Development of Reverse Logistics – Adaptability and Transferability

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Abstract

The increasing enforcement of take-back laws and the changing requirements of external environments, e.g. shorter lifecycle products, increasing customer demands, and growing electronic retailing and catalogues, have made both producers and distributors in the European industry face the challenges of managing returned and discarded products that relate to reverse logistics. In particular, manufacturers of electrical and electronic equipment have to perform the completely new tasks of collecting their products put on the market at the end-of-life and providing an appropriate recovery program at no charge. The return of products goes beyond the usual forward logistics and has some differences with logistical processes of supply chain management. The uncertainties regarding the quantity, quality, and timing of return flows present the complexities of reverse logistics management. Furthermore, there are many actors participating in the complicated processes of collecting, sorting, transporting, and recovering. Therefore, firms in the European electronics industry have adjusted their existing supply chain and adapted to reverse logistics to comply with the laws, satisfy customers, and minimize costs.

Previous studies on the topic the development of reverse logistics under strategic considerations have been limited and lacked theory-based answers. Therefore, this study attempts to trace the gap in the topic of reverse logistics development under strategic considerations and supply chain perspective with two main objectives:

1. investigating the adaptability to reverse logistics of firms in the European electronics industry and
2. analyzing the transferability of reverse logistics management models from European countries to other economies, especially in the case of the SR Vietnam.

This study investigates the adaptability to reverse logistics in the European electronics industry at firm and network level. Exploring the adaptability at firm level emphasizes the response of organizational related factors inside a firm to the changing requirements of external environments in the implementation of reverse logistics. Analyzing the adaptability at network level highlights the response of firms in coordination with supply chain partners for the implementation of reverse logistics. The empirical results show that both the external factor and the internal factor are significantly associated with performance of reverse logistics. They interactively promote the development of reverse logistics. The changes of resource commitments, strategy formulation, and internal capabilities of reverse logistics have significantly substantial effect on performance of reverse logistics. The strategic roles of firms in coordinating and governing network relationships, and developing network capabilities have also led to the cost-effectiveness and competitive advantages of the whole network in reverse logistics implementation.

The analysis of the transferability of reverse logistics demonstrates that returns management is being transferred to Vietnam to some extent. The globalization, the economic development, and the supports of information technology have made reverse logistics management models being borrowed and learned more quickly before they are acknowledged. In case of Vietnam, the external factors, e.g. the shortage of specific regulations, the lack of infrastructure and technology, the lower income, and the low public awareness have partly hindered firms from clarifying the status and roles of reverse logistics as well as developing a formal reverse logistics program.

This study makes some academic contributions towards enriching the applications of the organizational theories in the specialized field of reverse supply chain management. Moreover, this study also contributes to some managerial implications for producers, distributors, service providers, and policy makers to improve reverse logistics performance at both firm and network level.

Zusammenfassung

Die zunehmenden Regelungen bezüglich der Rücknahme von Altprodukten und die sich rasch ändernden Einflüsse aus der Umwelt des Unternehmens, wie z.B. kürzere Produktlebenszyklen, steigende Kundennachfragen und wachsender elektronischer Handel, stellen hohe Anforderungen an Hersteller und Händler in der europäischen Industrie hinsichtlich des Managements der Rückflüsse und der damit verbundenen Entsorgungslogistik. Insbesondere stehen die Hersteller von Elektro- und Elektronikgeräten damit vor ganz neuen Aufgaben, die Produkte am Ende der Nutzungsdauer kostenlos zurückzunehmen und einer angemessenen Verwertung zuzuführen. Die Rücknahme von Produkten geht über die übliche Versorgungslogistik hinaus und weist Unterschiede in den logistischen Prozessen des Supply Chain Managements auf. Die Unsicherheiten bei der Quantität, Qualität und dem Zeitpunkt des Rückflusses führen zu höherer Komplexität in der Entsorgungslogistik. Außerdem sind viele Akteure in den komplizierten Prozessen der Sammlung, der Sortierung, des Transports und der Aufarbeitung der Rückläufe eingebunden. Daher haben Unternehmen in der europäischen Elektronikindustrie ihre bestehende Lieferkette angeglichen und die Entsorgungslogistik angepasst, um die gesetzlichen Anforderungen zu erfüllen, Kunden zufrieden zu stellen, und Kosten zu minimieren.

Bisherige Studien zum Thema der Entwicklung der Entsorgungslogistik waren jedoch begrenzt und haben theoriebasierte Antworten gefehlt. Deshalb versucht diese Studie, die Forschungslücke des Themas “Entwicklung der Entsorgungslogistik“ unter strategischen Überlegungen und der Perspektive des Supply Chain Managements durch zwei wesentliche Ziele zu verfolgen:

1. Untersuchung der Anpassungsfähigkeit von Unternehmen hinsichtlich der Entsorgungslogistik in der europäischen Elektronikindustrie und
2. Analyse der Übertragbarkeit der Managementmodelle der Entsorgungslogistik europäischer Länder auf andere Volkswirtschaften, insbesondere auf die Volkswirtschaft der S.R. Vietnam

Diese Studie untersucht die Anpassungsfähigkeit an die Entsorgungslogistik in Europa auf der Unternehmensebene und der Netzwerkebene. Die Untersuchung der Anpassungsfähigkeit auf der Unternehmensebene betont die Reaktion von unternehmensinternen Variablen auf die sich schnell verändernde Umwelt des Unternehmens bei der Implementierung der Entsorgungslogistik. Die Analyse der Anpassungsfähigkeit auf der Netzwerkebene unterstreicht die Reaktion der Unternehmen in Abstimmung mit den Partnern in der Lieferkette zur Implementierung der Entsorgungslogistik. Die empirischen Ergebnisse zeigen, dass sowohl der externe Faktor als auch der interne Faktor mit der Leistung der Entsorgungslogistik signifikant verbunden sind. Die Änderungen der Ressourcenzuweisung, der Strategieformulierung und der Verbesserung der Fähigkeiten haben erheblichen Einfluss auf die Leistung der Entsorgungslogistik. Die strategischen Rollen der Firmen bei der Koordinierung und Beherrschung der Netzwerkbeziehungen, sowie der Entwicklung der Netzwerkfähigkeiten haben zur Kosteneffektivität und zu Wettbewerbsvorteilen für das gesamte Netzwerk der Entsorgungslogistik geführt.

Die Analysen der Diffusion der Entsorgungslogistik zeigen, dass die Rückführung wahrscheinlich bis zu einem gewissen Grad nach Vietnam übertragen werden kann. Aufgrund der Globalisierung und der wirtschaftlichen Entwicklung, können Managementmodelle der Entsorgungslogistik mit Hilfe der Informationstechnologie schneller erlernt und eingeführt werden. In Vietnam hindern externe Faktoren, wie z.B. der Mangel an spezifischen Regelungen, der Mangel an Infrastruktur und Technik, das niedrige Einkommen, und die geringe Sensibilisierung der Öffentlichkeit, die Unternehmen an der Klärung des Status und der Rolle der Entsorgungslogistik im Unternehmen und der Entwicklung eines formalen Programms zur Entwicklung der Entsorgungslogistik.

Diese Studie leistet einige wissenschaftliche Beiträge zur Bereicherung der Anwendungen der Organisationstheorien in dem Spezialgebiet des Reverse Supply Chain Management. Außerdem vermittelt die Studie auch Erkenntnisse für die Entscheidungen bei den Produzenten, den Händlern, Dienstleistern und den politischen Entscheidungsträgern, um die Entsorgungslogistik auf der Unternehmensebene und der Netzwerkebene zu gestalten.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

3PLPs	Third Party Logistics Providers
4PLPs	Fourth Party Logistics Providers
ACs	Air Conditioners
AMOS	Analysis of Moment Structure
AVE	Average Variance Extracted
B2B	Business to Business
B2C	Business to Customer
CBCEM	Covariance-based Structural Equation Modeling
CBOs	Community-based organizations
CE	Consumer Electronics
CLSC	Closed-loop Supply Chain
CO_2	Carbon Dioxide
CRM	Customer Relationship Management
CR	Composite Reliability
CRCs	Centralized Returns Centers
CRT	Cathode Ray Tube
CSR	Corporate Society Responsibility
CV Com	Cross-validated Communality
CV Red	Cross-validated Redundancy
DfE	Design for Environment
DfR	Design for Recycling
DVD	Digital Video Disc
EDI	Electronic Data Interchange
EEE	Electrical and Electronic Equipment
EFA	Exploratory Factor Analysis
ELVs	End-of-Life Vehicles
EoL	End-of-Life Product
EoU	End-of-Use product
EPR	Extended Producer Responsibility
ERL	Enterprise Reverse Logistics
ERP	Enterprise Resource Planning
EU	European Union
FRLP	Formal Reverse Logistics Program
GDP	Gross Domestic Product
GoF	Goodness-of-Fit
IT	Information Technology
IWS	Internet World Statistics
LCD	Liquid Crystal Display
LDA	Large Domestic Appliance
LISREL	Linear Structural Relations
LRHA	Law for Household Appliance Recycling
LSPs	Logistics Service Providers
LPUR	Law for Promotion of Effective Utilization of Resources
MI	Marker Indicator

MPs	Mobile phones
MS	Member State
NAO	Network Administration Organization
NGOs	Non-governmental Organizations
OC	Organizational capabilities
OEMs	Original Equipment Manufacturers
OLSC	Opened-loop Supply Chain
PAM	Product Acquisition Management
PC	People Committee
PC	Physical capabilities
PCs	Personal Computers
PLS	Partial Least Squares
PLS-PM	Partial Least Squares Path Modeling
PLS MGA	PLS-based Multi Group Analysis
POS	Point of Sales
PROs	Producer Responsibility Organizations
RBV	Resource-Based View
RC	Relational capabilities
RF	Recycling Fund
RFID	Radio Frequency Identification
RFs	Refrigerators
RL	Reverse Logistics
RLS	Reverse Logistics System
RLPs	Reverse Logistics Providers
RMA	Return Merchandise Authorization
RMF	Recycling Management Fund
RoHS	Restriction of the Use of Certain Hazardous Substances
RSC	Reverse Supply Chain
RSCM	Reverse Supply Chain Management
RV	Relational View
SCM	Supply Chain Management
sSCM	Sustainable Supply Chain Management
SDA	Small Domestic Appliance
SMEs	Small and Medium-sized Enterprises
SEM	Structural Equation Modeling
TCE	Transaction Cost Economics
TVs	Televisions
UEEE	Used Electronic and Electrical Equipment
WCM	Warranty Claim Management
WEEE	Waste of Electrical and Electronic Equipment
WMs	Washing Machines
WMS	Warehouse Management System
WDA	Waste Disposal Act

Note: *The abbreviation names of organizations and firms used in the dissertation are listed in the Appendix 9 with general information of their responsibilities, products, and websites.*

1. Introduction

This chapter provides an overview of this research work. Chapter 1.1 presents research problems and motivations. Chapter 1.2 discusses the information related to research objectives and research questions. Research approach and methodology is introduced in chapter 1.3. Chapter 1.4 explains the design of research work.

1.1. Research problems and motivations

1.1.1. Europe and reverse logistics

Over the last forty years, reverse logistics in Europe has passed a notable period of development from the viewpoints of both academic researchers and business practitioners. Reverse logistics is defined as the process of planning, implementing and controlling backward flows of raw materials, in-process inventory, packaging and finished goods, from a manufacturing, distribution or use point to a point of recovery or point of proper disposal.[1]The development of reverse logistics is closely related to the growing interests in environmental issues and the negative impacts of resource scarcity.

The origin of reverse logistics was partly attributed to the emergence of inexpensive materials and advanced technologies that had appeared in the Industrial Revolution in the 1800s.[2] The growth models in Western societies during this time were characterized by mass production and consumption with little concern in environmental problems. The negative effects of such practices did not become readily apparent until nearly a century later through environmental crisis and depletion of natural resources. Since then, there has been gradually greater concern for recycling and disposing secondary materials properly.[3] By the 1970s, the experts of the Club of Rome contended that there was a limit to the ongoing world growth trend without innovative alternatives in dealing with increasing population, industrialization, population, and resource scarcity.[4] Because of the increasing environmental challenges, there was a considerable shift in the thinking of development during the last quarter of the 20th century. The global concerns focused on reexamining the traditional model of development based on the logic of industrialism, reviving public interests in the uncertain future of the natural environment and nonrenewable resources, and reinforcing the attention on the question of sustainability.[5] The innovative changes initiated from the alternatives in the awareness of the whole society, the industry, and the government resulted in the emergence of a new concept coined "Sustainable Development." The sustainability approach seeks to combine the present industrial development with the requirements of future generations. In German academic literatures, the approach of sustainable development is presented based on the principle of responsibility, the principle of closed-loop economy, and the principle of cooperation.[6]

The principles of sustainability have influenced the formation and development of environmental policies and regulations in many countries since the 1970s, especially in Europe, where environmental and green awareness appears to be ahead of the rest of the world.[7] Since the 1980s, the protection of the natural environment due to the resource scarcity, the changes of societal awareness, and the resulting legal rules were some of the most important factors influencing the performance of firms.[8] The principle of closed-loop economy was developed in the root of waste prevention and recycling in the late 1980s in Germany with the Federal Act on Prevention and Disposal of Wastes. The main contents of this new legislation were the principle of extended producer responsibility towards the end-of-life products (EoL) and the partial reorganization of the responsibilities of waste with more possibilities for privatization in the collection, treatment, and

[1] See Revlog (2002), p. 2; Cf. also Rogers/Tibben-Lembke (1998), p. 17

[2] See Peterson (2005), p. 7-8

[3] See Brito/Dekker (2002), p. 1

[4] See Meadows/Donnela (1972), p. 6-9

[5] See Haque (1999), p. 204

[6] See Umweltbundesamt (1998), p. 3; Cf. also Hei/Scheicher-Tappeser (1998), p. 13; Ivisic (2002), p. 100

[7] See Rogers/Tibben-Lembke (1998), p. 150

[8] See Lemke (2004), p. 27

disposal of wastes.[9] It became one of the most important drivers at that time for the milestones of reverse logistics in Europe with the focus on product recovery and recycling for EoL products.[10] Extended producer responsibility (EPR) requires firms, which manufacture, import, and/or sell products to be financially and/or physically responsible for collecting and recovering their products after their useful life. The principle shifts the responsibilities for waste from government to private industries, obliging them to internalize waste management costs in their product prices. As part of closed-loop economy, many related legislative directives including packaging waste (Directive 99/31/EC), end-of-life vehicles (Directive 00/53/EC), and waste electrical and electronic equipment (WEEE Directives 02/96/EC and 02/95/EC) were adopted in Europe for achieving the objectives of this important principle. These Directives resulted in increasing legal, market, and financial pressures on firms' business performance in many industries in Europe.[11] Take-back, returns handling, test and sorting of discarded products for reuse, remanufacturing and recycling have posed new challenges to manufacturers, distributors, and logistics professionals, who had generally not been involved with these types of environmental issues in the past.[12] Responsibilities changing have made many companies steadily learn that by actively managing EoL products they can deal with the challenges regarding environmental concerns and regulatory enforcements, and likely obtain their economic goals. Therefore, the fields concerning logistics and operations of take-back and recovery of EoL products quickly became a new area of focus for both academics and practitioners. The terminology "Reverse Logistics" (RL) has been widely discussed in Europe since the mid-1990s. The development of reverse logistics in Europe can be briefly demonstrated in Figure 1 with three main periods.

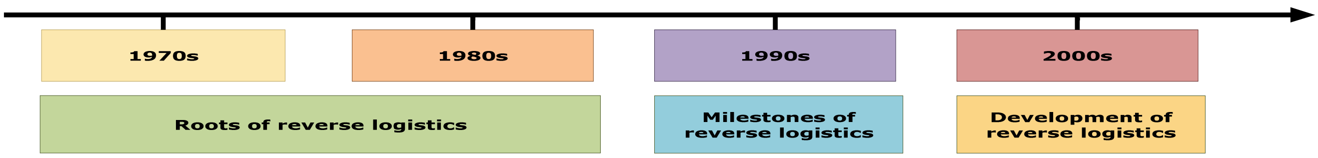

Figure 1 : Development periods of reverse logistics in Europe

Source: Own illustration

Reverse logistics has also roots in the marketing and business disciplines with its roles in after-sales customer services, repair and overhaul operations, and spare part services to increase customer satisfaction and improve profitability.[13] Since the 2000s, the growing customer power and the increased competition have required firms in many industries to take the initiatives in customer services, e.g. extended warranty, warranty returns, consumer returns due to buyers' remorse, and marketing returns because of unsold products, seasonal goods, and the need to reposition inventory. Manufacturers and their distributors have faced the challenges of managing returned and discarded products from their customers. Quick and efficient handling returned products is very critical in sustaining relationships with customers, creating repeat purchases, and reducing inventory cycle of products. Firms have also applied reverse logistics to clean out the distribution channel by removing unsold products or slow-moving items and make room for newer products. Stock rotation, therefore, has become a popular condition in distribution contracts between retailers and manufacturers.

However, dealing with reverse flows is riskier and more costly than moving product forward due to the complexity and uncertainty, the high initial investments, and potentially unprofitable business activities. Reverse logistics costs of EoL and customer returns management have become an important component in cost structure of the firms, which make up approximately 5% to 6% of total logistics costs in retail and manufacturing sectors,[14] and affect the profitability of firms directly with approximately 1.4% to 2% of total

[9] See Deubzer (2011), p. 22

[10] See Rogers/Tibben-Lembke (1998), p. 151

[11] See Maxwell/Vorst (2003), p. 883; Cf. also Arcadis and Eunomia (2008), p. 24

[12] See Haymon (2010), p. 1

[13] See Brito/Dekker (2002), p. 1; Cf. also Mollenkopf/ Russo/Frankel (2007), p. 570; Ciliberti/Pontrandolfo/ Scozzi (2008), p. 16

[14] See Minahan (1998), p. 111-112; Cf. also Daugherty et al. (2001), p. 107

cost.[15] At the beginning of 1990s, reverse logistics was not in practice a major part of firms' business because it has not been the key supply chain driver to create the differentiation and cost reduction, except some cases of large and multinational companies.[16] Most of the companies perceived reverse logistics as a cost center instead of a profit center, suggesting that it was a neglected area and not managed strategically. However, because of the legal pressures, the economic incentives, and the fast changing requirements of environments, 60% of the manufacturers and retailers in a 2008 survey in Europe stated that effective reverse logistics management is very important for overall company performance.[17] The effective management of reverse flows can save as much as 10% from total logistics costs of firms and improving reverse logistics capabilities can increase earnings by as much as 5%.[18] Nowadays, many manufacturers and retailers have recognized the impacts of returned and discarded products, and regarded reverse logistics management as an investment recovery strategy and as a way of reducing their operating costs,[19] indicating the development of reverse logistics.

In the European electronics industry, the Europe Directives on WEEE (2002/96/EC) and on the Restriction of the Use of Certain Hazardous Substances (RoHS) in electrical and electronic equipment(2002/95/EC) adopted in 2003 are the most likely key drivers behind all reverse logistics operations for EoL management since the onset of the new millennium. However, economic and supply chain issues in the electronics industry are today becoming more important in the fast-transformed market. For example, the rapid technological advances, the growth of the internet and online shopping, the increasing customer demands, and growing multichannel retailers have made the sales structure of the electronics firms more complicated and resulted in the increase in customer returns. Therefore, many companies have steadily adjusted the existing supply chain to adapt to reverse logistics, which helps them more effectively resolve the issues related to reverse flows, e.g. law compliance, corporate social responsibility, customer satisfaction, and efficiency of integrated supply chain. They have been more proactively focused on returns management by developing product recovery strategies, formalizing more liberalized returns policies, designing cost-effective reverse logistics networks, strengthening cross-functional integration, and increasing collaboration with supply chain partners to manage different kinds of reverse flows,[20] indicating the organizational adaptive capabilities to reverse logistics in practices.

