



**UNIVERSITY OF GOTHENBURG**  
**SCHOOL OF BUSINESS, ECONOMICS AND LAW**

## **Reverse Supply Chain Management**

-explore the feasibility to incorporate forward supply chain strategy into the reverse supply chain in the electronic industry

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Wei Yin

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## Master Degree Project in Logistics and Transport Management

Title: Reverse Supply Chain Management - Explore the feasibility to incorporate forward supply chain strategy into the reverse supply chain in electronic industry

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### ABSTRACT

Over the last decades, the issue 'reverse logistics' has been moved much higher up the agenda, owing to the increasing environmental awareness, regulatory initiatives and economic pressures. Individual companies have gradually included the backwards flows of end-of-life and end-of-use products within their scope of logistics planning and control, to increase their efficiency and effectiveness and create more sustainable supply chains. The purpose of this work is to explore the possibility for individual companies to incorporate forwards supply chain strategies into their reverse supply chains, in particular lean, agile and leagile strategies, and to examine under which circumstances each strategy should be applied respectively. The research is delimited within electronic industry, and focuses on commercial returns for repairs and maintenances. Empirical data was collected through a number of interviews with electronic retailers, which reveals the current situation of commercial returns in electronic industry. The findings were analyzed in collaboration with a comprehensive literature review of earlier studies over this topic, based on which conclusions to the research questions were generated as well as suggestions for future researches.

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# 1 INTRODUCTION

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*This chapter starts with background description and problem discussion, based on which the research purpose and detailed research questions of the thesis are later defined. Further, delimitations are presented due to the strict time frame and limited capacity. The last section in this chapter presents the disposition of the whole thesis.*

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## 1.1 BACKGROUND

Over the last decades, increasing attentions have been paid on the business concept 'Reverse Logistics', mostly due to the environmental concerns, regulatory impacts and the developing commercial recognitions. (Blumberg, 2005) This emerging area involves the activities in the returned products flow, starting from the end customer upwards along the forward commercial supply chain till the manufacturers or suppliers. (Harrison & van Hoek, 2008) A growing number of companies now start to focus a lot more on the reuses, remanufacturing, recycling and disposals of products and materials in their environmental management practices. (Kumar & Putnam, 2008)

### Environmental Concerns

As three decades have passed since the environmental revolution, many companies have realized the significant importance of the environment and gradually changed their ways of doing business. (Hart, 2007) Individual companies are becoming much 'greener', that they start to involve the environmental issues as matters of social responsibilities. (Ibid.) Rogers and Tibben-Lembke (1999) claimed it is from the environmental consideration that a majority of companies have started to include the reverse logistics system as part of their business. They take over the responsibilities to do no harm to the environment, either under contract to governmental organizations or for their own profits (Blumberg, 2005). They also recognize that it is possible to reduce waste and pollution while at the same time to increase their profits. In this way their manufacturing processes are turning cleaner with fewer wastes generated. (Hart, 2007) For example, given the facts that hazardous wastes from every segment and process of the supply chain are quite harmful to the environment, and that the environmental pollution level caused by the packaging materials is rising gradually, a large number of individual companies choose sustainable resources for production and take-back the after-used products from the end customers for reuses, reproduction or recycling. (Rogers & Tibben-Lembke, 1999)

### Regulatory Initiatives

General rising environmental concerns have acted as a catalyst for the promulgation of new regulations which prescribe the waste management and responsibilities of the manufacturers concerning their proper disposal of wastes. A certain amount of new regulations on various waste categories have come into play in most developed

countries. (Kumar & Putnam, 2008) European Union (EU) is seen at the leading place, which has released diversified legislations and directives on the waste management aiming at waste prevention initiatives, recycling and reuse of the wastes, and the waste incineration. (European Commission, 2011) Some relative regulations encompass End-of-Life Vehicle (ELV) Directive, Waste Electrical and Electronic Equipment (WEEE) Directive, Restriction of use of certain Hazardous Substances (RoHS) Directive, and the Packaging and Packaging Waste Directive. (Kumar & Putnam, 2008) The existing EU legislations require all the actors in the product life cycle to take their own responsibilities to 'take-back' the environmentally harmful products, components and packaging for recycling or reuse, in other words to arrange the proper treatments for the generated wastes. (Rogers & Tibben-Lembke, 1999)

In light of the regulatory forces, companies are obliged to comply with the legislations of the target markets by re-developing their business practices, in terms of product design and product returns, recycling and reuse system. (Kumar & Putnam, 2008) Hence they need to put forward new operational plans to manage and control the disposal and recovery of the wastes within the entire supply chains, in the interests of global competitiveness in the business.

### Business Pressures

Apart from the developing environmental concerns and regulatory forces, the newly revised definition of logistics management is another manifestation of the rising importance and general recognition of reverse products flow within the supply chain. In the newest version proposed by the Council of Supply Chain Management Professionals (CSCMP), both the forward and reverse goods flow has been integrated into the scope of logistics and supply chain management, which defines the logistics management as:

*“... part of supply chain management that plans, implements, and controls the efficient, effective **forward and reverse** flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements.”* (CSCMP, 2010)

Product delivery to the end customer is no longer the end of the product life cycle. It continues as the used-products go backwards along the supply chain for reuse, repairing, remanufacturing or recycling, which together constitute the primary process of reverse logistics. (Álvarez-Gil, Berrone, Husillos, & Lado, 2007) (See Figure 1) reverse logistics has both a service component, e.g. repairs, maintenances, recalls, etc., and an environmental component like the packaging recycling. (Harrison & van Hoek, 2008)



Figure 1: General products flow in a reverse logistics system



From a business perspective, the implementation and control of the reverse logistics system indeed requires a large amount of investments. However, it could also result in an increase in the overall business profitability, a better corporate image and a higher customer satisfaction level for individual companies. (Brodin, 2002)

The developing environmental concerns, regulatory forces and economic recognitions have simultaneously enhanced the responsibilities of companies on implementing and managing their reverse logistics systems. (Chouinard, D'Amours, & Ait-Kadi, 2007) As a consequence, reverse products flow ought to be involved within the scope of logistics planning and control for the sake of an all-round supply chain management of the company.

## 1.2 PROBLEM FORMULATION

Ballou (2004) proposed that the primary purpose of supply chain management is to achieve sustainable competitive advantages and long-term profitability for the individual companies within the supply chain. One common way for them to reach the goal is to shorten its costs while generating more revenues. In other words, companies attempt to maximize its efficiency and effectiveness<sup>1</sup> concurrently, bringing forward the trade-offs between cost and quality and also between price and customer service. (Jacobs & Chase, 2008) Take the commercial returns of damaged products for instance. If the primary strategy of a company focuses on its customer service level, referring to a quick response to the returns in this case, a low-cost strategy would not be compatible. When the trade-offs ever come into the play, the applicable supply chain strategy ought to be selected in alignment with the corporate strategy which represents the overall objectives of the company. (Ballou, 2004; Jacobs & Chase, 2008) Thus, it is increasingly vital to dedicate more efforts in the research and development of particular business strategies in the reverse supply chain management, in order to realize and maintain the efficiency and effectiveness of the commercial supply chain, and eventually achieve competitive advantages and long-term profitability, concerning not only the forward supply chain, but also in the reverse logistics system.

The research problem emerges when the particular reverse supply chain strategy has been taken into consideration, that which strategies are efficient and effective for the reverse supply chain, and that under which circumstances the companies would apply these strategies to achieve cost-efficient and quick response in the reverse supply chain. Thousands upon thousands researches and studies have been carried out regarding strategies for the forward supply chain. However, according to the Reverse Logistics Executive Council (RLEC), forward and reverse supply chains differ a lot in various characteristics, such as forecasting, distribution points, product quality, packaging and

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<sup>1</sup> Efficiency and effectiveness are both used as performance measurements of a logistics system. Generally speaking, to maximize logistics efficiency means to complete the logistics task with the least possible input, e.g. lowest costs, while to maximize logistics effectiveness requires the logistics system to attain the most output for the company, e.g. highest value. (Jacobs & Chase, 2008)

so forth. (RLEC, 2005) Thereby reverse supply chains should be managed by different business strategies in practice comparing to the forward supply chains.

In the area of reverse supply chain, previous studies have been done in related to the RL models design, but few was aiming to explore the specialized strategies for the management and control of reverse supply chains. Johnson (1998) has done his research regarding the industrial RL applications in the recycling system of ferrous scrap. He examined the roles of different functions in the system, assessed their contributions and identified six volume-based approaches for managing the RL system. (Johnson, 1998) Álvarez-Gil et al. (2007) developed a discussion about the motivations for companies to implement RL systems and suggested that the probability of RL implementation depends on the stakeholder salience, availability of resources and a progressive strategic posture of the manager. Wikner & Tang (2008) concluded from their study that the conventional customer order de-coupling point framework for forward supply chain can be extended to cover the reverse flows. Banomyong, Veerakachen, & Supatn (2008) explored the application of the 'leagile' concept in the RL process, which represents the combination of 'lean' and 'agile' paradigms<sup>2</sup>, and its impacts in terms of time and cost, focusing on the product return process from end-customers to the service center. Above these studies, there are still a lot of unexplored areas in the efficient and effective strategies for reverse supply chain management and a lack of analysis in the implementation of forward supply chain strategies into the reverse supply chains. Based on the study by Banomyong et al. (2008) regarding the application of 'leagile' concept in the RL process, there is also a need to raise another question concerning the feasibility to apply the lean and agile strategies in the system.

### 1.3 RESEARCH PURPOSE & QUESTIONS

The purpose of this thesis is set to explore the possibility for individual companies to apply the lean, agile and leagile strategies in order to manage and contrail the supply chain, which concerns not only the forward supply chain but also the reverse supply chains, and under which circumstances they ought to be selected relatively. Consequently the research question to be answered in this thesis is formulated as:

*“How should companies select business strategies for the reverse supply chains to realize and maintain its efficiency and effectiveness?”*

In order to answer this main research question, some sub-questions are developed in a more specific way:

---

<sup>2</sup> 'Leagile' paradigm positions *“the de-coupling point into the supply chain system so as to best suit the need for responding to a volatile demand downstream yet providing level scheduling upstream from the de-coupling point.”* (Banomyong et al., 2008)

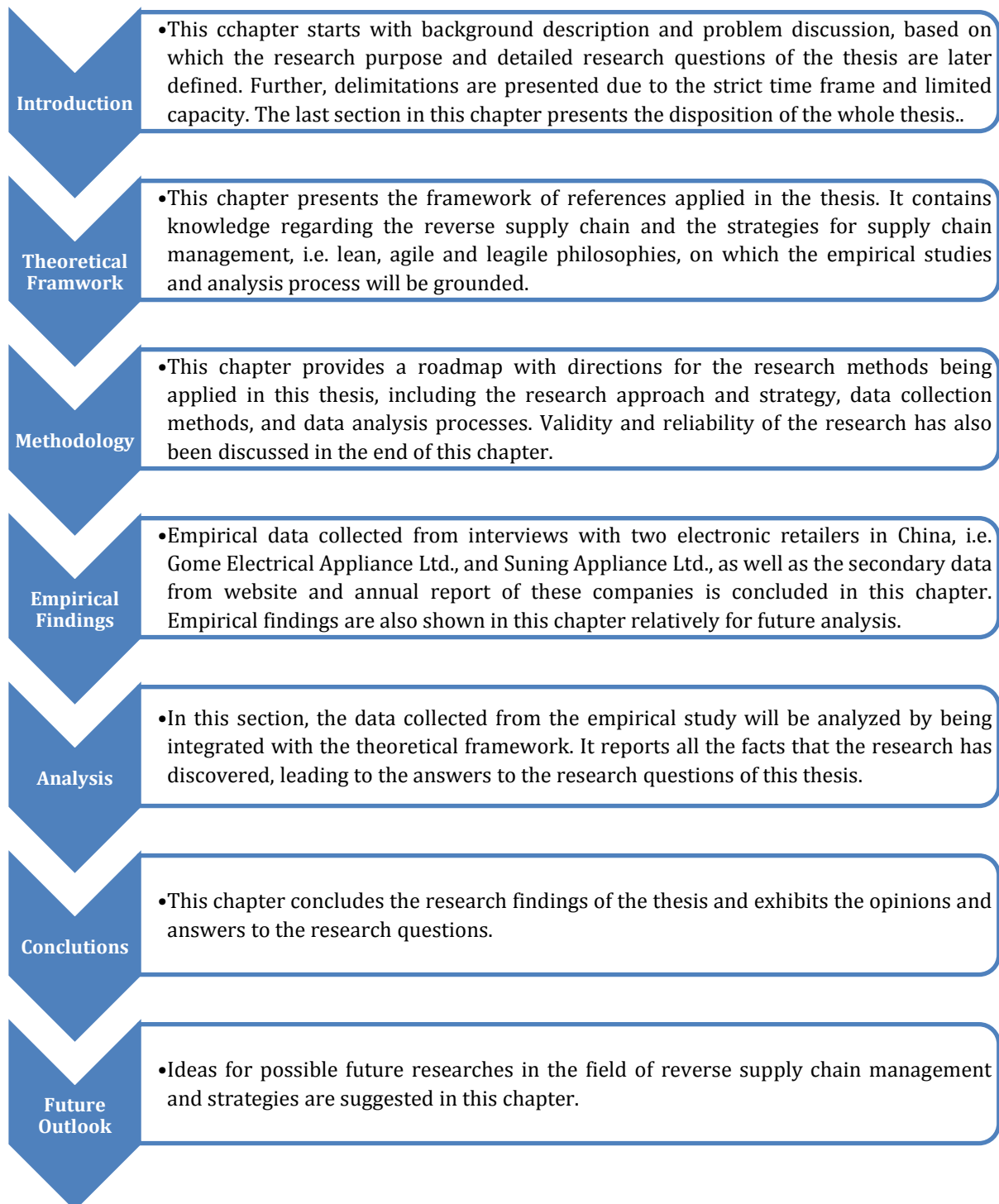
- *Is it feasible to incorporate the business strategies for forward supply chains, i.e. lean, agile and leagile strategies, in the reverse supply chains to realize and maintain its efficiency and effectiveness?*
- *If so, in what circumstances, lean strategy is preferable? In what circumstances, agile strategy is preferable? And in what circumstances, the leagile concept is preferable?*

## 1.4 DELIMITATIONS

Due to the strict time frame and limited capacity of the project, this master thesis is delimited in some aspects. Firstly, as reverse goods flows can be driven by commercial returns, repairs, maintenance, end-of-life returns, end-of-use returns, and reusable items (Harrison & van Hoek, 2008), this thesis will consider only the **commercial returns** which include wrongful deliveries, products having been purchased by customers that do not fulfill their requirements, and products returned for repairs and maintenances. Additional, in order to narrow down the scope of this thesis, the investigation and analysis of the reverse supply chain strategies will be only conducted within the **electronic industry** which has a relatively high-volume commercial return (Chouinard, D'Amours, & Aït-Kadi, 2007). Furthermore, the data collection process in this study will cover only **retailers** within the supply chains. End customers, warehouses, manufacturers (or repair points), suppliers and suppliers' suppliers are outside the range of the research.

## 1.5 DISPOSITION OF THE THESIS

This thesis is designed basically following a widely accepted structure for a business study report, suggested by Robson (2002). It is comprised of six chapters including: Introduction, Methodology, Theoretical framework, Empirical findings, Analysis, Conclusions. Besides, some ideas of possible future researched will also be proposed in the end of the thesis. In order to give out a much clearer understanding of the whole thesis and to guide the readers through it, the brief content details of each chapter are presented as bellow.



