prepare a machine for use in the company. These costs are, as determined by Coyle et al. (2002), **wages for the personnel** using the machine, as well as **the facility costs** used during the setup-time. If occurred often, these costs may be of enough relevance to be noticed, and therefore information about them is considered important. Though difficult to collect, this type of information could be identified, as mentioned by Vollmann et al. (2005), by **counting the setup-time**. In this case it could be, when working with a single product.

Repair costs are important costs to understand which imply setup or loss of capacity in an organization, according to Jonsson and Mattsson (2005). This view is not shared by the studied company’s Logistics and Sales managers. For the latter, this information is considered too difficult to gather about every machine in the studied company. The time that takes to get for example a wrench or a tool is difficult to be monitored and presented as information. It may sometimes be so rare and so short a time, that it may not even be relevant for adding to a cost of a product. This information is therefore not considered of relevance in this study.

As stated by the Logistics and Sales manager, capacity loss costs are almost impossible to identify as well because sometimes an employee needs to be used for some other task than the one he/she is intended to be doing. But, by keeping track of the **available capacity** of the company, such as **machines and personnel** in relation to the **number of orders**, as advised by Jonsson and Mattsson (2005), this information is relevant for better understanding capacity loss costs.

### 5.1.4 Capacity related costs

When analyzing the important information concerning capacity related costs, there are not many differences in opinion between the studied literature and the opinion of the two interviewed managers of the studied company. For example the **facility costs** which are stated to be a part of capacity related costs by Olsson (2005) as well as Jonsson and Mattsson (2005) are agreed to be important information by the Logistics and Sales manager. The latter divide these facility costs into **electricity, water** and **building costs**, i.e. rent.

**Total personnel costs**, as well as **total machine and vehicle costs** (and related **maintenance costs**) are also considered to be a part of defining the capacity that the company has at its disposal (Jonsson and Mattsson, 2005). Mattsson and Jonsson (2003) add that other relevant information is to determine **how many employees and machines are used**, and **how often these are used per day, week, month or year** for a specific operation. Oden et al. (2003) explain that to understand the capacity used in a company, operations and activities must be timed at their normal pace. The measure used when timing these procedures should be done using the **same unit**, like for example product/hour (*Ibid*). This **timing measurement** was something which the company’s interviewed managers did not discuss or gave an opinion about, but it is
information that would surely be relevant for putting more concrete numbers to these capacity costs.

5.1.5 Shortage or delay costs

Jonsson and Mattsson (2005) believe that information about lost income, lost customers and compensations to these customers due to shortage or delay in their orders, is important to acquire and part of the logistics costs related to shortage or delay costs. They also consider important to hold information about the current materials in stock, so that delays and shortage might be prevented (Ibid). The Logistics manager adds that sending the wrong order to a customer implies redoing the logistics activities so that the customer’s requirements are met, which means a doubling of logistics costs. The Sales manager means that especially important is to be able to track the number of materials in stock, which have great value and low demand, because these are bound to be in shortage if suddenly demand should increase.

Christopher (2005) and Bjornland et al. (2003) mean that a way of gathering information as to prevent delays and shortage, and so that the customers’ requirements are met is by measuring the service level of the company in accordance to the perfect order concept. This implies getting information about the number of completed orders without any faults which were completed in time (Ibid). Another way is to gather information about the number of reclamations done by customers as well as the company’s reclamations to their own suppliers, to ensure that they too provide good service to the studied company, and to understand if the suppliers are the cause of these delays or shortage.

5.1.6 Warehousing costs

Jonsson and Mattsson (2005) describe warehousing costs as being the most important and the biggest type of logistics cost in most manufacturing organizations and this was something which was agreed upon by both the Sales manager and the Logistics Manager. If seen from the financial point of view, the bank interest which the company has to pay for the investment in the company, in a relation to the return rate of the company, are considered types of information relevant for understanding the costs involved in warehousing (Vollmann et al., 2005; Jonsson and Mattsson, 2005). These types of information are important to understand in manufacturing companies, despite the fact that it was something not discussed by either the Logistics or the Sales manager of the studied company.

The warehouse locale costs and the personnel wages are costs consider by Vollmann et al. (2005) and Jonsson et al. (2005) as being important. Both managers in the company associate these costs to capacity related costs, i.e. knowing the capacity which exists in their warehouses. The packaging costs and related information (earlier analyzed, in section 5.1.2) is considered important to understand for warehousing costs, only if the packaging activities take place inside the company’s warehouse for finished goods, according to the Logistics manager of the studied company. This is the case since there are no packaging involved in the raw materials warehouse or in the soon-to-be-delivered warehouse. These packaging costs are in part, in accordance to Jonsson and Mattsson’s (2005) view of a company needing information about the warehousing and management equipment, which are part of warehousing costs.
Both of the interviewed managers in the studied company, as well as Jonsson and Mattsson (2005) are in agreement concerning transportation costs. The information about transportation costs considered of importance (in section 5.1.1) is also important to have in mind, when determining warehousing costs. But as stated by the Logistics manager, this type of information is only relevant if the transportation is internal and is done inside the three warehouses of the company (i.e., the raw materials-, finished goods- and soon-to-be-delivered warehouses). Information on administrative costs (which will be analyzed in the following section) was according to Vollmann et al. (2005) and Jonsson and Mattsson (2005) also part of warehousing costs, but only if it involves activities made which concern warehousing.

