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Reverse Supply Chain Management

A study of two companies in the personal computer industry

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Acknowledgement

Abstract

Title: Reverse Supply Chain Management - A study of two companies in the personal computer industry

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Environmental regulations, increasing returns and legislative initiatives as well as the rapid development of new products forces companies in the personal computer industry to focus more on their reverse flow. Reverse supply chain management (RSCM) is becoming more important to companies, from being seen as a nuisance, companies are starting to realize its potentials.

The purpose of this thesis was to investigate the role of RSCM and how economic value can be captured in the reverse supply chain (RSC) in the personal computer industry, and to fulfill the purpose a multiple case study was conducted. To gain knowledge on the subject, a literature review was made and interviews with managers at renowned manufacturers Hewlett Packard and Dell were carried out.

The results showed that economic value was captured through the reselling of used products but time- and resource intensive activities were required in order to capture value. The two companies had different approaches to their respective RSC's, mainly in terms of economy as a driver and the execution of the RSC processes. Legislations and customer citizenships were considered drivers to the companies, forcing them to operate comprehensive take-back programs.

The conclusions drawn from the findings are that keeping processes in-house comes with high initial costs, although increasing the potential to gain revenue in a long-term perspective. HP considered economy to be a driver and was also able to increase its revenue from reselling returned computers through different channels. Dell sees the reverse supply chain more as a necessity than a potential source of revenue and has outsourced most of its activities.

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1. Introduction

This chapter provides the reader with a necessary background description and a problem discussion of the chosen subject. The purpose of this thesis and the research questions are developed and stated in this chapter. Delimitations and the thesis disposition are the final parts of this chapter.

1.1 Background

Supply chain management plays an important role for today's companies through the coordination and management of complex networks, from the manufacturer to the end customer. But while companies have been focusing on fine-tuning their supply chains by streamlining the forward flow of goods to maximize efficiency and reduce costs, issues regarding the return flow of products within supply chains have emerged (Agrawal, 2012). Due to legislative initiatives, environmental concerns and an increasing number of customer returns, companies have been forced to pay attention to the flow of goods from the customer to the manufacturer; the reverse supply chain (RSC).

Reverse supply chain management is defined as the series of activities required to retrieve a used product from a customer and either dispose of it or reuse it (Guide & van Wassenhove, 2002). While sounding uncomplicated, the definition is a truly simplified description of a complex series of processes, starting with the acquisition of products, determining the correct action, and finally relocating the product to its proper place. There are several differences between the forward supply chain and the reverse supply chain, such as the difference in product quality, forecasting, supply chain speed and responsiveness (Gupta, 2013), that are all causing problems when trying to apply forward strategies on the reverse flow.

Much like traditional supply chains, RSC's consist of costly activities. The cost of transportation, handling, and determining the disposition of the returned products are the primary cost drivers (Agrawal, 2012). While the focus has previously been on reducing these costs by making the reverse supply chain processes as effective as possible and spending time and money on developing a superior forward supply chain, the reverse supply chain had to take a back seat.

With the emergence of environmental legislations and regulations, companies have been forced to recycle materials. For example, the directive *"Waste Electrical and Electronic*

Equipment" (WEEE) issued by the European Union in 2003, includes disposal requirements of hazardous electronic waste (European Commission, 2015). The WEEE-directive holds electrical and electronic manufacturers responsible for taking e-waste back from customers in an environmentally friendly manner. A similar directive is the European Union's "End of Life Vehicle", issued in 2000, which includes recovery and recycling of no longer usable vehicles (Agrawal, 2012). These directives create a flow of goods from customers upstream in the supply chain, forcing manufacturers to create and develop the reverse supply chain for collecting disposal products and waste.

A recent shift in attitude towards the reverse supply chain has occurred, largely due to a growing understanding of the potential benefits of reverse supply chain management. Besides reconditioning and reselling products in alternative markets for additional profit, successfully handling customer returns can also impact the brand image. Sales opportunities in the secondary market, end-of-life (EOL) take backs and pressure from customers are reasons why companies have increased their focus on creating a competitive reverse supply chain (Prahinski & Kocabasoglu, 2005).

1.2 Problem

Product returns from both consumers and companies are estimated to cost companies in the US between \$35 to \$100 billion annually (Klappish, 2008) and are increasing, making them a challenge for companies to cope with. Blackburn et al (2004) points out that since most companies have viewed commercial product returns as a nuisance, minimizing their cost has been a priority. This has led to creating RSC's that aim to handling the reverse flow of goods in a cost-efficient manner where time is not an important factor. This causes a series of problems when trying to capture value within the RSC, especially in industries with high marginal value of time (Blackburn et al. 2004), such as the consumer electronics industry. The lack of responsiveness in many RSC's makes a lot of the value a returned product possesses go to waste because of the often lengthy delays in cost-efficient RSC's. The longer it takes to retrieve a product that has been returned, the lower the probability to retrieve any economical value of the used product. For example, a printer's value can decrease by up to 20 % during the process (Coyle et al, 2013). A more responsive reverse supply chain can maintain the value of the returned product due to lesser time spent in the return process.

Reverse logistics is receiving more attention from both academia and industries and there are environmental as well as economical reasons behind this trend (Gupta, 2013). Rapid depletion of raw materials, global warming and saturated land filled areas are the main environmental concerns. In addition to the above mentioned supranational directives, national governments impose stricter environmental regulations that require manufacturers to take back and handle their end-of-life products through a reverse logistics network (Gupta, 2013). Manufacturers of electronic equipment need to handle all of their end-of-life products and electronic waste as the manufacturers of vehicles need to handle their unusable vehicles as well as waste from the vehicles.

The evolution of Internet and the growing amount of products ordered online have greatly increased product returns, further pushing companies to pay more attention to their RSC. Due to more liberal return policies and the increase in online shopping, the growth of returns is expected to continue. Another factor contributing to the increase in product returns is the high obsolescence rate in technology products which also accelerates the importance of time value for electronic products in the reverse supply chain (Coyle et al, 2013). Even though product returns have negative consequences, they are inevitable. The handling of returns is costly and time-consuming. No matter how well a company forecasts their demand or how much they invest in a zero-defect production philosophy, customers will return products and some products will remain unsold, making improvement to companies' RSC's a necessity.

An issue that supply chain managers face is the uncertainty of returns, in terms of the wide variety in quality of the returned products. The high variability in timing also makes forecasting a complicated task. Returned products can be defective or damaged, obsolete or brand new, which makes the inspection process complicated and time consuming (Gupta, 2013). A large portion of the returned products are EOL-products in the hands of end customers and while several companies within the personal computer industry are encouraging their customers to return their EOL-products, often by offering them compensation, predicting the number of items that will be returned during a specific time-frame is a hard task.

Despite the growing importance of reverse logistics, managers are still focusing more of their attention on the forward supply chain. By doing so, they are missing opportunities to improve their company's performance and profit (Agrawal, 2012).

The personal computer industry is a complex and changing industry that serves customers all over the world. The rapid development of new electronic components and products contributes to a competitive market where companies need to find new ways to achieve and maintain an advantage compared to their competitors. The fierce competition between the actors in the industry forces the companies to handle and manage their supply chains as efficient as possible to keep customers satisfied and to gain competitive advantage. The increase in product returns, environmental concerns and national regulations forces companies to improve and focus more on their reverse supply chain. The rapid development of new products causes the products to become obsolete much faster. How can personal computer companies create value from returned products in some way? Reverse supply chain management is becoming more important and companies are starting to realize the potential of RSCM. However, how companies can increase economic value in the reverse supply chain has not been fully investigated.

1.3 Purpose

The purpose of this study is to investigate the role of RSCM in capturing economic value for manufacturers in the personal computer industry. The subsidiary purposes are to analyze different aspects of the reverse supply chain, the processes included in RSCM, and how companies in the personal computer industry manage the RSC.

1.4 Research questions

In order to fulfill the purpose of the thesis, a research question needs to be developed. The research question to be answered in this thesis is formulated as:

- *How can reverse supply chain management increase economic value for manufacturers in the personal computer industry?*

In order to answer the main question, two sub-questions are to be answered:

- *What are the main drivers of the reverse supply chain for the manufacturers in personal computer industry?*
- *What are the similarities and differences between the manufacturers' reverse supply chains?*

1.5 Delimitations

Due to a strict time frame, this thesis will be limited in some aspects. It will only focus on the studied manufacturers reverse supply chains in Sweden, and their extended parts in Europe. In this geographical area, the same regulations and laws apply which must be followed. In order to narrow down the scope of this thesis, it will only include computers in the studied reverse supply chains.

1.6 Disposition

The overall structure of this thesis is divided into six sections. The first section gives a brief introduction to, and a discussion of the problems associated with the subject. Section two is concerned with the methodology used in this thesis. A theoretical framework based on previous research is presented in the third section. In the fourth part of the thesis, the empirical findings and results are presented. An analysis of the results is developed in the fifth section and the conclusions are to be found in the sixth section of the thesis.

2. Methodology

In this chapter, the research methods used in this thesis are presented. The methodology aims to explain the methods used when writing a scientific research. The chapter will cover research methods, qualitative data, data collection, analyze methods and lastly, reliability and validity.