*Table 1: Disposition of the thesis*

## 2 THEORETICAL FRAMEWORK

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*This chapter presents the framework of references applied in the thesis. It provides profound knowledge regarding the reverse supply chain and the strategies for supply chain management, i.e. lean, agile and 'leagile' philosophies, on which the empirical studies and analysis process will be grounded.*

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### 2.1 DEFINITIONS AND SCOPES

Owing to the growing environmental awareness, regulatory initiatives and developing economic pressures to reduce the consumptions of non-renewable resources over the past decades, the issue concerning the backwards supply chain has moved much higher up the agenda with the purpose of creating sustainable supply chains. (Blumberg, 2005) The theory of reverse flow within the supply chain suggests that the product life cycle does not actually end with its delivery to end-customers, but still continues as the end-of-life and end-of-used products may be brought back from the end customers upwards to the manufactures or suppliers along the supply chains for reuse, repair, recycle or disposal. (Álvarez-Gil et al., 2007)

#### 2.1.1 Reverse Logistics

Being a newly emerging research subject within the field of business logistics, there is a great variety of definitions of reverse logistics which changes in scope and significance continually. (Vogt, Pienaar, & de Wit, 2002; Dyckhoff, Lackes, & Reese, 2004)

The expression reverse logistics was firstly called 'reverse distribution', referring to the retro-movement of outdated or damaged products and later including the retro-movement of end-of-life products for recycling as well. (Brodin, 2002) The scope of the definition has now been expanded to encompass all the activities in the whole logistics system in the opposite direction of forward logistics flow. (Vogt et al., 2002) A widely used definition, concluded by Kopicki, Berg & Legg (1993), suggests that RL refers to:

*"... the logistics management skill and activities involved in reducing, managing, and disposing of hazardous or non-hazardous waste from packaging and products. It includes reverse distribution, which causes goods and information to flow in the opposite direction of normal logistics activities." (Kopicki et al., 1993)*

Based on this definition, Vogt et al. (2002) broadened its scope to cover the cash flow in the opposite direction of logistics system. Additionally, Dyckhoff et al. (2004) enclosed all the activities of hazardous or non-hazardous waste from production into the scope. Moreover, deriving from the definition of logistics by CSCMP, RL was defined by Rogers & Tibben-Lembke (1999) as *"the process of moving goods from their typical final destination for the purpose of capturing value or proper disposal"*. It clarifies that the hazardous or non-hazardous waste mentioned in the definitions consist of used and

damaged products, obsolete, seasonal or excess inventory, packaging materials, production scrap and other residues. (Rogers & Tibben-Lembke, 1999)

Various definitions emphasize that RL deals with goods and relevant information flow in the opposite direction comparing with the forward logistics flow, which aims to reduce and control the generation and disposal of wastes and to maximize the long-term profitability of the business (Vogt et al., 2002). In light of it, general activities in RL system comprise collection, delivery, reuse, recycling and final disposals of the wastes. (See figure 2) (Dyckhoff et al., 2004)

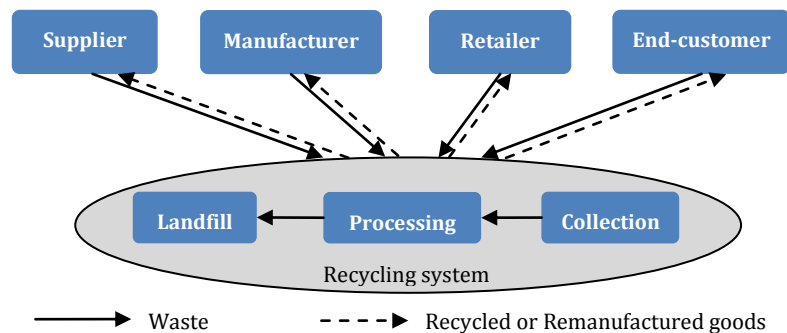


Figure 2: Flow of Goods in Reverse Logistics System (Dyckhoff et al., 2004)

### 2.1.2 Reverse Supply Chain

Referring to approximately the same research area, 'reverse logistics' is sometimes termed as 'reverse supply chain' or 'reverse chain' by different researchers. The definition of reverse supply chain brought forward by Guide & van Wassenhove (2002) has been adopted in a number of studies by other researchers, which explained that reverse supply chain refers to "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) In alignment with it, Prahinski & Kocabasoglu (2006) clarified that the scope of reverse supply chain is somehow a little broader than RL. The latter concept gives a focus on the activities involved in transportation, warehousing and inventory management, while the former one covers the coordination and collaboration with channel partners additionally. (Prahinski & Kocabasoglu, 2006) In this regard, RL can be seen as one of the components in reverse supply chain.

From a business perspective, the implementation and controlling of reverse supply chains requires a large amount of investments, however it also brings economic advantages and strategic importance to the companies. (Brodin, 2002) In the first place, reverse supply chain operations offer companies the possibilities in cost reductions owing to the lower prices of raw materials and spare parts, and also the possibilities in more revenues by reselling materials and products after being scrapped. (Álvarez-Gil et al., 2007) Values of damaged and non-functioning products are recovered from product reparation. Thus, the overall business profitability could be improved through the effects by cost reductions, improved revenues, extra building-up costs of the reverse supply chain. (Brodin, 2002) For example, a company in the phone remanufacturing

industry, named Recellular, has remanufactured over a million phones for almost 10 years and found an important profitable market in this area. (Álvarez-Gil et al., 2007)

Speaking of its strategic importance, reverse supply chain helps the company to generate its 'green image' with sustainable recognitions. (Álvarez-Gil et al., 2007) It assists the company to create a positive association with customers to enhance its competitive advantages. (Ibid.) For instance, Nike encourages its customers to return their used shoes to be shredded and made into the basketballs, in which way Nike has gradually developed its green management in environmental sustainability and attract more consumers. (Ibid.) Moreover, considering from the customers, an effective reverse supply chain contributes to the better customer relationship with their customers. The commercial returns are sent back to repair points for reparation and maintenances, therefore customers tend to be free from the risks of buying damaged, non-functioning or unsatisfied products. (Álvarez-Gil et al., 2007) The 'green image' together with increased customer satisfaction strengthens the customer loyalty to the company, contributes to a more stable long-term demand and ultimately maximizes its long-term profitability. (Blumberg, 2005)

## **2.2 PRODUCTS CATEGORY OF REVERSE FLOW**

As a first step to highlighting reverse logistics activities and reverse supply chain processes, it is of significant importance to explore the products categories in the reverse flow. Environmental Department in European Commission mandate that several specific waste streams which cannot be prevented during the manufacturing process should be recycled or reused to the possible greatest extent, including end-of-life vehicles, batteries, electrical and electronic waste, packaging waste. (European Commission, 2011)

In relevant literature, there have been a number of schemes suggested by different researchers. Rogers & Tibben-Lembke (1999) divided products categories by their sources, either entering the reverse logistics system from end-customers, or from other member in the supply chain such as retailers or distributors. In particular, items from end-customers include defective products, warranty returns or recalls; and those from other supply chain partners could be end-of-life products, excess stock returns or in-transit damaged goods. (Rogers & Ribben-Lembke, 1999) Similarly, De Brito and Dekker (2003) distinguished the returns also from their origins which have been sorted as production, distribution or use. In addition they classified the products flow based on another dimension referring to the reason for disposal of goods, i.e. defective products or products that are no longer needed by the sender. (de Brito & Dekker, 2003) Moreover, Fleischmann (2001) proposed to categorize the return goods into five groups including end-of-life returns, commercial returns, warranty returns, production scrap and by-products, and reusable packaging material.

Furthermore, Krikke, Balnc & Velde (2004) suggested that the returns category can also be classified from the dimension of product life cycle. Products or components coming to the end of its economic or physical life, i.e. *end-of-life returns*, will be collected from the end-customers, delivered to the disposition points for proper treatment. (Krikke et al., 2004) For instance, a car will be scrapped when it can no longer be driven on road or resold, and most of the components will be returned into the production process again instead of being disposed or incinerated. (Brodin, 2002) *End-of-use returns* represent the products or components that are collected back from the users after a period of usage, which would be maintained, remanufactured and used by other customers, such as a car leased from the rental company. (Krikke et al., 2004) Another type of returns is the *commercial returns* representing the wrongful product deliveries, damaged and non-functioning products, or sales returns owing to the inconformity to customer's needs. Usually, commercial returns are returned by the users after having purchased, and sent to repair points for reparations or upgrades. (Ibid.) Under some circumstances, a product or some of its components can be used again by customers for several times, and this group of returns belongs to *reusable items*. A well-known example for this category would be the reusable packaging materials from the products. (Ibid.)

In this thesis, the classification suggested by Krikke et al. (2004) has been employed. Nevertheless, among these four groups, attentions will be attached to the commercial product returns, including products for refunding and exchanges, and damaged and non-functioning products returning for repair and maintenances from the users upwards along the supply chain channel, with an emphasis on electronic industry.

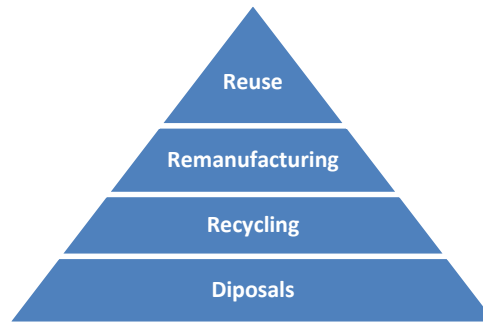
## 2.3 REVERSE LOGISTICS ACTIVITIES<sup>3</sup>

As we mentioned above, reverse logistics system deals with all the activities involved in reverse flows from the end-customers to suppliers via retailers and manufacturers, it is considered to be a necessity to specify the range of reverse logistics activities. Based on different products category, Vogt et al. (2002) classified five types of waste treatment activities, namely reverse distribution of products, return of unsold goods, product returns (e.g. damaged goods, wrongful delivered goods, warranties and repairs, etc.), product recalls and waste management. From another point of view, Dyckhoff et al. (2004) demonstrated the reverse logistics activities with a hierarchy (See figure 3) according to how the wastes are treated in the system. Clearly, it can be interpreted from the hierarchy that reuse has the first priority in reverse logistics system followed by remanufacturing and recycling, and disposals of goods, either with energy recovery or in landfill, come into the play at the last stages. (Dyckhoff, Lackes, & Reese, 2004)

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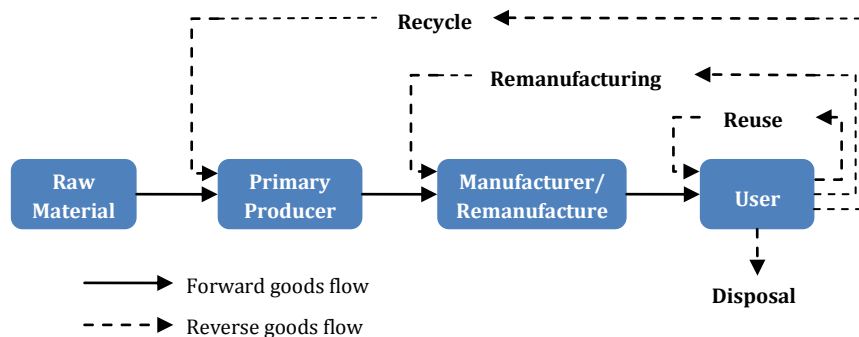
<sup>3</sup> Some researchers used other terms such as 'product recovery strategies', 'waste treatment activities', 'deposition alternatives' referring the same meaning and scope of 'reverse logistics activities'.





*Figure 3: The Hierarchy of Reverse Logistics Activities (Dyckhoff, Lackes, & Reese, 2004)*

According to Rogers & Tibben-Lembke (1999), Dyckhoff et al. (2004), these activities have different characteristics. At the first level, products are reused by customers for nearly the same purpose, which maximizes the efficiency of the system. Under some circumstances, a product or its components would be repaired or remanufactured to be used again, but with poorer quality than new products. The next level of activity requires more major additional treatment, as the product could be disassembled into components, some of which may be reused or remanufactured while the rest would turn as inputs for productions. If the product and its components cannot be reused, or remanufactured, or even recycled, owing to either its poor condition or the environmental restrictions, disposal into the environment is the only way it could be treated. (Rogers & Tibben-Lembke, 1999; Dyckhoff et al., 2004) The relationships between all activities mentioned in the hierarchy can be described as following figure.

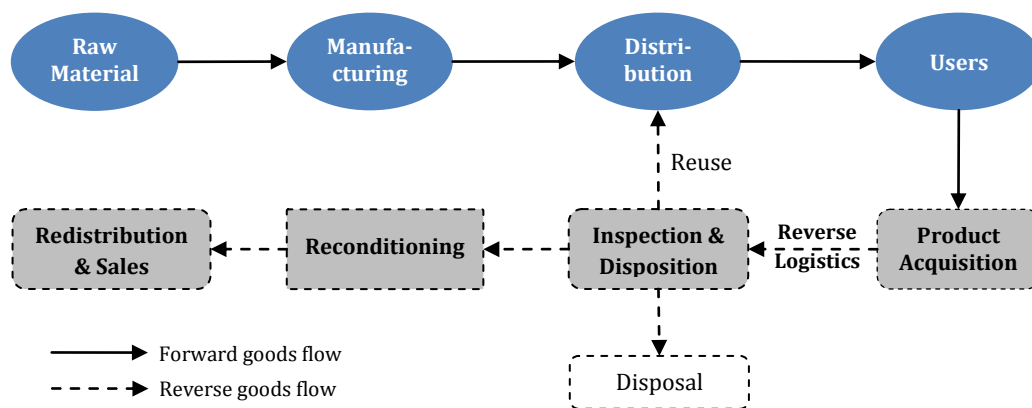


*Figure 4: Activities in closed-loop supply chain (Insanic, 2010)*

Provided that the combination of conventional forward supply chain and the reverse supply chain represents the closed-loop supply chain (Wikner & Tang, 2008), different amount of players embodied in the reverse supply chain refers to different activities in the system. In addition, the size of the loop is related to the environmental and economical costs and the system efficiency, meaning that the larger loop implies greater environmental costs, greater economical costs and lower system efficiency. (Insanic, 2010) In other words, among all the activities, reuse of return goods requires the least amount of environmental and economical costs and maximizes the system efficiency, while in the meanwhile disposals generate the most environmental and economical costs and make least or even no use of the products. (Dyckhoff et al., 2004)

## 2.4 REVERSE SUPPLY CHAIN PROCESSES

When a company is under the consideration to set up a reverse supply chain, one of the biggest challenges is to determine the appropriate structure that is tailored to maintain the cost- and value- efficiency and effectiveness of the whole system. In order to achieve the strategic goals, Guide & van Wassenhove (2002) stated it is crucial for the company to analyze its activities, to decide whether some activities should be outsourced, and decide how to maximize the cost efficiency and value recovery of the system. Apart from having the knowledge about product categories and waste treatment activities in the reverse logistics system, the company ought to understand the key components of the reverse supply chain processes so as to better control and manage its supply chain among all the channel partners. As Guide & van Wassenhove (2002) identified, a majority of reverse supply chains are arranged going through five primary processes: product acquisition, reverse logistics, inspection and disposition, reconditioning, redistribution and sales. (See figure 5)



*Figure 5: A General Reverse Supply Chain (Guide & van Wassenhove, 2002)*

### 2.4.1 Product Acquisition

A majority of reverse supply chains are triggered by product acquisition, which has been referred as collection in some researches (Fleischmann, Krikke, Dekker, & Flapper, 2000). It represents the process of retrieving the used products, components or materials from the users. (Guide & van Wassenhove, 2002)

There are three main origins of used products as declared by Prahinski & Kocabasoglu (2006): from forward supply chain, existed reverse supply chain, or waste streams. Typical examples of product acquisition from the forward supply chain can be the product commercial returns or recalls. The defective or damaged products are normally pushed upstream through the same chain members. On the contrary, if the used products are acquired from the established reverse supply chain, they are pulled upstream by various incentive policies, such as deposits or refunds for product returns. Waste stream is another source for product acquisition, in which the products can be land-filled or be diverted from land-fills and reused. (Prahinski & Kocabasoglu, 2006)

Guide & van Wassenhove (2002) pointed out that product acquisition is the critical process for establishing a profitable reverse supply chain. The product returns should be well managed in terms of quality, quantity and timing, to avoid the possible chaos that receiving a large amount of used products at the same time spot. In light of this, it is important for companies to coordinate the collection process with the retailers or distributors. (Guide & van Wassenhove, 2002)

#### **2.4.2 Reverse Logistics**

Once being collected, the used products, components or materials would move forward to the next stage, 'reverse logistics' in particular. In this process, returned products are supposed to be delivered to the facilities for inspection, sorting and disposition. (Blackburn, Guide, Souza, & van Wassenhove, 2004)

Activities in this process consist of transportation, warehousing, distribution, and inventory management, with the common goal of cost minimization and value maximization in the supply chain. (Prahinski & Kocabasoglu, 2006) Effective management of all these activities is required for the companies to ensure that the total costs of renewal products or materials derived from the reverse system would not exceed the costs for new products or materials. (Ibid.) Additional to the costs for transportation, warehousing and inventory, careful consideration must also be given, in this process, to the issue concerning how fast the product value would erode away. (Guide & van Wassenhove, 2002) On account of this concern, the reverse network ought to be tailored to every particular product in supply chains, leading to the prevailing outsourcing of the reverse logistics process to Third Party Logistics (3PL) company. (Ibid.)