As for the shortage and delay costs, analyzed in the previous section, in warehousing costs it is also of importance to have the information of the products in stock, especially those that have great value and are not on demand. It is important to understand that if these products are not sold, they must be sold at a cheaper price, or thrown away. And of course, if a customer order was sent wrong then it is also important to understand its impact on warehousing costs, as seen by Vollman et al. (2005) and Jonsson and Mattsson (2005). Insurance costs for the stock are seen by both the Logistics manager, and Jonsson and Mattsson (2005) as important information concerning warehousing costs. This is true for even the products which disappear from the warehouse. This implies, on the other hand, that continuous inventory control must be made.

### 5.1.7 Administrative costs

When analyzing the information considered relevant for this type of logistics cost, it can be examined that many activities can be made in a company which involve administration. What both Jonsson and Mattsson (2005) and both managers interviewed from the chosen company agree upon is that wages for administrative personnel are considered an important part of administration costs. Activities involved in planning, negotiating, controlling and dealing with invoices are considered administrative costs by Jonsson and Mattsson (2005). The Logistics and Sales managers agree in this statement and make a difference between how these administrative activities vary when dealing with purchasing raw materials from suppliers, from when dealing with a production order for the customers. This is also viewed by Mattsson and Jonsson (2003). Both managers also add on the importance of understanding reclamations done by customers. Reclamations imply that there will be doubled administrative work as well for planning another production order and taking the old order back into the company. Information about reclamations is therefore considered as a very important administrative cost in the company.

Johansson and Samuelson (1997) state that office material, office machines, telephone and fax bills and postage expenses are types of information connected to administrative work. Despite agreeing that these costs play a part in administration activities, the Sales manager explained that these costs would be very difficult to gather in the system and associate to a determinate product cost. The same can be said of the costs of the IT-systems, which are also a part of administrative costs according to Bjornland et al. (2003) and Aronsson et al. (2003). The investments made in developing and maintaining the system, are considered too difficult to associate to a product as well, mean the Sales manager.
5.2 Answering the first objective

Having made the analysis in this section, what is then the answer to this thesis’ first objective? What information about logistics costs should, in fact, be taken into account by manufacturing companies for understanding the total cost of specific products? Appendix 7 illustrates a summarization of the answer to the first objective. As has been discussed, there is no hierarchy and the information concerning logistics costs is not divided in order of importance since, as stated by Oskarsson et al. (2006), all logistics costs interact with each other and thus affect total cost.

When it comes to Transportation costs, information concerning the type of vehicle being used is information important to understand. This since different types of vehicles may involve different types of costs to an organization. A truck which runs on electricity and a car which runs on fuel imply different costs. Information on the costs involved in the vehicle also affects total cost. Such information is for example the purchase cost of the vehicle, fuel, electricity and lubricant costs for making the vehicle function. Even repair costs and insurance costs is information which is associated with transportation and which affect total cost in organizations. It is also important for organizations to have information on how much, for example products, a vehicle can transport (its capacity), for how long (vehicle’s route length) as well as the costs involved in for example pallets for transporting these products. Of course, personnel costs connected to transportation activities, is also information which organizations should understand. Product or infrastructure damage costs and costs related to accidents during transportation should also be understood by organizations.

Packaging costs are equally logistics costs for organizations to take into account. Personnel wages as well as material and machine costs involved in product packaging activities is information that manufacturing organizations should take into account. The materials can for example be the plastic, labels, cupboard base and pallet when packing products. The type of package as well as its weight and size is also information to take into account since it influences the Transportation and Warehousing costs. Because some cupboards belongs to the organization and can be reused in packaging, whereas others are destined to the customers, it is equally important to have the information on the type of cupboards being used when packaging. This is because cupboards that can be reused cost less than cupboards which go directly to the customers.

When it comes to Setup and capacity loss costs, information is also needed by manufacturing organizations. It is important to have information concerning the capacity at hand and this is information about the personnel and machines needed to perform a specific order, which may involve a determinate number of products. The personnel wages, facility costs and machines costs when performing a determinate order is also information that organizations should be aware of. Also, for determining the setup time costs it is important to have information about the actual setup time, i.e. the time it takes to prepare a machine for usage in an organization. This information can be counted when for example producing a specific product.

Of course not only the Setup and capacity loss costs are important to have information about. It is equally important for manufacturing organizations to take into account the information concerning the actual capacity the organization has at its disposal. This is information concerning the total personnel, machine and vehicle cost for performing an operation. This can be measured by determining how many employees and machines are used for that specific operation. These operations should, as previously
mentioned, be timed so that it can be associated to for example a specific product’s logistics costs.

Information about shortage and delay costs is also important for manufacturing organizations to take into account. Information about the cost of lost income, lost customers and compensations to customers is important since it affects total cost, and thus also ultimately product cost. Additional information which is good to have is the number of reclamations done by customers and to suppliers if shortage or delays occur. Also, measuring the service level by the organization’s suppliers and to the organization’s customers will give a better understanding about shortage and delay costs. Service level is measured by determining how many orders are completed, in time and without any faults. This is especially important for products that have great value but little demand. It is important to monitor and have information about how many of these products are in stock so as to prevent shortage costs when these products are in demand by customers.

When dealing with warehousing, there is much information that manufacturing organizations should take into account. From a bigger financial point of view it is a good idea to have information concerning the relation between the return rate of the organization in question and the bank interest which must be paid from the investment in the organization. Additional information to have into account are the capacity related-, packaging- and transportation costs which exist when performing warehousing activities. Warehouse locale costs and personnel wages when performing warehousing activities, are costs not only associated to capacity related costs, but also to warehousing costs. When in the finished goods warehouse, packaging costs are also seen as warehousing costs. Also administrative costs concerning warehousing are seen as warehouse costs and is valuable information to take into account for manufacturing organizations. Shortage and delay costs also affect warehousing costs and again, information concerning products in stock, continuous inventory control and stock insurance costs is information important to hold.