2.1 Research strategy

To get an insight into reverse supply chain management and how companies in the personal computer industry are practicing RSCM, different methods have been used. The theoretical framework is based on previously research in form of books and science articles. Empirical findings were developed through case studies, including interviews with company representatives Hewlett Packard and Dell.

2.1.1 Qualitative research method

There are several differences between a quantitative and a qualitative research approach and most obviously, qualitative research tends to be concerned with words rather than numbers (Bryman & Bell, 2011). The quantitative research can be construed as a research strategy that emphasizes quantification in the collection and analysis of data while qualitative research can be construed as a research strategy that usually emphasizes words rather than quantification when collecting and analyzing data. The quantitative research strategy can be described as deductive, testing of theory, and the qualitative strategy can be seen as inductive, generation of theory (Bryman & Bell, 2011). When conducting research on organizations, a qualitative method is more suitable than a quantitative.

In order to study the selected manufacturers, and to describe and analyze their reverse supply chains, a qualitative research approach is considered to be the most suitable for this thesis. The qualitative research method information gathering will be conducted through a qualitative interview. By selecting a qualitative research method, the researcher can get closer to the people being investigated which can provide details and rich understanding of the subject and the organization's work. The qualitative data consists of richer and deeper data, in contrast to quantitative data, which can been seen as hard and reliable (Bryman & Bell, 2011).

2.1.2 Case study

This study will involve two companies in the selected industry to gain understanding, insights and to compare the companies. The case study will involve both primary and secondary collection of data. Furthermore, the case study will be focusing on the reverse supply chain management of the two companies, not the organizations as a whole.

A case study investigates a phenomenon in its realistic environment or context, where the boundaries between the phenomenon and context are not given and in which multiple sources of evidence are used (Backman, 2008). This is a strategy of particular interest if the researcher wishes to gain a rich understanding of the context of the research (Saunders et al. 2003). A case study can be a very worthwhile way of exploring existing theories, and a simple and well-constructed case study can enable you to challenge an existing theory. The data collection methods employed in a case study may be documentary analysis, interviews, observation and questionnaires. One pitfall to avoid is to generalize the findings of the case study and view it as representation of a large population. Rather, the results of a case study should be seen as an opportunity to define theoretical concepts (Yin, 2014).

A case study associates with a geographical location, such as an organization or workplace and the research design is focused on a bounded situation or system (Bryman & Bell, 2011). This thesis was conducted through a multiple case study of two companies in the personal computer industry. One advantage a multiple case study has compared to a single-case study is that the results from a multiple study could be considered more robust. When designing a multiple case study, the cases must be selected so that the results aim to be either similar or contrasting (Yin, 2014). A multiple-case design allows the researcher to compare and contrast the findings deriving from each case, using more or less identical methods of two or more contrasting cases. The cases can be organizations; nations, people and data are collected from each case (Bryman & Bell, 2011).

2.3 Data collection

The data collection consists of primary data and secondary data. The interviews with respondents from each company provided the primary data and the secondary data was gathered from literature reviews.

2.3.1 Primary data

This thesis aims to describe reverse supply chains in the personal computer industry and to be able to conduct an analysis; a comparison with the manufacturers' in the personal computer industry was made through primary data. To receive information on how companies in this industry manage and handle their reverse supply chains, interviews with top managers were made.

Interviewing

One main research method associated with qualitative research is qualitative interviewing (Bryman & Bell, 2011) In qualitative interviewing, the approach is to be less structured and there is much greater interest in the respondent's point of view. Qualitative interviewing tends to be more flexible and responds to the direction in which the interviewees take the interview. The two main types of interviews in a qualitative research are unstructured interview and semi-structured interview (Bryman & Bell, 2011). Both interview processes are flexible and new questions that may occur can be answered.

In this thesis, semi-structured interviews were used in both cases. The semi-structured questions are conducted with a rather open framework, which gives the interviewee a great deal of opportunities in how to reply (Bryman & Bell, 2011). The researcher has a list of questions, often referred to as an interview guide. Questions may not necessarily follow exactly in the outlined way, and questions that are not included may be asked by the interviewer when picking up things said by the interviewee.

An interview guide (Appendix 1) was used during the interviews and follow up questions were asked when noticing interesting and important aspects. A series of questions were predetermined and more questions were asked as the interviews went along, depending on the respondents' answers to the predetermined questions. In this way, deeper and more thorough answers were collected and analyzed. Due to a cancelled appointment, the interview with the respondent from Dell was conducted over the phone and the call was recorded and transcribed. To understand and perceive all information and minimize the risk of misinterpreting something said by the respondent, the researchers of this thesis had different roles during the interview. One acted as interviewer and asked all the questions while the other acted as listener, noted and wrote follow-up questions.

The respondent from Hewlett Packard was interviewed in-person in Solna, Stockholm and the conversation was recorded and transcribed. The scheduled Friday interview was postponed to the following Monday. As a result of this sudden postponement, only one of the two researchers was able to be present for the hour-long interview, take notes, and ask follow up questions. Afterward both researchers listened to the recorded interview and transcribed it. Both respondents were contacted some time after the interviews by e-mail to tie up loose ends and to ask further questions. They also proofread the empirical findings to reduce the risk of misunderstandings.

2.3.2 Secondary data

Secondary data is data that has been gathered previously by researchers or organizations. Secondary data has several advantages compared to primary data in that it is less cost- and time consuming, enabling the researcher to spend more time on the analysis of the data (Bryman & Bell, 2011). It is often of high quality and the sampling procedure is usually very thorough and conducted by organizations specialized in gathering data.

The main sources of secondary data for this thesis were gathered from the Economic Library of the University of Gothenburg. The databases of the University of Gothenburg were used to search and collect relevant previous data. To develop a foundation for a discussion and an analysis of the collected information, a literature review of academic articles and books was carried out. The academic articles of previous research in the field were reviewed and collected from different databases. The books used in the theoretical framework are written by researchers with knowledge of the studied field and were primarily collected through University of Gothenburg's databases. In addition to books and academic articles, reports and journals were used to develop and create a reliable theoretical framework. As this research focuses on the reverse supply chain management in the personal computer industry, relevant information regarding the selected manufacturers was gathered through websites and annual reports.

2.4 Sampling

To answer the research question and objectives, data collection is necessary. Restrictions of time, money and often access, requires sampling techniques for providing methods to reduce the amount of data by considering only data from a subgroup rather than all cases (Saunders et al. 2003). The sampling techniques can be divided into two types: Probability and non-

probability sampling. With probability sampling, the chance of each case being selected from the population is known and usually equal for all cases (Saunders et al. 2003). Non-probability sampling can provide the strategy in a qualitative research to answer the research question and meet the objectives through in-depth study, focusing on a small case selected purposively. A range of non-probability sampling techniques is available and it depends on the research question and objectives - what do you need to find out and what will be useful (Saunders et al. 2003). One of the sampling techniques in non-probability sampling is the purposive sampling. Purposive sampling enables the researcher to use its judgment to select cases that will enable you to answer your research question and meet the objectives of the thesis. *Homogeneous* sampling is a purposive sampling method, which focus on a particular subgroup where all the samples are similar (Saunders et al. 2003). To answer the research question and meet the objectives of this thesis, two similar companies have been chosen through *homogeneous,* purposive sampling.

In order to answer the research question of this thesis, two companies were selected to be investigated. The companies compared and investigated in this thesis were chosen for several reasons. Hewlett Packard and Dell are some of the largest manufacturers of personal computers in the world (Gartner, 2015), operate all over the globe, and both companies are present in Sweden. The two companies operate return flows of computers and handle a large amount of product returns and end-of-life products. The chosen companies are two companies in the personal computer industry with national headquarters, and the most employees, in Sweden. Since operating in the same markets, the regulations and legislations apply to both companies. Therefore, the selection can give a good overall picture of the reverse supply chain in personal computer industry.

The interviewed respondents were chosen after the initial contact with the companies, depending on their position in each company. Both respondents are top managers at their respective companies and have a wide and deep knowledge of their companies' reverse supply chains.

2.5 Analyzing method

There are different approaches to the process of analyzing qualitative data. The qualitative data collection and analysis can be approached from either a deductive or an inductive perspective (Saunders et al. 2003). The inductive approach starts with data collection without

a predetermined theoretical framework. The theory emerges from a process of data collection and analysis. The deductive perspective commences by using existing theory to formulate research questions. Commencing the work from a theoretical perspective may have certain advantages, it will link the research to the subject area and provide with the initial analytical framework (Saunders et al. 2003). When using this analytic strategy, key themes and patterns to search for in the data will be provided. In order to analyze the empirical findings and link it to the theoretical framework, a deductive perspective was carried out. The analysis of this thesis was conducted by attaching units of data to categories and examining these for emergent patterns while being guided by the theoretical propositions and explanations.

2.6 Reliability and Validity

The credibility of the research findings are dependent on the chosen research method and the quality of the used research method. To reduce the possibility of getting the answer wrong, attention has to be paid to two emphases in research design: reliability and validity (Saunders et al. 2003).

Reliability is concerned with the replication of the results in the study (Bryman & Bell, 2011). External reliability means the degree to which a study can be replicated; this is a difficult criterion to meet in qualitative research method due to differences in social settings and circumstances. Internal reliability is concerned with whether the members of the research team agree about what they see and hear (Bryman & Bell, 2011).