#### **2.4.3 Inspection and Disposition**

Rogers and Tibben-Lembke (1999) claimed that it is normal that customers return either used or non-used products for a million of different reasons. However, those various reasons would not be as obvious to the distributors or manufactures who receive the returned goods. (Prahinski & Kocabasoglu, 2006) In light of this, it is of significant importance to carry out the inspection and disposition process when the returned products arrive at the assigned location for further treatments.

The process encompasses the activities including disassembly, inspection, testing, sorting and rating of the returned products, aiming to identify the quality level of those returned products and to select the most appropriate and valuable product recovery strategy for each product. (Guide & van Wassenhove, 2002; Prahinski & Kocabasoglu, 2006) In other words, all the returns are split into different groups of distinct recovery options primarily according to the distinct characteristics and quality levels of the products. (Guide & van Wassenhove, 2002) Other crucial factors may include market demand, contractual relationships among channel members, and so forth. (Rogers & Tibben-Limbke, 1999) Nevertheless, Guide & van Wassenhove (2002) declared, for the benefits to maximize the cost efficiency and value recovery of returned products, the

proper disposition alternative ought to be selected in the earliest possible stage in the reverse supply chain, in which way the logistics costs can be reduced while the products being recovered would be distributed to the market much faster. (Guide & van Wassenhove, 2002)

Closely related to what we discussed in 2.1.3, Prahinski & Kocabasoglu (2006) suggested four predominant groups of product recovery strategy, namely direct reuse, product upgrade, materials recovery and waste management, and specified every category with detailed disposition options respectively, see table 2.

Product Recovery Strategy	Detailed Disposal Options
Direct Reuse	Direct reuse Resale
Product Upgrade	Repair Refurbishing Remanufacturing
Materials Recovery	Cannibalization Recycling
Waste Management	Incineration Land-filling

*Table 2: Product Recovery Strategies (Prahinski & Kocabasoglu, 2006)*

Among all the returned products, part of them may be never used before or still in an excellent condition and can be returned to the forward supply chain for distribution or to the secondary market for resale. (Blackburn, Guide, Souza, & van Wassenhove, 2004) Products in a rather poor condition which are not chosen for reuse, upgrade or recovery may be incinerated or land-filled. (Prahinski & Kocabasoglu, 2006)

#### **2.4.4 Reconditioning**

If the product upgrade or material recovery has been determined as the most suitable and profitable disposal alternative for the returned products during the inspection and disposition process, they are moving forward to the reconditioning process. (Prahinski & Kocabasoglu, 2006) Valuable components or used products as a whole are repaired, refurbished or remanufactured for resale and reuse, both with the purposes of recovering to original specifications and capturing additional value from them. (Guide & van Wassenhove, 2002; Blackburn et al. 2004) There is one strategic issue regarding the reconditioning process that must be kept in mind, referring to its rather low predictability owing to the high degree of uncertainties in both the timing and quality of returns. (Guide & van Wassenhove, 2002; Prahinski & Kocabasoglu 2006) Thereby, the suggestion for inspection and disposition is brought into the scene again, that it is substantial to select the most suitable recovery strategy for every product at the possible earliest stage in the reverse supply chain. (Guide & van Wassenhove, 2002)

### 2.4.5 Re-distribution and Sales

Distribution and sales process in the reverse supply chain is quite similar to the process in the forward supply chain. (Krikke et al., 2004) While in the forward supply chain the process deals with the new products, re-distribution and sales in reverse supply chain is to sell the reconditioned and re-usable products to the market. (Fleischmann et al., 2000; Prahinski & Kocabasoglu 2006) Guide & van Wassenhove (2002) proposed at the very beginning in this step, companies need to identify the proper market for the reconditioned or re-usable products, either existing demands or potential consumers. By potential consumer for reconditioned or re-usable products and components, it denotes both original customers in traditional market, and new customers in different markets, for instance those who do not want to or are unable to afford new products. (Guide & van Wassenhove, 2002) The key of a newly created secondary market is to discover the potential consumers and demands and then to educate them; hence the creation of a secondary market requires a fairly large amount of investments. (Ibid.)

## 2.5 REVERSE SUPPLY CHAIN DESIGNS

The implementation and management of the reverse supply chain requires the individual company a plenty of investments. (Brodin, 2002) Every step in reverse supply chains implies a considerable amount of costs, from waste acquisition to its ultimate disposition. A majority of companies actually view the commercial product returns, either for repair or maintenances, not as the necessity of daily operations but as a nuisance instead. (Blackburn et al., 2004) Hence most reverse supply chains have been designed with the primary purpose to minimize the overall costs of product recovery. (Ibid.) In this regard, Kumar & Putman (2008) proposed that the first step of reverse supply chain designs is to choose the best take-back channel, in other words the most appropriate collection method that return products to the manufacturers. Three typical collection methods were discussed in their research (see figure 6): manufacturer collects directly from the users (A), or via retailers (B), or by third-party companies (C). Returns collection method by third-party companies is preferable when manufacturers are able to benefit from remanufacturing and the third-party company is under cooperation with a number of manufacturers. (Kumar & Putnam, 2008)

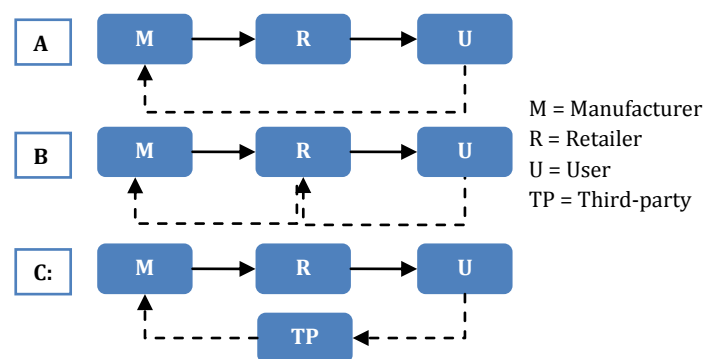
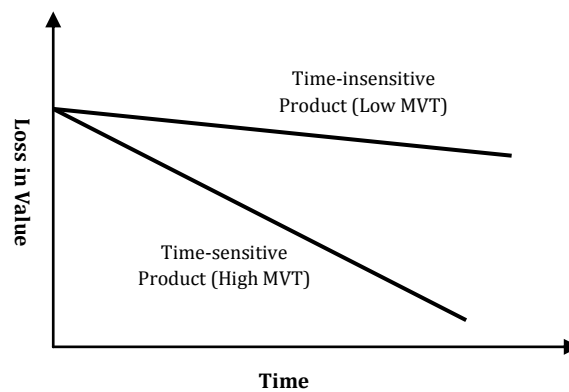


Figure 6: Typical returns collection methods (Kumar & Putman, 2008)

Except from overall recovery costs, the importance of time value in reverse supply chains must be addressed as well. It is obvious that the cost efficiency varies in inverse proportion to responsiveness of the reverse supply chains, meaning that cost efficient chains always denote longer time to retrieve and re-distribute the returned products. The time delays also reduce the value of products while they move through the reverse supply chain to their ultimate dispositions, either being re-sold or scrapped. Deriving from the fact, Blackburn et al. (2004) introduced the concept of marginal value of time (MVT) as one vital product configuration for reverse supply chain designs. It is defined as the value loss per unit of time spent in the reverse supply chain, and can be employed to measure the costs of time delays. (Blackburn et al., 2004)



*Figure 7: Differences in Marginal Value of Time for Returns (Blackburn et al., 2004)*

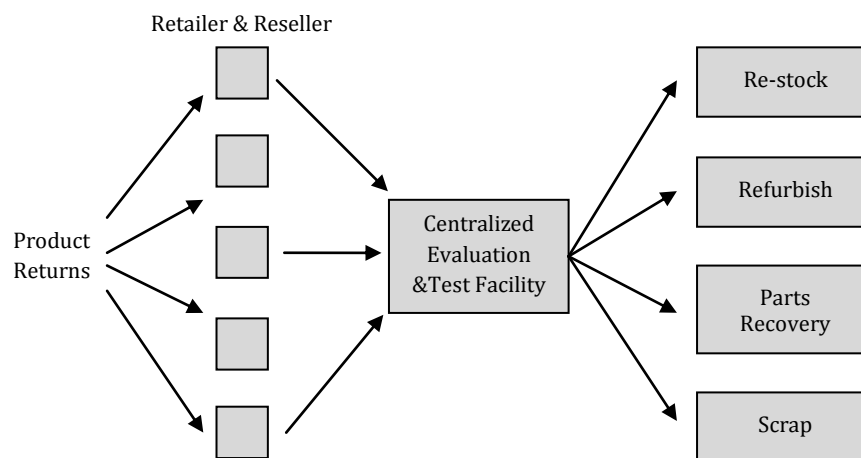
The MVT varies widely from different product industries and categories. (See figure 7) Based on the difference, products can be divided into two groups in general, namely time-sensitive products and time-insensitive products, depending on how fast the product value is decreased with time passing by. The MVT of time-sensitive products are higher, indicating a faster reduction in value losses due to the lengthy delays in the reverse supply chains. On the contrary, products with lower MVT are insensitive to time, meaning that the costs of time delays are much lower and the product value is more easily to be recovered. Consequently, in order to reduce the timely value losses to a minimum level, responsive reverse supply chain designs are considered to be more suitable for time-sensitive products, while time-insensitive products may call for cost-efficient reverse logistics systems. (Blackburn et al., 2004)

With an eye to both cost reduction and unavoidable timely value losses in return flows, the reverse supply chains must be redesigned not only to gain remarkable overall monetary values, but also to respond faster and reduce the costly time delays. (Rogers & Tibben-Lembke, 1999; Blackburn et al., 2004) Increasing attention has been attached by a number of recent researches to the debate on two fundamental reverse network designs, regarding the centralized and decentralized reverse supply chains. Rogers & Tibben-Lembke (1999) described the principal benefits of centralized reverse supply chains and emphasized its significant importance. Skjott-Larsen, Schary, Mikkola and Kotzab (2007) thereafter specified the pros and cons of both centralized and

decentralized reverse supply chain designs. Moreover, as we discussed earlier in this section, Blackburn et al. (2004) has proposed the significance of marginal time value in reverse network design. They declared that managers ought to understand the marginal time value of the returns and employ it as one of the critical criteria for the reverse supply chain designs. (Blackburn et al., 2004)

### 2.5.1 Centralized reverse supply chain

In a centralized reverse supply chain, centralized return centers are introduced into the system where returned products are being handled and processed, for the sake of achieving economies of scale in processing and transportation and minimizing the processing costs. (Rogers & Tibben-Lembke, 1999)



**Figure 8: Centralized Reverse Supply Chain Model (Blackburn et al., 2004)**

The fundamental schematic of centralized reverse supply chains is illustrated in figure 8. Similarly to forward commercial supply chain with a centralized facility, in centralized reverse supply chain, every returned product is delivered to a centralized facility for testing, inspection and evaluation, so as to grade its quality level and select the proper product recovery strategy. After the disposition alternative being determined, the product is transferred to the corresponding location for its ultimate disposition, i.e. restocking, refurbishing, recovery or scrap. In this case, retailers send all the returns back to a central location, and they are not responsible for any evaluation or quality test of the returns. (Blackburn et al., 2004)

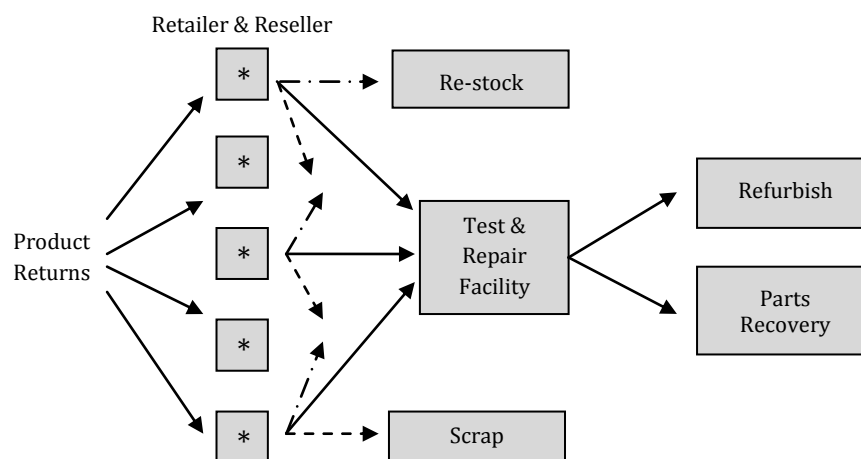
This type of reverse supply chain is designed to minimize both transportation costs and processing costs through economies of scale. Returned products are not transferred to the central facility for inspection and evaluation once being collected by retailers or resellers. They will be consolidated at the points of retailers and resellers and shipped in bulk to the central facility, in which way the transportation costs would be minimized. Nevertheless, processing costs are reduced by postponing inspection, testing, sorting and grading of returns to the centralized facilities, where labour forces are professional and skilled, specialized equipments are utilized and operations are standardized. (Rogers & Tibben-Lembke, 1999) Owing to the cost reduction in a large scale, this

supply chain design with centralized facility/facilities has been widely used by managers of reverse supply chains.

However, much of the value for the high MVT products erodes away due to the lengthy delays in the centralized reverse supply chain model. Its fundamental design principal of postponement denotes long time delays and a plenty of value losses in the return system. Thereby even though this approach can be rather beneficial for low MVT products, it should be employed less as a strategy for designing the reverse supply chain networks for time-sensitive products, since there is little to be obtained from product differentiation postponement. The value of the products with high MVT declines rather fast as time passes by, which results to a great plenty of costs of time delays and cannot be recovered easily in the whole reverse system. (Blackburn et al., 2004)

### 2.5.2 Decentralized reverse supply chain

Distinguished from delayed product differentiation in centralized reverse system, another typical structure being discussed by a lot of researchers, namely decentralized reverse supply chain, enjoys the time advantages by performing the product differentiation task much earlier within the supply chain network. (Blackburn et al., 2004) The general network design is displayed in Figure 9.