Finally, administrative costs concerning Logistics activities also involve information for manufacturing organizations to take into account. This information is merely the wages of administrative personnel dealing with invoicing, planning, negotiating and controlling of either purchase or production orders. It is also information on the costs deriving from reclamations involving Logistics.
6 Material – Preparedness of self-developed ERP-system

A brief background of the studied company’s ERP-system is presented in section 6.1. Section 6.2 presents how the ERP-system calculates the total cost of a product and the type of information which this calculation is based upon. The data gathered in this section will be utilized to answer the second objective for this thesis. This is to determine how well prepared manufacturing companies’ self-developed ERP-systems are for supporting information about logistics costs, so that the understanding total cost of specific products can be facilitated. Thus, this section corresponds with the forth step for answering this thesis research aim (see section 3.2.4).

6.1 ERP-system’s background

The studied company’s ERP-system was constructed in 1999. It works using the help of Access 97 and supports information about customer orders, production orders, articles, customers and suppliers. The ERP-system does not support the payment of orders and personnel wages. It also does not support Electronic Data Interchange, which is according to Bjornland et al. (2003), a standard format for sending business documents between different Information Systems electronically. The company uses another system for sending EDI files to their suppliers, customers and distributors. The company’s ERP-system has been periodically updated during unspecified periods of time. Through document reviews and according to the system’s developer, there are many functions and system’s parameters which are not fully developed or which have been added to the system but never used and have yet not been deleted. One of the functions which the company’s ERP-system developer believes should be improved and better developed is the calculation of a product’s total cost.

6.2 How the company’s ERP-system determines total product cost

According to the ERP-system developer, the function of calculating the total cost of a product is simple. The cost of a product is done solely based upon information about material costs. It is done by first defining the material cost of a tin of the content. This calculation is done by first identifying the filling degree of the content (in liters) per product and multiplying this number with the size of the actual tin. This number will then be multiplied by the purchased price of a liter of the content for the particular product. After that, the cost of a tin of the content is known. The next step if adding the cost of the tin used, the tin’s lid and the cost of the label printed to the tin. The final step done in the system is to multiply the result by 1.03 which means that an additional three percent will be added to the total product price. The company’s developer was not sure of why the extra three percent was included in the calculation.

This information is gathered in the system using the help of database tables and database relations. The Filling degree attribute is gathered from a database table called Article. This table is the biggest table in the ERP-system and has attributes related to an article. After observing the table, the most important attributes which can be relevant for getting the total product cost is the Article number, which is unique for every article, the article name, the Variant type, the Environmental cost (which is not currently used, but still present), Number of articles in stock, and finally, as previously mentioned, the Filling degree the article, which is done in percentage.
Another table used when calculating the total product cost is the *Size* table. This table consists of the attributes *Tin number*, *Tin Size* and *Pallet*. Different tins have different sizes which can hold different amounts of liters of the content. The main function of this table is to gather information about a specific tin size. To have information about the actual content price, there is a table called *Formula*. This table consists of how an article is build. The attributes in this table are among others, *Formula number*, *Formula description name*, *Material cost*, *Quantity (liter)*, *Cost (liter)*, *Liter weight (in kg)*. The developer says on the other hand that only the liter cost attribute is needed to perform the intended calculation.

Information about the tin costs can be found in the table called *New Tin*. In this table the unique attribute *Tin ID* is included, as well as *Type of material*, *Weight*, *Number in stock* and of course, *Price*. The weight of the tin and of the content is important for cargo costs, according to the ERP-system developer. Information of the *supplier* that has sold the tin to the studied company is also included. The same information which exist for the tin are also the same for the lock. This means that the attributes which exist in table *New Tin* are also included in the table *Lock*. The only difference is that, in *Lock*, the attribute *tin ID* is replaced by the attribute *Lock ID*, which is unique.

The next table, called *Label*, has the attributes *Label ID*, which is unique for a product, *Category*, *In stock* and *Price*. The attribute *in stock* is not used because the developer mentioned that the label is created as the orders are created and are never kept in storage. The attribute *Category*, determines the type of label used which has different costs. The entire relation to the total product cost is:

\[
[[\text{Article} \mid \text{Filling degree}] \times [\text{Size} \mid \text{Tin size}] \times [\text{Formula} \mid \text{Content Cost per liter}] + [\text{New tin} \mid \text{Cost}] + [\text{Label} \mid \text{Cost}]] \times 1.03.
\]

The developer wishes to increase the number of tables so that additional costs can be involved in this calculation. He also adds that these costs are not considered to have a great impact on the product cost. Finally, he believes that, opposed to what the Sales manager stated, additional product costs should be added in relation to the cost per liter and not in relation to the cost per loading pallet. Additionally, during the review of the documentation of the system, information about single loading pallet costs was found. The database model of the present ERP-system database, can be viewed in the UML class diagram in Appendix 7. This class diagram shows the relations, tables and attributes (discussed in this section) involved for determining the price of a product.
7 Material Analysis - Preparedness of self-developed ERP-system

This section analyzes how the studied company’s ERP-system currently supports the information on logistics costs to be taken into account by manufacturing organizations. Therefore, section 7.1 serves as the answer for the second and final objective stated in section 1.2. It gives an answer to how well prepared manufacturing companies’ self-developed ERP-systems are for supporting information about logistics costs, so that the understanding total cost of specific products can be facilitated. This section corresponds to the fifth step for answering this thesis’ research aim (see section 3.2.5).