Moreover, the changing environments, especially the intensified collaboration and the development of dynamic networks for collecting, sorting, and recovering product returns, indicate that a network-level thinking in reverse logistics operations is also becoming a more important factor for the development of reverse logistics in Europe. The increased collaboration with supply chain partners, e.g. suppliers, distributors, and logistics service providers, help firms avoid returns, solve arising problems related to returns management, maximize asset recovery, and improve profitability. Moreover, it has also created opportunities for firms to delegate the implementation of reverse logistics to external third party service providers, therefore increasing the adaptability to reverse logistics.[21]

Identifying important factors driving and facilitating the implementation of reverse logistics and evaluating the influence of the factors' interaction on the development can support this study in exploring how reverse logistics in Europe evolves and how companies react and adapt to the requirements of external environments under strategic considerations. By examining the trend of outsourcing and collaboration in reverse logistics operations, this study may explain how inter-organizational reverse logistics networks are developed, how they are governed and coordinated, and how the collective outcomes can be achieved. The factors influen-

[15] See Ivisic (2002), p.2; Cf. also UK Department of Transport (2004), p. 4

[16] See Herold (2007), p. 68, 180 & 200

[17] See Verweij et al. (2008), p. 40; Cf.also Greve (2011), p.8

[18] See Minahan (1998), p. 111; Cf. also Daugherty/Myers/Richey (2002), p. 82; Cf. also Greve (2011), p. 6

[19] See Marien (1998), p. 44; Cf. also Taylor/Dowlatshahi (2010), p. 1364

[20] See UK Department of Transport (2004), p. 17; Cf. also Verstrepen et al. (2007), p. 310 – 311; Mollenkopf et al. (2007),p. 580; Krikke/Zuidwijk (2008), p. 1207; Janse et al. (2009), p. 8; Mollenkopf et al. (2011), p. 391; Bernon et al. (2011), p. 484

[21] See Krikke (1998), p. 3-4; Cf. also Walther/Spengler (2004), p. 363; UK Department of Transport (2004), p. 5; Winkler/Kaluza/Schemitsch (2006), p. 9; Janse et al. (2009), p. 6

cing the performance of reverse logistics, the adjustments to reverse logistics at firm level, and the increasing inter-organizational collaboration for reverse logistics operations have directed us to explore the adaptability to reverse logistics in Europe over the last decade. The development of reverse logistics in Europe in this study is analyzed in the perspective of supply chain management and under strategic considerations by exploring the adaptability to reverse logistics at both firm level and network level. The European electronics industry is an ideal subject for this study, due to not only its intrinsic economic important to Europe but also a key sector in the relevance to closed-loop supply chains for value added recovery.

1.1.2. Vietnam and reverse logistics

Vietnam, with a population of nearly 90 million, has been growing both demographically and economically over the last decade. The country's gross domestic product (GDP) growth has reached around 7% over the last decade, which surpasses that of many countries in the region. Vietnam moved from the group of poor countries to the one of average income with GDP per capita of nearly $1,400.[22] Moreover, Vietnam has a young, literate, highly motivated, and intensively brand-aware population. A thriving private consumer market making up around two-third of the total GDP indicates an increase in consumption of goods ported by the rising incomes. Over 30% of the population living in cities, the increasing disposable income, and greater exposure to new lifestyle trends have resulted in increased retail demand, which topped almost $65 billion in 2009 and nearly tripled to that in 2004.[23] The trend of urbanization and increasing consumption in Vietnam has meant the increasing amount of discarded products and waste.[24] The conflict between economic growth and environmental issues has been a challenge for Vietnam in the process of development for recent years.

The concept of reverse logistics is still relatively new for both academic researchers and business practitioners in Vietnam because little value is attributed to customer services and environmental issues seem to be less important in business management. Reverse logistics or returns management process is commonly not a major component of firms' business, especially in Vietnam where 97% of companies have small and medium size (SMEs). However, reverse logistics has informally operated in practical business to increase sales and satisfy customer demands to some extent. Many firms concentrate primarily on the management of returns from consumers in warranty period, but they are lacking profound awareness of reverse logistics.[25]

In Vietnam, reverse logistics is also reviewed in the aspect of environmental issues by its roles in informal collecting and recycling system of EoL products, particularly with packaging waste, waste paper, and used electronic and electrical equipment. Vietnam has recovered recyclable wastes informally for decades with the involvement of different partners such as households, junk buyers, waste pickers, service/secondhand shops, scrap dealers, craft villages, and recycling plants. However, the system has caused risks for environment, bad influences on public health, and waste of recyclable materials. Due to economic growth, fast urbanization, and increasing income, the system has gradually transformed to municipal system of waste management, especially in urban areas.[26] However, the municipal system of urban environment companies handles practically only a minor fraction of the potential discarded products generated by industries, shops, institutions, and households.[27] The existence of social groups associated with waste work, the lack of public awareness, and the shortage of infrastructure and technology are challenges for developing a formal reverse logistics system for management of EoL products. Consequently, EoL management is being operated in Vietnam with a mix of municipal system, private enterprises, and informal sectors, in which the application of reverse logistics is at the infant stage.

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[22] See GSO (2011), p. 8-15; Cf. also CIA Factbook (2011a)

[23] See Dang et al. (2010), p. 4-8

[24] See MONRE (2004), p. 6-12

[25] See Pfohl/Ha (2011), p. 2-3

[26] See Furedy (1994), p. 6-8

[27] See Quang (2008), p. 24

Reverse logistics is just at the beginning stage in most industry sectors in Vietnam. However, the increasing consumption of electronic products, the changing business to customer orientation, the growing amount of discarded products, and likely the increasing enforcement of laws related to the EoL products have motivated companies in this industry to pay more attention to the management of reverse flows. To date, there has not officially been an academic research in Vietnam on reverse logistics because public awareness, environmental legislations, and the infrastructure have been still insufficient. Quang (2008) implemented his research on assessment of the recycling system for home appliances in Vietnam. MONRE (2008a) conducted a cross-sectional survey with producers and importers to build a reverse logistics management model for collecting and recycling used battery and accumulator.[28] Therefore, the second motivation of this study aims at exploring the current practices of reverse logistics management in the Vietnam electronics industry and the transferability of reverse logistics management models from European countries to Vietnam.

1.2. Research objectives and research questions

By scanning related literatures and observations of reverse logistics practices in both European countries and Vietnam, some implications were found to be significant to the direction of the study on development of reverse logistics:

- In our view, the development of reverse logistics under strategic considerations is firstly observed through the adaptability of firms to reverse logistics and secondly through the capability of diffusion of reverse logistics management models.
- In Europe, reverse logistics has grown to a significant business sector over the last decade and it has received more attention from academics over the last decade. However, it is still a young field and appears to be a growing topic of supply chain management for both academics and practitioners.[29] Additionally, studies on reverse logistics have been lacking strategic aspects and theory-based answers to underpin managerial implications.[30] Reviewing of existing literatures also shows that only few researches have addressed a holistic approach of evaluating the factors influencing reverse logistics development and the adaptability to reverse logistics at firm level as well as at network-level. Therefore, this study directs its findings to provide more insights in investigating the development of reverse logistics that in part satisfy this need.
- In Vietnam, there is a strong need to have a concrete understanding of current practices of reverse logistics management at network and firm level. It is necessary to extract the contextual differences of Vietnam to assess the opportunities and challenges for the implementation of reverse logistics. The evaluation of the likelihood of adopting a formal reverse logistics program is also essential to analyze the transferability and suggest solutions suitable for the country.

Therefore, this study is conducted with a twofold objective. The first objective is to investigate the adaptability to reverse logistics in Europe, especially in the European electronics industry**.** The development of reverse logistics is explored in Europe under the viewpoint of the adaptability to reverse logistics at both firm level and network level. This objective can be specified by answering three concrete research questions:

- ***How are external and internal factors influencing the development of reverse logistics in Europe?***

There are many external and internal factors influencing the establishment and implementation of reverse logistics over the last decades in Europe. The presence of different factors in internal and external environment can become barriers or facilitators for reverse logistics operations. The outcomes in the implementation of reverse logistics at both firm level and network level (e.g. improved customer satisfaction, increased volume of discarded product collected and recovered, and cost reductions of logistics and treatment) have partly indicated that there are more factors driving and supporting the development of reverse logistics in Europe.[31] This research question aims at investigating the adaptability to reverse logistics in terms of the

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[28] See MONRE (2008a), p. 79-85

[29] See Brito (2003), p. 29-30; Cf. also Mollenkopf et al. (2007), p. 569; Taylor/Dowlatshahi (2010), p. 1363

[30] See Rubio/Charmoro (2008) , p. 21

[31] See Carter/Ellram (1998), p. 91-97; Cf. also Roger/Tibben-Lembke (1999), p. 48; Ivisic (2002), p. 244; Verweij et al. (2008), p. 82; Zoeteaman et al. (2010), p. 420; Kapetanopoulou/Tagaras (2010), p. 92

relations among the changing requirements of external environments (external factors), the organizational adaptive capabilities (organizational related factors or internal factors), and RL performance. Critical factors motivating and influencing the development of reverse logistics from both external and internal environment should be determined. The effect size of these factors and their interaction on the performance of reverse logistics are also examined to evaluate the adaptability to reverse logistics.

- ***How does a firm adapt to managing reverse logistics at firm level?*** This question analyzes the development of reverse logistics under strategic considerations by exploring the influences of organizational adaptive capabilities on reverse logistics performance at firm level. The adaptability to reverse logistics emphasizes the influence of organizational related factors such as the commitments and allocations of resource, the formulation of strategy, the formalization of returns policies, and the development of internal capabilities on RL performance. The analysis of adaptability at firm level focuses on investigating the degree to which a firm commits, allocates, and uses a variety of company resources to formulate strategy, align liberalized returns policies, and develop RL capabilities to obtain the effectiveness and efficiency of RL performance.
- ***How do firms adapt to reverse logistics at network level?*** The adaptability to reverse logistics has occurred not only at firm level but also at network level. The stricter take-back laws, the fast-changing environments, the requirements of substantial investments, and the complexity of reverse flows have led to the increased outsourcing of reverse logistics services to third parties. The increased outsourcing and collaboration in reverse logistics operations has brought in many different actors and stimulated the development of specialized networks for collecting, sorting, transporting, and recovering product returns. The concept of adaptability to reverse logistics at network level in this study emphasizes the capabilities of coordinating with supply chain partners, governing network relationships, combining network resources, developing network capabilities. These capabilities support firms in the network in obtaining cost-effectiveness and competitive advantages to respond to changing requirements of external environments.

The second objective is to analyze the transferability of reverse logistics models from European countries to Vietnam with three main questions:

- ***What are contextual differences in Vietnam and their influences on the transferability of reverse logistics management models at network level?*** The differences of legislation, economic development, infrastructure and technology, and public awareness are determined to have important impacts on the transferability and the implementation of reverse logistics in Vietnam. The analysis of transferability is conducted by identifying opportunities and challenges, looking for a similar context, and making comparison to look for the relevance and the potentials of transferring reverse logistics management models.
- ***How is the acceptability of implementing of a formal reverse logistics program at firm level in the Vietnam electronics industry?*** The transferability of reverse logistics to Vietnam is also explored at firm level because firms play the important role in implementing reverse logistics management to comply with the laws and satisfy customer demands. Furthermore, the current practices of reverse logistics management at firm level demonstrate the barriers, the drivers, and the acceptability to conduct a formal reverse logistics program, suggesting the transferability of reverse logistics.
- ***Which aspects of reverse logistics management models should be transferred to Vietnam?*** There are many opportunities for Vietnam to select different reverse logistics management models from the practices of European countries to transfer and implement because reverse logistics has been in its embryonic stage of development. For the successful transferability of reverse logistics to Vietnam, it is necessary to select an appropriate model and modify it for the implementation in Vietnam due to the contextual differences. At firm level, a model of decision-making process for identifying external motivations and internal supports, and a reference model of a formal RL program are suggested based on the theoretical models developed for firms in the Europe electronics industry. At network level, the transplantation of EPR-based policy with specific take-back regulations, and the transfer of PRO-based model are proposed for the case of Vietnam with some important modifications. Some solutions are recommended related to developing a sufficient framework of legislation, improving public awareness, supporting policies, enhancing the infrastructures,

facilities, and technologies for reverse logistics operations, and strengthening the collaboration between supply chain partners for effective implementation of RL models.

1.3. Research approach and methodology

1.3.1. General research approach

The general research approach of this study follows Ulrich's (1981) and Lee and Lings' (2008) suggestions of regarding management and business studies as belonging to the applied science field. While pure or fundamental research directs to explaining the existing reality with general theories and rules, the objective of applied science is a conceptual nature and aims at creating new models for dealing with reality as well as contributing to theory.[32] Research in the applied sciences field lies in the area of practice and is measured according to its utility for practice. Following this perspective, the main research object of this study focuses on analyzing the development of reverse logistics in different contexts from European countries to Vietnam. In Europe, this study contributes to developing theoretical and conceptual models to identifying influential factors and adaptability to reverse logistics in the European electronics industry at firm and network level. In Vietnam, this study develops the framework of analyzing the practices of reverse logistics implementation and the transferability of formal RL management models from Europe countries to developing countries like Vietnam. The main object of this research is limited to the domain of firms in the electronics industry. For the first research objective, the domain covers producers and distributors making business in the European electronics industry as well as their service providers of RL operations. For the second research objective of exploring transferability, the domain ranges from firms in the Vietnam electronics industry to consumers in Vietnam electronics market.

As observed in many studies on reverse supply chain management concerning strategic issues, qualitative methodologies with case study, conceptual description, and literature review are frequently employed.[33] Some studies on reverse logistics combined both qualitative and quantitative research methodologies at the same time. However, case study has been used as the most popular methodology since the 1990s because reverse logistics is still a young research field. Only less than 5% of reverse logistics articles published between 1995 and 2005 used a survey methodology.[34] Since the late 2000s, there have been more studies using quantitative method with survey to explore the research problems of reverse logistics.[35] In this study, the approach of exploratory and confirmatory research with both quantitative and qualitative assessment is combined to investigate research questions.

According to Hair et al. (2006), exploratory studies are those, which define possible relationships in only the most general form and then allow multivariate techniques to estimate a relationship(s). In exploratory research, the researcher is not looking to "confirm" any relationships specified prior to the analysis, but instead allows the method and the data to define the nature of the relationships. Exploratory research is known as descriptive statistics with inductive reasoning that may be either experimental or observational. However, it is often based on secondary research of reviewing available literature and qualitative approaches such as informal discussions with consumers, employees, managers, or competitors, and formal approaches through interviews, focus groups, and case studies. Exploratory research is used when the topic or issue is new and when data is difficult to collect. The objective of exploratory research is to gather preliminary information that will help gain new insights, from which new hypotheses are developed.[36]

Confirmatory research proceeds from a series of alternatives and priori hypotheses concerning some topics of interest. It is followed by the development of a research design (often experimental) to test (confirm) those hypotheses. Confirmatory research is known as inferential statistics with deductive reasoning that includes

[32] See Ulrich (1981), p. 1; Cf. also Lee/Lings (2008), p. 10

[33] See Rubio/Charmoro (2007), p. 1109

[34] See Janse (2008), p. 4

[35] See Alvarez-Gil et al. (2007), p. 467; Cf. also Verstrepen et al. (2007), p.45-67; Janse et al. (2009), p. 497; Erol et al. (2010), p. 43

[36] See Babbie (1989), p. 67-70

gathering data, analyzing data, and ending with the researcher's inductive reference.[37] The fields of reverse logistics in Europe are growing fast, thus, it is necessary to structure theoretical models investigating influential factors and the adaptability of firms to reverse logistics based on literature review, and then examine by empirical results of survey.

We use three general methodological approaches of deductive and inductive reasoning, and arguments by analogy to make a logical reasoning process for the overall research work. For analyzing the development of reverse logistics in Europe, this study combines confirmatory and exploratory research approach to investigate the research questions. For exploring the adaptability to reverses logistics at firm level, this study biases toward a confirmatory research with deductive logic of explanation because deductive reasoning works from the more general to the more specific and conclusions follows logically from premises. Based on the existing theory and literatures, we develop hypotheses and theoretical models regarding the adaptability to reverse logistics at firm level. We design a research strategy to gather related data and test the hypotheses. For examining the adaptability to reverse logistics at network level, this study uses exploratory research with inductive reasoning to develop a conceptual model and formulate propositions through content analysis of published case study. However, it is not quite simple as the common definition and boundary of deductive and inductive reasoning. As in most real-world research contexts, induction and deduction tend be linked together in investigating the adaptability to reverse logistics in the European electronics industry.[38]

For analyzing the transferability of reverse logistics to Vietnam, we adopt the approach of exploratory research with inductive reasoning and arguments by analogy. Inductive reasoning is recommended for studies where the objective is to improve understanding of a phenomenon with limited previous research.[39] The logic of inductive approach includes the process of building and generalizing theories or conclusions from the analysis of collected data.[40] Inductive reasoning in this study generalizes the explanations based on the empirical results of conducting exploratory case studies with firms and a cross-sectional survey with customers. An argument by analogy occurs whenever one makes a comparison of two or more things and concludes, because of the similarity of the things compared, and because one of the things has a certain characteristic, then the other thing(s) has this characteristic too. An argument by analogy is applied when this study makes a comparison between Vietnam and selected countries for exploring contextual similarities and differences to evaluate the transferability of reverse logistics.

In general, a mixed methodology is adopted in this research. It consists of content analysis of literature review, survey approach, case study method, and participant observations. Figure 2 presents the research activities with the logical steps and the research methodologies to explore the research objectives. It may be referred to triangulation method, which uses literature review and observations as the fundamentals for empirical researches conducted through survey and case study to explore research questions. Triangulation approach may be applied to not only examine the same phenomenon from multiple perspectives but also enrich our understanding by allowing new or deeper dimensions to emerge.[41]

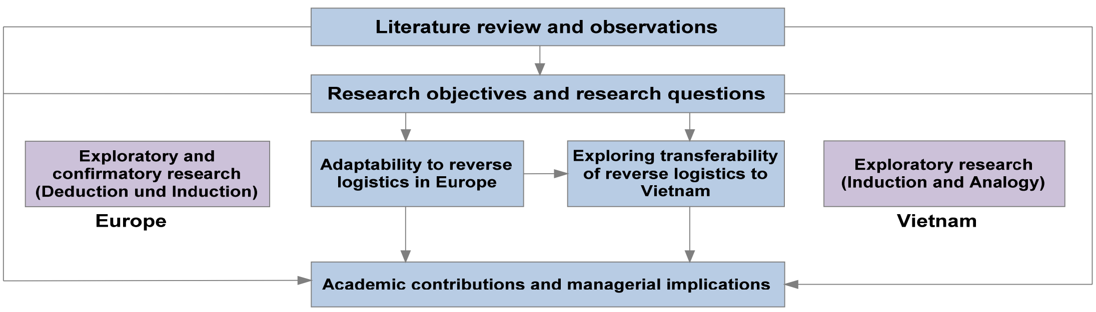

Figure 2: Overview of research methodology

[37] See Jaeger/Halliday (1998), p. 64

[38] See Lee/Lings (2008), p. 10

[39] See Dubois/Gadde (2002), p. 554

[40] See Saunders/Lewis/Thornhill (2009), p. 65

[41] See Jick (1979), p. 3

1.3.2. Content analysis

The research process started with collecting data broadly from literature review and observations as a method to increase validity and reliability in qualitative and quantitative studies.[42] The data and information related to factors influencing reverse logistics, the current practices of reverse logistics operations, and the adaptability to reverse logistics over the last decade were examined. The documents concerning the current development of Vietnam as well as the preconditions for developing reverse logistics were also explored from both local and overseas sources. In order to search the related documents, we used some main key words such as Reverse Logistics, Returns Management, Reverse Supply Chain, Closed-Loop Supply Chain, Developments of Reverse Logistics, Product Recovery, Remanufacturing, Recycling, Waste Logistics, and EoL Management. We found 1259 results related to the contents of reverse logistics field with different journals such as European Journal of Operation Research, International Journal of Physical Distribution and Logistics Management, International Journal of Logistics Management, Industrial Marketing Management, and International Journal of Production and Economics. According to the summary of literature review in this research, 12 books, 15 conference proceedings, and 173 articles were published related to our research topic to some extent. It means that reverse logistics has gradually become consolidated with the growing appearance of research papers on the topic. Relating to the concrete research topic of the development of reverse logistics, we discovered 119 related results; however, only a few of them had clear and profound contents to the research. The phrase "Development of Reverse Logistics" is used in relevant papers but has not been studied in detail in some aspects, especially for the adaptability and transferability. In case of documents related to reverse logistics in Vietnam, there are less than 20 articles related to the topics such as concepts and understanding of reverse logistics, informal collecting system, recycling networks, and current waste management.