**Figure 9: Decentralized Reverse Supply Chain Model (Blackburn et al., 2004)**

In this approach, the inspection and evaluation of product is decentralized to achieve early product differentiation and to achieve time advantages from the responsive supply chain. (Blackburn et al., 2004) Current condition of returned products are initially inspected and evaluated at the retailers' or resellers' sites, instead of the single centralized evaluation point (Skjott-Larsen et al., 2007), where the disposition alternative is also determined for every returned item. The early product differentiation has been defined as 'preponement' on the contrary to postponement. (Blackburn et al., 2004) Thereafter, all returns are transferred to the most appropriate product flow till its disposition point. (Krikke et al., 2004) More specifically, new and unused products are directed to be re-stocked for resale or reuse; products in extreme poor conditions or non-valuable products are sent to be scrapped and disposes into the environment; and



the rest products are delivered to the test and repair facility for further testing and evaluation by professionals.

According to Blackburn et al. (2004), decentralised reverse supply chain model helps to reduce time delays in the returns flow and make the supply chain more responsive. With initial evaluation and inspection of returns at the retailers or resellers, the time delays for disposition of new and scrap products are reduced to the minimal level, which is especially crucial for those time-sensitive products. Additionally, preponement is able to accelerate the processing of the returns requiring for further diagnosis by specialists, as there are less products being sent to the professional test and repair facility which in turn reduces the time delays in queuing and evaluation and the corresponding value loss for these products. (Blackburn et al., 2004)

As the value of assets recovered from the reverse supply chain varies inversely to overall processing costs, it is not complicated to understand the logics of increased costs in this model. Transportation costs are increased comparing to the centralized return system, as products are no longer shipped in bulk but in smaller sizes. (Blackburn et al., 2004) Besides, labor costs are also enlarged since the product evaluation by retailers' and resellers' sites call for extra skilled workers. (Skjott-Larsen et al., 2007)

## **2.6 SUPPLY CHAIN STRATEGIES**

### **2.6.1 Supply Chain Strategy Selection**

Companies today have realized how important the supply chain management (SCM) is to the great success of individual companies, the primary purpose of which is to achieve sustainable competitive advantages and long-term profitability for channel members of the supply chain. (Ballou, 2004) One common way to reach the goal is to maximize its efficiency and effectiveness simultaneously, bringing the trade-offs between cost and quality, and between price and customer service on the stage. (Jacobs & Chase, 2008) Once the trade-offs occurs, proper supply chain strategies ought to be selected in aligned with the corporate strategy which represents the overall objectives of the company. (Ballou, 2004) An effectual and practical supply chain strategy is often grounded on the business goals of the company and customers' demands, which aims at cost reduction, capital investments reduction and customer service improvement, concerning not only the forward commercial supply chain but also the reverse supply chains. (Ballou, 2004; Jacobs & Chase, 2008)

Some researchers pointed out, when selecting the most suitable supply chain strategies, it is necessary to match them with the characteristics of the particular product and the market demand, for example the product life cycle, demand predictability, product variety, and market standards for lead times and service. (Fisher, 1997; Lee, 2002; Jacobs & Chase, 2008) Fisher (1997) suggested that products could be divided into two categories as primarily functional products or innovative products according to the product life cycle and demand predictability. People's basic needs can be satisfied by

primarily functional products, which have quite stable, predictable demand and long life cycles. In the meanwhile, owing to the low demand uncertainty, fierce competition is brought into the market of functional products and consequently results to rather low profit margins. Thereby innovations are introduced to the products by companies in fashion or technology so as to achieve high profit margins and be more competitive in the industry. The demand of innovative products tends to be much more unpredictable, and their life cycle becomes much shorter. Thereafter, Fisher (1997) proposed two fundamental supply chain structures for each group of products: efficient supply chain aiming to deliver product at low costs, and responsive supply chain aiming for speed of response. He also suggested an appropriate matching of different products to these supply chain strategies. (See table 3) Efficient supply chains are more preferable for functional products with the primary purpose to fulfill predictable demand at the lowest possible costs, whereas the responsive supply chains are best for innovative products which require quick responses to the unpredictable demands and short life cycle time, so as to minimize stock-outs and obsolete inventories. Distinct supply chain strategies should be selected for each group of products, and mismatches may lead to various problems within the supply chain. (Fisher, 1997; Jacobs & Chase, 2008)

	Functional Products	Innovative Products
Efficient Supply Chain	Match	Mismatch
Responsive Supply Chain	Mismatch	Match

*Table 3: Fisher's Matrix for Supply Chain Strategy (Fisher, 1997)*

Based on Fisher's taxonomy of strategic design choices, Lee (2002) expanded the matrix by emphasizing more on the supply side of the supply chain. Apart from the product demand characteristics, supply uncertainty has also been involved as one of the criteria for the strategy selection process. When the manufacturing process and underlying technology in the supply chain is mature, the supply process with low supply uncertainty is named as a stable supply process; whereas if the manufacturing process and fundamental technology is still under early development and changing fast, it is categorized as an evolving supply process. (Lee, 2002) By adding the supply uncertainty into consideration, the matrix for supply chain strategy selection has been summarized as table 4, together with some examples of corresponding product categories.

		Demand Uncertainty	
		Low (Functional Products)	High (Innovative Products)
Supply Uncertainty	Low (Stable Process)	Grocery, basic apparel, food, oil and gas <b>Efficient Supply Chain</b>	Fashion apparel, basic computers <b>Responsive Supply Chain</b>
	High (Evolving Process)	Hydroelectric power, some special food produce <b>Risk-Hedging Supply Chain</b>	High-end computers, telecom, semiconductor <b>Agile Supply Chain</b>

*Table 4: Lee's Matrix for Supply Chain Strategy (Lee, 2002)*

Furthermore, Christopher and Towill (2002) declared the selection of an appropriate supply chain strategy should be aligned with the market characteristics, higher level of customer responsiveness and less overall total costs in the supply chain, and they also suggested the particular circumstances for lean and agile philosophy applications in the supply chains. A three-dimensional classification approach has been introduced for the supply chain strategy selection process, including products (standard or special), demand uncertainty (stable or volatile), and replenishment lead-time (short or long). However, the dimension of product characteristics is actually related closely to the demand uncertainty in practice. For example, being standard, the products are standardized in designing and manufacturing process and their demand are quite stable, with a probably long life cycle. On the other hand, a special product has often been customized where demand is more volatile and life cycle tends to be shorter. Hence the taxonomy is able to be simplified into two dimensions: demand predictability and replenishment lead-time, see table5. (Christopher & Towill, 2002; Christopher, Peck and Towill, 2006)

		Demand Predictability	
		Predictable	Unpredictable
Replenishment Lead-time	Long lead time	<b>LEAN SUPPLY CHAIN</b> (Plan and Execute)	<b>LEAGILE SUPPLY CHAIN</b> (Postponement)
	Short lead time	<b>LEAN SUPPLY CHAIN</b> (Continuous Replenishment)	<b>AGILE SUPPLY CHAIN</b> (Quick Response)

*Table 5: Christopher's Matrix for Supply Chain Strategy (Christopher et al., 2006)*

Possible generic supply chain strategies have been described as well for every quadrant in the matrix. When the product demand is predictable and replenishment lead time is short, continuous replenishment is the ideal solution for supply chain management and vendor managed inventory could be one possible way for implementation. If the replenishment lead time of the product with predictable demand is quite long, the appropriate strategy may tend to be the lean supply chain which focuses on the reduction or even elimination of waste in the supply chain through long term planning and scheduling of the supply chain operations. At the right side of the matrix, product demands are much more unpredictable. With the combination of unpredictable demands and short lead time, agile supply chain is called to be executed based on quick response. The fourth quadrant describes an extreme circumstance where demand is unpredictable and lead time is long. In this case, the requirement for a 'hybrid' lean/agile strategy is adopted, namely leagile supply chain, which aims to realize the

postponement concept in the supply chain to keep strategic inventory and postpone part of the production process till the actual demand is placed. (Christopher et al., 2006)

### **2.6.2 Lean, Agile and Leagile Philosophies**

As we already mentioned above, in recent years, discussions and researches concerning supply chain strategy have revolved around two fundamental philosophies, i.e. lean and agile supply chains, together with their combination – leagile philosophy. Each concept will be illustrated in details in this section, in terms of the understandings, application in the supply chain and analysis in reverse supply chains, providing more powerful theoretical groundings for the following research in this paper.

#### **Lean Supply Chains**

The idea of ‘lean thinking’ has been developed by Womack and Jones (1996), firstly originated from the Toyota Production System proposed by Taiichi Ohno (1912-1990), the Toyota executive. Lean thinking mainly emphasizes on the reduction or elimination of muda, referring to all kinds of waste that creates no value with resources, especially the human activities. (Womack & Jones, 2003) Ohno (1988) has classified the muda into several groups for reference: defects in production, overproduction, inventories, unnecessary processing, unnecessary movement of people and goods, and waiting time for employee. Besides, Womack & Jones (1996) included the products and services which fail to fulfill the customers’ requirements into the range of muda as well. Lean thinking aims to develop an integrated set of activities to eliminate all wastes in all aspects of a business, including time, materials, and costs, and to enrich values from the customers perspective. (Ballou, 2004) It suggests the logic that nothing will be produced until it is demanded from the customers, which in other words implies the production is triggered by the actual demand for the specific product. (Jacobs & Chase, 2008) In short, lean thinking pursuits to gain more and more outputs with less and less input, such as less human efforts, less equipments, less costs and time. (Womack & Jones, 2003)

Today, the lean thinking has been involved not only in internal manufacturing processes, but also in the entire supply chains. (Oliver, Delbridge, & Lowe, 1993) It is suggested that the lean approach has the opportunity to be applied where the product demand is relatively stable and predictable, for the eliminations of all types of wastes within the network and for pursuit of cost reductions and efficiency improvements in the supply chain. (Christopher et al., 2006) As we outlined in previous section, application of the lean approach as a supply chain strategy differs from the lead time of product replenishment. For products with a short lead time, continuous replenishment is best suitable for the supply chain (Ibid.) To realize and ensure the continuous replenishment, the company ought to apply real-time information sharing within the supply chain network by the assistance of Internet and information technology tools, such as EDI and RFID. Possible methods for the implementation could be Vendor Managed Inventory (VMI), Continuous Replenishment Programs (CPR), and Collaborative Planning, Forecasting and Replenishment (CPFR). (Yao & Dresner, 2008) In the case of long

replenishment lead time, the planning and execution strategy is preferable instead. (Christopher et al., 2006) Companies in the supply chain work together in order to plan and pre-schedule the manufacturing process ahead of demand in the most efficient way. (Ibid.) Demand forecasting is called for these companies with the help of, for example Enterprise Resource Planning system (ERP), Material Requirement Planning (MRP). (Herrin, 2010)

Recalling what we have discussed above concerning the centralized reverse supply chain model, for time-insensitive products, the centralized approach would be adopted for reverse supply chain design with the main objective to minimize overall return and recovery costs in the system, in line with the lean approach. As the product's marginal value of time is rather low, high speed and saved time costs a lot but actually adds little value to the products for the manufacturers or suppliers. Hence the evaluation and test activity ought to be centralized in one facility to save the costs for a number of separate facilities, and eliminate the waste of costs in terms of transportation and processing time. (Blackburn et al., 2004) For applying the lean philosophy in the reverse supply chain, it requires a large extent of information sharing, excellent forecasting over product demands, and effective joint work among all members in the supply chain. Thus information technology and demand forecasting are included as necessities for implementing a lean supply chain.

### **Agile Supply Chains**

For those situations where demand is neither stable nor predictable, and requires mass customization for the products, agile supply chains should be brought into the stage, which concerns basically with the responsiveness of the system. (Christopher et al., 2006) Agility originated as a business idea in flexible manufacturing process. The philosophy behind agile paradigm has an objective of improved customer services by quicker response to their demands. (Harrison & van Hoek, 2008) It requires companies to adopt market knowledge and virtual corporation to exploit profitable opportunities in a volatile market. (Banomyong, Veerakachen, & Supatn, 2008) Another prerequisite for implementing agile thinking in the supply chain refers to a short replenishment lead time of the products. As the agile thinking aims to maximize the customer services, it is clear that the focuses of an agile supply chain lie in the customer and market, indicated by customer satisfaction level and capabilities of the companies. (Harrison & van Hoek, 2008)

In order to act as agile supply chain successfully, it must be market sensitive, representing the ability to respond to the actual demand in the market. The efficient response to the market demand requires the data capturing from the retailers and users through the use of information technology, instead of forecasting based on past sales data. With the help of information technology and information sharing, companies within the supply chain are able to work on the same data for market demand throughout all the operations in the supply chains. (Christopher & Towill, 2000)

For the reverse supply chain, it is of crucial importance to ensure the agility and responsiveness of the return system, both of which are also the key elements for decentralized reverse supply chain mode. In a decentralized reverse supply chain model, the facility or point for inspection and evaluation of the conditions of returned products has been moved to the point of retailer or reseller. Thereafter new and unused products are directly transferred to be re-stocked for resale or reuse, and products in extreme poor conditions or non-valuable products are sent to be scrapped and disposed into the environment, and only the products requiring for further testing and reconditioned will be delivered to the central test and repair facility. (Blackburn et al., 2004) In this regard, responsiveness of the return system is improved, at least over the reusable and scrapped products, which increases the customer satisfaction instantly. According to Blackburn et al. (2004), the decentralized reverse supply chain is more appropriate for the high MVT products, in other words, the agile supply chain is more suitable for the reverse supply chain design of the high MVT products, as the speed for recovery becomes a critical element which should be maintained as fast as possible in order to avoid the substantial value losses due to lengthy delays. (Ibid.)

### Leagile Supply Chains

Lean and agile supply chains are claimed to be able to serve various purposes and designs of different supply chains. Nevertheless, in practice, when the product demand is unpredictable and replenishment lead time is rather long, any one single strategy cannot fulfill the objectives of individual company or the entire supply chain; thus an integration is required under this circumstance.