7.1 Answering the second objective

Taking the way the studied organization’s self-developed ERP-system currently determined total product cost, it was apparent that the studied manufacturing organization’s self-developed ERP-system would be poorly prepared for supporting information about logistics costs. As can be seen in section 4.3.2., the system was developed in a way that it took information concerning the material costs of a specific product and added a three percentage additional costs which also include the logistics costs of the product. Since Bjornland et al. (2003) claim that logistics costs are around fifty percent of organizational costs, only including three percent in an ERP-system for determining the total cost of a product shows that important information concerning logistics costs have been left out of the self-developed ERP-system.

Concerning Transportation costs, the studied manufacturing organization’s ERP-system only supported information on the costs of loading pallets utilized for holding the specific product during transportation. It was not developed to support information concerning the vehicles used in the organization such as vehicle type and vehicle cost. The vehicle cost information being, as previously stated, the insurance cost and buying price for the vehicle. It is also information concerning lubricant, fuel or electricity used per mile for each vehicle. Additionally, the system does not support information concerning vehicle damage costs and its repair costs. Also, information concerning organizational vehicles’ route length per operation and capacity is not supported by the system. No information concerning product damage costs associated to transportation is supported by the system, as well as accident costs of personnel if accidents were to take place during transportation in the organization. Personnel wages are not supported by the studied organization’s ERP-system which implies that there is no information concerning personnel costs during transportation activities.

Packaging costs information is partly supported by the studied ERP-system. The material costs related to packaging, such as plastic, labels, cupboard bases and loading pallets, is information supported by the studied manufacturing organization’s self-developed ERP-system. There is also support for information concerning the type of package being used for that specific product, as well as its size and weight. On the other hand, information about machine costs for taping products as well as printing its labels is also information not supported in the system. Other information concerning Packaging costs not supported in the system is the type of cupboard being used in an order, whether it is a cupboard that will be dispatched to the customer or a cupboard that can be reused by the manufacturing organization.
Setup and capacity loss costs is another logistics costs type which has information that is poorly supported by the self-developed ERP-system. The system only has information concerning the number of orders being developed but no information about the counted setup-time of operations. There is neither support in the studied manufacturing organization’s system for information about the facility costs, total personnel wages and the available capacity (number of machines and number of personnel) when these setup-times occur.

When it comes to the Capacity related costs, the studied organization’s self-developed ERP-system did not support any information analyzed as logistics costs information to take into account when determining total product cost. The information not supported was total facility costs such as electricity cost, water cost and building rent. Information lacking support in the system was also total personnel, machine and vehicle cost for performing an order or operation. Finally, no information is supported about the timing of operations or the number of machines and employees used for each operation.

For information about Shortage and delay costs the system is also poorly prepared. The self-developed ERP-system only supports information about the organization’s materials in stock, but it does not divide this information into material value and material level of demand. It does not support information about compensations to customers, lost customers and lost income connected to order delays or shortage. The number of reclamations done by the organization’s customers and to the organization’s suppliers concerning delays or shortage is also information not supported by the system. Additionally, the ERP-system is also not prepared for supporting information about the service level to customers and by suppliers of an organization. This is information about orders completed in time and without any faults.

When dealing with Warehousing costs, the ERP-system does not support the information concerning the relation between the interest of the bank of the organization’s warehouse and the return rate for this investment. Associated to the information about Warehousing costs is the information on Packaging costs, Capacity related costs Packaging costs, Administrative costs and Shortage and delay costs which deal with warehousing activities. This is for example warehouse locale costs and personnel costs for the Capacity related costs. It is also information about the Packaging costs inside the finished-goods warehouse and all the Administrative costs associated to the organization’s warehouse. Even information on products in stock, inventory insurance costs and continuous inventory control which is information on Shortage and delay costs, is also associated to Warehousing costs. All this associated information is, as has been seen, not supported in the studied self-developed ERP-system.

Also, the ERP-system studied is not prepared for supporting information concerning Administrative costs. Such information is administrative personnel costs for planning-, negotiating- and controlling activities, as well as the dealing of invoices for purchase orders or production orders. Also, information concerning reclamations done by customers to the organization is also not supported by the studied manufacturing organization’s self-developed ERP-system.

To sum up and as has been analyzed in this chapter and can be easily seen in Appendix 7, much information concerning the logistics costs that manufacturing organizations should take into account for facilitating the determination of total
product cost, is in fact not supported by the system’s ERP-system. There is currently no support at all for information concerning Capacity related costs, Warehousing costs and Administrative costs in the ERP-system. The system only holds information on the materials in stock for the Shortage and delay costs, and the number of orders for the Setup and capacity loss costs logistics type. For the Transportation costs logistics type, the studied ERP-system only supported information concerning the cost of loading pallets. The system was best prepared for the information concerning the Packaging costs logistics type, where information about material cost for packaging, package size, weight and type was supported. Overall though, it is analyzed that the system is not developed in a way that when determining the total cost of a determinate cost, logistics costs are taken into account.


8 Conclusions

This chapter is divided into two sections. In the first section of this chapter (section 8.1), this thesis’s research aim will finally be answered. Highlighted in bold is the information which is concluded to give an answer to this thesis’s research aim. In section 8.2, this thesis’s problem area and conclusions will be looked at in a larger perspective.

8.1 Conclusions – answering the research aim

It has finally come the time to answer this thesis’s research aim. So, what information about logistics costs, not supported by manufacturing companies’ self-developed ERP-systems, should be considered by these organizations and included in these systems for facilitating the understanding the total cost of specific products?

A single representative manufacturing organization was chosen for this thesis. Having this case study in mind, what can be concluded is that if manufacturing organizations choose to develop their own ERP-systems, there is some information on logistics costs which organizations should be more attentive of and consider when the development work takes place. This since it is information which can easily be neglected and thus is not supported by self-developed ERP-systems. This is information that should be considered and included in these systems if manufacturing organizations want to gain a better understanding of their total cost and consequently, the total cost of specific products.