This study adopted content analysis of scientific literatures of surveys and case studies to explore the practices of reverse logistics management at both firm level and network level. Content analysis is an observational research method that is used to systematically evaluate the symbolic content of all forms of recorded communication. This method also helps to identify the literature in terms of various forms, thereby creating a realm of research opportunities.[43] Content analysis has been used popularly in analyzing different research topics related to logistics.[44] This study applied content analysis because it is a transparent research method that may be applied to a wide variety of unstructured information.

1.3.3. Survey method

Survey method is also employed to understand the current practices of reverse logistics and to test and validate the theoretical models through empirical results. Reverse logistics has been still regarded as a growing scientific field that falls short of empirical research, especially survey method. Still, survey methodology is proved a valuable research tool to approach several layers of the extended supply chain.[45]

- Sample design

An internet-based survey was conducted in this study with the target population of two specific actors in reverse supply chain including producers and distributors to investigate the adaptability to reverse logistics in Europe. For obtaining a more profound understanding of changes and adaptabilities to reverse logistics, the electronics industry was selected for this study due to the combination of huge market volume, short product life cycles, and a potential of repair processes, which results in a large potential supply for reverse logistics.[46] However, the study focused on exploring the level of adaptability to reverse logistics mainly with manufacturers and retailers that have medium and large business size because large organizations may be more likely than small ones to have well-structured reverse logistics management.

[42] See Hall/Rist (1999), p. 293
[43] See Jayant/Gupta (2012), 87
[44] See Brito et al. (2003), p. 3; Cf. also Gold et al. (2010), p.232; Wong/Karia (2010), p. 51
[45] See Verstrepen et al. (2007), p. 304-305
[46] See Fleischmann/Nunen/Grave/Gapp (2004), p. 4-5

DIGITALEUROPE - the pre-eminent advocacy group of the European digital economy acting on behalf of the information technology, consumer electronics, and telecommunications sectors - provided the population base for the survey. The group’s members include 57 leading corporations and 37 national trade associations from across Europe, altogether 10,000 companies with 2 million employees and 1,000 billion Euros in revenues.[47] A mailing list of 850 members of DIGITALEUROPE was collected through the website and the related member associations as sampling frame, from which a random sample of 650 companies was selected by a random quota sampling method.

- Questionnaire and Data collection

Depending on a wide comprehensive review of the literatures and field interviews with some professionals, managers, and consultants, a questionnaire for survey in Europe was shaped. The content and structure of survey questionnaire was discussed with four academics and three practitioners who reviewed and gave comments for the improvement. Some adjustments were done with the questionnaire before posting online and mailing it. The questionnaire consists of 5 main parts (See Appendix 6): (1) General information of reverse logistics management (reason of returns, implementation time of a formal reverse logistics program, and drivers); (2) Influential factors (external factors, internal factors); (3) Adaptability (returns policy, resource commitments, strategy formulation, capabilities, and performance); (4) Outsourcing (services outsourced, decision factors); (5) Company information (location, turnover, and employee). The questionnaire was mailed to departments responsible for sustainability issues, marketing, sales, and logistics because they are assumed to be most aware of reverse flows and returns management. We conducted the survey in three phases, in which the online ones was firstly posted and then mailed by online survey service. Reminder mailings for each phase were sent two times: once after two weeks and again after four weeks, both times with some information about the first result. The information and response rates in each phase are presented in Figure 3.

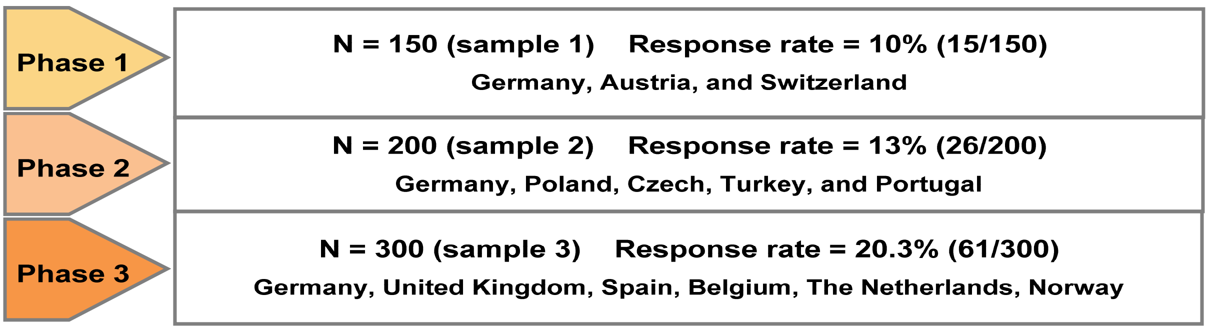

Figure 3: Survey results with three phases

Online survey is increasing rapidly in use because of many advantages such as multimedia diversification, e.g. picture, audio, and video; real-time statistical compilation; elimination of time constraints for panelists; improved quality of final data due to convenience for panelist; and lower cost than other surveys. However, it is also reported that online surveys have lower overall response rates than onsite surveys. Wright (2005) suggests response rates of only slightly than 10% being common because online questionnaires can be easily ignored and deleted at the touch of a button so getting a reasonable response rate can be challenging,[48] especially with a sensitive topic like reverse logistics.

For understanding public awareness in Vietnam, especially for consumer behavior of discarding and returning products, a cross-sectional survey collecting data to make inferences about a population of interest at one point in time was conducted (See Appendix 7).[49]This study conducted the survey with 181 households by semi-structured interviews in Hanoi and two provinces in northern Vietnam during a two-month field trip. Given the difficulties of getting households to agree to be interviewed, the sample was an opportunistic one,

[47] See DIGITALEUROPE (2010), p. 1

[48] See Wright (2005), p. 2

[49] See Abramson/Abramson (2000), p. 2

with the ones drawn from among people who already knew us and were willing to join. Most of the households selected have an average of four persons and belong to middle or high income group in urban (60.2%) and rural (39.8%) area because only families that possess many electronic products could more easily reply to the related questions. Because of the limited size of the sample population, the result might have limited representativeness for the general situation. However, some semi-structured interviews implemented with open circumstances allowed for focused, conversational, and two-way communication, which made the households expressed their opinions of environmental issues, their disposal behavior of discarded products, and their comments of firms' returns policies.

1.3.4. Case study method

A case study is an empirical inquiry that investigates a contemporary phenomenon within its real life context, when more than one source of evidence is used, and when the investigator has little control over events.[50] Case study is normally used to explore new processes and behaviors.[51] Case study method was conducted in this study to explore the likelihood of adoption of implementing a formal reverse logistics program at a firm level in Vietnam because reverse logistics has just been at the beginning stage in most industry sectors, and the concepts as well as the applications of reverse logistics in practice have been informal with firms. Case study, a particular individual program or event, was used in this study in an effort to understand more about a little known or poorly understood situation of practices of returns management at firm level. We contacted ten companies in the Vietnam electronics industry to schedule the visits and interviews with managers about their returns management. However, only four companies agreed to participate in our interviews. The rest of the companies refused because of no management attention to returned products and a very low returns rate. The interviews focused on issues related to specific practices of reverse logistics including their awareness of the related laws, their understanding of reverse logistics, their formalization of returns policies, drivers and barriers for the implementation of reverse logistics, and their practical operations of returns management.

1.4. Research design

We determined two main objectives of this study concerning the adaptability to reverse logistics in Europe and the transferability of reverse logistics to Vietnam with six research questions. As this study reviews the development of reverse logistics in the perspective of supply chain and under strategic considerations, some set of topics matching with these objectives were selected to conduct the research as follows:

- Part 1: Adaptability to Reverse Logistics in Europe
- Part 2: Transferability of Reverse Logistics to Vietnam
- Part 3: Conclusions and Recommendations

Apart from the acknowledgement, the abstract, and the introduction, this study is carried out in three main parts with eight chapters. A sketch map of research design is shown in Figure 4.

Part 1: Adaptability to Reverse Logistics in Europe

In chapter 2, the development fundamentals of reverse logistics are analyzed to make foundation for the next chapters. We define a closed-loop economy as a fundamental for reverse logistics development in Europe in the aspects of environmental concerns and sustainable development. The evolution of logistics from physical distribution, cross-divisional function, and integrated logistics has also motivated the development of logistics as subsystem of logistics with cross-functional natures and process management. The collaborative approach of supply chain management with sustainability has also renewed the roles of reverse logistics in reverse supply chain management. By analyzing the development fundamentals of reverse logistics, we clarify the concepts and boundaries of reverse logistics in different angles. The interfaces of reverse logistics with waste management, green logistics, and forward logistics are also explored. This chapter also gives a

[50] See Yin (1994), p. 25

[51] See Hartley (1994), p. 13

general overview of the electronics industry with some practical figures, main characteristics, and their impacts on the development reverse logistics in Europe.

Chapter 3 aims at building theoretical foundations for analyzing the adaptability to reverse logistics in Europe. We start with framing a potential theoretical foundation. The theory of social development is analyzed as the theoretical base for the analysis of reverse logistics development. Institutional theory and the resource-based view are used as theoretical background for analyzing the adaptability to reverse logistics at firm level. We also define some key terms including adaptability, strategy formulation of reverse logistics, and reverse logistics performance, which relate to analyzing the adaptability to reverse logistics at firm level. Developing theoretical background for the adaptability to reverse logistics at network level is also explained with the support of the transaction cost economics, the relational view, and the network-level approach. The conceptual model of adaptability at network level is also developed in this chapter.

Chapter 4 reviews the literatures studying factors influencing the establishment and implementation of reverse logistics over the last twenty years. Laws and regulations, awareness and demand of customers, globalization, information technology, and collaboration among supply chain partners are extracted from many studies as some of the most important external factors driving and facilitating the development of reverse logistics in Europe. Internal factors including company policies, top management support, and availability of resources have also contributed significantly to more strategic focus on reverse logistics management and improving RL performance. We develop the first theoretical model with the hypotheses related to the influences of these factors and their interaction on performance of reverse logistics. The empirical study through the internet-based survey is used to explore the effect size of these factors as well as their interaction on performance of reverse logistics. Mediation effect with bootstrapping method demonstrates the effect size and the importance of external and internal factors on the development of reverse logistics. Moderated mediation effect with four controlling variables is also investigated to determine the adaptability to reverse logistics in different contexts.

In chapter 5, a content analysis of twenty four published case studies in the European electronics industry discusses some changes of awareness, involvement, and strategy in the implementation of reverse logistics at firm level over the last decades**.** This chapter evaluates the adaptability to reverse logistics by analyzing the influences of organizational adaptive capabilities on RL performance through developing the second theoretical model. This model investigates the effects of allocating resources, formulating reverse logistics strategy, and developing internal capabilities on reverse logistics performance. The level of current adaptability to reverse logistics is also investigated through analyzing the mediation effect of resource commitments through formulating a RL strategy and developing RL capabilities on RL performance. The empirical study obtained from internet-based survey is analyzed through with Partial Least Square Path Modeling.

Chapter 6 evaluates the adaptability to reverse logistics at network level by analyzing the practices of outsourcing in reverse logistics. The increased outsourcing of reverse logistics to third party service providers and the intensified collaboration between supply chain partners for the implementation of reverse logistics, especially for EoL management, are addressed. We identify and analyze inter-organizational reverse logistics networks developed in the implementation of reverse logistics over the last decade. The organizational types of these networks are also discussed to some extent. This chapter focuses on analyzing strategic networks with the role of hub firms to investigate the capabilities of coordinating with network members, governing network relationships, bundling network resources, and developing network capabilities to achieve network outcome and competitive advantages for reverse logistics implementation in the European electronics industry.

Part 2: Transferability of Reverse Logistics to Vietnam

Chapter 7 analyzes the current context, the opportunities, and the challenges for the implementation of reverse logistics in Vietnam at network-level, which makes the fundamentals for analyzing the transferability of reverse logistics and finding solutions for the implementation. This chapter develops the framework of transferability with concepts, typologies, and analysis methodology. Factors influencing the transferability of reverse logistics to Vietnam and the model of identifying contextual differences are also determined. Data collection and analysis methodology for seeking similarities and identifying differences are also provided in this chapter. Contextual similarities are investigated in comparison with Germany and Romania to identify the potentials and relevance for the transferability.

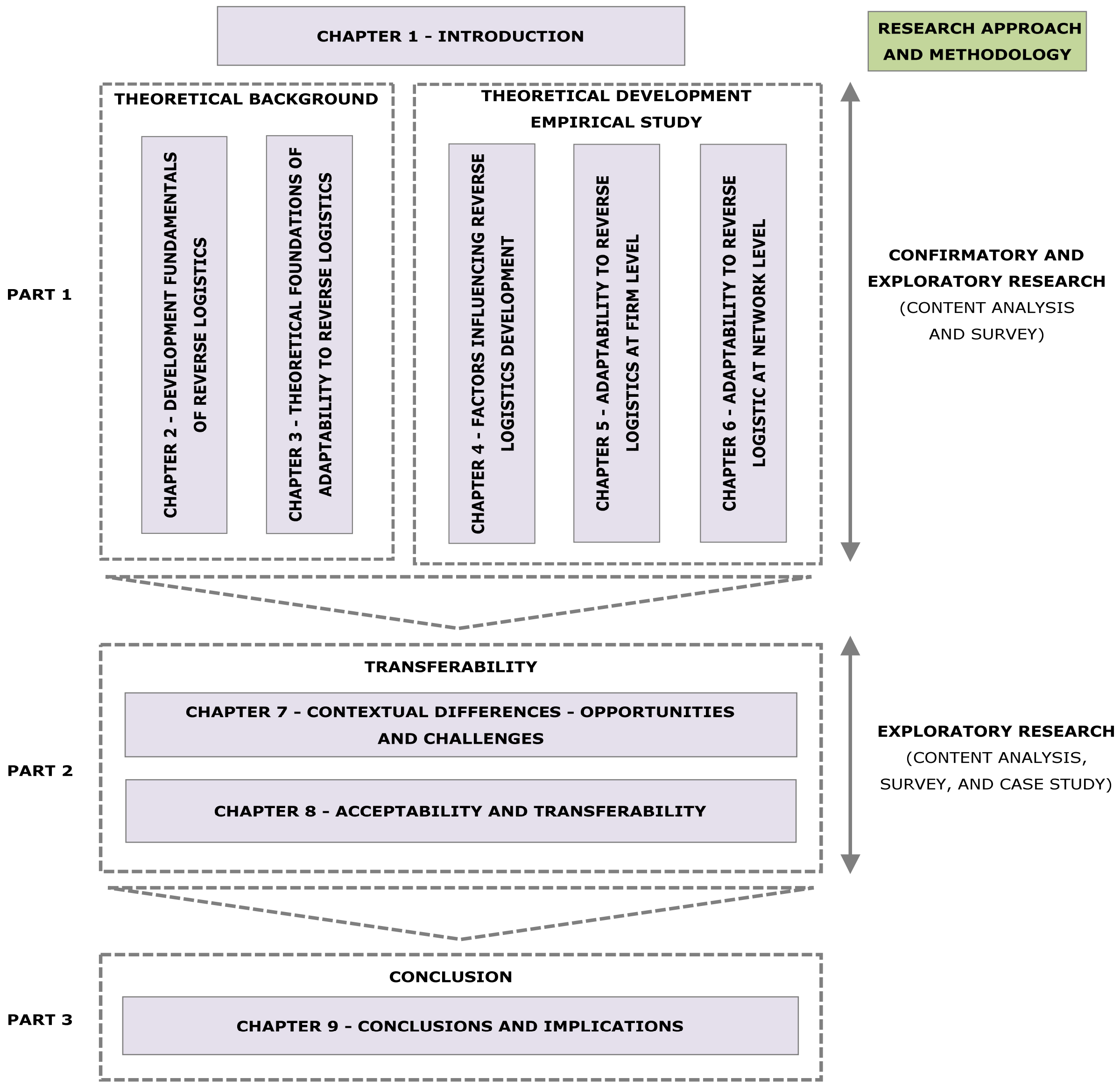

Figure 4: Research design

In chapter 8, the likelihood of adopting the implementation of a formal reverse logistics program is assessed from the viewpoints of producers and distributors through content analysis of previous survey and empirical results of case study. The current practices of reverse logistics management in some electronics firms in Vietnam are explored to identify the acceptability and the transferability of formal reverse logistics management models at both firm and network level. Models of reverse logistics for EoL management in some Asian countries transferred from best practices of European countries are also evaluated in this chapter to provide support for selecting and modifying a suitable model of reverse logistics at network level. A PRO-based model is proposed in the study for EoL management, and then is followed by the some suggested solutions. A model of decision-making process and management for implementing a formal reverse logistics program is suggested for reverse supply chain management at firm level.

Part 3: Conclusions and Implications

Chapter 9 summarizes the main results and research contributions, discusses the limitations, and recommends guidelines for future research on reverse logistics.

2. Development Fundamentals of Reverse Logistics

This chapter analyzes the development fundamentals of reverse logistics in term of concepts, understandings, interfaces, and innovations. In chapter 2.1, a closed-loop economy is identified as a fundamental for reverse logistics development in Europe in the aspects of environmental concerns and sustainable development. Chapter 2.2 explains the motivations for reverse logistics development based on the evolution of logistics from physical distribution, cross-functional integration, integrated logistics, and supply chain management. Chapter 2.3 focuses on identifying the innovations of reverse logistics in the perspective of supply chain management. By analyzing the development fundamentals of reverse logistics, we clarify the concepts and boundaries of reverse logistics in different angles. The interfaces of reverse logistics with waste management, green logistics, and forward logistics are also explored. Chapter 2.4 also analyzes the growth and the characteristics of the European electronics industry as well as its impacts on reverse logistics development in Europe.

2.1. A closed-loop economy - A fundamental for reverse logistics development

2.1.1. Sustainable development - The integration of economic and ecological goals

Prior to the late 1960s, there was relatively little concern regarding environmental degradation. The rapid pace of industrialization and societal issues have not been yet perceived as problems to be addressed.[52] Since the 1970s, more countries have realized the weakness of traditional predatory use of resources and linear economic growth model, namely from over-exploitation, over-production, and over-consumption to over-wastes, resulting in resource crises and environmental issues. They inevitably hindered the sustainable development of production and consumption and brought serious challenges to human survival and development.[53] Clearer notions of the environment and a sense of the need to protect it grew following the European Nature Conservation Year in 1970, the United Nations Environmental Conference at Stockholm in 1972, and the report issued by the Club of Rome in 1972. Sustainable development is defined under different viewpoints including from the government, the business sector, and the citizens. The most widely known one is the one from Brundtland committee in 1987 report, according to which the core concept is to satisfy the needs of the present generation in such a way that it will not lower the chance of the future generations in satisfying their needs.[54] Sustainable development is originally defined as the reconciliation of “triple-bottom line” factors of economic, environmental, and social dimensions.[55] The expression of “triple-bottom line” is often used in the business world to convey this notion of a three-way trade-off. Organizations are increasingly aware that choices made about products and processes can have profound environmental and social implications. However, they must balance ecological and economical goals to ensure a reasonable return on investment and long-term enterprise viability for organizational stockholders.[56]

In German literature, the concept of sustainability works is based on three principles of responsibility, closed-loop, and cooperation.[57] Responsibility principle emphasizes the inter-generational duties to protect and improve the environment for present and future generations. The cooperation principle expresses the ability of interlocking and making the agreement between different processes and stakeholders to obtain value-added chain. Meanwhile the principle of closed-loop refers to the dependence and integration between economic and ecological goals of obtaining sustainable development. Organizations have been aware of the trade-offs between business, economy, and the environment.[58] The integration is not only important from the aspect of the environment and society but also from the perspective of business. Legal regulations and market environments (e.g. stakeholder pressures and customer demands) that have required more environmental

[52] See Desta (1999), p. 12

[53] See Baojuan/Zu (2007), p. 1

[54] See WCED (1987), p. 54

[55] See Umweltbundesamt (1998), p. 3; Cf. also Hei/Scheicher-Tappeser (1998), p. 13; Ivisic (2002), p. 100; Seitz (2006), p. 15

[56] See Presley/Meade/Sarkis (2007), p. 4596

[57] See Kaluza/Pasckert(1997), p. 105; Cf. also Ivisic (2002), p. 100

[58] See Neto et al. (2008), p. 6

responsibilities from business can have a positive influence on economic performance.[59] For example, stricter environmental legislations have required many OEMs to work very closely together with their partners in different stages of supply chain to enhance the efficiency of resource conservation, cost reduction, and customer satisfaction.