By combining both lean and agile approaches, the named 'leagile' supply chain attempts to introduce a 'de-coupling' point (D.P.) into the network, and practices the lean and agile approaches at different stages according to the varying situations, as shown in Figure 10. (Banomyong, Veerakachen, & Supatn, 2008)

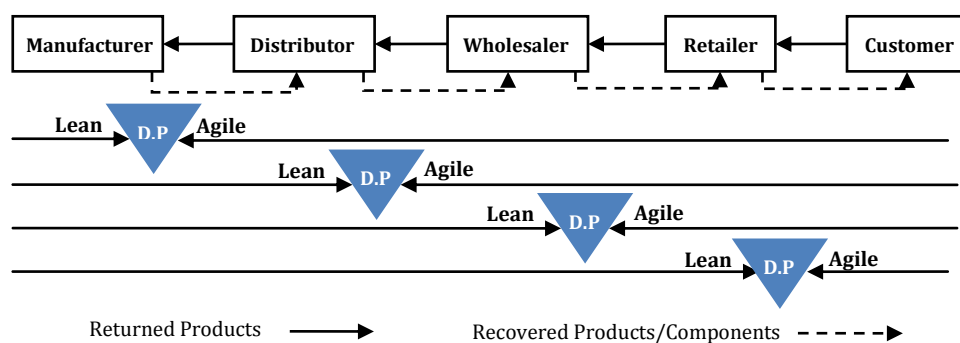


Figure 10: Leagile Supply Chain with de-coupling point (Banomyong et al., 2008; modified by the author)

The introduction of de-coupling point into the reverse supply chain network represents the application of postponement strategy. It intends to implement lean approach for predictable standard products or components and agile approach for unpredictable, special products or components. To be more specific, the lean approach is applied from

the manufacturer side till the de-coupling point for the purpose of waste elimination, while simultaneously the agile approach is utilized from the de-coupling point downstream to the customer in order to ensure quicker responses to the volatile market demand and improve the customer satisfaction. In this sense, the leagile reverser supply chain model benefits from both concepts, i.e. overall lead time and cost reductions, and customer service improvements. (Christopher et al., 2006)

A variety of de-coupling point locations in the leagile reverse supply chain are indicated in Figure 10. The introduced de-coupling points act as service spots for products repairs and maintenances, in order to cope with the fluctuated customer demands. Most of the returned products are tested, disassembled, inspected and repaired at the service points, which to a large extent results in a reduction in lead time and waiting time for repairs. Moreover, the closer the location of service point is to the customers, the higher flexibility and responsiveness the system could achieve. Instead of the agile strategy as from the repair service points, from the manufacturer site till the de-coupling points, a lean strategy is adopted to reduce the transportation costs by a fairly large scale, as the demands for spare parts or products are consolidated in the service sites and can be measured as high and predictable. However at the same time, it creates also inventory at the sites of repair services which would lead to an extra costs and thereby it demands a good forecasting on the demands of spare parts or products. According to a case study carried out by Banomyong et al. (2008), about the comparison between the previous reverse system and a newly applied leagile reverse logistics process, the transportation costs and space rental costs for repair spots have been reduced while more operation costs and inventory holding costs have been caused, which on the whole contribute to a large amount of savings from the leagile reverse supply chain structure. (Banomyong et al., 2008)

Nevertheless, the implementation of leagile strategy in a reverse supply chain design has some requisites. In practice, it calls for generic modular product designs and productions for various products to enable the implementation of leagile approach, in which way, the holding inventories in the repair service points, in other word the de-coupling points, would be reduced to some extents. In this regard, special product designs are needed. Besides, along with the establishments of service points, information technology system ought to be implemented to keep track of all the information on sales, demand and inventory level for each kind of spare parts or products at every spot for repairs and maintenances. (Christopher et al., 2006; Banomyong et al., 2008)

# 3 METHODOLOGY

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*This chapter provides a roadmap with directions for the research methods being applied in this thesis, including the research approach and strategy, data collection methods, and data analysis processes. Validity and reliability of the research has also been discussed in the end of this chapter.*

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## 3.1 RESEARCH PHILOSOPHY

Saunders, Lewis and Thornhill (2003) claimed that research philosophy is grounded on how the development of knowledge is perceived by the researchers. It is not unusual that some sound researches have been conducted without any ideas on the adopted research philosophy; however, the way we think about the development of knowledge is useful for the research design and the choice of particular research approach and strategy. (Saunders, Lewis, & Thornhill, 2009) According to Blumberg, Cooper, and Schindler (2008), there are two extremities existed in philosophical reviews: *positivism* and *interpretivism*. Besides, more diversified philosophies can be positioned between them, for instance the realism. (Blumberg, Cooper, & Schindler, 2008)

### Epistemology

Positivism is adopted by the natural scientists, referring to the principle that knowledge is developed through investigating observations on objective phenomena in the social world (Saunders, Lewis, & Thornhill, 2009), by examining whether or not the objective facts support the hypotheses deriving from pre-existing theories (Blumberg, Cooper, & Schindler, 2008). In this way the same knowledge of the social world is supposed to be generated by different researchers who observe the same fact. (Bryman & Bell, 2007) It requires a highly structured methodology and quantitative analysis of the facts. (Saunders, Lewis, & Thornhill, 2009) On the contrary, interpretivists believe the social world is way too complicated to be understood in the way of natural sciences, and they advocate a different research philosophy: interpretivism, which was applied in this thesis. It donates that the social world is constructed subjectively by intentional behaviours of people. Researchers try to generate knowledge through understanding the social facts and presenting how people interpret the social world. Consequently, researchers are actively involved in the research together with participants. It is their personal interests which guide the research design and the choice of research approaches. (Blumberg, Cooper, & Schindler, 2008)

### Ontology

Another key concept which is closely related to epistemology refers to ontology. While epistemology aims to answer the question how the knowledge is developed, ontology regards the nature and existence of the social world. It differs in the way how the social world is perceived. One ontological position, *objectivism*, claims that the social world should be considered objectively and the reality is independent and distinctive outside



individuals. It is associated with positivism in epistemology. On the contrary, *constructionism* is an alternative ontological assumption, where the social world should be considered subjectively based on individuals' or groups' experiences and interpretations. Hence, the understanding about the same reality can be different from individuals and can also change over time and circumstance. Constructionism is often related to interpretivism from the epistemological view. (Eriksson & Kovalainen, 2008)

In this thesis, a real-life problem was supposed to be solved about strategy selections in reverse supply chain within the electronic industry. There is a need to gather a set of information from certain companies regarding the current development of reverse logistics system, and to investigate the underlying interpretation of the collected data from our subjective point of view, aiming to provide suitable solutions to the problem. It requires exploration of the feasibility to incorporate particular forward supply chain strategies, i.e. lean, agile and leagile paradigms, into the reverse supply chain, based on the subjective assessments of managerial performances by participants. Hence, interpretivistic and constructionism philosophy is followed in this research.

### Theory and Research

In addition to epistemological and ontological considerations, the relationship between theory and research should also be considered in the dimension where theory is introduced in the research, specifically speaking deductive and inductive approaches. (Bryman & Bell, 2007) *Deduction* is the dominant approach in natural sciences, in which researchers start with developing a hypothesis or hypotheses deduced from the existing theory, and design a research strategy to gather empirical data and test the hypothesis or hypotheses. (Saunders, Lewis, & Thornhill, 2009) In a valid deductive study, the conclusions will always be true as long as the hypotheses are true. (Blumberg, Cooper, & Schindler, 2008)

However, in stark contrast to natural science, a large account of business study research follows the logic of *inductive* study. It entails a process as building and generalizing a theory from the analysis of collected data. (Saunders, Lewis, & Thornhill, 2009) The induced conclusion is one, but not the only, explanation to the observed fact, as it is drawn by the researchers grounded on their personal experiences and interpretations. (Blumberg, Cooper, & Schindler, 2008) To put these approaches simpler, deductive approach moves from theory to empirical data while in an inductive stance theory is the outcome of empirical study, as illustrated in following figure.

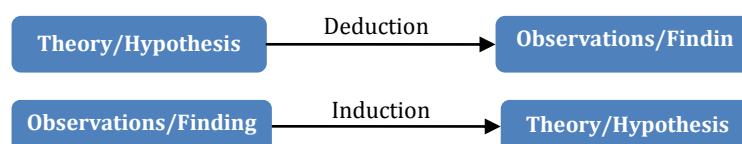


Figure 11: Deduction and Induction (Bryman & Bell, 2007)

The research process in this thesis was primarily conducted along inductive approach, which in the meanwhile also entails an element of deduction (Bryman & Bell, 2007). We

gained certain knowledge and understandings about the chosen topic in the area of reverse supply chain, grounded on which the research questions were raised and the interview questions were formulated. Induced from the analysis of empirical data, the theoretical reflection would be inferred about the possibility to apply existing strategies into the reverse logistics system. Afterwards, more data were collected to exam the validity of these theoretical reflections, i.e. in which specific circumstances the certain strategies should apply.

## **3.2 RESEARCH PURPOSE AND DESIGNS**

### **Research designs: Exploratory, descriptive, casual designs**

From the perspective of differences in research purposes owing to the specific research questions, studies can be grouped into three categories, including exploratory, descriptive and explanatory studies. (Saunders, et al., 2009; Hair, et al., 2007; Blumberg, et al., 2008) However Saunders et al. (2009) also suggested that some of the groups can be applied in the same research project as the research question can be both descriptive and explanatory.

An exploratory research is appropriate when the research problems are vague or when researchers have limited information and knowledge regarding the research problems. (Blumberg, Cooper, & Schindler, 2008) Researchers develop concepts more deeply, discover new relationships or patterns through exploratory studies, (Hair, Money, Page, & Samouel, 2007), which are conducted primarily by using qualitative techniques, such as literature review, interviews with experts and focus groups (Saunders, Lewis, & Thornhill, 2009). In this regards, it is especially useful in highly innovative industry, information technology as an example, as well as when identifying innovative management and production practices or developing new strategies. (Hair, Money, Page, & Samouel, 2007) The greatest benefit of exploratory study represents its flexibility and adaptable to changes, as the way in which the project is conducted can be changed resulting from new data and insights occurred. (Saunders, Lewis, & Thornhill, 2009)

Descriptive research is designed to describe a situation, problem or phenomenon from data collection process using descriptive statistics. (Hair, Money, Page, & Samouel, 2007) Hence, researchers must initially have a quite clear picture about the concerned situation or problem or phenomenon ahead of collecting data. (Saunders, Lewis, & Thornhill, 2009) Furthermore, in contrast to exploratory research, descriptive studies are more structured and tailored to measure the characteristics of the research topic, i.e. the situation, problem or phenomenon, as relevant data is usually collected by well structured processes, for example data observation or structured interviews. (Hair, Money, Page, & Samouel, 2007)

The third group of research designs except from exploratory and descriptive studies refers to explanatory studies, which is termed as 'casual research' as well by some researchers. It aims to test the causal relationship between variables, which in other

words means to identify whether one event causes another, and whether the change of one event causes its corresponding change in another event. (Saunders, Lewis, & Thornhill, 2009)

This paper aims to explore the possibility to apply lean, agile, leagile strategies into the reverse logistics system, and to clarify in which circumstances certain strategy should be appropriate. According to the research purpose, in this paper, exploratory research is chosen for specific research designs. Owing to the lack of knowledge and studies about the applicability of the lean, agile and leagile paradigms in reverse supply chain, new innovative management practices and strategies in the area of reverse supply chain ought to be developed by collecting data theoretically by literature reviews and practically by in-depth interviews. Another sign for exploratory research is the changes of research process due to the continually appearing of new data during the whole research.

### **3.3 RESEARCH METHODS: QUALITATIVE VS QUANTITATIVE**

Many researchers believe it is critical to distinguish the differences between quantitative and qualitative approaches in research, as it helps to classify different research designs and how the research should be carried out in particular. (Bryman & Bell, 2007) Eriksson and Kovalainen (2008) explicitly concluded that most researches in social sciences, e.g. business researchers, are conducted along qualitative approach, while in contrary quantitative approach dominates the studies in natural science. However it is also outlined that there is no general guidelines for determining the appropriateness of quantitative or qualitative approach. What should be considered when choosing one of the research approaches include the specific research problem, the purposes of the research and required information. (Blumberg, Cooper, & Schindler, 2008)

The widely used distinction between quantitative and qualitative studies lies on the type of information collected to answer the pre-set research questions. (Blumberg, Cooper, & Schindler, 2008) Quantitative studies place its emphasis on testing of hypothesis through statistical analysis of collected numerical data, while qualitative studies entail generation of new theory out from observations, in which data are not collected in the form of numbers but from the interpretation of the social world by participants. (Bryman & Bell, 2007) Even though, many researchers have their preferences for one or the other type of research approaches on the basis of their own experiences, it is also possible to apply both approaches in the same study. (Ghauri & Grønhaug, 2002)

In this regard, qualitative approach was considered to be more suitable for this thesis. It gives comprehensive descriptions of the current development of reverse supply chain both theoretically and practically in the electronic industry. In addition, it explores if it is possibility to apply specific strategies in the reverse supply chain, out of the data

collection process and the framework of references. However, quantitative approach was not adopted in this study as statistical analysis will not contribute to understanding and interpreting the behaviors in electronic industry regarding their reverse supply chain management.

In qualitative studies, information are gathered in the form of words, sentences and narratives using unstructured data collection techniques, for instance observations, focus groups, in-depth interviews and/or case studies. (Blumberg, Cooper, & Schindler, 2008) The application of unstructured data collection methods in qualitative studies ensures a probing investigation into the research problem (Hair, Money, Page, & Samouel, 2007), but also entails the nature of time consuming (Eriksson & Kovalainen, 2008). Owing to the uniqueness of each interview, it requires considerable input of time in detailed analysis before developing specific interview questions, as well as in the thorough interpretations of collected information involving the researchers' judgements. (Eriksson & Kovalainen, 2008) The nature of time consuming may limit the number of respondents in the research, thus the representativeness may also be problematic. Further the empirical findings and ultimately conclusions are to a large extent grounded on the subjective observations and interpretations by participants and researchers (Hair, Money, Page, & Samouel, 2007), revealing the subjectivity of qualitative approach.

## **3.4 DATA COLLECTION PROCESS**

### **3.4.1 Primary Data Collection Process**

Closely related to the above section, this paper aims to describe the current situation regarding commercial returns for repairs and maintenance in the electronic industry and to discuss the feasibility and applicability to manage and control the reverse supply chain with forward supply chain strategies, i.e. lean, agile and leagile manufacturing. Consequently, qualitative research approach will be chosen specifically for the primary data collection process, in particular the interviews.

Hair et al. (2007) listed two broad qualitative data collection techniques including observation and interviews, which should be consistent with the research questions and research objectives. Observations are more appropriate for data collection when the purpose of research lies in the examination of people's behaviors or events, through systematically recordings, description, analysis and interpretations of people's behaviors or events. (Eriksson & Kovalainen, 2008; Hair et al., 2007) On the other hand, if the objective of the research is to understand and explore the internal causes of research topic, interviews are overwhelmingly preferred by researchers (Eriksson & Kovalainen, 2008), where they tend to gather valid and reliable empirical data related to the research questions through discussions with other people. (Saunders, Lewis, & Thornhill, 2009)

Interview can be classified in different categories in various manners. With regards to the way how researchers interact with the participants, interviews may be grouped as

'face-to-face' interview, telephone interview, or electronic interview via Internet/Intranet. (Saunders, Lewis, & Thornhill, 2009) In this thesis face-to-face interviews are considered to be more advantageous comparing to the other forms of interviews. Researchers are enabled to communicate personally with the interviewees with the help of visual supports and body language, so as to obtain more useful feedback from the participants about their interpretations on the current situation of commercial returns in electronic industry. Furthermore, the quality and relevance of gathered information and knowledge can be well controlled by explaining and clarifying misunderstandings and confusions. (Saunders, Lewis, & Thornhill, 2009)

Another typology which is related to the level of structure and formality of predetermined questions differentiates between structured, semi-structured and unstructured interviews. (Saunders, Lewis, & Thornhill, 2009) The interviews we conducted with three selected retailers within electronic industry follow the semi-structured approach. Unlike the structured interviews which predetermine open-ended questions in certain sequence and the informal unstructured interviews which have no predetermined list of questions (Hair et al., 2007), in semi-structured interviews, researchers have an overall structure and direction of the detailed questions needed to be covered in the interview, while it is at the same time flexible to include unanticipated questions which were not set originally, or to modify the order of questions depending on every specific interview and conversation.

As mentioned above, the interviews we conducted in the research process aim to explore the perceptions and interpretations by retailers concerning the commercial product returns for repair and maintenance in the electronic industry. Semi-structured interviews, in this regard, could bring out unexpected and insightful information which will in turn enhance the empirical findings of this research.