When using interviewing for collection and gathering of data, it might be difficult to test the reliability. Every social situation is unique and the interviews conducted in this thesis cannot be completely replicated. To replicate this thesis's results, the same questions can be asked during an interview, the theoretical framework can be replicated and the companies' reverse supply chains can be studied in other ways. Both authors of this thesis have listened to and read the transcription of the interviews and agree on the gathered information.

Validity is concerned with whether the findings are really about what they appear to be (Saunders et al. 2003). Internal validity means if there is a good match between the researcher's observations and the theoretical ideas (Bryman & Bell, 2011). The degree to which the findings can be generalized across social settings can be measured with external

validity. The external validity represents a problem for qualitative researcher because of small samples and case studies (Bryman & Bell, 2011).

The sampling of the thesis can be perceived as bare minimum, since there are only two respondents being examined. On the other hand, Hewlett Packard and Dell are some of the largest manufacturers of computers and the population is small since there are not that many computer manufacturers, which makes the sampling representative. Regarding internal validity, the observations and theoretical ideas can in most aspects be reviewed as a good match. However, since Dell has outsourced a significant part of its reverse supply chain, the validity cannot be fully achieved.

When interviewing representatives for a company, it could be in their interest to spare details that would not be beneficial for the company, and highlight certain aspects in order to build the brand image of the company. This may cause a lack of transparency and give a skewed foundation for the empirical findings of the thesis. However, the respondents for the interviewed companies have pointed out aspects that are beneficial, as well as problems regarding the reverse supply chain, leading the researchers of this thesis to believe that lack of transparency is not an issue.

3. Theoretical Framework

This chapter represents the references applied in this thesis to develop the theoretical framework. It provides knowledge of reverse supply chain management and the essential parts included in the field. Including the design of the reverse supply chain and revenue- and cost drivers associated.

3.1 Definitions

There are different concepts included in reverse supply chain management. The forward supply chain is a fundamental part of a company and determines the prerequisites of the return flow and the reverse supply chain.

3.1.1 Supply Chain management

Supply chain management can be defined as: "*...a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize systemwide costs while satisfying service level requirements.*" (Simchi-Levi et al, 2009, p.1)

The term Supply Chain Management was coined in the early 80's and is a much wider concept than logistics. It emerged when companies started seeing the benefits of collaborating and integrating processes with one another. Thus, the concept of supply chain management refers to the network of organizations and companies collaborating and integrating processes in order to optimize the flow of materials, information and resources (Christopher, 2011). Globalization, along with the evolution of technology, has been a primary driver of the emergence of supply chain management. As the globalization continues, companies have gotten a wider market for their products and a bigger supplier base. Information technology has enabled this by providing a way for companies to instantly correspond with their suppliers all over the world.

3.1.2 Reverse Supply Chain Management

The definition of reverse supply chain stated by Guide and Van Wassenhove (2002, p.25) has been used in several studies by other researcher and it refers to *"the series of activities required to retrieve a used product from a customer and either dispose of it or reuse it"*. In alignment with Guide and van Wassenhove, Prahinski and Kocabasoglu (2006) agrees with the definition and clarifies that reverse supply chain is broader than reverse logistics. The

scope of reverse logistics management focus on transportation, warehousing and inventory management while reverse supply chain management also includes coordination and collaboration with partners. According to this definition, reverse logistics can be seen as one of the processes of reverse supply chain management.

The management of reverse supply chains can be seen as an extension of the traditional supply chain with material or used products either being reprocessed or discarded. A company will face many challenges when establishing a reverse supply chain, whether it is established by choice or as a necessity and it will have to create new points of contact with customers and educate them (Guide & Wassenhove, 2002). Which activities to outsource needs to be decided as well as figuring out how to keep costs to a minimum, find innovative ways to recover value, and meet strict environmental standards. Reverse supply chain management represents an opportunity to businesses to improve their efficiency, sources of revenue and knowledge that can be employed to improve product design (Agrawal, 2012). By treating returns as perishable assets, a stream of value can be created. Companies usually see the return flow as a waste stream but there are actions managers can take to extract value from the reverse supply chain (Blackburn et al, 2004).

All processes involved in the reverse supply chain are associated with costs, which makes managing the RSC crucial in order to minimize them. It is hard to estimate the total cost involved in reverse supply chain management, but reports are saying that reverse logistics cost companies in the US $100 billion annually (Sumner, 2008). Logistics accounts for a large part of a company's total cost. According to Delaney (2000), logistics costs accounts for almost 10 % of the US economy.

3.2 Differences Forward-Backwards

There are several differences between the forward- and reverse flow of goods and using the existing forward flows for returns will not create sufficient efficiency in the reverse supply chain. In the forward flow, products are transferred from one or a few manufacturers to several distributors and since there is demand for the product, forecasts can be made (Gupta, 2013). In the reverse flow, products are acquired from multiple sources and transferred to a few facilities where the value-adding activities occur. Traditional forecasting methods cannot be applied to the reverse flow due to the lack of demand. It is therefore difficult to forecast the correct requirements and allocate resources to the product return system (Coyle et al,

2013). New products have been packaged to minimize shipping costs and make handling easier. Products in the reverse flow on the other hand, can be returned in original packaging, without packaging or modified packaging, making the handling and shipping less efficient.

The condition of returned products vary greatly and there can be parts missing or damaged, which makes every product unique (Gupta, 2013). That requires every product to be handled individually in order to capture as much value as possible. Other challenges in the return flow can be the lack of the right competences at local receiving places. If inspection, evaluation and disposition are made in the wrong way or done incorrect, costs for delays and decreasing market value will occur which will affect the economic value of the returned product (Skjøtt-Larsen et al, 2007).

3.3 Reverse Supply Chain Drivers

De Brito and Dekker (2003) point out that the reasons for why companies have a reverse supply chain are that they can profit from it, because they have to, or because they feel pressure from society or customers. These reasons boil down to three drivers of reverse supply chain management; economics, legislation and corporate citizenship.

3.3.1 Economic

Studies have shown that economic benefits can be the lone driver for a reverse supply chain and that recycling for reuse and remanufacture has potential of being profitable (Coyle et al. 2013). This means that activities in the reverse supply chain can create economic value itself, without the other benefits that comes with a RSC, such as better customer service.

The main source of revenue in a reverse supply chain primarily comes from selling remanufactured, refurbished or repaired products. These can be returned to the marketplace and sold to full, or close to full price, or sold to secondary markets at a lower price. Parts that are not sold to a third party but used within the firm can also be viewed as revenue (Agrawal, 2012). Since some of the reconditioned parts are sold in a secondary market at a lower price and to a market segment that might be unwilling to pay the full price of a new product, companies can generate additional revenue (Blackburn et al. 2004).

Parts and materials that are going to be scrapped are generally sold to third-party scrap dealers that pay a fee for the scrap, which also generates revenue. By recycling, companies

also require less raw materials and can reduce disposal costs (Rubio & Jiménez-Parra, 2014). Furthermore, companies can obtain valuable spare parts from product returns and decrease waste material (Şükrü Akdoğan & Coşkun, 2012). Unsold products can be another source of revenue in the reverse supply chain. Products that have not been sold can be transferred to another geographical area where demand is higher. By doing so, the company does not have to lower the prices, although the transportation costs causes the margins to shrink (Skjøtt-Larsen et al, 2007).

Besides the direct revenue that can be obtained from the activities mentioned above, Agrawal (2012) argues that there are intangible values attached to the reverse supply chain that also need to be considered. A company's RSC strategy affects the customer's view on the company and the brand image. For example, more generous warranties and replacing defect products with new ones instead of repairing them might increase RSC costs but have positive effects on the brand image, increasing revenue in the long run.

3.3.2 Legal

Over the last few decades, there have been an increasing number of legislations and regulations applying to producers in most industries, but especially in the consumer electronics and automotive industry. Several of theses regulations refer to an extended producer responsibility and it holds manufacturers responsible for the whole product life cycle. In Europe, regulations such as *The Directive on Waste Electrical & Electronic Equipment* (WEEE) put electronic and electrical companies under special legal pressure (de brito & Dekker, 2003). The idea behind the directive is that every producer should be financially responsible for the disposal of products that they have put on the market. The directive aims to increase the recycling by forcing companies to take back EOL-products from consumers free of charge. This can be done either individually or in collaboration with other producers in a collective scheme (European Commission, 2015). The regulations do not only apply to the actual products; companies are also responsible for the packaging.

3.3.3 Corporate Citizenship

Corporate citizenship concerns social as well as environmental issues. The increasing environmental awareness among customers puts pressure on companies to live up to the high expectations. Therefore, companies are trying to establish an image so that the customers will see them as an environmental and responsible organization (Şükrü Akdoğan & Coşkun,

2012). Increasing the customer awareness for returning and refunding options, focusing on environmental aspects and improved customer service can affect a company's image and provide benefits. Rubio and Jiménez-Parra (2014) mention that the increasing social awareness has led to a more responsible environmentally behavior, especially regarding carbon emissions and waste generation.