Under the approach of sustainable development, a new economic growth model named "Closed-loop Economy" appeared in Europe since the late 1980s. The principles of closed-loop economy are "Reduction, Reuse and Recycle," in which reduction indicates lower input (resource and energy) flowing into production and consumption process and less pollution is generated. The principle of reuse maximizes the rest value of returned products through the utilization of effective repair, refurbish, and recondition programs. The principle of recycling that refers to the best route for material recovery of products indicates lower waste for final disposal and lower natural resource consumption by turning wastes to secondary resources. By translating disposal to resources through recycling process, negative influences on environment and resource is greatly reduced (see Figure 5).

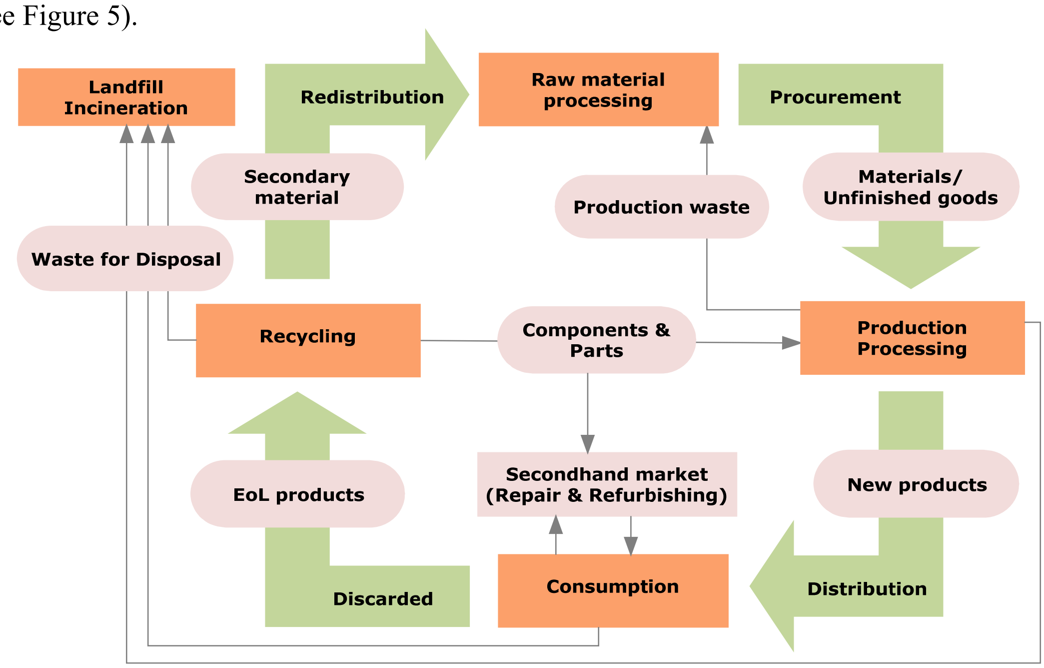

Figure 5: A closed-loop economy - A fundamental of reverse logistics development

Source: Adapted from Baumgarten/Walter (2003), p. 9

The closed-loop economy, with closing material cycle as the core, utilizes ecological laws to reorganize economic activities that increase the utilization ratio of resources and energy to an extreme extent. It can create the ecological balance of economic activities, eliminate environmental pollution, and improve the quality of economic development.[60] Sustainable development with "triple-bottom line" factors supports standing of the environmental efficiency of closed-loop economy as well as implies the economic efficiency by managing resources with the activities of product take-back, reuse, refurbishing, recycling, and energy production.

2.1.2. A closed-loop economy – A fundamental for reverse logistics development

Still in the early 1970s of the last century, wastes from private households and from businesses, including hazardous wastes, were untreated and dumped in municipal landfills.[61]A closed-loop economy with the ecological and economic integration has expanded the approach of waste management. The pursuit of the ideal of closed-loop economy leads to a new waste management approach emphasizing the basic principles

[59] See Winkler/Kaluza/Schemitsch (2006), p. 6

[60] See Schmid (1996), p. 107; Cf. also Baojuan/Zu (2007), p. 1

[61] See Wehkling et al. (1995), 12; Cf. also Wuttke (2011), p. 8

of reduction, reuse, and recycling. They stipulated the cores of the closed-loop economy.[62] The concept of waste management under closed-loop orientation developed an organizational and technical platform for the implementation under considerations of economic and ecological objectives. Therefore, many European countries have enacted waste legislation for the adoption of new waste management approach for prevention and recycling in order to reduce the amount of wastes and recapture value from wastes.[63] Recycling has become an important component of modern waste management approach that is defined as the process of systematically collecting, sorting, decontaminating, and treating used material waste into new products.[64]

The increasing attention to modern waste management approach based on the principles of reduction, reuse, and recycling was perceived as the fundamental for the development of reverse logistics in the 1990s.[65] From the new waste management approach, one of the elements in order to maintain sustainable development is to manage economically and ecologically the problem of wastes, which need the supportive processes of collecting, transporting, warehousing, sorting, testing, dismantling, and recovering. It is considered as logistics management of waste streams. Noting the global approach to the problem of wastes is a noticeable trend of increasingly greater use of logistics management processes of waste streams to meet the principles of sustainable development, while combining ecological and economic objectives. The ecological purpose stresses the relationship between logistics and the environment, which is to protect natural resources and reduce pollution arising from the presence of wastes. The economical objective is clear from the essence of logistics to reduce operation costs while improving services of waste management. In the long term, these objectives are most consistent and the attempts to achieve them lead to positive results for closed-loop economy. Positive results of logistics in waste management have led to popularizing the concept of reverse logistics, which contributes to the practical implementation of the philosophy of sustainable development, both at the level of individual enterprises and extended supply chains.[66]

In the perspective of closed-loop economy, reverse logistics refers to the role of collecting, transporting, handling, warehousing, recycling discarded products; a broader perspective includes all relating to logistics activities carried out in source reduction, recycling, substitutions, reuse of materials and disposal; which have been seen as the important solutions for environmental problems and sustainable development.[67] Under this perspective, the concept of reverse logistics emerged as an attempt to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, and reduce the need for "conventional" waste disposal, which is also regarded as waste logistics. Waste recycling falls into a first management category in reverse logistics functions because the early literatures in RL focused on recycling.[68] Many researchers suggested that resource reduction ought to be the ultimate goal of the reverse logistics processes in closed-loop economy.[69]

Although reverse logistics is closely linked with waste logistics and recycling, it differs somewhat from waste management, as the latter is mainly concerned with the efficient and effective collection and processing of wastes: that is, products for which there are no longer any reuse potential (no recovery value).[70] Reverse logistics concentrates on the flows where there is some value to be recovered and the outcomes enter a (new) supply chain (low to high value recovery).[71] The methods of product treatment are very important in defining boundaries of reverse and waste management. In our view, if the goods are discarded with the similar characteristics and in the same format into the consumer market; or the goods are dismantled, broken up in spare parts for refurbishing, remanufacturing, and recycling, then it is still relevant to

[62] See Ivisic (2002), p.11; Cf. also Deubzer (2011), p. 22

[63] See Mager/Waltemath (1997), p. 6; Cf. also Deubzer (2011), p. 22

[64] See Wiard/Sopko (1989), p. 6; Cf. also Wildemann (1997), p. 8

[65] See Enarsson (2006), p. 185-187

[66] See Starostka-patyk/Grabara (2010), p. 698

[67] See Stölzle (1993), p.150; Cf. also Rogers/Tibben-Lembke (1998), p.17

[68] See Guitinan/Nwokoye (1975), p. 28; Cf. also Pohlen/Terrance (1992), p. 35; Wu/Dunn(1994), p. 20; Marien (1998), p. 43

[69] See Carter/Ellram (1998), p. 85; Cf. also Enarsson (2006), p. 186; Kocabsoglu/Prahinski/Klassen (2007), p. 1141

[70] See Brito/Dekker (2002), p. 1-4; Cf. also Cherrett et al. (2010), p. 243; Gevaers/Voorde/Vanelslander (2010), p. 4-6

[71] See Brito/Dekker (2002), p. 4

discuss reverse logistics. If the goods have no recovery value and are therefore disposed of incineration or landfill, it is regarded as waste management.[72] Moreover, major differences also exist between the network types and the demand side. While a flow of recovered products are frequently directed toward reuse markets, waste streams eventually end at landfill sites or incinerations plants after various treatment processes.[73] However, the similarities in the supply side of products discarded, e.g. households and business customers, and the processes of recycling create very thin differences between waste management and reverse logistics in the aspects of environmental considerations and under the perspective of closed-loop economy. Figure 6 demonstrates the brief review of reverse logistics processes and the difference from waste management.

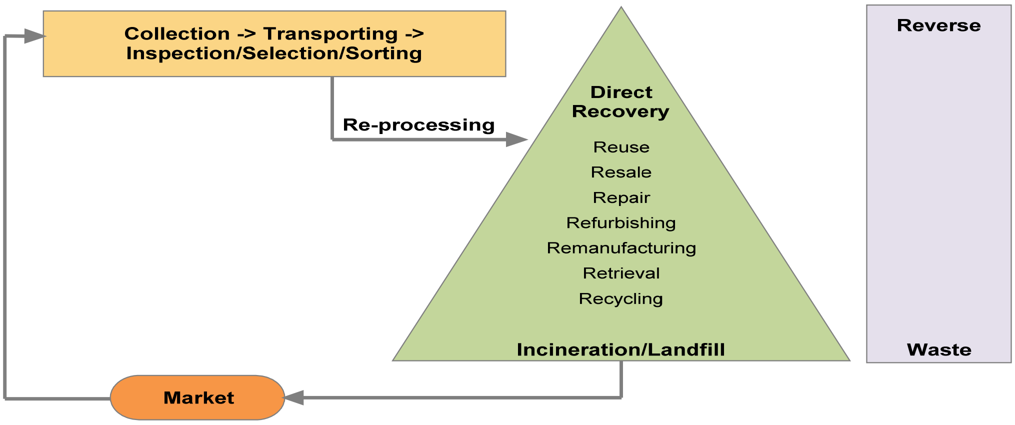

Figure 6: Processes of reverse logistics and difference from waste logistics

Source: Adapted from Brito (2003), p. 40

Although the processes of reverse logistics are not new because product recovery and recycling in itself has been applied for centuries,[74] the management of discarded products with the new driving forces and the emphasis of extended responsibility of manufacturing industry for the entire life cycle is new and has obtained noticeable attentions. A closed-loop economy has harmonized economic development with environmental protection by regulating related take-back laws following the principle of extended producer responsibility. Since the 1990s, the commercial sector and industrial companies in Europe have paid increased attention to the environmental problems by formulating sustainability strategies and recovery programs. Increasing investments in product eco-design as well as take-back and recovery of EoL products applied in many firms in Europe over the last decades are the examples of integration of economic and ecological goals for sustainable supply chain management. The impacts of environmental concerns have occurred in all phases of the cycle of products including research and development, procurement, production, distribution, use and disposal, which require the integration of different functions and organizations in business networks. Along with the development of logistics, reverse logistics is regarded as an integral part of logistics system.[75] The evolution of logistics also motivated the development of reverse logistics.

2.2. Logistics - Motivations for reverse logistics development

2.2.1. Logistics development and reverse logistics

Logistics is the term now widely used to describe the transport, storage, and handling of products as they move from raw material source, through the production system to their final point of sale or tion.[76]The start of awareness for logistics in business community and academic field of management studies was located and dated in the US in the early 1960s with the creation and awareness of Marketing Logistics,

[72] See Thiery et al. (1995), p. 417; Cf. also Gevaers/Voorde/Vanelslander (2010), p. 4-6

[73] See Cherrett et al. (2010), p. 243

[74] See Krikke (1998), p. 2-3

[75] See Stölzle (1993), p. 154-155

[76] See McKinnon (2010), p. 3

Business Logistics, and the Logistics of Distribution.[77] Some years later, the development of logistics practices and research also evolved in Europe[78] and in other parts of the world. In the 1970s, the awareness of logistics was regarded as classical logistics relating largely to Marketing and Physical Distribution, in which the models of well-managed distribution system, the treatment of the issues of transportation and warehousing were explored.[79] "Material" logistics or "physical" logistics in German language referred to as "TUL" logistics (Transport, Umschlag, Lagerung) indicated the role of logistics in transport, handling and warehousing. It is the sum of material and quantifiable activities of "placing", "pacing", and "parsing" goods and things.[80]

During the 1980s, companies tried to optimize good flows in order to cut logistics costs by the improvement of outbound (i.e. distribution) and inbound (i.e. supply and production) flows.[81] Companies in this period also optimized the total flows by developing an overall process for managing information and goods flows. Logistics is structured as a cross-divisional function or integrated logistics at the company level. Functions of procurement, inventory control, transport, warehousing, material handling, packaging and after-sales services are increasingly coordinated in a single flow of material movements.[82] Companies also began outsourcing logistics operations to gain cost reduction and flexibility. The professionalization and concentration of "Third Party" transport and Logistics Service Providers (LSPs) initially emerged.[83] The instrumentations of logistics through "hard" engineering technologies (mechanized and automated transport, warehousing, packing, and other equipment) were increasingly employed in Europe in this period. The terminology of reverse logistics did not surface officially in published papers in Europe during this time. Most of the related contents of reverse logistics were often labeled waste disposal, or waste management, and recycling in the aspects of environmental concerns.

The significant development of modern logistics occurred in the 1990s in which the holistic understanding of logistics is explored as intra and inter network of processes.[84] Logistics is integrated with various functions in not only internal business networks but also cross-institutional integration that brings benefits of value-added chain. Logistics is regarded as a competitive advantage in business performance and becomes a more complex process with the increasing cooperation of downstream and upstream partners. Control of flow dynamics in the integrated logistics networks is set up under customer demands and synchronization of the flow across multi-stage sequences of activities.[85] For example, customer satisfaction can be increasingly improved through after-sales services and warranty services with the support of integrated logistics networks. The emergence of returned products from customers and the implementation of take-back responsibility for EoL products have initially increased the complexity of integrating and the requirements of optimizing logistics performance. The principles of closed-loop economy have required the possible extra associated costs and the need to effectively coordinate with the other functions of logistics. Many numerical studies and case studies indicate that logistics management of reverse flows can efficiently be integrated in existing logistics processes.[86] In fact, reverse logistics adds to the dominant position of logistics with the tight interlocking in other areas of logistics because all logistics domains of procurement, production and distribution have to confront the issues of reverse flows from input, throughput and output, and the goals of waste minimization in each process.[87] Reverse logistics is also characterized with cross-functional natures in business process management of a company by interfacing with many other functional areas within an organ-

[77] See Stock/Lambert (2001); Cf. also Ballou (2007), p. 333

[78] See Pfohl (1972), p. 12

[79] See Baumgarten/Walter (1996, 2000), p. 2 and p. 4

[80] See Sheffi/Klaus (1997), p. 3

[81] See Malmborg (2004), p. 3-4

[82] See Waters (2007), p. 4

[83] See Peter Klaus (2009), p. 57-59

[84] See Baumgarten/Sommer-Dittrich (2003), p. 240

[85] See Peter Klaus (2009), p. 57-59

[86] See Flecischmann et al. (2001), p. 13

[87] See Pfohl (1993), p. 214

ization. Decisions made in each of these areas have an impact on the ability of logistics to conserve resources, generate additional revenues, and achieve green goals.[88]

The increasing roles of logistics in cross-functional integration have led to the increased attention to managing all operations and activities in a firm following the process chain to maximize value chain.[89] Therefore, the orientation of managing the chain of cross-functional and cross-institutional processes was initially established in the business activities of many companies with the objectives of satisfying customer demands and optimizing the logistics processes. Management of process chain has united the internal and external value chain of firms to create competitive advantages. In each firm, there are frequently four essential processes including process for research and development, process for supply, process for order processing, and process for returns management (see Figure 7).[90] Process chains are closed by the integration of reverse logistics into basic functions,[91] e.g. procurement, production, and distribution. The performance of each process chain is equally dependent on how effectively and efficiently a firm integrates internally and cooperates externally with its direct partners and on how well these business partners cooperate with their own partners.

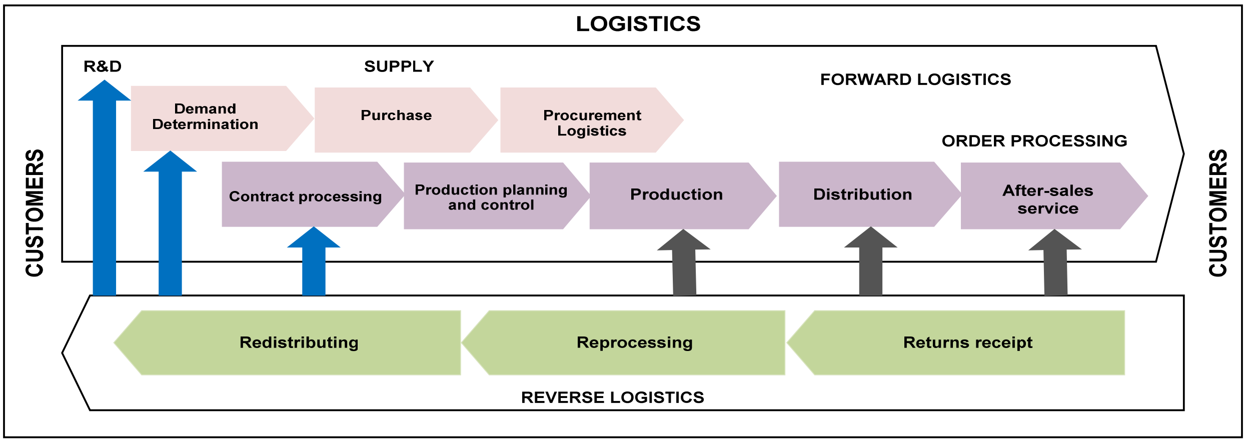

Figure 7: Process chains in logistics

Source: Adapted from Baumgarten/Darkow/Walter (2000), p. 28-29; Cf. also Ivisic (2002), p. 148

The process of development focuses on designing new products and services, which plays an important role in improving the competitive advantages for firms through attractive design, convenient and modern functions, and eco-friendly products. This process has integrated with reverse logistics operations by developing innovative design of package and products for easily delivery and recovery. Therefore, selecting partners to collaborate in the process of research and development is very critical for firms in improving their value chain.[92] Demand determination, purchase, and procurement logistics are the most important activities in the process of supply. This process focuses on forecasting and planning the demand of materials, accessories, equipment, and information for production. The cross-functional integration and intensified collaboration with supply chain partners (e.g. suppliers, logistics service providers) help firms ensure the optimization of supplying and using materials and facilities for production. The process connects closely with reverse logistics operations in balancing the volume of products or components returned, recovered, and reused for new production, which help firms reducing the costs of materials, production, and disposal.[93]

The process of order processing is strongly influenced by customer orientation and is implemented by many sub-processes to ensure that the contracts of customers are conducted effectively.[94] Reverse logistics is

[88] See Stock (1998), p. 56

[89] See Baumgarten/Sommer-Dittrich (2003), p. 7

[90] See Baumgarten (1995), p. 148

[91] See Pfohl (1993), p. 214-216

[92] See Baumgarten/Risse (2000), p. 32

[93] See Pfohl (1993), p. 243

[94] See Baumgarten/Darkow/Walter (2000), p. 10

involved strongly and positively in this process by managing effectively the returns in production, from distribution, and after post-stage consumption. For example, the integration of reverse logistics into distribution and consumption of goods through after-sales services, spare part management, and returns management has contributed to increasing customer satisfaction, reducing costs, and improving profitability.