### **3.4.2 Literature Review**

As part of the research process, it is necessary for researchers to undertake a literature review which presents the previous researches in related to strategies for managing reverse logistics system by other people and their findings. (Hair, Money, Page, & Samouel, 2007) A critical literature review develops a profound understanding of the most relevant and significant existing theories about the research topic, and provides insights into the development and future trends. (Saunders, Lewis, & Thornhill, 2009)

Comparing to the forward supply chain within which materials flow downwards from the suppliers to end customers, there is a limited number of studies regarding the reverse logistics system, and a large account of existing theories regarding reverse supply chain management are discussed on the basis of traditional supply chain management. Consequently, the critical literature review started with providing a comprehensive account of theories on reverse supply chain, by clarifying various definitions of 'reverse logistics' and 'reverse supply chain', followed by a detailed explanation about its classification, driving forces and system designs. At first we

searched relevant theories by key words with a focus on 'reverse logistics', 'reverse supply chain', 'supply chain strategy', 'strategy for reverse supply chain' etc. However, as literature reviews proceeded with reviewing and comparing the existing researches concerning the application of forward supply chain strategies within the reverse logistics system, the research scope was narrowed down to concentrate on the exploration of 'lean', 'agile', and 'leagile' strategies within the reverse supply chains. Thus, terms like 'lean manufacturing/production', 'agile manufacturing/production', and 'leagile manufacturing/production' are included in the key words list as well.

Sources of the literature being reviewed in this paper involve books, journals and conference proceedings, and previous theses and dissertations (Hair, Money, Page, & Samouel, 2007), which were accessed through university libraries, electronic databases such as Business Source Premier, Elsevier Science Direct, Emerald etc, together with internet search engines like Google Scholar.

### **3.4.3 Secondary Data Collection Process**

In contrast to gathered primary data, those data which were initially collected for some other research purposes or to answer some other research questions can be grouped as secondary data. (Hair, Money, Page, & Samouel, 2007) Given the fact that the primary data collection process is time-consuming and capital-consuming, secondary data has been seen as a good alternative for obtaining required information, which are already available and can be immediately analyzed once being accessed. (Blumberg, Cooper, & Schindler, 2008) Furthermore, from the re-analysis of the obtained secondary data, some unexpected insights would be brought out, contributing to the answers of research questions. (Saunders, Lewis, & Thornhill, 2009)

Sources of secondary data include the researcher's organization, governments, professional institution, trade associations, commercial enterprise, non-governmental organizations and the like (Hair, Money, Page, & Samouel, 2007), in the form of annual report, governmental documents, statistics, voice recordings, etc. (Blumberg, Cooper, & Schindler, 2008) As this research concerns the reverse supply chain management in electronic industry, the relevant information of selected electronic retailers were enclosed in secondary data, e.g. websites, brochures, annual reports.

## **3.5 VALIDITY AND RELIABILITY**

"Validity and reliability are essential tools in the positivist epistemology." (Waltling, as cited in Winter, 200, P.7) In a qualitative research, the discussion of the reliability and validity of outcomes need to be involved which is the importance factor in an either qualitative or quantitative methods since these factor are supposed to express distinctively.

### **3.5.1 Validity**

The concept of validity in qualitative research is liable construct, “referring to ground in the processes and intention of particular research methodologies and projects” (Winter, 2000). Validity is giving the contingent measurement for the qualitative research. The consequence of validity comes out from the author’s investigation and option of paradigm assumption. The validity is development based on the concept of constructing the qualitative research in terms of quality, rigor and trustworthiness.

### **3.5.2 Reliability**

Reliability is defined by investigating and estimating the data elicitation to help the readers understand an unfathomable and confusing situation. The author has to think about the reliability in research design, outcome result, and the quality of this research. The reliable qualitative research will convince the readers who may pay more attention and believe the result. To make the research finding is much more attractive to the readers, the qualitative research is judged by its own paradigm’s term with the determinant of credibility, neutrality, conformability, dependability and transferability to exam the trustworthiness of this research.

### **3.5.3 Testing Validity and Reliability**

This research is recognized by maximizing the validity based on the reliable qualitative study, referring to probe the deeper and comprehensive understanding instead of surface consideration. Therefore this research is acquiring to realize diverse realities and multiple data based on the information gathered in different ways which are multiple methods, involving interviews, observations, description, recording and data collection as well. The objectiveness of information collection is depending on the participation and interpretation of the investigators and researchers in diversified countries, locations and time to bring more plenty of angle to ensure the objectivity.

# 4 EMPIRICAL FINDINGS

*Empirical data collected from interviews with two electronic retailers in China, i.e. Gome Electrical Appliance Ltd., and Suning Appliance Ltd., as well as the secondary data from website and annual report of these companies is concluded in this chapter. Empirical findings are also shown in this chapter relatively for future analysis.*

## 4.1 OVERVIEW

This section will present the empirical findings based on the interviews conducted with two electronic retailers in China, referring to Gome Electrical Appliance Ltd. and Suning Appliance Ltd., and their websites, annual reports, etc., so as to pave the way for further analysis revolved around the research questions. The empirical findings will be described in light of general information about the interviewed retailers, primary returned products, and reverse supply chain processes with an emphasis on commercial product returns for repair and maintenances.

The leading Chinese electronic retailers Gome Electrical Appliance and Suning Appliance both supply a fairly wide range of products and services, in different areas within China and overseas. However the empirical study in this thesis mainly revolved around the product categories including communication products, computers, digital products, and small household consumer appliance, which exclude for example air-conditioners, refrigerators, washing machines, vacuum cleaners, ovens etc., as shown in Table 6. These particular product categories being considered in this study all have a short life cycle. In addition, the web-based retailing activities and physical retailing stores outside of Chinese Mainland will be excluded from the empirical study here.

<b>Communication products</b>	Mobile phones & accessories, telephone, walkie-talkie
<b>Computer and accessories</b>	Laptop & accessories, desktop computers, printers, external drives, networking products, scanners
<b>Digital products</b>	MP3 players & accessories, video games, camera & accessories, digital picture frame, recorders
<b>Small household appliance</b>	Toaster, egg cooker, rice cooker, blender, yogurt maker, coffee maker, water purifier, soya milk maker, iron, remote control, socket, humidifier, electric fan, razor, shaver, hair dryer, electric toothbrush, radiator, etc.

*Table 6: Detailed Analyzed Products for Each Category*



## 4.2 GOME ELECTRICAL APPLIANCE

### 4.2.1 General Company Information and Product Category



Gome Electrical Appliance Ltd. was firstly originated from a small-scale electronic appliance retail store in Beijing by Guangyu Huang in 1987, and started to set up its retail chain in 1999. (Gome, 2011) In 2000s, Gome acquired a number of local electronic appliance retailers and, in 2006, it merged with the third national appliance retailing chains, Yongle

Appliance, since when it took the leading place in the retailing chains in Chinese electronic appliance market. (Ifeng Technology, 2010) From 2009 Gome ranks the first in the industry of electronic appliance retailing chains in China, and ranks the 22<sup>nd</sup> worldwide. (Ibid.) Up to 2010, Gome group has run over 1,400 chain stores in over 300 cities all over China, with its annual sales around 23.1 billion US dollars. It has employed about 300 thousand employees who work in nearly 30 branch companies in China, including Hong Kong. (Gome, 2011; Gome Annual Report, 2011)

In line with the mission of Gome group, *'to achieve superior quality of life'*, Gome group has defined its vision as *'to become a leading excellent, respected and sustainable home appliance retailing chains all over the world'*. (Gome, 2011) With the purpose to realize the vision, Gome group has continually expanded its business scale and enlarge its market share by requisitions. It keeps adjusting and optimizing its way of providing services, through the means of accurate market positioning and innovative operating strategy, so as to eventually fulfill customer requirements. The value creation and customer satisfaction can also be obtained by selling mass customized products at lower prices and profits but higher turnover. (Gome, 2011; Ifeng Technology, 2010)

Gome constantly considers the management and optimization of an up-to-date effective logistics system as its core competitiveness throughout its development. It has established an efficient and technical logistics network, which focuses on the improvements in operation efficiency, mass customization, quick response to demands and ultimate customer service satisfaction. Its main logistics department in Beijing plays a vital role in the management and controlling of the daily logistics operations. In the meanwhile, specific logistics tasks are carried out by its own 49 sub-logistics centers in over 200 large- and middle-scale cities, which are able to effectively serve 800 retailing stores and 200 thousand customers per day in average through the country. The overall objective and goal of the logistics system is to manage the deliveries within seven days and the product claims/returns in 15 days at the most. (Gome, 2011; Gome Annual Report, 2011)

The dominating strategy that Gome applies in its logistics network and supply chain represents a model similarly to the centralized supply chain model. The main logistics department regulates the logistics operations in sub-logistics centers, by setting up

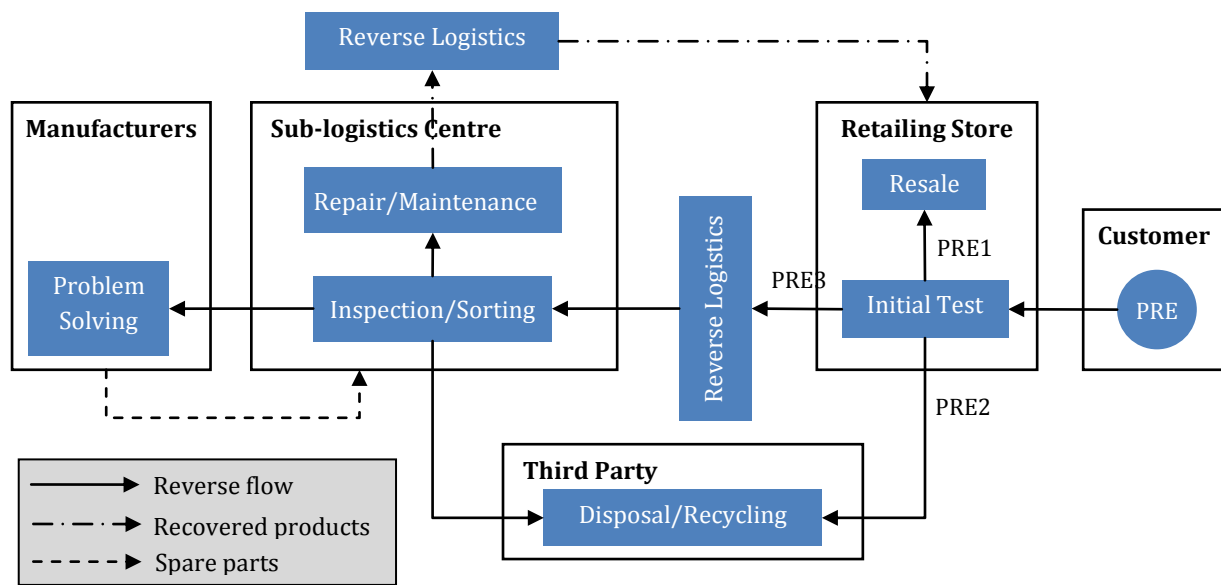
relevant standards at a uniform rate, for instance the inventory level in each sub-logistics center. Every sub-logistics center acts as the distribution center for a number of retailing stores being allocated by the main logistics department according to their geographical areas. In this regard, products are ordered from upstream suppliers by each sub-logistics center, based on the sales information of the retailing stores that are covered by the corresponding sub-logistics center. Enterprise resource planning system has been implemented in Gome during recent years for information management, aiming to realize real-time data sharing among the network. (Gome, 2011)

Gome group supplies an extensive range of products, mainly referring to the communication products like mobile phones; computers and laptops; digital products such as cameras, recorders, MP3/MP4 and the like; small household appliance including hair dryers, fans, coffee machines and so forth. (Gome, 2011) All these product categories together take up around 97.8% of overall sales and revenues bring about 96% of profits to the company. (Li, interview, 2011-05-13) Concerning the reverse logistics, product returns exist in every product category, yet, the primary types are claimed to be in line with the principle products categories as well, owing to the fact that commercial returns can be found mostly in products like communication products, computers and other digital products. (Ibid.)

#### **4.2.2 Reverse Supply Chain**

In the pursuit of high quality customer service as its primary objective, Gome group has proposed a number of policy and strategies with regards to the product backwards flow for returns, exchanges, repairing and maintenances, as a means of improving customer satisfaction and achieving efficiency and effectiveness of the company. A special group of products can be returned back to Gome group for the replacement of new products within the regulated product range. Moreover, products with a poor quality or performance, and products failed to fulfill customers' demands are guaranteed and ensured to be returned or exchanged unconditionally within a certain period after having been purchased by the customers. (Gome, 2011) In light of this, the processes of the reverse supply chain in Gome vary from case to case, which in general can be divided by product returns for refunding and exchanges (PRE), and products for repair or maintenances (PRM). (Li, interview, 2011-05-13)

## 1) Product returns for refunding and exchanges



**Figure 12: Reverse Supply Chain Process of Product Returns for Refunding and Exchanges in Gome**

Reverse supply chain process of the returned products for refunding and exchanges is described in the above figure. In this case, products are brought back directly to the retailing stores by customers after being purchased, where initial product quality testing and evaluation would be carried out by specialists. The initial evaluation aims to filter out the new or unused products (PRE1), and the non-valuable products (PRE2) from all the returned products. After being sorted, the new and unused products will be directed to the counters for resale, and the non-valuable products will be sent to the cooperated third party company for recycling or scrap. In practice, some simple renewing and repairing tasks are performed by specialists in the retailing stores as well, and the products after being renewed will be resold again. Customers return products for refunding will come to the end of this deal here, yet the customer return goods for exchanges are still involving in the business. When the new product is available in stock, the customer is able to receive the new product immediately; however if the new product is out-of-stock, customer ought to wait for the delivery of new product, normally 3-5 days, of which the costs are paid by Gome itself. (Gome, 2011; Li, interview, 2011-05-13)

Returned products with poor quality yet which are still valuable and profit to be recovered are sent to the sub-logistics center that acts as the distribution center of the specific retailing store through its reverse logistics system. In the sub-logistics center, more professional staffs and engineers are employed, who are working for further inspection and evaluation of the returns to find out the internal causes to the poor quality and determine the proper recovery alternative for each product, either remanufacturing for resale or disposal. A small portion of these returns will be put on the way back to the manufacturers, only if the problems and causes of the poor product

quality are new that have not been encountered before; thereby the manufacturers will (Li, interview, 2011-05-13)

Apart from the backward flows, spare parts for all kinds of products, and sometimes new products, are delivered by the manufacturers to the sub-logistics centers, according to the demand forecasting based on historical sales data by the logistics department in the headquarter. In this sense, spare parts and new products for refilling the inventory at the spot of sub-logistics center are delivered in a large amount periodically, by which Gome intends to reduce the transportation costs while ensure the customer service level. (Li, interview, 2011-05-13)

Generally speaking, in this case, during the stages of product acquisition and initial product test and evaluation in retailing stores, Gome seeks to put the emphasis mainly on the processing speed and responsiveness to the demand of product exchange, aiming to provide a high level of customer service. During the following process in the reverse supply chain, processing costs are taken into consideration. After the initial product test, a certain amount of returns that require further inspection and reconditioning would be consolidated in the retailing store and moved to the sub-logistics center together. *‘Once the product has been refunded or exchanged in the retailing store, the customer is already satisfied. So what we try to realize in the following processes is to minimize the costs.’* (li, interview, 2011-05-13)