3.4 Product categorization

One major challenge RSCM faces is the disparity of the products entering the reverse supply chain. Products usually greatly differ in quality, condition and age, because of how they have been used and where in the product's life cycle it has been acquired. Several authors have categorized products in order to create better understanding of the difficulties of RSCM. Coyle et al. (2013, p. 630) categorize eight different products returns in the reverse flow.

- Products that have failed or are unwanted, damaged, or defective but that can be repaired or manufactured and resold.
- Products that are sold, obsolete, or near the end of their shelf life but that still have some value for salvage or resale.
- Products that are unsold from retailers, usually referred to as overstocks, that have resale value.
- Products being recalled due to a safety or quality defect that may be repaired or salvaged.
- Products needing "plug and replace" repair before being put back in service.
- Products that can be recycled, such as pallets, containers, and computer inkjet cartridges.
- Products or parts that can be remanufactured and resold.
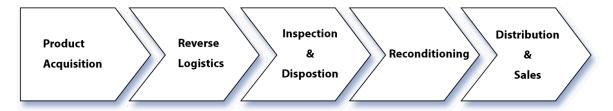- Scrap metal that can be recovered and used as a raw material for further manufacturing.

De Brito and Dekker (2003) identify several categories, such as warranty returns, end-of-use returns and end-of-life returns. End-of-use returns refer to products acquired after a lease is expired and end-of-life products refer to the products that have reached the end of their economic or physical life cycles.

Gupta (2013) lists five categories of product returns. *Consumer returns* refer to the products returned from end customers due to liberal return policies. *Repair/service returns* are products that fail to perform their functions but can be repaired and returned to the market. Lately, the amount of *EOL-return* has greatly increased. EOL-products are products that have reached the end of its life cycle, but can still have value. This is due to the rapid technological development that causes consumers to discard their IT-products while they are still functional. *Reusable container returns* are items such as bottles or cans and *leased product returns* refer to products retrieved after a lease contract is terminated.

3.5 Reverse Supply Chain Processes

The reverse supply chain (RSC) can be divided into five processes: product acquisition; reverse logistics; inspection and disposition; reconditioning and distribution and sales (Guide & Wassenhove, 2002).

Figure 3.1 Reverse Supply Chain Processes

3.5.1 Product acquisition

The first process of the reverse supply chain design is the *product acquisition*, in which the product or material is obtained from a customer. Guide and Van Wassenhove (2002) see the product acquisition process as the key to a successful RSC, and the quality, quantity and timing of the returns must be managed in such a way that the company is able to handle the return flow. Barker and Zabinsky (2011) divide the acquisition process in two parts; *the propriety collection*, where a company only collects its own products, and *industry-wide collection*, in which products from multiple manufacturers are collected. Proprietary collection helps preserve intellectual knowledge about the product and build up customer relationships, while the industry-wide approach is better for high volume since the cost is divided among several manufacturers.

There are three main sources from where the products can be retrieved; the forward supply chain, from an established reverse supply chain, called market-driven systems, or the waste

stream (Prahinski & Kocabasoglu, 2006). The products coming from the forward supply chain are mainly returns or recalls where the product has been brought back to the retailer. Products in a market-driven system are acquired by getting pulled from customers by incentives policies, such as leasing or deposits. Products retrieved from the waste stream can either be discarded or, if value can be recovered from the product, diverted from landfills and reused (Prahinski & Kocabasoglu, 2006).

3.5.2 Reverse logistics

Reverse logistics focus on the transportation, warehousing and inventory management of products returns. Reverse logistics has always been a part of an organization's logistic management, but increasing attention has been given to this field the last decades. According to Blumberg (2005), reverse logistics includes the coordination and control, physical pickup and transportation of material, parts and products from the field for processing, recycling or disposition.

In industries where the products have a relatively short life cycle and fast clock speed, such as the consumer electronics industry, the value of products decrease faster than in industries with slower clock speed and longer life cycles, which calls for a more rapid reverse logistics process in order not to lose too much of the product's value. Consumer electronics products like computers, that are time-sensitive and have a fast clock speed, can decrease in value with a pace at 1 % per week (Blackburn et al, 2004).

Some of the most evident costs are associated with reverse logistics; the transportation and warehousing activities (Agrawal, 2012). Since most activities in the RSC require transportation of the products, i.e. to a facility after being acquired or from a remanufacturing facility to a secondary marketplace, the reverse logistics makes up for a lot of the RSC costs. According to Coyle et al. (2013) transportation costs can account for up to 25 % of the total cost of the reverse flow. Prahinski and Kocabasoglu (2006) agree that transportation is generally the biggest cost associated with reverse logistics, but not merely transportation costs should be taken into account when managing reverse logistics. The pace in which the products decrease in value plays a significant role in the reverse logistics process (Guide & Van Wassenhove, 2002).

3.5.3 Inspection and Disposition

In the inspection and disposition process, the products retrieved from customers are being sorted, tested and graded based on the quality of the product. Prahinski and Kocabasoglu (2006) identify four alternatives on how to dispose returned products; reuse, product upgrade, materials recovery and waste management. Reuse means that the products are immediately brought back to the market. Product upgrade refers to activities such as repackaging, repairing, refurbishing and remanufacturing. Materials recovery is mainly recycling but also cannibalization, which is when parts of a product are taken out and placed in a different product. By recycling materials, companies can significantly decrease the energy use since processing recycled material requires less energy than processing raw materials. It also reduces material cost and has several environmental benefits such as minimization of carbon emissions (Gupta, 2013). Waste management refers to landfilling of products (Prahinski & Kocabasoglu, 2006).

The inspection and disposition process is labor and time consuming, but it can be partly automatized by using technical aids such as sensors or bar codes (Guide & Van Wassenhove, 2002). For example, Bosch uses a built in sensor in their power tools that registers the activity. When returned, the power tool can be connected to a test machine in an inspection facility and the recorded data will give an indication to whether the product should be remanufactured, recycled or scrapped. The same technique is used in the printer industry where a chip placed in a printer can register the amount of pages printed, making the inspection process faster. This allows companies to do the inspection at an earlier stage since the equipment needed for the inspection can be installed at resellers (Blackburn et al. 2004).

3.5.4 Reconditioning

The reconditioning process is the first process in which value can be created. The products that have been decided not to be scrapped or immediately returned to the market will be sent to a reconditioning facility where they will be repaired, refurbished, remanufactured or recycled, depending on the condition of the product (Prahinski & Kocabasoglu, 2006).

Reuse

Reuse is the process of putting recovered products back on the market after inspecting and cleaning them. This is especially common with bottles, pallets, containers and furniture. Reusing is the activity that can capture most of the value from a returned computer, since it

takes the least amount of resources to put back on the market. (Rahman, 2012). Reusing returned products implies very basic activities to recondition the product (cleaning, minor repairs) that do not modify its structure or their nature (Rubio & Jiménez-Parra, 2014).

Remanufacturing

Remanufacturing is the process of turning a used product into a product with the same warranties as a new product. This is because remanufactured products consist of previously used, refurbished parts, as well as brand new parts (Gupta, 2013). After arriving at a remanufacturing facility, the products are inspected and disassembled into parts. The parts that are in good enough condition are sorted out and if necessary, repaired or refurbished. Some minor upgrades to the parts might also occur in the remanufacturing process. The last part of the process is reassembling of the parts into a remanufactured product (Gupta, 2013). The remanufacturing process requires thorough work since the products often are completely disassembled. The purpose of remanufacturing is to bring back products to a condition as good as new, which makes it a process that greatly recovers value (Skjøtt-Larsen et al, 2007).

One challenge in remanufacturing is the uncertainty concerning the product's condition. Even though the products have been inspected, whether components and parts can be reused is not fully determined until the recondition process (Guide & Wassenhove, 2002).

Recycling

Recycling refers to the disassembling of products and sorting out and categorizing the different materials in order to process them into recycled materials. By recycling raw materials and use them in the production of new products, costs can be cut since recycling requires less energy than processing new materials (Gupta, 2013). Even so, recycling is considered to be the recovery alternative that generates the least value to a company because it abolishes the features and characteristics of the original product (Coyle et al. 2012). Therefore companies should try to focus on reuse or remanufacturing and use recycling only as a last resort. Because of the low value that can be captured from recycling, the primary drivers are regulations and legislations, which force companies to recycle their material.

The reconditioning processes are affiliated with costs since it requires a lot of resources in form of labor and equipment. There are direct costs, such as handling, disassembly, sorting

and cleaning, as well as indirect costs, such as examination of products and parts, involved in this process (Agrawal, 2012). Maintaining the facilities also incur costs.

3.5.5 Distribution and Sales

While some remanufactured and refurbished products can be used within the company to serve as spare parts or in some cases in the production of new products, the majority is sold to customers. It is therefore important to find new distribution channels for the reconditioned products. They could be distributed in the same channels as new product, as long as it is emphasized that the reconditioned products are not new. The products can also be sold to third-party retailers that sell the products to a lower price (Prahinski & Kocabasoglu, 2006). In the automotive industry, the majority of the remanufactured products are sold in the aftermarket for between 50 - 75 % of the value of a new product (Agrawal, 2012).