Information about transportation costs can be neglected and not supported by self-developed ERP-systems and should be considered when developing these systems. This is information concerning the type of vehicles the organization has, and that vehicles’ cost. Vehicle cost information can be insurance cost; the vehicles’ buying price; fuel and lubricant used; damaged costs and repair costs. It can also be information about the route length of these vehicles and the vehicles’ capacity (how many products it can transport). Personnel wages, possible personnel accident costs and product damage associated to transportation is also information that may not be supported and which should be considered when developing ERP-systems.

Additional information that should be considered by manufacturing organizations and which may not be supported in their ERP-systems is information about packaging costs. This involves information concerning personnel wages and machine costs associated with product packaging activities. Additionally it involves information concerning the type of cupboard being used, if it is reusable for the organization or if it will go directly to the customers.

Setup and capacity loss costs also contains information which may not be supported by self-developed ERP-systems and which should be considered by manufacturing organizations during the development of these systems. This is information about personnel wages, facility costs and available capacity (number of machines and personnel) during the time it takes to time it takes to adjust the machines from one manufacturing order process to another. Information about the actual time
should be timed by organizations and this is also information which should be considered and may not be included in their self-developed ERP-system.

When it comes to the capacity related costs much information may be neglected and should have the attention of manufacturing organizations if they wish to self-develop their ERP-systems. Information to take attention upon are facility costs, total personnel costs, total machine costs and the total vehicle costs when performing an operation or order. It is also information about the number of personnel and machines used per operation, as well as the time it takes to perform specific operations or orders.

Information about lost income, lost customers and compensations to customers related to shortage or delays of orders and products is information that manufacturing organizations should consider and which are in risk of not being supported by their ERP-systems. This is also true about information concerning the measurement of service level to customers and from the organization’s suppliers. Service level is information on orders that are completed in time and without any faults to the customers. Also, information about the number of reclamation done by customers and to the manufacturing organization’s suppliers can be neglected in the development of ERP-systems and should be considered. Additionally, when it comes to Shortage and delay costs another information to be consider and which may not be supported by self-developed ERP-systems is the materials in stock for products with low demand but great value. This is because products in low demand and great value usually exist in smaller amounts in stocks and thus are more subjective for not being available when the demand increases. These are thus more subjective to shortage costs.

Information about Administrative costs is also a type of logistics cost which can be neglected by manufacturing organizations when self-developing ERP-systems. Information to be considered in this case is information on all costs related to reclamation done to the organization concerning orders. It is also information on personnel wages when dealing with planning, negotiating as well as controlling and dealing invoices for purchase orders as well as production orders.

During warehousing activities is when the most important and biggest logistics costs derive. Associated to these costs are Capacity related costs, Packaging costs, Transportation costs, Administrative costs and Shortage and delays costs. These types of costs are associated to Warehousing costs only if they are associated to warehousing activities. Therefore all information that shall be considered by manufacturing organizations and that may not be supported by their ERP-systems, concerning the above-mentioned types of logistics costs, shall also be included in the information that shall be considered for warehousing costs. This is the case as long as these logistics costs types affect and derive from when warehousing activities take place. Besides this information, manufacturing organizations should also take into consideration, information concerning the relation between the bank interest from the investment on the warehouse, and the return rate of the organization in question.
Appendix 8 illustrates in a more summarized manner, the conclusions of this thesis and thus this thesis’s research aim. It can serve as a guideline or a check list for manufacturing organizations who want to self develop an ERP-system and would like to have a more detailed view of their logistics costs for facilitating the determination of the total cost of their products.

8.2 Conclusions and problem area

Since such a study which deals with logistics costs and self-developed ERP-systems has not yet been made it is difficult to analyze it with conclusions from other studies on this specific problem area. On the other hand, this thesis’s conclusion that the majority of logistics costs are not supported by self-developed ERP systems in manufacturing organizations is in agreement with the view of Oskarsson et al. 2006. This is the view that states that many manufacturing organizations choose not to analyze all costs in the organization since they are difficult to understand and capture (Ibid). The conclusions of this thesis will thus serve as a guideline of the most important logistics costs and help organizations realize that much information on logistics costs can be supported by the organization’s ERP-system.

The conclusions of this thesis are also in accordance with Beynon-Davies (2002) which state that many functions and parameters are neglected when organizations self-develop their ERP-systems. This thesis’s conclusions can help organizations realize and test whether their current self-developed ERP-systems support this information on logistics costs or whether they must focus on adding new functions and parameters to its existing ERP-system or developing a new self-developed ERP-system.

Having this thesis’s conclusions as a guideline, manufacturing organizations may acquire a more detailed view of their entire logistics costs which, as stated by Oskarsson et al. (2006) implies that the organization’s economical situation can be easier analyzed.
9 Discussion

This chapter is divided into two sections. Section 9.1 presents the author’s own thoughts and critical attitude towards the chosen method as well as how the chosen method influenced the quality of the gathered data (result) and material analysis. Section 9.2 suggests future studies which can be made based upon this thesis.

9.1 Chosen method

This section discusses the choice of method. Section 9.1.1 argues the author’s choice of a qualitative approach and case study for this thesis. Also, the different steps chosen for reaching this thesis’s research aim are discussed in section 9.1.2.

9.1.1 Qualitative approach and case study

Jensen (1991) warns that the results from qualitative approaches tend to be more unsecure than that from quantitative approaches, due to the difficulty of testing and measuring these results. This was noticeable while working with this thesis. Not being able to test or measure the conclusions made it vital that the chosen organization was in fact representative for this study. Also it made it important that the gathering and analyzing the material for this thesis would give detailed and accurate outcome.