In the decade of the 2000s, the integrated logistics networks, the increasing management of process chain, and the growing inter-organizational collaboration have motivated the development of supply chain management as a network of firms that interacts to manage the total flows of business processes. All organizations along the supply chain share the same objectives of satisfying final customers and improving their profitability, therefore increasingly cooperating to achieve this aim. Most opportunities for cost reduction and value chain enhancement lie at the interface between supply chain partners. The integrated logistics in this period aims at improving overall effectiveness and reducing overall costs at both firm and network level.[95] Moreover, the inter-organizational integration is not limited to national boundaries; therefore, the current phase of the logistics evolution is characterized by the setup and optimization of integrated international and global networks.

The integrated logistics has also motivated the development of intra-and inter-organizational reverse logistics system, especially in regional and international level. For intra reverse logistics, it has implemented some functions for a long time including reduction of waste in production, prevention or reduction of packaging waste, in-house management of operation and assembly, verification of accumulating hazardous wastes, etc. For inter reverse logistics, due to increasingly stringent laws, firms have coped with managing returns from customers and implementing their extended producer responsibility of take-back, recovering, and recycling of their products discarded by their customers. These changes have required firms to collaborate with different partners in supply chain to accommodate product returns, reuse of such products, remanufacturing or recycling. Moreover, under pressures of more powerful customers and the increase in multichannel distribution, supports for after-sales services and spare part management are more standardized in regional, international, and global scope. From a logistics perspective, the larger issues common to all of these activities is how a firm can get the products from where they are not desired to where they can be processed, reused, and salvaged effectively and efficiently in the collaboration with different partners.[96] Firms can implement reverse logistics as a management task and replace the operational reverse logistics functions through a strategic process orientation by integrating with different subsystems in logistics network and increasing collaboration with network partners in an extended supply chain.[97]

2.2.2. Reverse logistics - Interfaces with forward logistics

Because reverse logistics represents a relatively young research area and has rather many requirements because of pressures from legislation as well as changing awareness of both consumers and the company itself, there are many academic researchers and associations trying to give out definitions and dimensions of reverse logistics in two main directions including object orientation and flow orientation.[98] The study does not intend to review and list all theories of reverse logistics. However, some definitions demonstrating the theoretical development of reverse logistics as a logistic subsystem with both object and flow orientation are analyzed.

Pfohl and Stölzle (1992) define reverse logistics as the application of logistics concepts to manage the returns with all activities of the space-time transformation, including the quantity and variety change, to get the objectives of economic and environmental efficiency of the returns flow. The logistical processes in the reverse channels include collection, separation, transportation, inspecting, storage, remanufacturing, recycling, thermal treatment, and orderly disposal. Objects of reverse logistics derived from procurement, production, distribution, consumption, and even logistics processes, which are so called returns or wastes. What

95 See Waters (2007), p. 5

96 See Roger/Tibben-Lembke (1998), p. 26

97 See Sommer-Dittrich (2010), p. 41-42

98 See Quesada, (2003), p. 2-6; Cf. also Brito/Dekker (2002), p. 2-5; Pokharel/Mutha (2009), p. 176-177

is considered returns is then broadened with different kinds such as returned products from customers, end-of-life products, end-of-use products, returned parts, commercial returns, reused containers and packaging.[99]

Thiery et al. (1995) define "Reverse Logistics" under the term "Product Recovery Management," which describes all those activities encompassing the management of all used and discarded products, components, and materials that fall under the responsibility of a manufacturing company. The objective of product recovery management is to recover as much of the economic value as reasonably possible, thereby reducing the ultimate quantities of wastes. These authors did not use the term "Reverse Logistics," and activities of direct reuse/resale and incineration/landfill were kept out from product recovery management. According to them, products and materials can be sent back either to the original manufacturer (in the same business chain), or to other companies involved in other business chains.[100]

Rogers and Tibben-Lembke (1998) describe reverse logistics including the goals and the processes (the logistic characteristics) as "the process of planning, implementing, controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal."[101] This definition is rather ambitious because it mentions different types of returns and the initial point of origin in traditional chain is accepted as destination of reverse flows, indicating the closed-loop supply chain for reverse flows.

The European Working Group on Reverse Logistics (2002) gives out the definition with the focus on process orientation of planning, implementing, and controlling backward flows of raw materials, in-process inventory, packaging and finished goods, from a manufacturing, distribution or use point to a point of recovery or point of proper disposal. The above definition is more extensive than the one proposed by Rogers and Tibben-Lemke (1998). They do not refer to "point of consumption" nor do the products need to be returned to their origin. The returns may be back to any point of recovery, suggesting the integration of closed-loop and open-loop in reverse logistics. By developing this definition, they incorporate more flows that fit naturally in the definition and have characteristics the same as of other reverse logistic streams. At the same time, they keep the essence of the definition as put forward by Rogers and Tibben-Lembke (1998), which is subsystem of logistics.[102] Considering the main characteristics of logistics, the definition proposed by European Working Group on Reverse Logistics is the most complete and incorporates the principal characteristics of what reverse logistics contains.

Although reverse logistics is an integral part of logistics system, it differs from forward logistics in many ways beyond the fact that the flow is reversed and the roles of actors are less clearly defined.[103]There are differences as well as interfaces between logistic subsystems including procurement logistics, production logistics, and distribution logistics in management of reverse flows including forecasting, distribution network, routes and destination, distribution costs, product quality, product packaging, disposal options, price, importance of the speed of disposal, inventory management, and production planning, product life cycle, marketing techniques, and process visibility.[104]

The driving mechanism is the main difference between forward and reverse logistics. While the flow of forward logistics is driven by pull mechanism with the demand of customers, reverse logistics is motivated by push mechanism with the availability of returned products to trigger the sequence of RL operations ranging from collecting to product recovery. Returned products that are forced into the reverse flows by regulatory and customer demands as well as economic benefits mostly initiate recovery programs and RL activities.[105]

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[99] See Pfohl/Stölzle (1992), p. 573; Cf. also Pfohl (2008), p. 219-222

[100] See Thiery et al. (1995), p. 114

[101] See Roger/Tibben-Lembke (1989), p. 16-17

[102] See Brito/Dekker (2002), p. 3

[103] See Marcotte/Halle/Montreuil (2008), p. 4

[104] See Rogers/Tibben-Lembke (2001), p. 130-135; Cf. also Tibben-Lembke/Rogers (2002), p. 275-281

[105] See Fleischmann et al. (2004), p. 3

One of the largest differences between forward and reverse logistics is the direction of reverse flows. Forward logistics is generally the divergent movement of product from one origin to many destinations (e.g. from OEMs to many distributors, and from distributors to many end users).The flows of reverse logistics are convergent from many origins to one destination (e.g. from many customers to return centers, points of recovery, or points of proper disposal). Moreover, the supply side of reverse logistics is much more reactive and much less visible, which results in the difficulties in forecasting and planning of reverse flows. The greater uncertainty comes from the fact that the company never knows in advance when, where, and how the products will be returned. The differences in quantities and qualities of returns also present high variation and complexity in RL operations. The returns units do not arrive in bulk on pallets like the distribution of goods in forward logistics and are often single units in non-standard packaging.[106]

Reverse logistics consists of many complicated processes such as collection, transport, handling, sorting, testing, recovery, and disposal. Meanwhile forward logistics includes three main basic processes of procurement, production, and distribution. The returned products are collected from many widespread sources and consolidated for further inspection, handling and processing.[107] Therefore, reverse logistics is more complex than forward logistics as there are many actors involved in the reverse logistics processes. A reverse logistics network is composed of all the members in the forward logistics network plus third parties involved in reverse logistics operations such as service providers of collecting, repairing, remanufacturing and recycling, and other related organizations, e.g. industry associations, governmental agencies, collective schemes, and charity organizations. Reverse logistics can take place through a separate reverse channel, or through the integration of forward and reverse channel. The number of origin and destination points is relatively complicated in reverse logistics based on the types and conditions of returns.[108] In addition, end-markets for recovered products may not be well-known, exposing redistribution planning in reverse logistics to even more uncertainty. Whereas new products are sold in uniform quality with rather similar prices to different distributors, the price of recovered products in reverse distribution varies based on the quality and the volume of recovered products, the demands of market, and the power of brokers.[109] Table 1 shows some basic differences between reverse and forward logistics.

All these main differences lead to the important discrepancy of costs in nature and the visibility between forward and reverse logistics. In forward logistics, the costs are well defined and well known by accounting system in business processes of moving products to end users. In reverse logistics, the major costs associated with acquiring, transport, storage, repair, repacking, and recycling are rather difficult to forecast and calculate clearly across the full business processes. Therefore, the measurement of reverse logistics performance is more difficult to conduct. Moreover, the costs of transportation, handling and inventory holding for reverse logistics are always higher than forward logistics for new products because the reverse shipments are much smaller, not frequent, and mixed.[110]

Criteria of differences	Forward logistics	Reverse Logistics
Driving mechanism	Pull (demand driven)	Push (supply driven)
Flow direction	Divergent	Convergent
Supply side	Controlled and demand forecasting	Less visibility, difficult forecast
Product quality	Uniform and controlled	Not uniform and mixed
Process	Procurement, production, distribution	Collection, transport, handling, sorting, testing, recovering, and

[106] See Toffel (2004), p. 126. Reverse logistics associated with product recovery are subject to much more uncertainty than forward logistics for at least seven reasons: "(1) the uncertain timing and quantity of returns, (2) the need to balance demands with returns, (3) the need to disassemble the returned products, (4) the uncertainty in materials recovered from returned items, (5) the requirements for a reverse logistics network, (6) the complication of material matching restrictions, and (7) the problems of stochastic routings for materials for repair and remanufacturing operations and highly variable processing times.

[107] See Cherrett/Maynard/Mcleod/Adrian (2010), p. 242

[108] See Fleischmann (1997), p. 5

[109] See Roger/Tibben-Lembke (2002), p. 277

[110] See Roger/Tibben-Lembke (2002), p. 279

		disposal
Actors	Suppliers, producers, logistics providers, distributors, and end users	Actors of forwards logistics plus collectors, dismantler, recyclers, and other related organizations
Price	Relatively uniform	Dependent on many factors
Cost	Well-defined, well-known, and lower	More difficult to calculate and higher

Table 1: Basic differences between forward and reverse logistics

Source: Fleischmann et al. (2001), p. 8; Cf. also Roger/Tibben-Lembke (2002), p. 271; Gobbi (2008), p. 58

2.2.3. Reverse logistics - Interfaces with green logistics

Over the last 40 years, logistics has extended its original focus on the outbound movement of finished products (physical distribution) to companies' entire transport, storage, and handling systems (integrated logistics), and then to the interaction with business upstream and downstream (supply chain management). Moreover, the development of logistics is emphasized by the increasing concerns for the environment issues and the environmental impacts of logistics operations. For example, due to the increasing public and government concerns for the environment, companies have tried to reduce the environmental impacts of their logistics operations, e.g. CO_2 emissions, freight transport externalities (noise, accidents, vibration), and issues in city logistics. However, making logistics sustainable in the longer term involve more than cutting carbon emissions.[111] Green Logistics, therefore, has developed gradually over the last decades in terms of the functions, processes, and relationships. Green logistics has extended its original focus on reactive monitoring of the general environment management programs to more proactive practices implemented through various Rs (Reduce, Re-use, Rework, Refurbish, Reclaim, Recycle). In reviewing the development of green logistics, many researchers have represented the convergence of several strands of research that began at different time over the past 40 years (see Figure 8).[112]

Researches in reverse logistics in separate strand of green logistics were developed in the early 1990s when governments and business began to reform the management of waste, reducing the proportion of waste material being dumped in landfill sites or incinerated, and increasing the proportion that was reused ad recycled. For example, research on reverse logistics in Germany was stimulated by the introduction of packaging waste ordinance in 1986 as the background for the German Dual Systems for packaging materials. Reverse logistics concerning the return of waste product and packaging for reuse, recycling and disposal is regarded as a key part of green logistics.

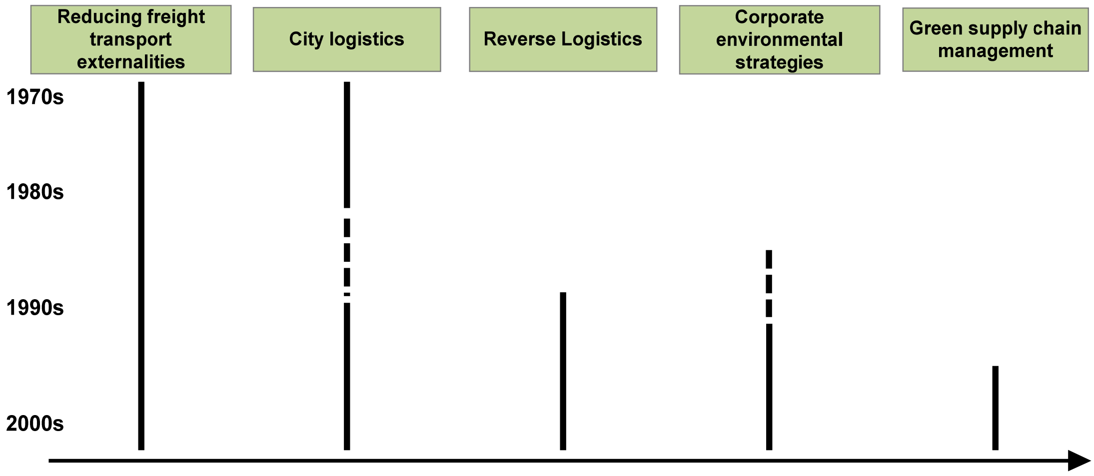

Figure 8: Logistics development in the perspective of environmental concerns

Source: Adapted from McKinnon (2010), p. 7

[111] See McKinnon (2010), p. 4

[112] See McKinnon (2010), p. 6; Cf. also Abukhader/Joumlnson (2004), p. 137

However, a common problem when talking about reverse logistics is the confusion existing between reverse and green logistics. Many authors emphasized a strong bias to which reverse logistics development is the important period of green logistics development.[113] In fact, green logistics evolving over the past 40 years focuses on the environmental aspects of all logistics activities such as reducing freight transport externalities, green design, environmental management system, eco-efficiency, green purchasing, and green supply chain. However, green logistics activities focus on the processes of forward logistics operations rather than reverse channel. Redesigning packaging to use less material, or reducing the energy and pollution from transportation are important activities that might be better placed in the realm of “green” logistics. They are not specific of reverse logistics processes.[114] If no goods or materials are being sent “backward,” the operation is probably not a reverse logistics activity. The logistical processes in the reverse channels include collection, separation, transportation, inspecting, storage, repair, refurbishing, remanufacturing, and recycling which are keys to recapturing value from products returned due to reasons as damages, returns of unsold or seasonal inventory by retailers, returns from customers, end-of-use and end-of-life returns.[115] Therefore, there are some similar activities applied in both green logistics and reverse logistics, e.g. reuse, remanufacturing, recycling and waste management. Figure 9 describes the interfaces between reverse logistics and green logistics.

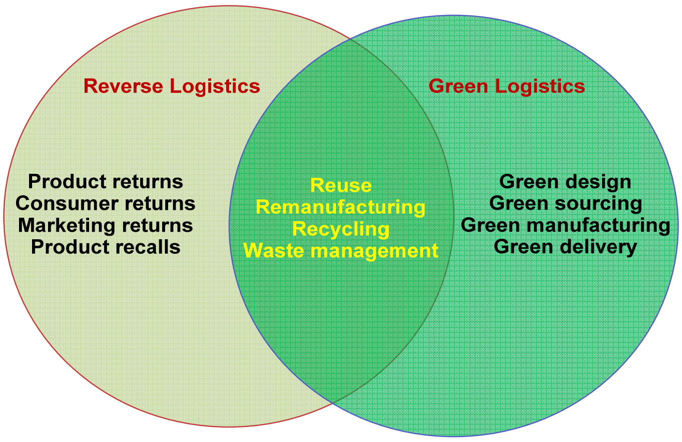

Figure 9: Interfaces between reverse logistics and green logistics

Source: Adapted from Roger/Tibben-Lembke (1998) with modification

2.3. Supply chain management - Innovations for reverse logistics development

2.3.1. Sustainable supply chain management - newly broader view of reverse logistics

The focus to the relationships in inter-organizational chains and distributed networks of suppliers, customers, and other stakeholders took place in the 1980s. The development of integrated logistics also leads companies to think about the extended supply chain that they are involved in, and to try to improve both their own performance, and the performance of the broader processes to meet the demands of final customers.[116] The term of supply chain management is originally proposed with the objectives of designating a new form of strategic logistics management.[117] The phenomena of cross-organizational integration named “the logistics of supply chain” have been fully developed through the popularity of Supply Chain Management (SCM) since the end of the 1990s.[118] The SCM addresses new issues of the full complexities of the design, planning, operation, and control of value chains and networks that extend beyond individual enterprises and their

[113] See McKinnon (2010), p. 7; Cf. also Srivastava (2007), p. 57

[114] See Quesada (2003), p. 8; Cf. also Brito/Dekker (2002), p.4-7

[115] See Roger/Tibben-Lembke (1998), p.3

[116] See Water (2007), p. 35

[117] See Keith/Webber (1982), p. 63-64; Cf. also Pfohl (2000), p. 8-9

[118] See Baumgarten/Sommer-Dittrich (2003), p.310; Cf. also Klaus (2009), p.57-59

immediate suppliers and customer relationships.[119] The most critical point of supply chain management is the development of collaborative approach with the increased importance of inter-functional, inter-instrumental, and inter-organizational integration.[120] The objectives are to deliver products or services to the end of customers, to link flows from raw material suppliers to final delivery, and to achieve the effectiveness and efficiency of the entire supply chain (e.g. cost, time, and quality) and bring benefits for end customers. The collaborative approach of supply chain management is more necessary when supply chain aims at ensuring simultaneously economic, environmental, and social performance on a product's total lifecycle basis,[121] e.g. sustainable supply chain management, green logistics, and reverse logistics.