3.6 The value of time

The flow of returned products is a considerable asset stream for companies but much of the value from the assets is lost in the reverse supply chain, therefore managers need to consider the value of time for a product return and use it to redesign the reverse supply chain for asset recovery (Blackburn et al, 2004). Skjøtt-Larsen et al (2007) point out that delays in product returns reduces the value of the products and the time to remarket is essential for products with time-sensitive status as electronic equipment and mobile phones. The effects of time delays can be a significant loss in asset value for companies; Blackburn et al (2004) demonstrated that the loss in asset value could be as high as 45%. Other aspects affecting the value depreciation of product returns can be technology innovations, new products and price cuts from competitors (Skjøtt-Larsen et al, 2007).

The design of the reverse supply chain should be driven by the products' differences in the marginal value of time. For time sensitive products, with high monetary value of time and a short-life cycle such as computers, a responsive reverse supply chain is preferable. A cost efficient chain is preferable when handling time insensitive product returns with low monetary value of time (Blackburn et al, 2004). The design of the reverse supply chain is therefore a tradeoff between cost efficiency and speed. To achieve maximum value recovery from time sensitive product returns, a fast and responsive chain is necessary. The major difference between the cost efficient and responsive reverse supply chain is the positioning of testing and evaluating of the product returns.

3.7 Reverse Supply Chain Network Strategies

The RSC network strategy describes the physical setup of a RSC, and as opposed to forward supply chains, the reverse supply chain network strategies are still rather undeveloped (Blackburn et al. 2004). Due to the differences between product categories, characteristics and monetary value of time, Blackburn et al (2004) present two different network strategies; centralized and decentralized reverse supply chains.

3.7.1 Centralized reverse supply chain

The return flow in a centralized reverse supply chain is designed for economy of scale (Blackburn et al, 2004). The returned products are sent to a central location for testing and evaluating to determine the condition. To minimize the cost of the returned products, all returns are usually sent in bulk to the central facility where the condition of the products is determined. This often comes at the expense of long delays, and according to Blackburn et al (2004), these delays can be excessive. Therefore, the centralized design is suited for product with low marginal value of time.

3.7.2 Decentralized reverse supply chains

The decentralized, responsive, reverse supply chain has the advantage of preponement. The condition of the product is determined immediately at the retailer instead of at a central facility; enabling companies to maximize asset recovery and minimize the delay costs (Blackburn et al, 2004). Since the condition is determined locally, an individual product can be sent directly to the correct value reclamation. The decentralized network favors time-based strategies to support value reclamation such as refurbishment of high-value products, e.g. computers (Skjøtt-Larsen et al, 2007).

To make a reverse supply chain responsive and achieve preponement, testing and evaluating must be decentralized (Blackburn et al, 2004). For a decentralized return system to be effective, some issues need to be managed. First, technology feasibility, being able to determine the product return's condition in the field as quickly and inexpensively. Second, how to engage the reseller to do these activities at the point of return (Blackburn et al, 2004). This requires local skills to perform the initial inspection in the field, and also a logistics infrastructure to pass the product returns further into the activities in the reverse supply chain. With a decentralized system, costs occur when building up and maintaining the resources and competence needed to manage the processes in the decentralized system (Skjøtt-Larsen et al, 2007).

4. Empirical Findings

This chapter presents the results of the empirical study of Hewlett Packard and Dell. To gather the necessary data, two interviews were conducted in accordance with the research theories presented in the methodology chapter.

4.1 Company description

4.1.1 Hewlett Packard

Hewlett Packard was founded in 1939 by William Hewlett and Dave Packard in Palo Alto, United States (HP, 2015a). HP is a multinational technology company and is one of the leading personal computer manufacturers (IDC, 2015). In 2014, the total revenue of Hewlett Packard was 111.5 billions of dollar (HP Annual Report, 2014). HP manufactures and sells commercial electronic equipment such as personal computers, printers, scanners and handheld PC's, as well as hardware and software services. Hewlett Packard merged with Compaq in 2002 and has been acquiring several electronic companies since its founding (HP, 2015b). The headquarter is located in Palo Alto, California and HP has a national headquarter in Stockholm, Sweden.

HP collects used products for recycling and resale in 73 countries and territories in the world (HP, 2015c). Since the start of HP take-back program in 1987, HP has recovered 3,36 billion pounds of computer hardware for reuse and recycling (HP, 2013). To extend the life of IT hardware, HP has remanufacturing and refurbishing program. These programs are performed at HP's renewal centers, one is located in Erskine, Scotland and the other is located in Andover, Maryland in United States.

The respondent from HP is working at Hewlett Packard's headquarters in Stockholm, Sweden, and all quotations and the empirical findings regarding HP's reverse supply chain originates from the said respondent.

4.1.2 Dell

Dell is a computer technology company founded in 1984 by Michael Dell in Texas, United States, and the headquarter is located in Round Rock, Texas (Dell, 2015a). Dell sells personal computers, servers, printers, and software and is one the leading personal computers manufacturer in the world (IDC, 2015). Dell is famous for its supply chain and "build-to-

order" model, manufacturing individual PC's for customers (Van Weele, 2010). In 2013, the total revenue of Dell was $56.9 billion dollars (Dell, 2013). Dell is employing 103,000 people worldwide, which makes them one of the largest technology corporations.

Dell's TakeBack programs cover 78 countries and aim to recover 2 billion pounds of used electronics by 2020 (Dell, 2015b). A majority of the RSC functions are outsourced to third parties so that Dell can focus on its core business - produce IT equipment.

All quotations and the empirical findings regarding Dell's RSC in this chapter originates from a respondent working as a manager for Dell at its headquarters in Stockholm, Sweden.

4.2 Empirical findings of Hewlett Packard

4.2.1 Main Drivers

The main drivers of Hewlett Packard's reverse supply chain are a combination of different aspects: environmental requirements, satisfying customers and to generate revenue. The environmental requirements are not static over time and constantly changes which needs to be considered. Regulations and directions have to be followed and HP has been a part of the development of WEEE and compliance with regulations on national level as well. Environmental directives such as WEEE affected the construction of the return process and how the company is working with the return flow. The waste disposal has changed the last years and is now more bureaucratic which requires more certificates and needs to be followed.

As the interviewee said: *"The main drivers are a combination of customer requests, pressure from stakeholder in society and to provide a safe recantation of products from customers. The environment, customer satisfaction and to generate revenue. Fixed assets in the reverse flow are costly and it took some time to make it turn around. To generate money".*

The customer requests regards take-back program for electronic equipment and thorough computer security. In procurement, be able to provide a safe recantation of the products in line with the customer requests and as leasing is a part of our business, offer the customers full take back of their products. Another driver is the pressure from stakeholder in society regarding the lifetime of products and the need of collecting obsolete products. But there is a conflict between the environmental work and the relatively short lifetime of a product that

needs to be managed. Investor and stakeholder trust are other important drivers that HP focuses on.

4.2.2 Hewlett Packard's Reverse Supply Chain

Hewlett Packard has a take-back program called HP Planet Partners. It includes hardware reuse and hardware recycling and the program operates and collects used products in 73 countries and territories worldwide. Through the program, HP collects used products in several ways depending on national regulations and the scope of the HP Planet Partners in that country.

The product acquisition process depends on the product category. In Sweden, El-kretsen is collecting end-of-life products at recycling stations where private customers, free of charge, can turn in their used products. This is a service HP must provide due to the responsibility of producers, the WEEE directive. HP is a member of El-kretsen and has been so since the start of El-kretsen in 2001.

"In the beginning, it cost HP millions of SEK every year to be a member of El-kretsen but since a couple of years back, HP is getting money back due to material content although the prices on the global market has decreased pretty much. And because the volumes of CRT glass are rapidly shrinking."

When acquiring used computers from companies, HP offers free recycling when placing an order for new HP computers, regardless of the brand of the old computers. After collecting the used computers, they are either sold in an aftermarket or recycled. Leasing contracts are a substantial part of HP's business and that results in a lot of used computers being collected by HP. If not placing any orders for new HP computers, the companies have to turn in their EOL-products to a recycling station where EL-kretsen collects and recycles the products.

Most activities revolving reverse logistics are outsourced to third party companies while Hewlett Packard performs some functions. The transportation of used products is outsourced to a subcontractor that has to follow strict guidelines to assure that the requirements from HP are fulfilled. The chosen subcontractors are being evaluated and HP follow up their work to make sure all rules and the expectations against customers are fulfilled. El-kretsen is one of the companies performing reverse logistics activities for HP when collecting, sorting and organizing the recycling the returned EOL-computers.

"The transportation of products is performed by a transportation company. We guarantee a certain flow of returned products, when a subcontractor collects the products we need to guarantee the customers that the products will not get lost. The transporter must fulfill our requirements."

The biggest difference between the forward- and reverse supply chain is the time aspect. From the moment a customer places an order for an HP computer, delivering is of highest importance due to a fast changing industry where new models and processors are developed. This is primarily affecting HP's forward supply chain but also the reverse supply chain. The used computers are also being affected by their depreciation in value, and the price and attractiveness decreases and affects HP's opportunities. The capacity of the computer and the development of the market since the products were put on the market for the first time also affect the opportunities.

"We do not send all returned products to the renewal center in Scotland, the condition of the returned products are determined here in Sweden."