I believe that the qualitative approach was a good method choice because it enabled a deeper understanding of the chosen organization and its needs. A way of controlling the quality of the chosen material, analysis and conclusions would be to actually develop an ERP-system based upon the conclusions of this thesis and test its quality.

It would have been interesting to verify how well prepared other organization’s self-developed ERP-systems actually support information on logistics costs and how other organizations view logistics costs information. Different organizations, besides employing the same view of logistics as the one stated for this thesis, have different products and thus this information could likely differ. If the time for conducting this thesis was not an issue, I would have tried to conduct at least three case studies, hence possibly enriching the conclusions of this thesis. In today’s business world it occurs often that organizations cannot understand their logistics costs (Oskarsson et al., 2006). This is also true with this thesis’s studied organization, making it representative for most organizations who want to get a better view of their logistics costs. I believe it to be representative not only for organizations that self-develop their ERP-systems, but also for organizations that buy standardized ERP-systems. This is because I believe that all organizations can analyze how their ERP-systems support information on logistics costs.

9.1.2 Steps for reaching research aim

While working with step one, I understood that there are many types of logistics costs and it was vital to gather as much material on these costs as possible and from different sources. This is since material collected from only one single source could have a negative impact on reliability and relevancy. Having material from different literary sources also gave a better preparedness, quality and relevancy when collecting data in step two.

Despite the delimitations imposed, the time and space limitation also affected this step since logistics costs is a very extensive subject where much material in literary works
can be found. It was challenging to determine what material should be included and what should be left out. It would be interesting to verify if the material gathered for this step would have been the same, if time and space limitations were no boundaries.

When it came to the chosen sources I am confident in the quality and reliability of the gathered material. The majority of the sources concerning logistics costs were text books found in University libraries. Since, as stated by Christopher (2005), the modern concept of logistics derives from the Second World War and it has changed little over the years, the year of sources to be searched not necessarily needed to be the last decade, even though the majority of the sources used in this thesis are dated from the last decade. The sources searched were in both English and Swedish languages, which I believe also enrichen the quality of the gathered material since it was not limited to Swedish literary works.

Since not many studies were done concerning the integration of Logistics costs and Information System Development, only a few scientific research journals were used in this thesis. These were found in library databases on the Internet and most were electronic journals. Sources from the Internet outside these library databases were on the other hand avoided to ensure that only data from scientifically qualified sources were used, thus increasing the data’s reliability (Berndtsson et al. 2002).

While working with the second step, the interviewees agreed to be open and did not reflect on the dictaphone being present. This may in great part derive from the fact that a contract was signed prior to the study of the chosen organization. This was done in order to ensure that the company’s name and data which directly identified the organization would be altered in order to fulfill its secrecy rules. I believe that in doing so, the data gathered from these interviews reflect the real thoughts of the Sales and Logistics managers of the studied company, thus enrichening the data’s quality.

Jensen (1991) mentioned the danger of group interviews in that sometimes the person higher in the hierarchy is more active. This was a risk even in this thesis. The interviewees participated actively during the interview with own ideas, which then slightly reduced the risk of this problem. On the other hand, it was noticed that the Sales manager and former CEO of the organization participated more than the Logistics manager during this interview. The Logistics manager would sometimes merely agree when the Sales manager conveyed his ideas. In this case, this thesis can assume that the material was in fact gathered from both managers, even if it was the Sales manager who conveyed his opinion in the first place. It would have been interesting to have instead made individual interviews with each of the participants instead, to verify if more ideas and discussions could have come from the Logistics manager. But I believe that both interviewees had good knowledge on the topic of logistics costs and sometimes other ideas and opinions. Then discussions would evolve and the material gathered would have greater quality.

I trust that the personal tone used with the studied company’s CEO through the unstructured interviews was a good choice. A company’s CEO has generally the most knowledge of an organization as a whole. Therefore having interviews alone with the CEO enabled me to gain material which I believe is rich in quality and accuracy.

In step three I am convinced that the chosen method of analysis was the optimal technique. It could possibly be made through another analysis technique but it was chosen for its simplicity, structure and depth for analyzing the collected material. I believe that in using this analysis technique, all data could be closely analyzed.
Besides, there are, as previously mentioned and stated by Holme and Solvang (1997), no real rules or guidelines for analysis techniques in quantitative studies are included in this thesis. This also gives the freedom to choose the analysis technique believed to be the most adequate for analyzing the large amount of material for this step.

Marshall and Rossman (1999) mean that to validate the material analysis and ensure its quality and relevance, the research team must discuss and give feedback concerning issues, hypotheses and eventual problems with the data collected. To validate and enrich the quality of the analyzed data, the material gathered was shown and discussed by fellow colleagues in the areas of Logistics and Information System Development, who gave me valuable feedback. Also, it was shown and discussed with the Sales and Logistics manager of the studied organization.

In step four, a problem with conduction unstructured and individual interviews was that sometimes the interviews got off-topic making it more challenging to sort out the material which could be used. The usage of a dictaphone was of great help because it enabled to go back and ensure that no vital material was missed and it was noticed that the system’s developer did not mind being recorded since the discussion was very open. The fact that the interviews with the ERP-system’s developer were done individually is, in my opinion something which could not have been done any other way. This since he was the only one who had developed the system and understood it best. Having chosen group interviews with other employees would in this case therefore have been more an obstacle than an advantage.