Sustainable development provides a framework for managing the development of organizations, communities, nations, regions, and indeed the entire planet to ensure efficient resource use, development of efficient infrastructures, protection and enhancement of the quality of life, and creation of new businesses to strengthen economies. Sustainability has become increasingly important for organizations and has permeated a number of managerial and organizational decisions for almost all businesses in the twenty-first century.[122] Sustainability are increasingly addressed in the SCM literature, arguing that organizations have expanded their sustainability strategies into their entire supply chains.[123] Sustainable development with "triple bottom line" factors and the SCM with collaborative approach have motivated the development of sustainable supply chain management (sSCM) over the last decade. The development of sSCM has been analyzed particularly from both the perspective of supply chain, legislation compliance, environment concerns, and economic benefits.[124] Winkler et al. (2006) specify a sustainable supply chain network with its main goals of contributing to both economic and ecologic resource conservation. The dissolution of the contradiction between ecological and economic system is to close material loops and continuously to improve both eco-efficiency and economic efficiency.[125] Carter and Rogers (2008) define sSCM as the strategic management and integration of an organization's social, environmental, and economical goals through systematic coordination of key inter-organizational business processes to improve the long-term economic performance of the individual company and the extended supply chain.[126]

Reverse logistics has traditionally been a function within organizations delegated to logistics, customer service, or marketing departments, where customers with warranted or defective products can return them to their suppliers.[127] A warranty return network normally does not focus on environmental concerns and involve less actors and activities than in the network of recovery and recycling. Sustainable supply chain management highlights the importance of process chains through sustainable planning, sustainable purchasing, sustainable production, and sustainable distribution for both forward and reverse flows. All parties participating in the life chain of a product (or more products) depend on each other in the implementation of environmental and economic improvements, which leads to the in thinking from a firm to a network level in supply chain.[128] Supply chain could be viewed as networks, indicating that business activities are performed in relation to more than one chain and a network view complements the common chain approach of logistics. Therefore, sSCM has played an important role as a catalyst of generating valuable inter-organizational resources and thus possible sustained inter-organizational competitive advantage through collaboration on environmental, social, and business issues.[129] New conceptualization of sSCM bases on the approach of sustainable development has renewed the roles of reverse logistics in the perspective of supply chain man-

[119] See Klaus (2009), p. 61

[120] See Pfohl (2000), p. 9

[121] See Gold/Seuring/Beske (2010), p. 230

[122] See Presley/Meade/Sarkis (2007), p. 4596

[123] See Peters/Hofstetter/Hoffmann (2011), p. 52

[124] See Teuteberg/Wittstruck (2010), p. 1011

[125] See Winkler/Kaluza/Schemitsch (2006), p. 25

[126] See Carter/Rogers (2008), p. 360

[127] See Presley/Meade/Sarkis (2007), p. 4605

[128] See Winkler/Kaluza/Schemitsch (2006), p. 26

[129] See Gold/Seuring/Beske (2010), p. 230

agement. The terminology "Reverse Supply Chain" has emerged with the collaborative approach and emphasized the process management of reverse logistics operations, which has much broader scopes in terms of the sustainable supply chain management. Therefore, reverse supply chain encompasses the processes (see Figure 10):

- product acquisition (obtaining returned and discarded products from customers),
- logistics (activities to collect, transport, consolidate, handle, and store returned products from the point of use to the places for gate-keeping, sorting and disposition),
- gate-keeping and disposition (identify what products are accepted as returns and inspect to determine products' conditions and make decision about what to do with returned products to obtain both ecological and economic benefits),
- recovery (reuse, resale, repair, refurbishing, remanufacturing, and recycling),
- and redistribution (remarketing and developing secondary market for recovered products).

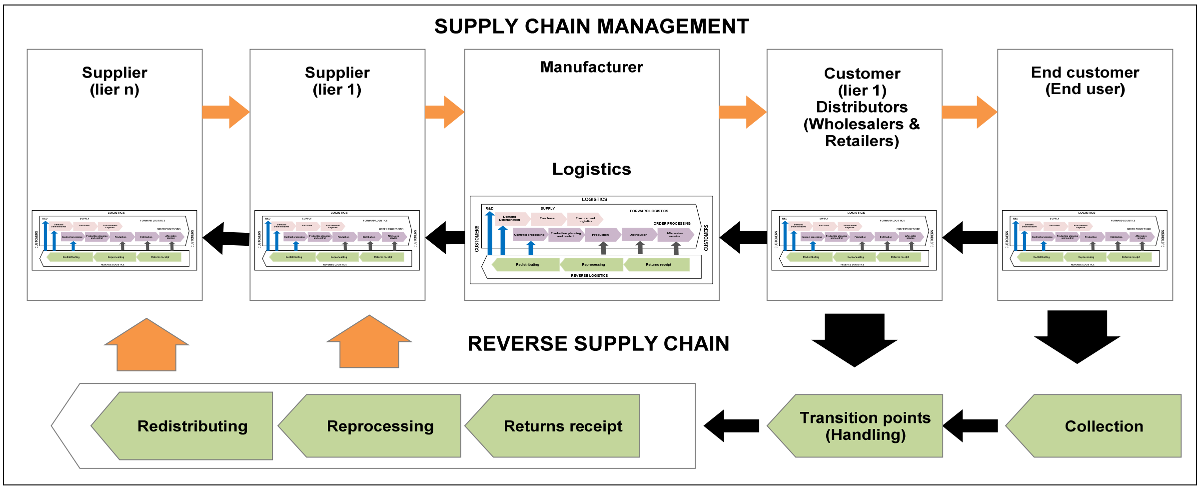

Figure 10: Processes of RSCM and relationships within an extended supply chain

Source: Adapted from Zadek/Emmermann (2009), p. 12; Cf. also Sommer-Dittrict (2010), p. 43 with modification

Reverse supply chain management (RSCM) is defined in this study as the integrated process- and customer oriented organization, implementation, and control of related material, information, and cash flows associated with the flow of goods from the last owner to reuse points for the purpose of creating value from recovery and recycling of returns while minimizing the environmental impacts.[130] As this study is conducted in the perspective of supply chain management and under strategic considerations, the terms of "Reverse supply chain" and "Reverse logistics" are used interchangeably with the same meaning as above defined. Reverses supply chain management views the whole picture of reverse flows through different tiers of supply chain, not only with the individual partner but also in the relationship with multiple stakeholders and partners dealing with the forward and reverse logistics. Supply Chain Management and Logistics can be seen as complementary approach, which have closed relations through the continuous process to support for the development of reverse logistics.[131]

Reverse supply chain has today become more important in coordination with other process chains to contribute to both economic and ecological goals for firms conducting a sustainable supply chain. The impacts of RSC cover all sustainability measures, especially when its primary motivation is to recover or recycle used products and materials.[132] For example, from an environment perspective, a broader collection of used materials and products, and special waste can be conducted in the process of supplying, order processing, distribution, and post-stage consumption to reduce the waste and recover the value of returned products. Through

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[130] See Luger/Herrmann (2010), p. 93; Cf. also Prahinski/Kocabasoglu (2006), p. 519

[131] See Sommer-Ditttrich (2010), p. 43

[132] See Presley/Meade/Sarkis (2007), p. 4605

the recycling and reuse of used materials and products, additional values and economic benefits can be generated for each member and the whole supply chain. Therefore, it is also important to obtain optimization for the whole supply chain by strategically integrating reverse supply chain in overall supply chain processes. From a strategic perspective and in terms of sustainable supply chain management, RSC today has increasingly taken on the role of "closing-the-loop" for supply chain management.[133]

A "closed-loop supply chain" (CLSC) is a terminology that emerged at the beginning of the 2000s,[134] and reflects the recognition that products/parts/materials indeed flow both ways along the supply chain: forward and reverse.[135]A CLSC requires an integrated perspective on the acquisition front end (collecting, procuring, and sorting), the engine (durability design decisions affecting the remanufacturing and recycling operations), and remarketing back end (redistribution, with the life cycle and time value of the product). A closed-loop network consists of a reverse supply chain plus an extra loop to connect it to the original forward supply chain. An after-sale service is a popular example of a CLSC because appliances sold are provided with the range of services for returning, exchanging, and repairing form the original point. Nowadays, there are many different types of returns during and after the product lifecycle for which require the dynamics of supply chain management to find innovative ways to integrate the forward and backward chains to recover values. CLSC activities focus mainly on products returned for reuse, repair, refurbishing, and remanufacturing, in which products are frequently returned to the point of origin.[136] Moreover, reverse logistics costs[137] for a CLSC consider different costs such as acquiring, sorting, transporting, treatment, and redistribution, suggesting high initial investments. A closed-loop supply chain also adds complexity to overall supply chain management by the issues of product design for recovery, re-engineering, product data management, installed base support, or evaluating end-of-life scenarios that can be barriers for the planning and organizational structure.[138] Creating a closed-loop supply chain to obtain both economic and ecological objectives at firm level for recycling operations is not realistic and impossible due to the limitation of resources and capabilities.[139] To reach the goals of sustainable supply chain management, reverse logistics operations requires the active participation of each chain member, which refers as a network-level approach to develop closed-loop supply chain with broader view.

Therefore, the concept "closing-the-loop" can be widely recognized as interlocking different partners in supply chain to collect, reuse, repair, remanufacture, and recycle the returned and discarded products based on the principle of closed-loop economy and total lifecycle basis of a product. A returned product does not have to return to the production phase (initial phase) for the loop, but can return to any phase along the forward supply chain.[140] A reverse supply chain can be viewed as an "Open-loop supply chain" (OLSC)[141] or an open-loop system, which material flows enter at one point of logistics system and leave at another.[142] An OLSC are also composed of the same key processes of product acquisition, collection, testing, sorting, disposition, and recovery activities, as well as remarketing.[143] OLSC also adds much complexity to a closed-loop supply chain management due to the diversified involvement of different partners.[144] Following this, products and materials can be sent back either to the original manufacturer or to other companies involved in other business chain providing services and operations related to managing and reprocessing the returned products. For example, reselling returned products to a third party to be marketed into the secondary market

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133 See Fleischmann/Grave/Gapp (2004), p. 4-6; Cf. also Guide/Wassenhove (2009), p. 11; Kumar/Dao (2006), p. 47-48; Presley/Meade/Sarkis (2007), p. 4605

134 See Wells & Seitz (2005), p.1

135 See Kumar/Dao (2006), p. 50

136 See Daughterty/Autry/Ellinger (2001), p. 108; Cf. also Ostlin et al. (2008), p. 336-337

137 See Guide (2001), p. 67

138 See Kumar/Malegeant (2006), p. 4

139 See Winkler/Kaluza/Schemitsch (2006), p. 21

140 See Guide/Harrison/Wassenhove (2003), p. 1; Cf. also Kumar/Malegeant (2006), p. 1129; Saibani (2010), p. 8

141 See Kumar/Dao (2006), p. 50

142 See Guide/Harrison/Wassenhove (2003), p. 2-3

143 See Guide/Harrison/Wassenhove (2003), p. 1; Cf. also Krikke et al. (2004), p. 23-25; Blackburn/Guide/Souza/Wassenhove (2004), p. 7-8

144 See Krikke et al. (2004), p. 23-25

is clearly managed by the open-loop concept. Reverse logistics networks are frequently operated in an open-loop system while dealing with recycling tasks, but now also occur with remanufacturing works.[145] An effective solution for recycling networks requires the cooperation and share of resources and capabilities among many companies of an extended supply chain and not only the efforts of one single company.[146] Figure 11 depicts reverse supply chain with CLSC and OLSC that manages and controls different types of returns sent by one member of the supply chain to any other previous member of the same chain or to other members of different chain for the purpose of product recovery or proper disposal.

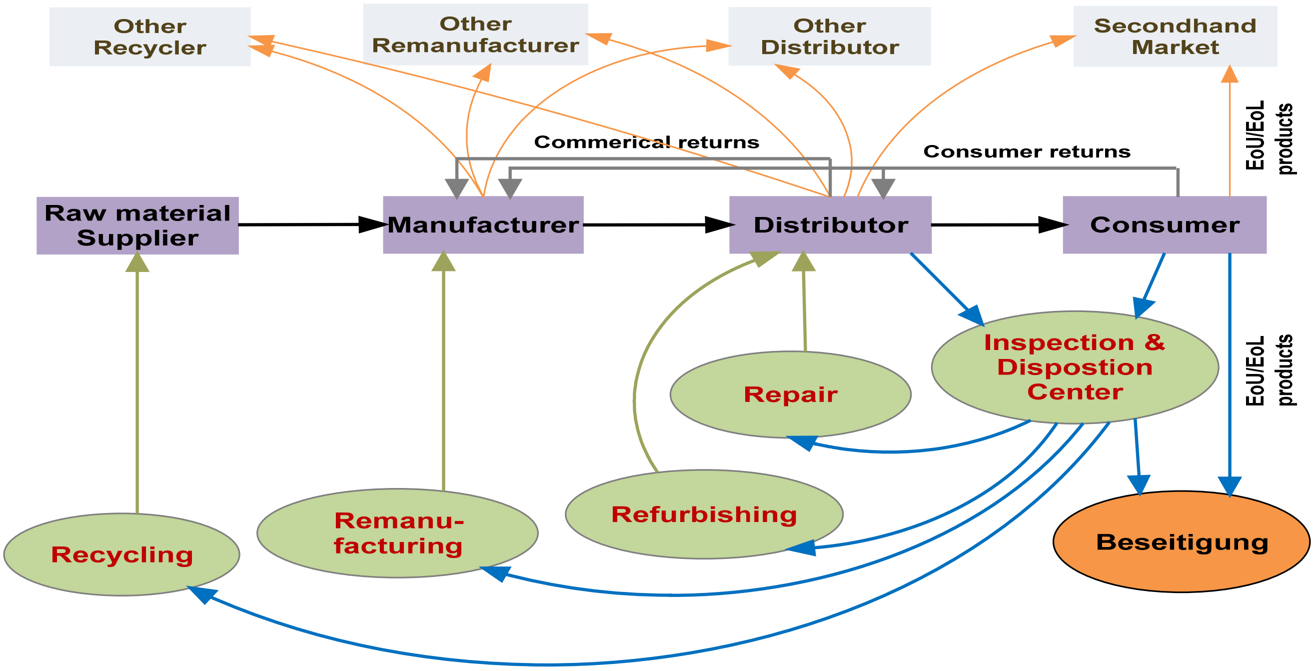

Figure 11: Model of reverse supply chain with open-and closed-loop

Source: Own illustration

2.3.2. Innovations of reverse supply chain management

While reverse logistics focuses on the process of moving goods from their typical final destination for capturing value, or proper disposal, reverse supply chain management emphasizes the strategic logistics management of efficient acquisition of product, the right disposition and product recovery options, and the ability of redistribution of recovered products. Guide and Wassenhove (2002) support the viewpoint of RSCM and give out the concept of Product Acquisition Management (PAM), which is regarded as the important innovation for reverse logistics in the aspect of supply chain management.[147] Acquisition is the process of obtaining the product from the customer, which includes three sources of products.

- From the forward supply chain: consumer returns due to buyers' remorse of unexpected products, products with quality and technical issues in warranty time, products with defect and damage in delivery, or marketing returns from distributors because of unsold products, seasonal goods, and the need to reposition inventory;
- From the market-driven stream: financial incentives motivate customers to return their used product in the right quality due to economic benefits of product recovery and protection of brand image
- From the waste stream: end customers discard their end-of-life products and firms passively accept these entire discarded products by the enforcement of laws.[148]

[145] See Fleischmann (1997), p. 4; Fleischmann (2004), p. 5

[146] See Gold/Seuring/Beske (2010), p. 231

[147] See Guide/Wassenhove (2002), p. 25

[148] See Guide/ Wassenhove (2002), p.25; Cf. alsoBeullens (2004), p. 1; Prahinski/Kocabasoglu (2006), p.520

Acquisition process refers to as different activities of collection and procurement of returned and discarded product, and differentiates more clearly the source of waste and goods in reverse flows. Therefore, it has settled the long-time argument of these definitions in reverse logistics, where waste handling system dominates the content of reverse logistics.

For acquisition from forward supply chain, it includes consumer returns due to buyers' remorse, product defects or damages, quality problems of products in warranty time, and product recalls. Customer returns are often back through the supply chain to manufacturers by retailer channels, suggesting the existence of closed-loop supply chain. Because of increasingly competitive markets, more companies have conducted less restrictive return policies that make it easy for consumer to return products. Manufacturers and retailers have increasingly worked in a more collaborative way to control and reduce the amount of product returned. Besides, marketing returns also occurring from a position forward in the supply chain are linked to sales processes such as unsold products, seasonal merchandise, and close-out returns or buy-outs.[149] The returns from forward supply chain have increased rapidly due to the changing requirements of customer demands and fiercer competition between suppliers. In this study, we regard the returns from forward supply chain as "commercial returns" and focus on customer returns for more explanations.

For market-driven system, returned products are pushed upstream by various incentive policies including leasing or rental contracts, trade-in systems (credit-based rules), buy-back systems, voluntary take-back programs, and "old for new" campaigns with the discount bonus.[150] Therefore, firms can acquire the good used products and control the level of quality of returned products due to setting some minimal standards based on the above-mentioned systems. Firms can also estimate the amounts of returned products based on involving themselves in take-back programs. The uncertainty of reverse flows can therefore be minimized and the management of reverse supply chain is planned to maximize the economic benefits. For returns from market-driven system, closed-loop supply chain is also applied in because there is integration of the forward and reverse channels, and products from market-driven system are frequently returned to original producers or their service providers for product recovery.[151] For this closed supply chain, customers frequently act as both a customer for remanufactured products and a supplier of input to remanufacturing companies.[152]

Acquisition from waste stream includes environmental returns such as the disposal of EoL products and hazardous materials to comply with take-back regulations. Products that enter RSC of waste stream often include large volume of discarded products from end customers with low or no recovery potential. Therefore, waste stream is often recycled, incinerated, or landfilled depending on the conditions of discarded products collected. Waste stream system is viewed as less attractive than market-driven system because of high uncertainty and unknown quality. However, RSCM of used electronic and electrical equipment discarded has become more important due to its valuable secondary materials for closed-loop economy and the negative impacts of hazardous wastes on environment. Therefore, responsibilities of collection and recovery of special discarded products from waste stream are frequently enforced by the laws requiring manufacturers to take back, recover, and recycle their EoL products. The EU Directives on EoL products such as packaging waste, EoL vehicle, and waste of electronic and electrical equipment are primarily directed at proper recycling and landfill avoidance. Companies have tried to minimize the financial impacts of compliance (cost minimization) by network collaborations with service providers to share inter-organizational resources and capabilities. Reverse logistics network for EoL management is also a central topic for analyzing the development of reverse logistics in this study.

For logistics networks in RSCM, OEMs use their own fleet or their logistics providers' vehicles to collect returned products with high value from end-customers and retailer stores. Returns are backhauled from distributor stores to original manufacturing facilities or to regional distribution centers/central returns centers for inspection, sorting, and making disposition options. The CLSC like this is suitable when the rate of

[149] See Croxton/Dastugue/Lambert/Rogers (2001), p. 149-150

[150] See Ostlin et al. (2008), p. 338-343

[151] See Sasikumar/Kannan (2008), p. 236-238

[152] See Krikke et al. (2004), p. 23-25

returns and the distribution frequency are high. In other cases, a separate network is used for managing returns, typically operated by service providers that contract with manufacturers/distributors for collecting and recovering their returns products, or third parties that buy used products from OEMs, retailer stores, and end-customers for their own recovery and distribution.[153]

RSC is not frequently integrated with forward supply chain if the level of returns varies in volume and the value is generally low, e.g. retailers' decisions in reselling returned products to refurbishing companies or secondary market instead of shipping back to manufacturers or suppliers. In case of EoL products from households, reverse logistics operations for product take-back and recovery are often outsourced to third-party service providers. RSC characterized by open-loop system with the collaboration and involvement of many stakeholders can exploit economies of scale, reduce management and logistics costs, and improve company image. Moreover, the opportunities of remarketability of recovered products and recycled materials have also been attached to specialized third parties, e.g. brokers, dismantlers, remanufacturers, and recyclers. All these activities may have today increased the openness of reverse supply chain.