## 2) Product returns for repair and maintenances

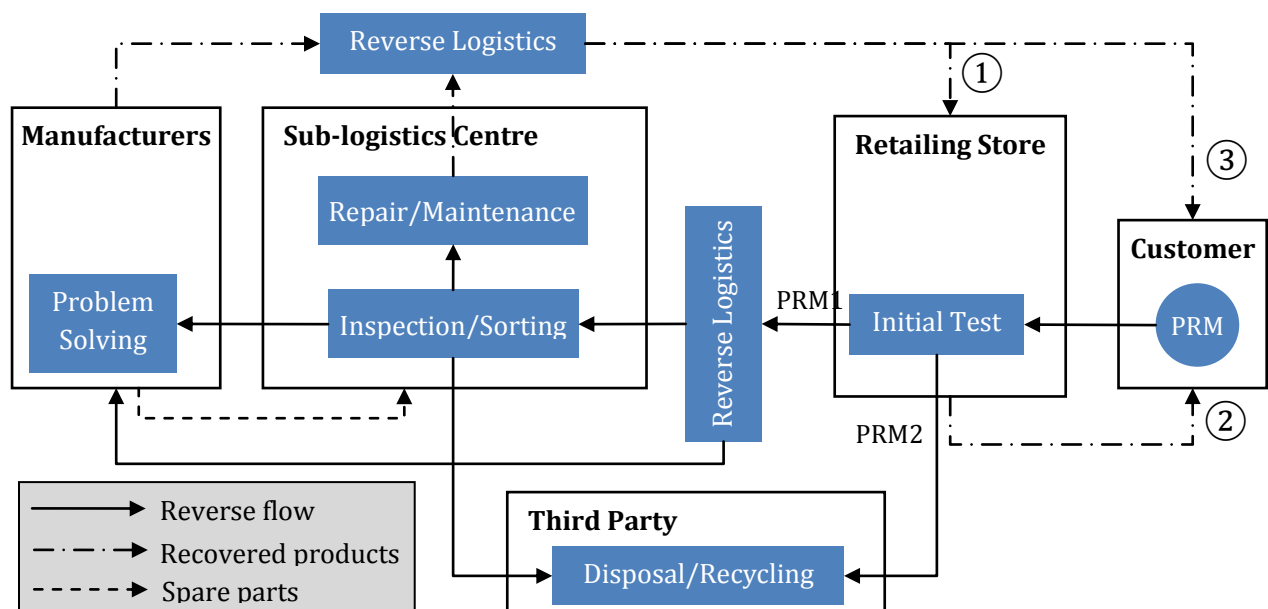


Figure 13: reverse supply chain Process of Product Returns for Repair and Maintenances in Gome

The above figure shows the way how reverse supply chain proceeds when the products are returned for repairing or maintenances in Gome owing to their poor quality. Similarly to the acquisition of products for refunding and exchanges, products under this circumstance are sent to the retailing stores by customers themselves. They need to

sign a couple of particular forms to complete the product acquisition step, which regulate the duty and responsibility of both sides, and state clearly the delivery issues about the recovered products, such as delivery time and who ought to pay the related costs. (Li, interview, 2011-05-13)

In the retailing stores, returned products will go through the initial test as well, which enables the sorting of all the required products into repairable products (PRM1) and non-valuable products (PRM2). The non-valuable products can produce few profits for the company and will be directly recycled, scrapped or land-filled. Meanwhile, repairable products are pushed into the reverse logistics system to be transported to recovery spots, which in this case can be grouped into several sub-categories according to the damages and problems to the products. Returned products with problems and damages to a small extent which can be fixed and solved by Gome will be transferred to its sub-logistics center for further inspection and recovery or disposals; yet if the damages to the products are too severe for Gome to repair, or if the problems causing the poor quality have not been encountered by Gome before, they will be sent back to their original manufacturers for thorough reconditioning and investigation. Yet, if the problems causing the poor quality of goods are new to the original manufacturer, they will be transferred to their manufacturers for further research and improvements. (Li, interview, 2011-05-13)

After being remanufactured and reconditioned, either by Gome sub-logistics center or by original manufacturers, the products will be again placed in the logistics system and be transferred eventually back to the customers. There are three different situations for the final delivery. Most of the recovered products are transported from the point of remanufacturing to the retailing stores, as stated as ① in the above figure; afterwards, the products can either be post to the customers who are paying for the transport costs (②), or be collected from the retailing store by customers. However some special products may demand quick response regardless of costs. Thus they will be put on the track directly to the specific end customers (③), of which the transportation costs are on the customers' account and could be much higher than the first situation. Normally, Gome contributes all the best to control the processing time for product claims or returns which should be less than 15 days. (Gome, 2011; Li, interview, 2011-05-13)

Distinguished from the product returns for refunding and exchange, the reverse supply chain of the returns for repair and maintenances has been designed mainly to achieve higher speed and responsiveness to the customer demands. *'We always put our customers at the first place and we provide the best customer service as possible. Customers coming to return their products for repairing always hope that they can get the recovered products back as soon as possible. You cannot let them wait for like one month or even longer to having their goods back. Otherwise, they will not come to your store any longer.'* Yet, the flows of spare parts from manufacturer to Gome's sub-logistics centers adhere to the strategy of cost minimization as in the situation for refunding and exchanges. (Li, interview, 2011-05-13)

## 4.3 SUNING APPLIANCE

### 4.3.1 General Company Information and Product Category



Suning Appliance is one of the leading companies in the industry of 3C (consumer appliance, computer and communication products) appliance retailing chains in China. It was founded in 1990 as a specialized store selling only air conditioners in Nanjing, and has continually developed its chain store model which now represents a combination of

flagship stores, neighbourhood stores, specialized stores, and boutique stores. In 2009, Suning acquired LAOX Home Electronics Store in Japan and Hong Kong Citicall Appliance, to expand its business. Until 2010, Suning has run 1,500 chain stores covering more than 300 cities in China and also Japan, with 150 thousand employees bringing its annual sales volume up to above 23 billion US dollars. Meanwhile, Suning pursues its development in a steady and rapid pace by opening 200 new chain stores annually to expand its national-wide coverage and increase its revenue and profits. (Suning, 2011)

In the near future, Suning Appliance aims to continually contribute to the establishment of the best chain service brand in China. It considers service as its unique product and customer satisfaction as its ultimate goal. Suning has moved the service positioning up on the agenda which enables to provide customer service even before purchasing. Moreover, it persists in business innovations and service expansions in order to attract a larger number of customers and to improve the customer satisfaction. Till now, Suning has established close relationships and cooperation with nearly 10,000 suppliers both national and abroad, and built up a high efficient supply chain among all the participants. Together with suppliers, experts and researchers as well as social institutions, Suning also makes efforts to explore the development tendency and cooperation strategy, so as to promote the development of the entire home appliance industry in China. (Suning, 2011)

Suning Appliance considers logistics as one of its core competitiveness. Currently, it has set up a distribution network nationally composed by regional distribution centers, city distribution centers and cross dock. A certain amount of modernized logistics centers have been developed in Beijing, Hangzhou, Nanjing and Shenyang, while more are still under constructions. The construction and allocation of 60 logistics and distribution centers in China are expected to complete by 2015. The modern logistics centers serve the retail distribution within the radius of 150 km at most and support an annual sale of 769 million US dollars. Except from serving the retailing stores, the logistics centers function as regional after-sales service center, regional call center and regional training center as well. Quick response has been applied in the product distribution by Suning. Responding time to customer real demands has been reduced from four hours to two

hours with a higher punctuality. In the meantime, express distribution service is provided in 13 different cities in China including Beijing and Shanghai, which aims to complete the product distribution tasks in the city area within 12 hours. (Suning, 2011; Suning Annual Report, 2011)

Currently, Suning offers eight major categories of home appliance, including air-conditioner, refrigerator, washing machine, color TV, Audio-video products, small home appliance, communication products, computers and digital products covering more than 200 thousand specifications of nearly 1,000 brands. (Suning, 2011) In 2010, these major product categories occupy over 98% of the total annual sales and produce over 97% of total annual profits. (Suning Annual Report, 2011) Among all the categories, product returns can mostly be found in the communication products, computers, and digital products. (Meng, interview, 2011-05-20)

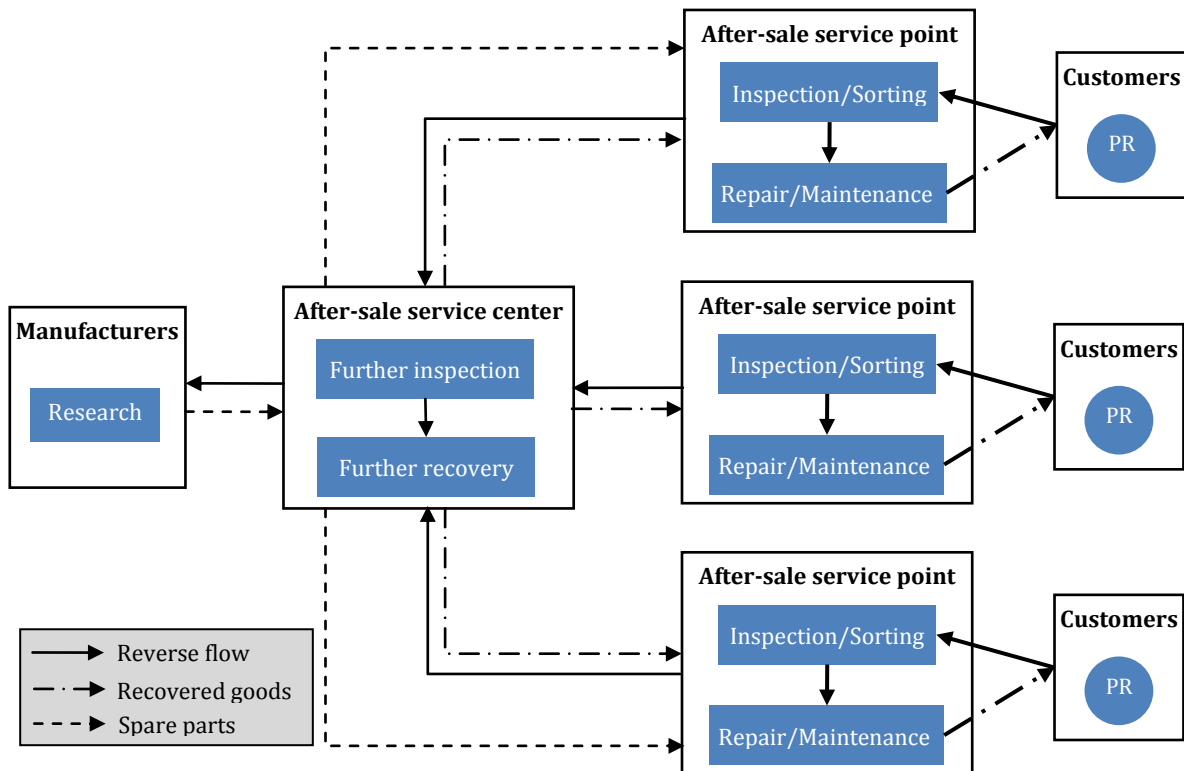
#### **4.3.2 Reverse Supply Chain**

Considering service as its unique product and customer satisfaction as its ultimate goal, Suning Appliance put a lot of efforts into the after-sale service development to expand and improve its services and to provide customers with more professional and reliable services. One strategy that Suning applies in their reverse supply chain represents localization of its after-sale service. Hence it has built up the after-sale service network to cover the whole country and to realize its goal that *'wherever you find a retailing store for electronic appliance, you will find at least one repair point nearby.'* The localization strategy secures that Suning is able to respond to the product returns from end-customers for repair and maintenance within 24 hours and complete the tasks within less than 2 days. In practice, Suning separates the reverse supply chain from the commercial forward supply chain network. Instead of the regional distribution centers and city distribution centers, up to 2010, Suning has established 90 after-sale service centers and nearly 3,800 after-sale points in its reverse supply chain. Customers are encouraged to walk in any after-sale service point to return products after having purchased, either for refunding, exchanging or for repairing and maintenances. (Suning, 2011; Meng, interview, 2011-05-20)

##### **1) Product returns for refunding and exchanges**

Through the assistance of the established after-sale service points with a fairly large coverage, the reverse supply chain process of the product returns for refunding and exchanging is quite simple. As the customer walks in one after-sale service point with the returned products, specialist employed by the after-sale service point starts with the initial tests on the products. Products with poor quality and that do not work properly are transferred to the inspection and remanufacturing stages within the same after-sale service point, while those products that work properly but fail to fulfill customers' needs are directed to counters again. In this regard, the returns can be exchanged in a quite short while, which is controlled within 4 hours if the new product is in stock or within 12 hours if the product is out-of-stock. (Meng, interview, 2011-05-20)

## 2) Product returns for repair and maintenances



*Figure 14: reverse supply chain Process of Product Returns for Repair and Maintenance in Suning*

As regards the product returns for repair and maintenance, the reverse supply chain operates as indicated in figure 14. The process is triggered by customers as they walk in the after-sale service points to return the damaged or nonfunctional products for repairing and maintenances. All the returned goods will go through the inspection step at the moment they have been accepted by the service point, by which returns are sorted into different groups. Repairable ones will be moved into reconditioning process for repairing and maintenances; whereas the irreparable products and product that are not valuable for maintenances, will be disassembled to be recycled or scrapped and the customers can receive a remanufactured product for free or a brand-new product with paying a certain percentage of its value, normally less than 35%. (Meng, interview, 2011-05-20)

In practice, most of the repairable products have simple problems and can be repaired at the after-sales service point by employed specialists. After products being repaired, customers will be informed to come and pick up the products, or the products will be post back to the customers and the deriving transportation costs are on customers' accounts. In this case the entire process of product repairs and maintenance needs to be finished within one or two days. Yet for some special situations, returned products may be transferred to the upstream after-sale service center for further inspection and reconditions, and even a small portion, of which the damages and problems have not been met by Suning before, would be sent back to the original manufacturers for investigation and research. For these special cases, customers do not need to wait till all



the reconditioning work being completes, as a new product will be redirected by Suning to the customers alternatively. (Meng, interview, 2011-05-20)

In order to enable and ensure the repairs and maintenances being localized in the after-sale service points, the manufacturers replenish the spare parts inventory to the after-sale service centers on a monthly basis, and the spare parts from various manufactures are transported afterwards to each service point on a weekly basis from the service center. The demand upstream from the after-sale service points is much more stable than the downstream where customers pop in randomly. Hence the spare parts replenishment method benefits Suning from the economies of scale in transportation. (Meng, interview, 2011-05-20)

# 5 ANALYSIS

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*In this section, the data collected from the empirical study will be analyzed by being integrated with the theoretical framework. It reports all the facts that the research has discovered, leading to the answers to the research questions of this thesis. Firstly the perception by companies regarding reverse supply chain and relevant strategies will be described, following with a comparison between the practical and theoretical reverse supply chain process and designs. Moreover, stating the criteria for lean, agile and leagile strategies selection, the implementation of these strategies in the reverse supply chain will be discussed in the last part.*

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## 5.1 PERCEPTION OF REVERSE SUPPLY CHAIN BY COMPANIES

Today it has been widely acknowledged that product life cycle does not come to the end with its delivery to its end-customer, but continues with the reverse product flow back to retailers or manufactures. In order to achieve sustainable competitive advantages for the individual companies within a supply chain, the reverse products flow has to be involved into the scope of supply chain management, which in other words represents the vital importance to plan and manage all the activities within the supply chain including coordination and collaboration with all the channel partners. Due to the fact that the establishment and controlling of reverse supply chain demands a fairly large amount of investments, it is claimed by some researchers that (Blumberg, 2005; Guide & van Wassenhove, 2002) a number of individual companies see the reverse flow in the supply chain as additional costs to the companies regardless of its economic advantages and strategic importance.