The chosen analysis technique for step five is, in my opinion a technique which I found the only suitable for the material analysis. It is a simple and structured way of closely analyzing the collected material. Since according to Holme and Solvang (1997) there are no particular rules or guidelines for analyzing techniques when doing quantitative studies, there is a freedom of the choice of analysis technique. This freedom can also make the actual technique very individual and it is possible that other researchers would probably choose another technique if dealing with the same collected material which should be analyzed. Being an individual technique and not being any concrete guidelines or rules, it also makes it difficult to ensure that another analysis technique would not have given a richer analysis of the collected material.

9.2 Future studies

Finalizing this thesis has revealed that there are several studies to be done which could not have been studied in detail in this thesis, due to the time limitation and delimitation requirements imposed. It would be interesting to do comparative studies by making similar case studies in other manufacturing organizations which self develop their ERP-systems. It would be interesting to determine whether these organizations’ self-developed ERP-systems were equally unprepared as the manufacturing organization studied for this thesis in supporting information on logistics costs.

Another study which could be very interesting and which is not covered in this thesis is to identify how this information concerning logistics costs can actually be captured in manufacturing organizations. It is a study that could analyze where in manufacturing organizations this information about logistics costs typically lie. Are there paper documents which hold this information, other computerized Information Systems or does this information lie perhaps in people? This study could then fall under the Knowledge Management area. This area is according to Aggestam (2008)
an area that helps make knowledge available to everyone in organizations when and where it is needed and can be captured and distributed by using the help from Information Technologies. Knowledge is, in this case according to Nonaka & Takeuchi (1995) and agreed upon by this thesis, created by semantic information, which is information which has a meaning. To be called knowledge, this information must be interpreted and utilized to solve problems or situations (Wiig, 1995).

As mentioned in section 3.1.1, it would be equally interesting to make a quantitative study based upon the analysis and conclusions deriving from this thesis. This quantitative study could test through calculations and statistical analysis the accuracy of calculating total product cost by using a self-developed ERP-system which actually supports all of the stated information on logistics costs, analyzed in this thesis and that should be taken into account by manufacturing organizations.

Finally, another type of study would be to identify exactly how much logistics costs really do affect the total cost of products in terms of economic measure, and how these costs can be distributed to all products in an organization. What percentage of these logistics costs can be added to a product? This is a very difficult but yet interesting study, and falls into the Industrial Economics and Logistics areas.
References


Appendix 1 - Overview of problem area as a whole

What is the total cost of this product?

ERP-system user

Self-developed ERP system

Research Aim

Process of determining what information about logistics costs which may not be supported by manufacturing organizations’ self-developed ERP-systems should be considered by these so that the understanding of products’ total cost can be facilitated

IS developer

Objective 1

Logistics costs information that should be taken into account by manufacturing organizations

Objective 2

Currently used self-developed ERP system

Process of defining how well prepared the current ERP system is for supporting logistics costs information

Business employers

Identification process of logistics costs information

What is the total cost of this product?
Appendix 2 - Logistics costs information – Background

Transportation
- Vehicle's purchase cost
- Cost of fuel per mile
- Cost of lubricant per mile
- Repair and insurance cost
- Vehicle's capacity
- Vehicle's route length
- Infrastructure investment
- Accidents costs during transportation
- Product damage during transportation
- Product handling during transportation
- Personnel costs during transportation
- Type of pallet or container used in transportation
- Type of vehicle used

Packaging
- Material for packaging/tagging
- Package type
- Package size (height, weight, width, length)
- Personnel costs associated with packaging
- Machine costs associated with packaging
- Transportation costs associated with packaging
- Administrative costs associated with packaging

Setup and capacity loss
- Time it takes to adjust the machines
- Personnel costs associated with setup and capacity loss
- Fixed costs of machines
- Facility costs
- Number of orders
- Actual capacity level for making the order
- Capacity related costs

Capacity related
- Facility costs
- Machines costs
- Personnel costs
- Vehicles costs
- Provision costs
- Cleaning costs
- Operation groups for producing the product
- Actual measured time at normal pace associated with product operations

Shortage or delay
- Income lost
- Customers lost
- Additional transportation costs associated with delay or shortage
- Compensation costs to the customers
- Material existence
- Number of completed orders
- Number of completed orders in time
- Number of completed orders without faults
- Number of completed orders in time and without faults

Warehousing
- Return rate
- Bank interest
- Warehouse locale
- Warehousing and management equipment
- Personnel wages associated with warehousing
- Internal transportation cost in warehouse
- Administrative costs connected to warehousing
- Product life cycle and number of unsold products
- Number of products which disappear
- Incorrect delivered product amount
- Income insurance
- Shortage or delay costs

Administrative
- Administrative personell costs
- Office materials
- Office machines
- Telephone and fax bills
- Postage expenses
- Purchase order administrative activities costs
- Information system investment and maintenace costs
- Production order administrative activities costs

Logistics costs information Background
Appendix 3 – Method - steps for reaching research aim

Step 1
Background
Logistics costs

Step 2
Material gathering:
Current ERP system and logistics cost information support

Step 3
Material analysis (Objective 1)

Step 4
Material analysis (Objective 1)

Step 5
Material analysis (Objective 2)

Objective 1

Objective 2

Research aim

• Literature reviews

• Structured group interviews

• Unstructured individual interviews

• Documentation review

Additional information

Input to
Appendix 4 - Logistics costs information – Studied organization

Transportation
- Internal transportation only (inside own organization)
- Capital invested in vehicles
- Cost of electricity per mile
- Repair and insurance cost
- Product handling during transportation (should be timed)
- Accidents costs during transportation
- Product damage during transportation
- Personnel costs during transportation
- Costs of pallet used (no containers)

Packaging
- Material for packaging/Bagging
- Package size (height, weight, width, length)
- Personnel costs associated with packaging
- Machine costs associated with packaging