Product acquisition is the critical process for establishing a profitable reverse supply chain. The product returns should be well controlled and 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 might cause. In light of this, it is important for companies to coordinate the collection process.[154] Collection covers logistics activities to transport, consolidate, transship, and store products from the point of use to the facility for gate-keeping, sorting and disposition. The efficiency of collection is critical to the performance of reverse supply chain. Normally, transportation cost is usually the largest component of reverse logistics costs. If the total costs associated with the reclamation efforts exceed the total costs of new materials or products, firms would have no economic incentives for dealing with returns.[155]

In addition, studies on RSCM have discussed challenges in collection process of returned and discarded products, among which the uncertainty of supply is the most complex issue.[156] The returns are often uncertain in quality, quantity, and timing, which make the companies reluctant in actively managing the process of acquiring. Besides the supply quantity, quality, and timing uncertainties, one last uncertainty exists regarding supply, which is the mix of returned products one might receive, especially for the collection of EoL products for remanufacturing and recycling.[157] Developing suitable reverse logistics networks for collection is nowadays based on the existing supply chain and the collaboration with supply chain partners, e.g. coordinating collection process with retailers, integrated vehicle routing, and using in-house distribution centers versus using centralized returns centers (CRCs). It supports firms in dealing more effectively with the reverse flows.[158] Using logistics service providers for collection of returned and discarded products is today extensively prevailing for many firms in European countries.[159] RSCM has strongly emphasized the cooperative approach in dealing with reverse flows.

Highlighting the strategic importance of a suitable product recovery strategy for returned products is the critical change of RSCM to manage the reverse flows efficiently. In such a strategy, decision rules are formulated on the handling of returned products in terms of reselling, refurbishing, remanufacturing, and disassembling for parts or recycling. A recovery strategy is determined in advance because it serves as a basis for strategic and tactical management decisions of resource allocations, reverse logistics network design, facility investments, and acquisition method.[160] Prahinski and Kocabasoglu (2006) suggest four predominant groups of product recovery strategy; namely direct reuse, product upgrade, materials recovery, and waste management. They also specify every category with detailed disposition options respectively (see Table 2).

[153] See Sundin (2004), p. 63; Cf. also Cherrett et al. (2010), p. 243

[154] See Guide/Wassenhove (2002), p. 25

[155] See Stock (1998), p. 76; Cf. also Prahinski/Kocabsoglu (2006), p. 521

[156] See Fleischmann (1997), p. 5; Cf. also Guide/Harrison/Wassenhove (2003), p. 2; Fleischmann et al. (2004), p. 16

[157] See Jahre/Flygansvar (2002), p. 4

[158] See Fleischmann (2001), p. 5

[159] See Lieb/Millen/Wassenhove (1993), p. 35; Verstrepen et al. (2007), p. 310; Erol et al. (2010), p. 46

[160] See Krikke et al. (1999), p. 741; Cf. also Brito/Dekker/Flapper (2003), p. 6

Product recovery strategy	Disposition Options	Content
Direct reuse	Direct reuse Resale	Direct reuse and resale with minimum alteration to another customer requiring similar product function
Product upgrade	Repair Refurbishing	Bring the quality of returned or used products up to specified level by disassembly to a module level
	Remanufacturing	Recover used products by complete disassembly down to component level as new quality standard
Material recovery	Cannibalization	Recover a small number of reusable parts
	Recycling	Recycle and reuse materials from used products
Waste management	Incineration Landfilling	Dispose used products/parts by incinerating or landfilling

Table 2: Product recovery strategy and disposition options

Source: Theory et al. (1995), p. 117; Cf. also Prahinski/Kocabasoglu (2006), p. 522

RSCM also focuses more on developing solutions for effective gate-keeping and disposition. Gatekeeping is refers to the ability to identify as early as possible what products should be accepted as a return. Disposition procedures encompass the activities of inspection and testing, aiming to identify the quality level of returned products and to enable quick routing of a return to the most appropriate destination.[161] Selecting a proper disposition can reduce logistics costs while recovered products will be distributed to the market much faster.[162]

Some issues related to making disposition options and developing product recovery strategy in RSC, e.g. the time value of returns and the high congestion level in the queue for inspection and disposition, are also discussed to improve the effectiveness and efficiency of RSCM.[163] For electronic and electrical equipment, time-sensitive products have short lifecycle as a result of high-speed technology growth such as laptops, hand phone, and digital camera, while low time-sensitive products have functional and long lifecycle, e.g. large household appliances, tools, and gardening equipment. Normally, the longer it takes to retrieve a returned product, the lower the likelihood of economically viable reuse options is, especially with the highly time-sensitive products such as information technology equipment and consumer electronics.[164] For example, the high congestion levels in the remanufacturing facility delay the sale of the recovered product at the secondary market, decreasing the value at which it can be sold.[165] The faster responses to collection, inspection, and disposition options support firms in obtaining the returned value effectively, which can be implemented by reengineering the current supply chain and reducing the time delays in inspection and disposition. Responsive reverse supply chain is appropriate for high time-sensitive products, whereas efficient reverse supply chain is appropriate for products with low time-sensitive products. Models of centralized and decentralized reverse supply chain (see Figure 12) exhibit the innovative solutions for companies in dealing with low and high time-sensitive products returned from customers. Value of time for product returns can be used use as a tool to (re)design the reverse supply chain for asset recovery.[166]

[161] See Roger/Tibben-Lembke (1998), 26; Cf. also Prahinski/Kocabsoglu (2006), p. 521; Genchev et al. (2011), p. 254

[162] See Guide/Wassenhove (2002), p. 25

[163] See Blackburn/Guide/Souza/Wassenhove (2004), p. 10

[164] See Blackburn/Guide/Souza/Wassenhove (2004), p. 6

[165] See Guide/Gunes/Souza/Wassenhove (2008), p. 6-7

[166] See Blackburn/Guide/Souza/Wassenhove (2004), p. 7-8

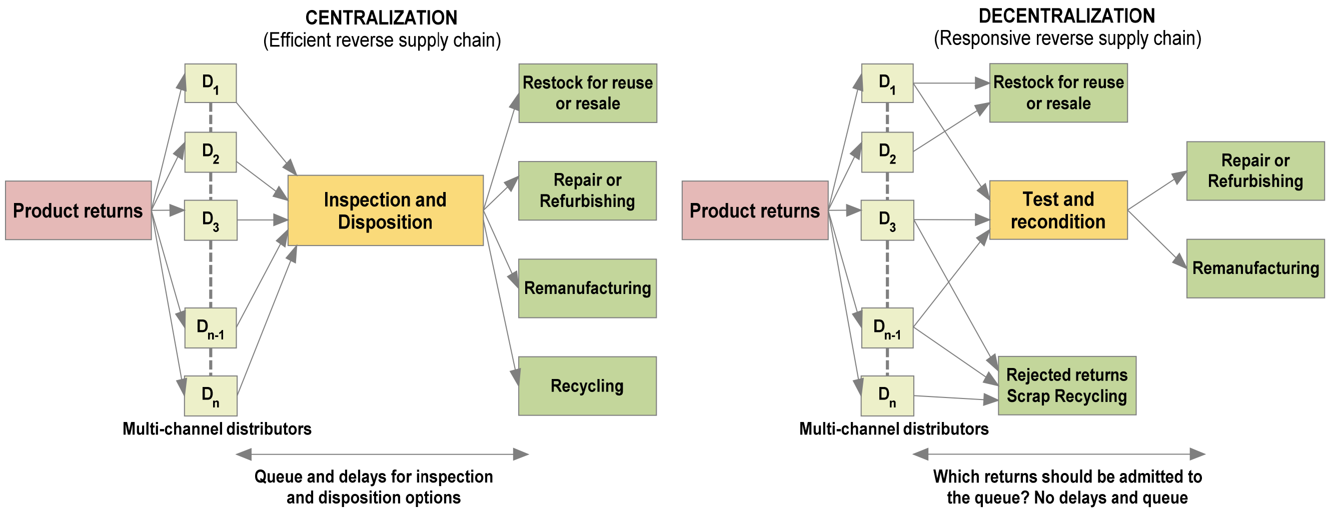

Figure 12: Model of centralized and decentralized reverse supply chain

Source: Adapted from Blackburn et al.(2004), p. 7-8; Cf. also Guide et al. (2008), p. 8

Reverse supply chain is frequently designed for cost efficiency where collection networks minimized logistics costs and the need for managerial oversight. The centralized and efficient supply chain structure using postponement strategy (late product differentiation) achieves processing economies by delaying credit issuance and testing, sorting, and grading until the returned products are collected at a central location. Responsive reverse supply chain is designed to maximize asset recovery by fast-tracking returns to their ultimate disposition (e.g. pre-ponement strategy or early product differentiation) and minimizing the delay cost.[167] Designing a decentralized reverse supply chain management requires the technical feasibility to determine the condition of product returns quickly and inexpensively. Therefore, the investments in information technology are necessary for developing a responsive reverse supply chain. Moreover, early product differentiation also requires some additional works from multi-channel distributors in sorting, handling, and repacking the returns. Proper incentive schemes via shared savings contracts or collaborative agreements may be the best way to induce cooperation and coordination between the manufacturers and distributors in dealing with products returns from customers.[168]

Reverse supply chain also highlights the roles of redistribution by developing capabilities of identifying secondary market and brokers for returned and recovered products, an important factor for a successful and profitable RSCM. Many channels can be used for the resale of returned and recovered products such as using the same channel for both new and used products or selling products via specific brokers. The brokers for returned recovered products can include remanufacturers, internet-based auctions, and catalogue sales to specialized partners, or retailers that specialize in returned goods or secondhand products (i.e. outlets). The remarketability of manufacturers depends on the capabilities of acquisition, refurbishing, and remanufacturing, strategic objectives of protecting brand image, and customer relationships.[169] Firms that are involved in remanufacturing and redistributing their recovered products frequently take into consideration the trade-off between protecting their brand name, and the influences of cannibalization of the recovered products on the sales volume of new products. OEMs also examine their decisions of either collecting used products directly from customers or allocating the collection and inspection responsibility to the retailers, and thus managing collection indirectly. Although retailers through collaborative agreements frequently operate collection of customer returns, the competition still happens when the retailers decide to ship back returned products to OEMs or withhold them for their own operation due to the value and the market potentials. The competition

[167] See Guidet et al. (2006), p. 19; Cf. also Blackburn/Guide/Souza/Wassenhove (2004), p. 16

[168] See Gooley (2003), p. 39; Cf. also Blackburn/Guide/Souza/Wassenhove (2004), p. 17; Guidet et al. (2006), p. 20

[169] See Adamides/Papachristos (2008), p. 260

with local remanufacturers also affects OEMs' strategic decisions to involve themselves directly in the redistribution of recovered products.[170]

In summary, it can be said that the development fundamentals of reverse logistics have originated from increasingly environmental concerns with sustainable development approach, in which the principles of closed-loop economy is the core factor for the development of reverse logistics in Europe. Under environmental considerations and logistics perspective, one of the important roles of logistics to maintain sustainable development was to solve the issues related to the wastes, so called as logistics management of waste streams or waste management. Modern approach of waste management highlights the importance of proper waste disposal and recycling that were the main activities of reverse logistics in the period of 1970s - 1980s. Continuously, closed-loop economy models with the principle of EPR have made a fundamental shift in waste management responsibility towards manufacturers, which motivated more concerns and investments from manufacturing industry to management of reverse flows in their logistics system, especially for EoL products. A closed-loop economy with the integration of ecological and economic objectives is motivated in a systematic product and process management to reduce the wastes, recover value, and improve profit.[171] Reverse logistics has become an important subsystem of logistics system and has coordinated with other domains of logistics to solve the problems of reverse flows occurring in different processes of procurement, production and distribution. The increasing inter-organizational collaboration in sustainable supply chain management also stimulates the development of reverse supply chain through the emergence of closed-loop and open-loop systems.

Although there have also been different viewpoints of reverse logistics in the perspectives of sustainable development, logistics, and supply chain management since the 1970s. "Reverse logistics" or "Reverse supply chain" has become popular in accordance with the evolution of closed-loop economy, logistics, and supply chain management. The changes are useful and necessary for effective and efficient management of reverse flows, suggesting the development of reverse logistics. Figure 13 visualizes the overview of development fundamentals of reverse logistics following time intervals.

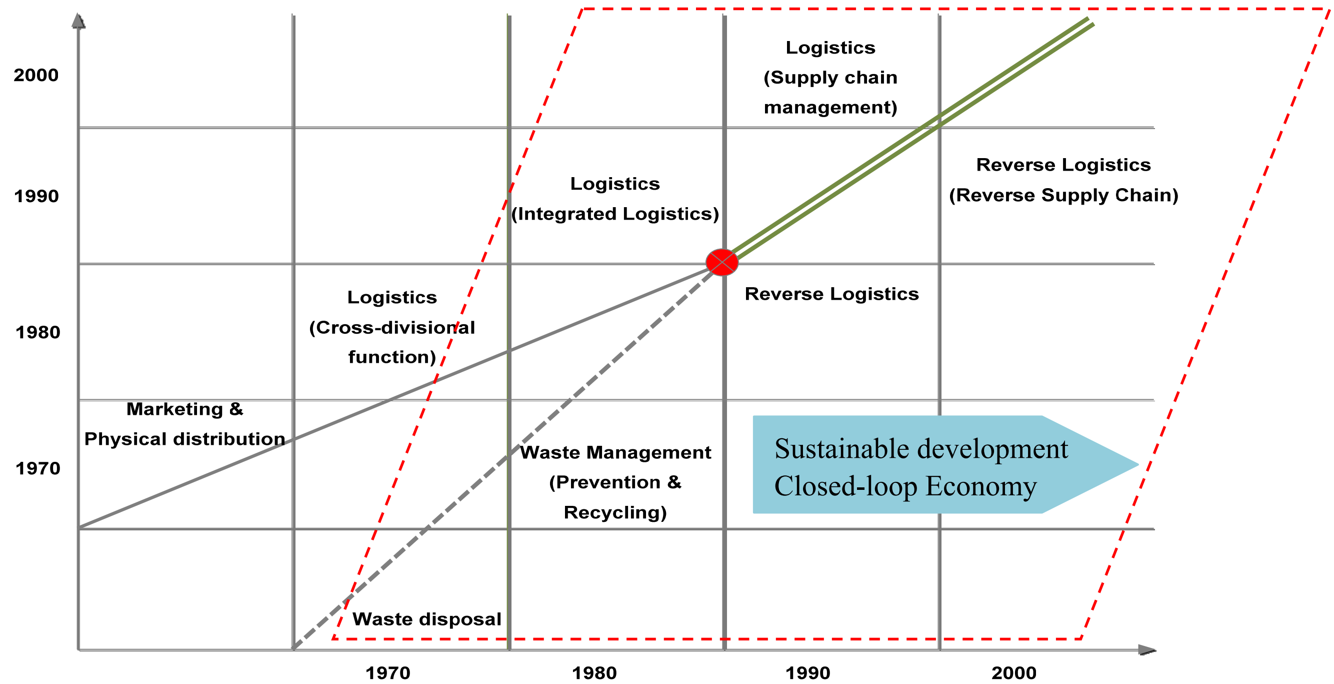

Figure 13: Development of logistics, supply chain management and reverse logistics

Source: Own Illustration

[170] See Sarvary et al. (2006), p. 4

[171] See Beaman (1999), p. 332

2.4. Electronics industry in Europe - A key industry for reverse logistics development

Due to the large scope of applying reverse logistics in different industries, this study focuses on electronics industry in Europe to explore the developments of reverse logistics. Electronics industry is an ideal subject for this study, not only due to its intrinsic economic importance to Europe, but also because of its influence on other industries as well as its position as a key sector in the emergence of reverse supply chains for value added recovery. This industry consists of some characteristics most suitable for analyzing the development of reverse logistics at both firm level and network level.

2.4.1. Growth of the European electronics industry

In the last two decades, the sharp contrasts between the Western and the Eastern European countries have been fading, which is the major driver for Europe's integration. Poland, the Czech Republic, Slovakia, Hungary, Slovenia, The Baltic States, Cyprus and Malta started becoming members of European Union (EU) as early as 2004. In 2007, Romania and Bulgaria have joined the EU. European integration has opened the vast market for the electronics industry.[172] Europe is a leading electronics producer in the world that accounts for about 20% of world production. European is also the biggest market for electronics goods in the world. In 2010, it accounted for 29 percent of the €632 billion worldwide market for "technical consumer products" (see Figure 14). Growth of the electronics industry is also stimulated by the liberalization of the market, the harmonization of standards, the rapid technological advance, and the customer orientation.[173]

Consumers in European countries have increased their consumption of EEE over the last decade.[174] According to Gfk Retail and Technology (2010), consumers in Western Europe spent almost €55 billion on technical consumers goods in the fourth quarter of 2010, an increase of 0.2% in total compared to the same quarter in 2009. The full year 2010 closed with growth of +2.1%, worth €187.6 billion. Demands from Austria, Germany, Sweden, and the United Kingdom (the UK) were the key drivers for the increasing consumption. Consumer Electronics (CE) remained the largest market in term of sales values, amounting to €48.2 billion in 2010. Flat television (TV) and peripheral products have still been the main category in CE due to the high household penetration of above 70%. Consumers in Europe are investigating more in portable devices and new sound sources as well as accessories such as loudspeakers, headphones, and TV mounts. Small Domestics Appliance (SDA) obtained the dynamic growth rate of 7.3% compared to the same period in 2009, especially with the increasing sales of coffee/espresso machines, personal care category, kitchen appliances, and floor care market.

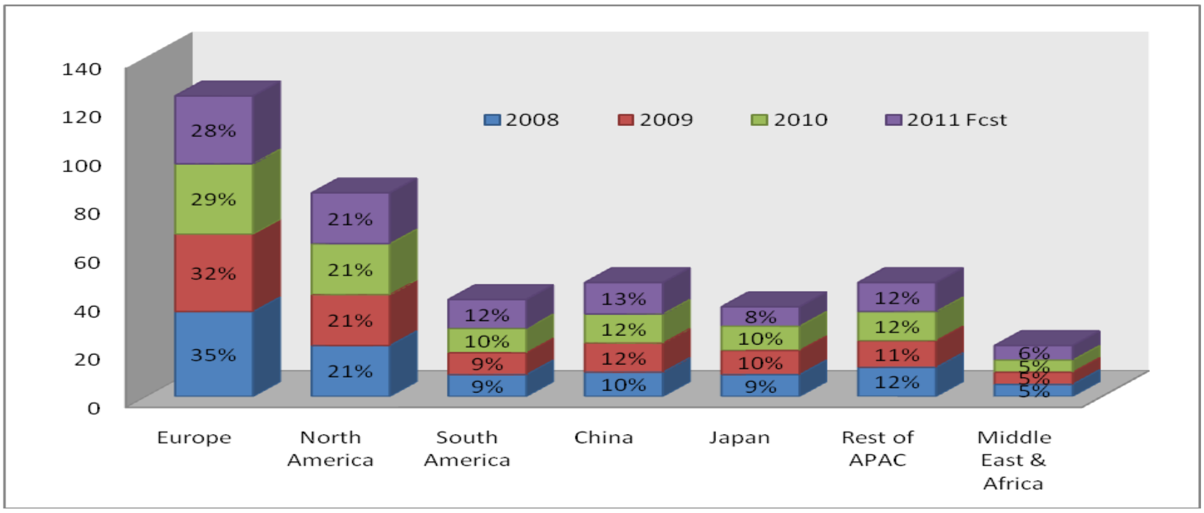

Figure 14: Share of global retail sales revenue by region

Source: IMAP (2010), p. 12-14

[172] See BWI (2008), p. 3

[173] See Janse/Schuur/Brito, (2009), p. 498

[174] See IMAP (2010), p. 17

Information Technology (IT) also maintained its leading positions in terms of growth rate with €45.7 billion in 2010. Mobile computers, digital technology, all-in-one desktop computing with communication and peripheral products drive IT market in Europe. Telecommunication market in Europe in 2010 showed a moderate increase of 0.8%, mainly with the sales volume from Smartphone. All European countries show a rapidly increasing trend towards Smartphone. Large domestic appliances (LDA) maintained its stable growth rate at 2.8% with the sales value amounting to €31.9 billion in 2010. The new EU energy label for washing machine, dishwashers and freezing appliances used on a voluntary basis in 2011 create positive impacts on markets, especially in Germany, Austria, Italy and Spain where energy efficiency has already been a core element influencing the consumer purchasing process for recent years.[175]

However, the European electronics industry has been a highly competitive market. Many new Asian manufacturers, especially from USA, China, Korea, and Japan, have expanded their business in Europe. Customers are becoming more price sensitive and informative because of online remote access and availability of products. The competition depends on not only technical features and low prices, but also the high requirements of modern fashion and customer services. Many market segments of the European electronics market have reached high saturation. The annual growth rate of many segments is less than 5% and even shrinks in areas such as consumer electronics and office equipment in 2010.[176] Manufacturers and distributors in the European electronics industry have paid more attention to differentiating by design, usability of their products, better after-sales services, extended warranty, and more liberalized returns policies to satisfy customer demand and obtain their loyalty.