The condition of the returned products is determined regionally. Not all products are sent to a renewal center, since the cost for transportation and diagnostic of the products are weighed against the future market value of the computers. HP uses an internal list where products with a high value get sent to a renewal center, and products with low value are handled regionally. The inspection determines the future activities for the products and where to send them.

If there is a market for the used computers, they are sent to the renewal center for reconditioning and to be erased of information. If the computers are too old, too defective and there is no demand in the aftermarket, the computers are recycled or HP takes care of the computers by scrapping them. The value of the product and transportations cost are aspects that needs to be considered before further handling.

"When controlling your own return flows, reusing material can be performed much more effectively."

Some materials are more complicated to recycle than others, and for these materials to be recycled as effective as possible, HP has to retrieve these materials. In order to successfully

recycle these materials, HP uses a qualified supplier. This results in a way to reuse these materials, which had not been done using a supplier without knowledge of these materials.

"The most costly activities, one aspect that people does not think about, is the guarantee towards the next customer. The product has to be gone through, electrically safe - no risks and tested. The equipment costs millions"

Reconditioning of products is a costly activity for Hewlett Packard. The test equipment for all kinds of products cost millions of SEK. The testing and evaluating of returned products are activities that have to be done at suitable places and cannot be performed anywhere due to very advanced equipment.

At HP's HPFS Renewal center in Erskine, Scotland, products are going through different processes depending on the condition. For example, computers that are end-of-lease returns are getting deep cleaned and hard drives are erased through a program called Asset Recovery Service. In this process, computer security is of high priority and the computers are thoroughly inspected. Additionally, HP has to make sure that the returned computers do not contain materials currently classified as illicit..

Returned products that need to be remanufactured or refurbished are being managed at the renewal center where the proper disposition is determined. The computers are repaired and fixed before being brought back to customers. The remanufactured parts are being used as input in new assembled computers.

"About 10% of all products sent to Scotland are evaluated as too broken or with the wrong capacity, these products are safely recycled".

The returned computers that will not be remanufactured or refurbished will instead be recycled. The recycled parts, that will not find a new market, are being buffered until someone interested in a certain material will buy large quantities of a certain material, which will give HP better prices.

"The products are getting to a free market, a pre established clientele is of tradition interested in used products with higher quality".

HP has several distribution channels for the returned computers which are being brought back to a market for distribution and sale. HP sells the computers by themselves and cooperates with brokers selling used computers. For some of the computers that has been refurbished and remanufactured at the renewal center in Scotland, HP has stakeholders interested in used computers. When the computers are done at the renewal center, they are sold to customers or sent farther in the supply chain before entering a market. The computers are not necessarily HP computers; it can also be collected computers of other brands that are being sold by HP.

HP Renew program is a channel for HP to sell remanufactured equipment and computers. The computers have been remanufactured or refurbished and are being sold at a lower price than newly produced computers. This channel can be used by companies as well as consumers interested in used computers.

Inrego, a leader in reused IT equipment in the Nordic countries, is one channel HP uses to sell used computers. Much like HP, Inrego has a "weekly list" of used equipment that is of interest when buying returned computers from HP. Inrego is an example of a third party that the HP interviewee mentioned as one of the largest brokers HP cooperates with in Sweden.

For HP to be able to distribute and sell used computers, several challenges have been dealt with. Knowledge, test equipment, customer guarantee, controls and follow up are all costly activities for HP when operating a reverse supply chain with distribution and sales. It is resource intense and the volumes need to be brought up to generate economic value.

4.3 Empirical findings of Dell

4.3.1 Main Drivers

The main drivers of Dell's reverse supply chain are the legislations and regulations, and customer service. There are regulations and legislations on different levels, such as national or regional. One regulation that has had a big impact on Dell's RSC is the WEEE directive conducted by the European Union. It forces companies in the consumer electronics industry to take full responsibility for obsolete products. This means that if a customer wants to return a product, the law obligates Dell to provide for complimentary recycling.

There are significant differences between the legislations in different countries. In some, Dell has to report every single component put on the market, while in some, no control regarding

what materials are being used are required. This causes Dell to spend a lot of resources making sure that its RSC is up to date with the prevailing legislations and regulations in each country. Sweden and other EU countries are highly regulated compared to other parts of the world, for example the Middle East and Africa. Besides the WEEE directive that applies to all of the member countries, there are laws prohibiting consumers of electronics to throw their e-waste in the trash. All electronic equipment must be turned into a recycling station.

"First and foremost, we need to follow the legislations. That is just how it is, it is the law around E-waste and we are dedicated to follow it. And that cost that comes with the legislation… well, not paying that is not an option. It is a cost, simple as that. But we are always trying to make our logistic systems as efficient as possible in order to keep the costs down."

The customer service aspect is the other main driver. Customers are getting more aware of environmental issues and might also have internal environmental goals that need to be fulfilled. To companies in Sweden, the environmental aspects are much more important than to companies in countries such as France and Spain, partly because of the national legislations, but also because of the mentality and approach to environmental issues.

Dell emphasizes computer security in the RSC and points that out to be the single most important aspect for many customers. The reason for this is that the IT-equipment that is turned in by companies often contains of delicate data and information stored on the hard drives that others should not take part of. Therefore, when choosing suppliers to work with, Dell does thorough research and set clear rules for its suppliers. They also do monthly follow-ups and audits to make sure that the suppliers' live up to the highly set expectations. The acquired products are sent to one of the suppliers' facilities.

A third driver permeates the entire organization with a focus on being environmentally friendly. This stems from the founder and CEO of the company and concerns everything from electricity usage at offices and facilities to only use recycled materials in the packaging. The mentality trickles down to the RSC as well, and Dell encourages its customers to turn in their used products so that they can be recycled, or preferably, resold.

4.3.2 Dell's Reverse Supply Chain

All of Dell's reverse supply chain processes are outsourced. This is because Dell wants to focus on its core business as a producer of computers and other IT-products. The reverse supply chain processes involve complicated activities and Dell believe that it does not possess the competence within the company to compete with its suppliers, therefore outsourcing these activities to experts within that area. As stated earlier, Dell first and foremost focuses on computer security in the reverse supply chain. A lot of the returned IT-products contains of delicate data that needs to be erased since it could be devastating for a customer to have that information leak to competitors. Dell offers its customers on-site or off-site data wipe, where the hard drives are overwritten either at a facility operated by a third party company in cooperation with Dell, or at the customers facility.

"We are working closely with two different suppliers within EMEA (Europe, Middle East, Africa) that are experts when it comes to taking care of old equipment and reselling it in a secondary market. They are also specialists in data wipe, erasing the data stored on hard drives, which is extremely important to Dell."

It is up to the customers to decide whether to resell the products or recycle them. Dell usually encourage its customers to resell the IT-equipment, partly because companies do not realize that their equipment still has value and could generate revenue, and partly because reselling equipment is more environmentally friendly than recycling. When a customer decides to resell a product, it gets the value of the product based off today's value. This causes Dell to create a rapid RSC in order for the products not to lose too much value before getting resold in a secondary market.

"It is up to the customer to decide whether we should resell the equipment or not. If they want us to recondition their old equipment and resell it in a secondary market, we will do that. A majority of the reconditioned products are sold in East Europe, but some are sold to daycares or schools in West Europe."

One of the biggest challenges for Dell is acquiring EOL-products. One way to acquire products is through the program "Consumer Free Recycling". Dell started the program to help its customers to recycle their IT-equipment in an environmentally friendly manner and the program aims to make it easier for consumers to turn in their EOL-products. A customer can print a pre-paid waybill to return their EOL-products for recycling. For companies, Dell

has a program called "Asset Resale and Recycling" (ARR). By law, Dell is forced to take back products and pay for the recycling fees although it does not have to pay for the transportation costs. The program also helps customers with data wipe so that all information stored on hard drives is erased before recycling or reselling the equipment.

Acquiring products from consumers is not highly prioritized at Dell. This is because consumers tend to use their products longer than companies do and usually find other uses for their products, such as passing them on to a relative or using them as backup. By the time a product is turned in, most of the economic value is lost. Another reason is that consumers in some countries, such as Sweden, are very environmentally aware and turn in their products to recycling stations without incentives from the producers. In countries less environmentally aware, Dell arranges events where consumers can turn in their EOL-products.

In order to fulfill its producer responsibility, Dell is a member of producer compliance schemes. A producer compliance scheme is a network of organizations within the consumer electronics industry, which aims to help its members recycle products and sell the materials. Dell works with two such organizations; El-kretsen and FTI. El-kretsen is collaborating with recycling stations all over Sweden and picks up IT-equipment that has been turned in by consumers and then recycle it. Dell, and other organizations that are members of the network, pay a fee for every sold product in order to help fund El-kretsen, thereby living up to their producer responsibility. FTI is a network that handles old packaging and aims to recycle the material and reuse it for new packaging.

When customers decide to let Dell resell the products, Dell has a set of pre-determined standards in order to make the RSC more efficient. Products less than four years old are considered to still have value and are therefore automatically forwarded to a reconditioning facility. For products older than four years an inspection is made to determine if the product still contain some value, but generally products that old have lost all value. The specifications of products also impact the value.