However, deriving from the interviews with two leading electronic appliance chain retailers in China, Gome Electrical Appliance and Suning Appliance, during the recent years, companies have put increasing focuses on the establishment and management of their reverse supply chain, associated with the 'after-sales service', 'claim management', and 'warranty service'. They mainly refer the backwards flow to those products returned from the customers for refunding, exchanges, and repairs and maintenances. A majority of the returns for repair and maintenances are just simple problems and can be easily fixed without complicated equipment, for example '*to adjust internal mechanical parts or to replace some small pieces of spare parts*'. (Meng, interview, 2011-05-20)

The end-of-life and end-of-use products take up a rather small portion in the reverse flow within the electronic retailing industry. One of the chain retailer being interviewed, Gome, has proposes one strategy regarding the acquisition of end-of-life and end-of-use products, which encourages the customers to give back products that coming to its physical life or end of usage, to any Gome retailing store for the replacement of new products. The products given back for replacement are regulated within a special product category such as mobile phones and computers.

In line with the perception of 'after-sales service' or 'warranty service', both chain retailers consider the reverse flow as part of their customer service. They always put their customers at the first place and set the customer satisfaction as their ultimate goals. They believe it is fairly critical to develop an efficient and effective system to plan and control the reverse flow, so as to provide the end-customers better service and quicker responses, regardless of the possible incurred large amount of costs. Gome group limits the processing time for product exchange in three to five days, and product for repair and maintenance within 15 days. Suning Appliance sets the time for responding within 24 hours and for tasks completion within 2 days.

## 5.2 REVERSE SUPPLY CHAIN PROCESS

According to what we described in the theoretical framework, the majority of reverse supply chains go through five steps in the entire process, including product acquisition, reverse logistics, inspection and disposition, reconditioning, and redistribution and sales. (Guide & van Wassenhove, 2002) However, it differentiates from the way how companies are progressed in practice which is much more complicate.

In the electronic retailing industry, reverse flows are always triggered by commercial returns which are taken back into the system by customers themselves after having purchased, instead of being retrieved from the customers by retailers. Theoretically the next stage refers to reverse logistics which tend to transport all the returns to the facility for inspection and sorting; whereas in practice it varies from case to case.

Gome often carries out an initial product test before putting the returns on the moving track in order to filter out the new or unused products and non-valuable products from the entire returns. The initial tests are performed at the retailing stores when customers return back the goods. Only the returns that are repairable and are worthy for repairing will be put into the logistics system and be delivered to sub-logistics center for further inspection and remanufacturing.

In Suning Appliance, the reverse logistics has been excluded in the reverse supply chain in most cases. Owing to the localization strategy, the after-sales service points act not only as a spot where customers can drop by with returned products, but also as a repair point for simple product repairs and maintenances. In this sense, most of the returns do not need to be transferred to other facility for inspection and further reconditioning.

After being remanufactured, recovered goods are sent back to the market for sale. Guide van Wassenhove (2002) declared that in this step a special secondary market ought to be identified which includes both original customers and new customers. However, in this thesis, the empirical study shows a different way. Because the commercial returns are taken back for refunding, exchanging, repairing and maintenances, in most cases the recovered goods are eventually delivered to their original customers, not new customers.

## 5.3 REVERSE SUPPLY CHAIN STRATEGIES

### 5.3.1 Criteria for Strategy Selection

Concerning the reverse supply chain management, it is of primary purpose for individual companies to select proper strategies in order to achieve sustainable competitive advantages and long-term profitability. (Ballou, 2004) When selecting the most suitable strategies, it must be kept in mind that an effectual and practical supply chain strategy is always grounded on the overall business goals of the company.

Gome group has defined its vision as *'to become a leading excellent, respected and sustainable home appliance retailing chains all over the world'*. (Gome, 2011) In order to achieve the goal, Gome continually expands its market coverage and optimize its customer positioning and contribute to the innovation in operations. It also has implement advanced information system during recent years to realize the real-time data sharing among all the participants within the network. With the combination of the means, Gome provides mass customized products at lower prices, and at the same time enables a responsive reverse supply chain for product returns, so as to level up its customer satisfaction and maintain the customer loyalty eventually. The returns for exchange should be handled as soon as the customers hand over the products as long as the new product is in stock, otherwise the process time is limited in three to five days. Returns for repair and maintenances are promised to be proceeded within 15 days.

Suning Appliance regards the service as its unique product and persists in business operation innovations and customer service expansion. It has separated the forward supply chain network from the reverse supply chain network, which is referred to 'after-sales service network' by Suning. A large amount of after-sale service centers and service points have been set up all over the country, by which Suning aims to localize the after-sales service and complete the repairing and maintenance locally at after-sales service points in most cases so as to provide the customers quick response to the product returns.

Another critical criterion for the strategies selection is the nature of the returns. Some researchers pointed out it is necessary to match the reverse supply chain strategies with the characteristics of the particular product and also market demand, for example product life cycle, demand predictability, product variety, and market standards for lead times and service. (Fisher, 1997; Lee, 2002; Blackburn et al., 2004; Jacobs & Chase, 2008) In this empirical study, the companies being analyzed are both engaged in the electronic appliance retailing industry in China. The ranges of products supplied by these two companies are almost the same, among which the share of each product category is similar and the commercial returns are identical. The product returns having been analyzed in the thesis are commercial returns, including the wrongful deliveries, damaged and non-functioning products, and also the returns owing to the inconformity to customers' demands. As customers return the purchased products randomly, the customer demands are hard to be forecasted, resulting to an unpredictable customer

demand. Moreover regarding the product characteristics, researchers suggested to consider the product life cycle, marginal time value and replenishment lead time. (Christopher & Towill, 2002; Blackburn et al., 2004; Krikke et al., 2004) All the products being focused in this thesis have a short life cycle and rather high marginal time value, and also the replenishment lead times of the products are rather short in this case.

### 5.3.2 Implementation of Lean, Agile and Leagile Approaches

Similarly to the commercial forward supply chain, in reverse supply chain, lean approach is applied to eliminate all the wastes in the process and to achieve the economies of scale in processing and transportation; agile concept ought to be adopted to ensure the agility and responsiveness of the return system; and the implementation of the hybrid 'leagile' reverse supply chain benefits the company from both costs reduction and increased responsiveness.

Christopher et al. (2006) have suggested a matrix for the supply chain strategy selection in alignment with the demand predictability and replenishment lead-time, as being described in section 2.6.1. When the product demand is predictable lean approach should be adopted no matter the lead time is short or long. With the combination of unpredictable demands and short lead time, agile supply chain is called to be executed based on quick response. Where demand is unpredictable and lead time is long, the leagile strategy is integrated into the supply chain.

Based on Christopher's matrix for supply chain strategy selection and the characteristics of the analyzed products in this thesis, it seems that agile approach ought to be selected as the most suitable strategy for the reverse supply chain in the electronic appliance retailing chains. However, when we took a closer look at the reverse supply chain process of product returns in the analyzed retailers, it is obvious that no agile reverse supply chain has been implemented throughout the whole process.

*'Supposing we order every single spare part for repairing and maintenances from the manufacturers as soon as the inspection and disposition being carried out in the sub-logistics center, and we send back the recovered product as soon as we remanufacture it, the transportation costs and processing costs will be incredible high and hardly to afford.'* (Li, interview, 2011-05-13) To solve this problem Gome consolidates the recovered products at the sub-logistics center to certain amount and delivers them together back to the retailing stores. Besides, the spare parts for product repairing are delivered from the manufacturers to sub-logistics center on a monthly basis to avoid unnecessary repeat in transportation. In general, a leagile reverse supply chain has been applied in Gome's reverse system, as can be seen from figure 15, which introduces a de-coupling point at the sub-logistics centers.

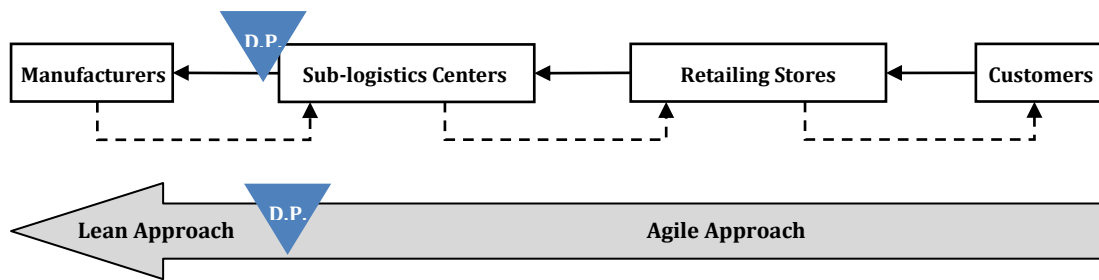


Figure 15: Implementation of Leagile Approach in Reverse Supply Chain by Gome

Upstream flows from the de-coupling point are managed with lean approach, where the demands are not as fluctuated as at the customers' side, and are much more easily to be predicted. Hence, the flows of returns from retailing stores to sub-logistics centers and the flows of spare parts from manufacturers to sub-logistics centers are consolidated before delivery, which are designed to achieve cost minimization through the economies of scale in transportation. Downstream flows from the de-coupling point are closed adhered to agile reverse supply chain, which enables Gome to realize the customer-orientation goals. In this part of reverse supply chain, Gome seeks to respond to customers' demand as soon as possible and control the processing time within 15 days, regardless of incurred costs.

Furthermore, Suning Appliance finds out from its experience that *'most of the returns for repair and maintenances are just simple problems and can be fixed without professionals and complicate equipments'*. (Meng, interview, 2011-05-20) Hence they has proposed a localization strategy over the commercial returns and established a large number of after-sales service points covering the whole country.

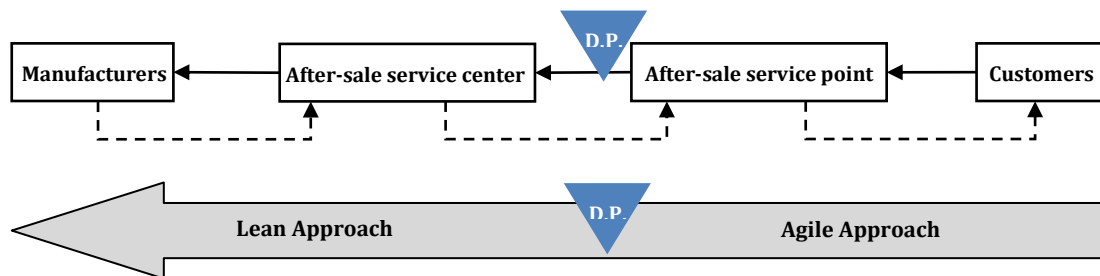


Figure 16: Implementation of Leagile Approach in reverse supply chain by Suning

According to the reverse supply chain process applied by Suning, it is also a leagile implementation with a de-coupling point introduced at the after-sale service point, as shown in figure 16. Under this structure, the established after-sales service points are equipped with specialists and machinery for simple repairing and maintenance tasks to fulfill a majority of commercial returns locally at the service points. It secures that Suning is able to deal with the product returns for refunded and exchanging within normally four hours, and 12 hours if the new product is out of stock. Additionally it also ensures that Suning can respond to the product returns from end-customers for repair and maintenance within 24 hours and complete the tasks within less than 2 days.

From the de-coupling point where the after-sale service points locate, an agile strategy is applied downstream to cope with the fluctuating customer demands and enhance the responsiveness to customers' needs. As in most cases, the commercial returns are exchanged and repaired at the service points, the lead time of recovery and customers waiting time in the reverse supply chain for repairing and maintenances have been reduced to a rather low level. In some special cases, a small portion of returns need to be sent back to the after-sales service center or even the original manufacturers. In order to maintain a high customer service level, Suning will send a new product to the customers instead of making them wait till the completion of reconditions. From the other side, this measure also enables the company to implement lean approach upstream from the de-coupling point, aiming to reduce the transportation costs and processing costs, and eventually keeping the balance between costs and services.

## 6 CONCLUSIONS

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*This chapter concludes the research findings of the thesis and exhibits the opinions and answers to the research questions.*

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With the purpose of this thesis being set as to investigate the application of lean, agile and leagile concepts in the reverse supply chain of companies engaged in the electronic industry, the study has been carried out towards addressing the research question which was formulated in the beginning of this work as:

*“How should companies select business strategies for the reverse supply chains to realize and maintain its efficiency and effectiveness?”*

To answer this research question, not only the feasibility of adopting lean, agile and leagile strategies in reverse supply chain needed to be explored, but under what circumstances each of the three strategies in question is preferable would be discussed. Besides, the scope of this study was delimited to the commercial returns of electronic products for refunding, exchanging, repair and maintenance.

With this in mind, a frame of reference was constructed where relevant definitions like reverse logistics and reverse supply chain were clarified and theories in existing literature were explained and compared in terms of different supply chain strategies. It has been pointed out that the selection of strategy is closely related to the characteristics of the products, e.g. demand predictability, product life cycle, etc. Moreover, centralized and decentralized reverse supply chains were contrasted, which paved the way for analyzing the business strategies in the context of a reverse supply chain.

Empirical data was then collected by conducting semi-structured interviews with two electronic retailers in China i.e. Gome Electrical Appliance Ltd. and Suning Appliance, which revealed their logistics system for commercial returns. The empirical findings, together with the theoretical framework constructed earlier, led to a further analysis on the chosen topic.

The data analysis revealed that in practice reverse supply chain is closely associated with ‘warranty service’ or ‘after-sales services’, which is actually considered as part of the customer services rather than within the logistics area. Criteria for strategy selection were then discussed. And the implementation of the lean, agile and leagile concepts in the two electronic appliance retailers were later analyzed.

When selecting the proper strategies, the nature and characteristics of the returns ought to be considered, including the market demand predictability, product life cycle, and replenishment lead time. When the product demand is predictable lean approach should be adopted no matter the lead time is short or long. With the combination of



unpredictable demands and short lead time, agile supply chain is called to be executed based on quick response. Where demand is unpredictable and lead time is long, the leagile strategy is integrated into the supply chain.

Based on the mentioned Christopher's matrix for strategy selection, agile supply chain is the most suitable one for the products with a short life cycle and short replenishment lead time, which features the analyzed commercial returns in the electronic industry. However, from the analysis on the reverse supply chain processes carried out by Gome and Suning, a leagile reverse supply chain is more possible to be applied in practice, which enables the retailing companies to reduce unnecessary transportation costs while at the same time achieve quick responsiveness to the customers' demands, and eventually to realize and maintain the efficiency and effectiveness of the whole supply chain.

# 7 FUTURE OUTLOOK

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*Ideas for possible future researches in the field of reverse supply chain management and strategies are suggested in this section.*

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Being a quite young topic, there are quite few researchers having been carried out to explore the specialized strategies for the management and controlling of the reverse supply chain. Current relevant researchers are revolved round the examination on the possibility to incorporate the forward supply chain strategies into the reverse supply chain. Future researches can be set in the area of exploration and investigation the tailored strategies for the reverse supply chain management.

Other possibilities of future researches also exist. For example as this thesis have emphasized only on the commercial returns, more studies of the lean, agile and leagile implementing in the reverse supply chain can be done with regards to the end-of-life products, end-of-use products and reusable products.

In addition, this thesis has been delimited in the electronic industry and the empirical study has been carried out about the Chinese electronic appliance retailing industry, the field of vision can be expanded to other industries, like automobile industry, paper industry and the like. Moreover, as only retailers have been analyzed here, other participants within the forward supply chains, i.e. suppliers, manufacturers, and distributors, can also be included into the horizon.

Last but not least, due to the limitation of this thesis, only reverse supply chain management has been studied. However, as the forward supply chain and reverse supply chain are actually closely related to each other, more studies regarding the management and strategy selection, for the forward supply chain and reverse supply chain as a whole, would also sparkle in this area.

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