Setup and capacity loss
- Transportation associated to warehouse
- Number of completed orders (to customers/from suppliers)
- Number of completed orders in time (to customers/from suppliers)
- Number of completed orders without faults (to customers/from suppliers)
- Number of completed orders in time and without faults (to customers/from suppliers)

Capacity related
- Facility costs
- Machines costs
- Personnel costs
- Vehicles costs
- Time when the capacity is used

Logistics costs information
- Studied organization

Material gathered from Sales manager/CEO (interview)
Material gathered from Logistics manager (interview)
Material gathered from both Sales manager/ former CEO and Logistics manager(interview)

Shortage or delay
- Transportation
-Warehousing
- Administrative

- Order control and visualization
- Material existence (especially of those with much value and with little amount in stock)
- Number of completed orders (to customers/from suppliers)
- Number of completed orders in time (to customers/from suppliers)
- Number of completed orders without faults (to customers/from suppliers)
- Number of completed orders in time and without faults (to customers/from suppliers)

- Packaging in the finished-goods warehouse
- Control of number of products in stock
- Number of products which disappear
- Stock insurance

- Total capacity associated with warehousing
- Following order
- Communication done inside company
- Communication done outside company (reclamations)

- Cost of electricity per mile
- Information considered too difficult to store
- Packaging
- Product handling during transportation
- Personnel costs associated with packaging
- Machine costs associated with packaging

- Facility costs
- Machines costs
- Personnel costs
- Vehicles costs
- Time when the capacity is used

- Material gathered from Sales manager/CEO (interview)
- Material gathered from Logistics manager (interview)
- Material gathered from both Sales manager/ former CEO and Logistics manager(interview)
Appendix 5 - Material analysis – Logistics costs information

Transportation
- Type of vehicle (car or truck)
- Vehicle cost (insurance, buying price, lubricant used per mile, fuel used per mile, damage costs, repair costs)
- Route length,
- Capacity
- Product (damage cost)
- Personnel (wages, accidents costs)
- Pallet cost

Administrative
- Administrative personnel cost (planning, negotiating, controlling and dealing with invoices; purchase orders or production orders)
- Reclamations

Warehousing
- Banc interest vs return rate
- Capacity related costs (warehouse local, personnel costs)
- Packaging costs (in finished-goods warehouse)
- Administrative costs (which is associated to warehouses)
  - Shortage and delay costs (information on products in stock, inventory insurance costs, continuous inventory control)

Packaging
- Personnel wages
- Machine costs;
- Material cost (plastic, label, cupboard base, pallet)
- Type of cupboard
- Type of package
- Package size
- Package weight

Setup and capacity loss
- Personnel wages
- Facility costs
- Counted setup-time
- Available capacity (number of machines and personnel)
- Number of orders

Capacity related
- Facility costs (electricity, water, building rent)
- Total personnel costs
- Total machine costs (and maintenance)
- Total vehicle costs (and maintenance)
- Number of employees used per time period operation
- Number of machines used per time period and per operation
- Timing measurement of the operation (same unit)
Appendix 6 - UML class diagram of the present ERP-system for determining product cost
Appendix 7 - Material analysis – Self-developed ERP-systems preparedness

Information about logistics costs not supported by self-developed ERP-system for determining total product cost

Information about logistics costs supported by self-developed ERP-system for determining total product cost

Transportation
- Type of vehicle (car or truck)
- Vehicle costs (insurance, buying price, lubricant used per mile, fuel used per mile, damage costs, repair costs)
- Route length
- Capacity
- Product (damage cost)
- Personnel (wages, accidents costs)
- Pallet cost

Administrative
- Administrative personnel cost (planning, negotiating, controlling and dealing with invoices, purchase orders or production orders)
- Reclamations

Warehousing
- Bank interest vs return rate
- Capacity related costs (warehouse local, personnel costs)
- Packaging costs (in finished-goods warehouse)
- Administrative costs (which is associated to warehouses)
- Shortage and delay costs (information on products in stock, inventory insurance costs, continuous inventory control)

Packaging
- Personnel wages
- Machine costs:
- Material cost (plastic, label, cupboard base, pallet)
- Type of cupboard
- Type of package
- Package size
- Package weight

Setup and capacity loss
- Personnel wages
- Facility costs
- Counted setup-time
- Available capacity (number of machines and personnel)
- Number of orders

Capacity related
- Facility costs (electricity, water, building rent)
- Total personnel costs
- Total machine costs (and maintenance)
- Total vehicle costs (and maintenance)
- Number of employees used per time period operation
- Number of machines used per time period and per operation
- Timing measurement of the operation (same unit)

Shortage or delay
- Lost income
- Lost customers
- Compensations to customers
- Materials in stock (especially with great value and low demand)
- Number of reclamations by customers
- Number of reclamations to suppliers
- Measure service level for customers and by suppliers (orders completed, orders in time, orders without any faults)
Appendix 8 - Conclusions

- Personnel costs
- Machine costs
- Types of cupboard
- Return rate
- Banc investment
- Capacity related costs,
  Packaging costs,
  Transportation costs
- Administrative costs
- Shortage and delays costs
- Return rate

Warehousing costs

Self-developed ERP system

Transportation costs

Packaging costs

Shortage and delay costs

Setup and capacity loss costs

Capacity related costs

Lost income
- Lost customers
- Compensations to customers
- Measured service level (customers and suppliers)
- Number of reclamations (customers and suppliers)
- Materials in stock (based on demand and value)

Personnel wages, administrative expenditures, short-term and long-term rentals, and projected sales

Information about logistics costs to be considered by manufacturing organizations and which may not be supported by their self-developed ERP system

Materials in stock (based on demand and value)