Remanufactured or refurbished products are sold in secondary markets through brokers specializing in selling used electronics. The biggest secondary market is East Europe, where customers do not have same economic situation as customers in other parts of Europe have. Another secondary market is West Europe, where used IT-products are primarily sold to schools and pre-schools, but also to consumers that cannot afford buying brand new products.

5. Analysis

In this chapter, the data collected from the empirical research will be analyzed by using the theoretical framework, a comparison between the companies' reverse supply chain will be developed and the empirical findings will be analyzed to answer the research question of this thesis.

5.1 Drivers

The findings presented in the empirical chapter show that the drivers of HP's RSC align with theories about what drivers there are for reverse supply chains. HP mentions legislative and economic reasons as well as satisfying customers as the main reasons for their RSC, which all complies with the three drivers pointed out by de Brito and Dekker (2003). Dell does not consider economy to be a driver, although stating legislations and regulations as main drivers. Dell also mentions customer service and an environmental awareness permeating the entire organization as drivers of its RSC. Legislations, regulations and customer service is consistent with the theories of de Brito and Dekker (2003).

The results of the interview with HP showed that economy is considered to be a driver for its RSC. Even though there are high costs associated with the return flow of goods, HP is starting to generate revenue from its RSC, much like the theories of Coyle et al. (2013) claim. The results of the empirical studies of Dell's RSC from an economic perspective contradict the theories provided by Coyle et al. (2013), saying that profitability can be the main driver for a RSC. Although there seems to be some value captured in the RSC through the reselling of used products in secondary markets, the revenue gained from said sales is not enough for profitability to be considered a main driver for Dell.

De Brito and Dekker (2003) highlight legislations and regulations as drivers of RSC's and use the WEEE directive as an example of how a regulation can affect or even create a reverse supply chain. Both companies point out legislations and especially the WEEE directive as one of the most important aspects of their RSC's.

To Dell, legislative aspects are the most important causes for its RSC. This is emphasized on several occasions throughout the interview and it aligns with what several authors (de Brito & Dekker, 2003, Gupta, 2013) point out about legislations being a primary driver for a RSC. The disparate legislations in different countries where Dell operates causes Dell to put a lot of

resources into keeping up to date with current laws. This also applies to HP, stating that regulations such as the WEEE directive have affected how it is working with the return flow. It can be argued that legislations and regulations are the most powerful drivers since there is no way around them. Companies within the consumer electronics industry are required by law to take back their products, which create a reverse flow of goods.

The third main driver, corporate citizenship that de Brito and Dekker (2003) identify is considered a driver for HP as well as Dell. Both companies operate take-back programs in several countries for customers returning their used computers as well as working with environmental focus. Rubio and Jiménez-Parra (2014) also mention that the increasing social awareness is a factor and the growing environmental awareness among consumers has been a driver to Dell and it has made them pay more attention the reverse flow of goods. HP also points out customer requests as a driver for its RSC - customers are asking for holistic environmental solutions to a greater extent than before.

A consequence for Dell and HP, and one of the most important issues regarding customers is computer security. When collecting used computers from customers, computer security has the highest priority. HP and Dell have to meet the customer requirements and guarantee computer security in two ways. First, the existing data of the customers' computers must be erased. Second, the future user of a pre-owned computer has to be assured that it gets a computer cleared of information and programs.

The biggest difference between the two companies lies in the economic driver, where HP sees revenue, or even profitability, as a driver for its RSC, while Dell does not consider it to be a driver. Dell even affirms to seeing its RSC as merely a cost without any potential of being profitable, while HP sees its revenue increase due to higher volumes and that it is in control of its own return flows. The fact that a majority of Dell's functions are outsourced to suppliers that handle the RSC processes might have a negative effect on the revenue since it keeps Dell from being able to spend resources on the potential gains in revenue that authors such as Agrawal (2012) claims exist in a RSC.

5.2 Reverse Supply chain processes

According to Guide and Van Wassenhove (2002), the process of acquiring used products is the key to a successful RSC. In Sweden, both Dell and HP are members of El-kretsen, an

organization that is handling all returns that are handed in by consumers to recycling stations. Both companies also offer their customers take-back programs in accordance with the WEEE directive in order to collect used products. Dell and HP are collecting used products from multiple manufacturers, which Barker and Zabinski (2011) call *industry-wide collection*. In order to fulfill the consumer responsibility, companies would have to collect all EOL-products at recycling station on their own. Therefore, collaborating with El-kretsen is an effective way to fulfill the consumer responsibility and let its network handle all products handed in to recycling stations. Due to the popularity of leasing IT-equipment, both companies get a lot of used products back when leases expire. Acquiring products that have been leased has several advantages because of the large quantity from one and the same place and the conformity in terms of age and specifications. HP and Dell acquire products from all three different sources mentioned by Prahinski and Kocabasoglu (2006). Products acquired through the forward supply chain are taken back through the companies' take-back programs. Products taken back when a lease is expired are acquired through the market-driven system and products handed in by consumers to recycle stations are acquired through the waste stream.

Most of the reverse logistics activities are outsourced at both Dell and HP. The companies are collaborating with transportation companies in order to move used products within the RSC network. Outsourcing the transportation of products makes perfect sense since transportation makes up for a lot of the total costs, as much as 25 % of the cost of a RSC (Coyle et al. 2013), and it would be hard to achieve economy of scale if a company decided to keep all transportation activities in-house, since the volumes are relatively low, the uncertainty and marginal value of time is high and products are spread out over a very large geographic area.

Successfully managing the RSC can also lower the costs. One way to minimize costs is to implement an appropriate network strategy for the RSC (Blackburn et al, 2004). A decentralized network strategy is better suited for a return flow of electronics and this strategy is utilized by HP. Because of its responsive RSC and decentralized network, HP can perform the inspection of products at an early stage, which shortens the lead-time of the reverse flow. Sorting out products that will be scrapped early also limits its transportation cost.

HP makes a trade off between responsiveness and economy of scale when managing its RSC. The time aspect is considered to be important, but not nearly as important as it is for new products in the forward supply chain. This does not completely conform to Blackburn et al (2004), who states that time-sensitive products like computers require a fast and very responsive reverse supply chain to decrease monetary loss. Since most of the returned products have been in use for several years, the importance of responsiveness declines and the potential benefits of economy of scale incur.

The inspection of products is conducted differently for HP and Dell. HP keeps its inspection, as well as reconditioning activities, in-house, which gives them full control of the reverse flow. By operating the inspection regionally, before sending the used product to its renewal center in Scotland, transportation costs can be kept down. This might cause the cost of inspection to increase due to the low volumes compared to inspecting all of the products at a central facility, where economy of scale could be achieved. Although, it should make the reconditioning activities more efficient since there is no inspection needed to slow the reconditioning process down. This conforms with the theories on a decentralized RSC network presented by Blackburn et al. (2004), that states that a decentralized structure is preferable for products with high marginal value of time, such as computers since it minimizes delays, related costs and affecting the future value. Regardless of product categorization, a decentralized reverse supply chain gives Dell and Hewlett Packard the opportunity to perform a correct disposition at regional locations.

Dell has outsourced the inspection and reconditioning to suppliers that are considered experts at reconditioning and reselling used products in order to fully focus on its core business. Even though outsourcing these activities can reduce costs from a short-term perspective, the economic potential in keeping these activities in-house could be lost. By outsourcing, no knowledge or know-how is gained, developed and kept within the company, allowing competitors to get an advantage.

Of the four different dispose alternatives presented by Prahinski and Kocabasoglu (2006), most of HP's products are upgraded, recycled or sent to landfill. Few of the returned computers are completely reused. While reusing products is the most beneficial from an economical perspective (Rahman, 2012), it is difficult to achieve with computers, partly due

to the high marginal value of time. And as mentioned before, the information stored in the returned computers must be erased before being sold to a new customer.

Remanufacturing is a resource intensive and costly process to HP, which aligns with Agrawal (2012) thoughts. Expensive test equipment accounts for a large part of the costs and the difference in the products' condition makes the handling of products difficult. The remanufacturing process at HP's renewal center conforms to Gupta's (2013) description of the remanufacture process. Inspection and proper disposition of the computers being processed are dependent on the condition, parts from computers that needs to be disassembled are recovered and reused by HP. Computers in need of minor improvements are refurbished or remanufactured before being sold. As a result of these processes, HP can recover a substantial part of the computer's value through remanufacturing and refurbishing.

Prahinski and Kocabasoglu (2006) emphasize the importance of finding appropriate distribution channels for reconditioned products. Products can either be sold through the same channels as new ones, or by third party retailers. Dell and HP sell their reconditioned products partly through their existing channels, such as their websites, where companies and consumers can purchase used IT-equipment. Selling used products through the same channel as new products might create the risk of cannibalization, since customers could be tempted to buy a used, less expensive computer instead of a newer, more expensive product. Another way of selling used computers, which Dell and HP do, is to use third party retailers. As Prahinski and Kocabasoglu (2006) point out, returned computers can be sold by a third party at a lower price. Consequently, this adds new channels and markets to both companies.

5.3 Creating economic value in the reverse supply chain

Economic value is primarily generated through the reselling of used products. HP sells remanufactured and refurbished computers in secondary markets to a lower price than new ones in order to generate revenue. Similar to Blackburn et al (2004) ideas, HP generates value by selling used computers to a lower price and can therefore reach out to market segments not willing to pay full price. HP Renew program perform this activity as a channel for HP when selling reconditioned computers. This conforms to what Agrawal (2013) discusses about creating economic value in a RSC. By taking back used computers from customers, refurbishing the computers and resell them, HP can create value from computer returns. Furthermore, when collecting end-of-lease computers, HP creates an opportunity for itself to

increase sales of used computers and not just their brand. Dell does not have the same opportunity to create value as HP, without a renewal center, since Dell has to cooperate with third parties for selling used computers. Not controlling all processes in the reverse supply chain might reduce the possibility to generate revenue. When not remanufacturing and refurbishing computers within the company, all the activities Agrawal (2013) describes as creators of economic value can therefore not be fully succeeded and the possibilities for revenue decreases.

HP and Dell utilize the channels presented by Prahinski and Kocabasoglu (2006), such as their website and through brokers. Besides selling products to customers through its website, Dell sells some of its reconditioned products in secondary markets such as East Europe and schools and pre-schools in West Europe. The customers in these markets either do not have the financial means to purchase, or do not have the need for a new product. By targeting these customer segments, Dell can increase its sales since there is a possibility these customers would not have bought a new product. This can be considered a new channel, which Prahinski and Kocabasoglu (2006) consider being important. In collaborating with Inrego, a broker operating on the Nordic market, HP gets another channel to distribute its products. Inrego specializes in selling used computers from several manufacturers to consumers as well as companies in secondary markets. From HP's point of view, this is a favorable channel where HP can sell the equipment to a distributer and get compensated without handling and managing the computers too much.

Another source of revenue in the RSC is the selling of scrap to third party dealers (Rubio & Jiménez-Parra, 2014), and this is something HP does. HP collects materials and sells them in large batches to a scrap dealer. The materials are left overs from remanufacturing and parts being misjudged and sent to the renewal center. This process increases economic value in the reverse supply chain and generates revenue for materials otherwise being scrapped. Products that cannot be fully restored in the reconditioning process can be used for taking parts out and using them in other products that need a new part, this decreases the need for new parts and reusing parts lowers the costs, which confirm Şükrü Akdoğan, and Coşkun (2012) ideas. All of these activities generate revenue to HP and aligns with Agrawal's (2012) theories regarding value creation in the reverse supply chain. In contradiction to Agrawal (2012), Dell has outsourced these functions. Although, being compensated for the computers by a third

party, Dell might be missing out of economic opportunities of reusing or selling computer parts.

HP's collaboration with El-kretsen is also starting to create revenue, due to larger quantities and more efficient handling. Through its collaboration with El-kretsen, HP achieves both legal obligates while generating economic value. Not only does recovering and recycling scrap generate revenue for HP, but also by doing so, the cost of disposal decreases. Dell's collaboration with El-kretsen is a way to fulfill the legislatives without performing the activity themselves. The collection of used computers has to be made and from Dell's point of view, this is the most effective way.

As Coyle et al (2013) point out, the reverse supply chain can create economic value. However, in order for the reverse supply chain to generate economic value, several processes have to be performed. Acquisition and collection of used computers need to be managed in an effective way and the condition of the computers must be determined at an early stage for proper disposition and to lower costs. Dell and HP need to erase all information on the used computers before reselling them and non-functional computers have to be repaired. Reusing material and remanufacturing returned computers is a necessity for HP to generate economic value in the reverse supply chain and it enables HP to sell the computers through new channels. HP's design of and performance in the reverse supply chain is similar to Agrawal (2012) and Blackburn et al (2004) theories about creating value in the RSC. Because it outsources most reverse supply chain activities, Dell cannot achieve the same economic potentials as Hewlett Packard. Instead, Dell focuses on its core business and manages the necessary activities through third parties in the reverse supply chain.

6. Conclusion

This chapter will provide the conclusions of the research findings in this thesis. Answers to the research questions will be developed in this chapter and a recommendation for further research in this subject will be made.

The purpose of this thesis was to investigate the role of RSCM and how economic value can be captured in the RSC in the personal computer industry. Authors such as Blackburn et al (2004) proclaimed that product returns should not be considered a nuisance and that companies can benefit from it, and Agrawal (2012) argued that a reverse supply chain could be turned into a profit center. Given these theories, an empirical study of HP and Dell, two renowned companies in the personal computer industry, was conducted. The following conclusions are based on the analysis and the empirical findings in regards to the research questions presented in Chapter 1.

In order to get a full understanding of how economic value can be created in the RSC, the underpinning processes and activities must be examined. While the actual revenue is generated when a product is sold in a secondary market, a series of resource intensive activities are required in order to put the used product back on the market. Because of the costs associated with these activities, reselling used products is not always profitable. The age, condition and specifications of a product have to be considered when deciding whether there is potential profit to be made by reselling the product or not. Therefore, creating economic value in the RSC is a combination of generating revenue through sales and making the activities as cost-efficient as possible.

HP and Dell have adopted slightly different approaches in order to achieve this. While HP keeps most activities in-house, Dell has outsourced the majority of the activities associated with the RSC. By keeping its functions in-house, HP has better control of their reverse flow, and can perform the activities presented by Agrawal (2012) to generate profit. In outsourcing the RSC activities to a third party, Dell limits its possibilities to make the RSC profitable. While some benefits can be derived from letting a third party conduct the RSC activities, the long-term potentials in keeping the RSCM in-house should prevail. As the initial investments in facilities and equipment are being paid off, the competence and knowledge increases and

improvements in the inspection phase makes the reconditioning process more efficient, there are potential gains in revenue to be made.

The difference in attitude towards potential economic value also becomes apparent when investigating the drivers of Dell's and HP's RSC's. Both companies put emphasis on legislations as a primary driver and mention customer service as another driver. HP argues for economy as a driver of its RSC in contrast to Dell, which merely sees its RSC as a cost. While it could be that economy is not considered a driver because there is no profitability to be made, it could also be looked upon the other way around. By not seeing economy as a driver, Dell could have a predetermined attitude towards the potential benefits of the reverse flow, limiting itself when managing its RSC.

The main driver identified by Dell and HP is legislations, and the WEEE-directive forces both companies to actively collect and recycle used computers. Although there are similarities between the companies in terms of drivers, a few differences can be observed. While both Dell and HP see legal as well as social aspects as main drivers of their respective RSC's, economy as a driver is viewed upon differently. HP acknowledges economy as a one of the drivers in the reverse supply chain while Dell does not consider that aspect as a driver. Furthermore, both companies identify customer service as one of the driver and this driver is expressed in their take-back programs.

There are several similarities between Dell and HP in what activities are performed in their respective RSC's although there are differences in how the activities are performed. Products are acquired through take-back programs, originally started as a consequence of stricter legislations. Products are then reconditioned and resold through one of the channels for used products, recycled or scrapped. In contrast to Dell, HP has its own renewal centers where products are sent for remanufacturing or refurbishing. HP keeps most of these activities in-house, while Dell has outsourced the majority of these activities. The two companies have different approaches to creating economic value in the RSC. Dell sees the reverse supply chain more as a necessity than a potential source of revenue. On the contrary, one of HP's main focuses in the reverse supply chain is to increase economic value through different value adding activities.

6.1 Further research

There are possibilities for further research in this field. This thesis has only studied the reverse supply chain and not the forward supply chain and the connection between these. In order to get a deeper knowledge in this field, studies of the whole chain and how reverse- and forward supply chain can affect the possibility to increase economic value.

This thesis only explores two companies in the personal computer industry, and to get a broader view of the potentials of reverse supply chain management, future research should investigate more companies in the same industry. As only manufacturers have been analyzed in this thesis, other actors in the supply chain such as suppliers, retailers and distributors need to be analyzed.

Moreover, this thesis has been delimited to the personal computer industry. To increase the knowledge and potentials of reverse supply chain management, more studies in other industries should be conducted. For example, in the apparel industry, to explore value capturing in reverse supply chain management in an industry that does not consists of products with several components and high-tech parts.

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Appendix

What are the primary drivers for the reverse supply chain in your company?

What does the reverse supply chain look like? What does the process look like?

Are some functions outsourced?

Are there regional/local differences?

How are the political decisions, regarding environmental aspects, concerning your company and the reverse supply chain?

Which are the biggest differences between forward and reverse flow?

Is the reverse flow and forward flow connected in any way?

What are the biggest challenges concerning the reverse flow of goods?

When deciding whether to remanufacturer, refurbish or recycle products, what does the decision process look like? And, what's the next step in the process?

Where is the most value, in terms of economic value, captured in the reverse flow?

How is economic value captured/created in the reverse flow?

What activities are most costly?

How is the rapid depreciation of consumer electronics products affecting the reverse supply chain?

How important is the time aspect? Does it differ depending on what product it is or in what condition the product is?

In what way do you think your organization benefits from the reverse supply chain?

What is the main focus in the reverse chain?

What kinds of tradeoffs are you forced to do?

Are all the recycled products and components used internally?

How is the disposal products handled?

How is the global reverse chain connected and organized?

After refurbishing or reconditioning, what market are the products being sold at?