2.4.2. Characteristics of the European electronics industry and reverse logistics

2.4.2.1. Electronics Industry and reverse logistics development

Electrical and electronic equipment (EEE) are products dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer, and measurement of such currents and fields. The European Directive 2002/96/EC defines four categories for consumer electrical and electronic equipment including large household appliances, small household appliances, IT and telecommunication equipment, and consumer equipment. This study covers all four categories to analyze and detail implications for development of reverse logistics in Europe (see Table 3). However, we focus more on consumer electronics and IT equipment named "technical consumer goods" such as computers, printers, communication devices, TV sets, and cameras because they are more complex than other EEE in terms of the uncertainty of product returns.

Large household appliances	**Small household appliances**
Washing machines	Vacuum cleaners
Refrigerators	Toasters
Clothes dryers	Hair dryers
Dish washing machines	Cooking equipment
Electric stoves	Coffee machine
Microwaves	Fryers
Other large appliances	Other small appliances
Information and telecommunication equipment	**Consumer equipment**
PCs and Laptops	**Television sets**
Cell phones	**Radio sets**
Telephone	**Video cameras**
Printers	Stereos
Other ICT equipment	Other CE equipment

Table 3: Classification of technical consumer equipment

Source: Official Journal of the European Union (2003), p. 2

[175] See GfK Retail and Technology (2010), p. 1-5

[176] See Verweij et al. (2008), p. 25-27

OEMs in the European electronics industry have been under dramatic competitive pressures to differentiate their products with unique functions, attractive fashion, and good price for customers because technical consumer electronics is a fast clock-speed sector, i.e. new products are being introduced at a high rate, especially in the entertainment segment. The rapid rates of technological innovation are clock-speed accelerators in the European electronics industry. The industry clock-speed firms are facing the increase in the father downstream it is located in the supply chain.[177] It means that the lifespan and development cycle of their products is shorter to compete more effectively and to be able to respond to rapidly changing customer demands. As an example, much IT equipment, such as mobile phones, has less than six months between new model introductions. Products such as these that have a very short shelf life can be restocked and returned to the original distribution centers. The average price of LCD/plasma televisions declined nearly 40% in the period of 2004 - 2008, which made the sales increase from €6.7 billion to €20.3 billion in Western Europe.[178] These factors lead to rapid price erosion, create the availability of electronics products to consumers, and offer better after-sales services, all of which are main causes for the high consumption volume. This, in turn, results in the high volume of products returned and discarded. As many experts explained, the management of product returns process in a timely and effective manner in the case of short life cycle goods presents enormous difficulties compared to products whose life cycle is longer.[179] Shorter product lifecycle and huge market volume of these electronic products have resulted in a large potential supply for reverse logistics.[180] Time sensitiveness of these products has impacts on the efficiency and responsiveness of reverse supply chain management.[181]

Moreover, over the last ten years, broadband penetration and Internet usage have increased dramatically across Europe. According to Internet World Statistics (IWS), the internet broadband penetration in 53 European countries increased from 6.2% in 2002 to 58.4% in 2010 with 475 million Internet users.[182] Internet has important impacts on consumer purchasing habits in Europe because they often visit multiple Internet websites, source different information related to goods quality, price differences, after-sales services of electronics producers and distributors, and shop online. Online retail, therefore, has developed rapidly in the European electronics industry, especially with multichannel retailers. Many OEMs such as Philips, Electrolux and Miele, also sell their products directly through their own websites. Nearly 80% of European internet users purchased a product or service online in 2007, which were up from 3% since 2006 and doubled the 2004 figure of 40%.[183] For example, between 1999 and 2005 online retail sales grew 720 percent in the UK, 1,060 percent in Germany, and 1,403 percent in The Netherlands.[184]

In the 1990s, we had yet seen the sharp rise of the online retailing and catalogue that has become prevalent as in the 2000s in the European retail market.[185] It has contributed to changes in multichannel retailers from store retailers to catalogue retailers and online shop, meaning that more commoditization of offerings including an increasingly lenient returns policy and the rise of home delivery.[186] Although the shift has made electronics products more affordable and easily accessible for customers, it has also increased the failed delivery and returns rate due to the misfit with customers in time and their expectations. Online retailing has brought more powers to end customers, increasing the need of after-sales services, services of collection-and-delivery points, and various kinds of support service such as onsite repair services and call centers.

[177] See Fine (2000), p. 271

[178] See Verweij et al. (2008), p. 30

[179] See Serrato/Ryan. (2007), p. 3-5

[180] See Fleischmann (2004), p. 4-5

[181] See Blackburn/Guide/Souza/Wassenhove (2004), p. 7-8

[182] See Internet World Statistics (2010), p.1-2

[183] See Verweij et al. (2008), p. 25-27

[184] See Weltevreden (2007), p. 3

[185] See Heymon (2010), p.1

[186] See Weltevreden (2008), p. 639

These changing requirements, therefore, have led to increasing the roles of reverse logistics for managing returns from forward supply chain.[187]

2.4.2.2. Waste of electrical and electronic equipment and reverse logistics development

Electronics products have direct impacts on the environment through their production, consumption, and end-of-life phase.[188] Due to the increasing consumption and shorter lifecycle of EEE, many electronic products end up in disposal sites. The increase of discarded products in the electronics industry is geared towards growing miniaturization, more complex and compact products, which need the methods of economic and ecological recycling. According to Organization for Economic Cooperation Development (OECD), waste of electrical and electronic equipment (WEEE) is any appliance using an electric power supply that has reached its end-of-life. In this study, WEEE and used electrical and electronic equipment (UEEE) are used as synonyms and include waste of four types of products as presented in Table 3 because in some developing countries like Vietnam there has not been specific definition of WEEE. The amount of WEEE is continuously rising in Europe since the 1990s, not only the amounts per capita but also absolutely due to the enlargement of the Union from 15 to 27 Member states.[189] In 1992, 4-6 million tons of WEEE were generated in the EU, in 1999 the estimates were 5.4 to 6.7 million tons, and in 2010 the number was expected nearly 10 million tons.[190] The report of Savage (2006) reported that WEEE is the fastest growing waste stream, at the rate of 3%-5% per year, which is three times faster than average waste source. Each EU citizen was estimated to produce around 15 kg of e-waste per year.[191]

WEEE contains toxic substances such as bromide, mercury, and lead, all of which are hazardous to the environment. Nonetheless, there are also considerable amounts of valuable materials from discarded electronics products. For example, manufacturing mobile phones and personal computers consumes 3 percent of the gold and silver mined worldwide each year, 13% of the palladium, and 15% of cobalt.[192] Therefore, the materials contained in WEEE are considerable values comparable to the volumes processed in traditional mining operations, which brings economic attractiveness for recovering and recycling. Given its valuable raw materials as well as harmful impacts on environment, there have been increasingly noticeable attentions to sound and effective WEEE management by reusing, recovering and recycling discarded electronics products from governments, manufacturers, recyclers and customers. The electronics industry is thus one of the few sectors for which the principle of EPR is deployed in place of the take-back regulation in the European Union. WEEE management has been one of the main flows in a closed-loop economy in Europe with different collection networks and treatment options. For manufacturers in the European electronics industry, they have responded to the WEEE Directive through EoL management that includes collecting, sorting, dismantling, and recycling. One way of minimizing the environmental impacts of WEEE, complying with the laws, and recapturing the value is to use reverse logistics to increase the amount of product collected and recovered from the waste stream.[193]

2.4.3. Drivers for reverse logistics development in the European electronics industry

Based on the current development and characteristics of the European electronics industry, economic benefits, legislation compliance, corporate citizenship, and customer service initiatives[194] are regarded as the four main drivers for reverse logistics implementation in Europe. In Europe, legislation and customer service initiatives are the main and conventional operational drivers, whereas economic benefits and business orientation for corporate social responsibility are major bottom line benefits and can transform returns manage-

[187] See RLEC PRoject, (2000), p. 3; Cf. also RLEC PRoject (2005), p. 4; Accenture (2010), p. 1

[188] See Herold (2007), p. 17-18

[189] See Henzler/Melnitzky/Lung (2008), p. 1-2

[190] See Doppelt/Nelson (2001), p. 9; Cf. also Ciocoiu/Tarliu/ Burce (2010), p. 14; Deubzer (2011), p. 13

[191] See Zoeteman/Krikke/Venselaar (2010), p. 1

[192] See Strassmann (2010), p. 1

[193] See Rahman/Subramanian (2011), p. 1

[194] See Roger/Tibben-Lembke (1998), p. 80; Cf. also Brito/Dekker (2002),p. 6; Fleischmann et al. (2004), p. 3-4;

ment to strategic assets (see Figure 15).[195] Compliance with the current take-back laws require producers in the European electronics industry to implement the collection and recovery of products and packages at the end of the product life cycle, to shift waste management costs to producers, to reduce volume of waste generated, and to increase the use of recycled materials. Otherwise, the law on consumer rights, especially for distant selling contract, has also put pressures on firms in the electronics industry to ensure that customers can return product within a minimum of 14 days after purchase without any reasons.[196] Therefore, the decisions of reverse logistics implementation have not been optional, but are obligatory to comply with the existing laws and are necessary to create the effectiveness and efficiency of the whole supply chain.

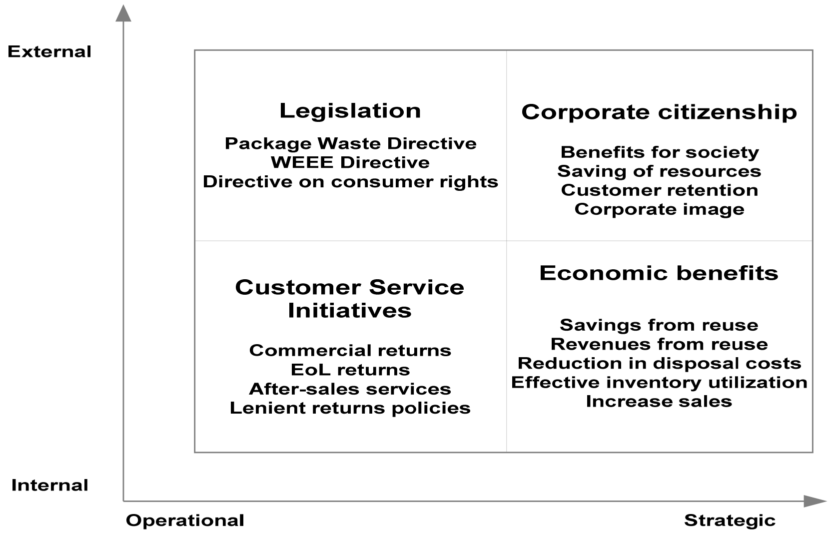

Figure 15: Drivers for reverse logistics development in the European electronics industry

Source: Adapted from Yellepeddi (2006), p. 27; Cf. also Thrikutam/Kumar (2004), p. 5 with modification

Customer service initiatives have been regarded as the important drivers for reverse logistics implementation in the European electronics industry due to the fast changing environments (e.g. the more powerful customers, the boom of multi-channel retailers, the growing competition), and the rapid technology progress (e.g. shorter life cycle, online shopping). The higher return rates have represented some challenges for the existing supply chain due to its complexity in time and variability in rate of returns. Developing customer service initiatives, e.g. convenient after-sales services, more lenient returns policies, and onsite technical services, has required the adjustments of the current supply chain to reverse logistics.

Beyond regulatory enforcements and customer service initiatives, economic benefits including direct benefits are seen as the driving force for reverse logistics relating to all recovery options. Guide and Wassenhove (2001) believe that economic incentives (e.g. cost reductions and value recovery) provide the strongest argument in favor of firms developing closed-loop supply chain for product recovery. Cost reduction is always a driving force for a new look at RL operations in many European electronics firms. The value recovered from used products and the reuse option offer production cost and time saving where parts, components, materials, and reusable packaging are reclaimed to the quality standard required and injected back into the forward supply chain.[197] For example, Dowlatshahi (2000) mentions that remanufacturing is estimated to save between 40 and 60% of the cost of manufacturing a completely new product while requiring only 20% of the effort. Giuntini and Gaudette (2003) argue that remanufactured products incur costs that are 40–65% less than those incurred in the delivery of new products are. Kapetanopolu and Tangaras (2010) indicate that costs range between 10% and 30% for refurbishing and from 30% to 40% for remanufacturing of total product costs of new product by exploring 12 case studies of SMEs involving in product recovery.[198] The reduc-

[195] See Thrikutam/Kumar (2004), p. 5; Cf. also Yellepeddi (2006), p. 27; Kuma/Putnam (2008), p. 306

[196] See European Commission (2008), p. 15

[197] See Saibani (2010), p. 12

[198]Giuntini/Gaudette (2003), p. 41; Kapetanopoulou/Tagaras (2010), p. 107

tion of costs resulting from fewer disposal activities is another major driver, especially given the significant rise in product disposal costs in recent years due to the scarcity of landfill and incineration capacity.[199] Reverse logistics also brings benefits by clearing out customers' obsolete or slow moving inventories, especially for shorter life cycle products of technical consumer electronics, so that these customers can purchase more and newer goods.[200]

Overall, for analyzing development of reverse logistics in Europe, especially for the focus on exploring the adaptability to reverse logistics, the electronics industry in Europe is one of the key industries for reverse logistics development and this industry has more motivations to invest in reverse logistics than others do.[201] The liberalization of the market, the harmonization of standards, the rapid technological advance, the customer orientation, and regulatory requirements have put pressures on companies in the European electronics industry to change and adapt their existing supply chain to reverse logistics, suggesting the development of reverse logistics at both firm-level and network-level.

[199] See Flapper/Van Nunen/Van Wassenhove (2005), p. 5

[200] See Andel (1997), p. 61

[201] See Fleischmann et al. (2004), p. 6

3. Theoretical Foundations of Adaptability to Reverse Logistics

Chapter 3 aims at building a theoretical frame for analyzing the adaptability to reverse logistics in Europe. We start with framing a potential theoretical foundation in chapter 3.1. The theory of social development is provided as the theoretical base for the analysis of reverse logistics development in chapter 3.2. In chapter 3.3, we discuss a theoretical background for analyzing the adaptability to reverse logistics at firm level that includes institutional theory and the resource-based view. We also define some key terms including adaptability, strategy formulation of reverse logistics, and reverse logistics performance, which are all related to analyzing the adaptability to reverse logistics at firm level. Chapter 3.4 focuses on developing a theoretical background for the adaptability to reverse logistics at network level with the development of inter-organizational networks in reverse logistics system. We use theory of transaction cost economics, the relational view, and the network-level approach to explore the adaptability to reverse logistics at network-level.

3.1. Framing a potential theoretical foundation

The purpose of this chapter is to build the theoretical foundations upon which this study is based. By reviewing the related literature, we found that studies on reverse logistics have been lacking strategic implications and the use of organizational theories to understand reverse logistics management in practice. Many studies have focused on topics of Operations Research in reverse logistics such as quantitative modeling for RL networks, production planning and inventory control in remanufacturing, optimal recovery and disposal options, and optimizing collaboration networks in product recovery.[202] However, there have not been so many studies dealing with strategic issues of reverse logistics management such as the influential factors, the collaboration between supply chain partners, the allocations of resources, the formulation of strategy, and the formalization of returns policy. The research objective of investigating the adaptability to reverse logistics at firm and network level leads us to using organizational theories applied in management and business research as theoretical foundations for this study.

Organizational theories combine several theoretical approaches stemming from a variety of other fields and disciplines including psychology, sociology, political science, engineering, and economics.[203] Organizational theories used as a management insight helps explain the changes of institutional environments, the adjustments of organizational behaviors, the strategic decisions of resources, and the development of internal capabilities at different levels of analysis.[204] Organizational theories have been in the early phase of broad introduction and application into operations management and supply chain management.[205] Academic researchers have begun applying organizational theories to the fields of environmental management and sustainable supply chain management. Sarkis et al. (2007) summarize some organizational theories, e.g. stakeholder theory, institutional theory, resource-based view, transaction cost economics, resource dependence theory, and social network theory, which are utilized to investigate various issues of environmental management and green supply chain management. They point out that researchers have started using a number of organizational theories in explicit ways to support the arguments of relationships in green purchasing, green logistics, and environment management.[206] In addition, Sarkis et al. (2007) state that organizational theories provide a very valuable source of theoretical underpinnings for investigating and furthering research in sustainable supply chain management. Therefore, there are still ample rooms for organizational theories examining young research fields like reverse logistics with topics that have not been significant investigated.

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[202] See Fleischmann (1997, 2000, 2001); Cf. also Guide et al. (1997), p. 3; Krikke (1998), p. 8; Krikke et al. (2003), p. 3689; Srivastava (2008), p. 535

[203] See Sarkis/Zhu/Lai (2010), p. 2; Cf. also Hatch (2006), p. 65

[204] See Scott (1987), p. 21

[205] See Ketchen/Hult (2007), p. 573

[206] See Sarkis/Zhu/Lai (2010), p. 19

The difficulty in grounding our research work of reverse logistics in existing theories is that reverse logistics is a young research field and the previous studies mainly focus on management and operational topics without theory-based answers.[207] Framing a potential theoretical foundation is not the same as picking and choosing a cornucopia of theories from all over the place to explain the research work.[208] For building the theoretical foundation in this study, we do not intend to create any kind of new theory, but we use the existing theories to develop our theoretical models explaining the behaviors of firms in adapting to reverse logistics and their collaboration in networks to improve the implementation of reverse supply chain. Through the content analysis of literature review and the interpretation of empirical results, we hope to contribute to broadening the theoretical implications of extant and new organizational theories used in the field of reverse supply chain management.

This study uses theory of social development as a theoretical base to explain the nature of RL development and the factors influencing the existence and development of RL at both firm and network level. Institutional theory and the Resource-based View are used as theoretical foundations for explaining to develop theoretical models investigating the adaptability to reverse logistics at firm level. In addition, we use the transaction cost economics, the relational view, and the network-level approach to develop a conceptual model of adaptability to reverse logistics at network level to analyze adaptability behaviors of firms in inter-organizational collaboration for reverse logistics operations. Figure 16 demonstrates a potential theoretical frame for reference in analyzing the adaptability to reverse logistics in Europe. For processing the theoretical frame, we briefly describe the theory and then follow with the reasons to use it in our research. We also introduce some key terms that support developing the models of the adaptability to reverse logistics in Europe.

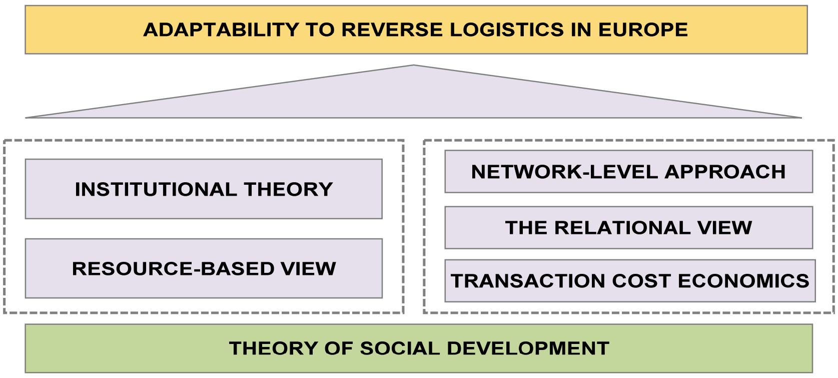

Figure 16: A theoretical frame for adaptability to reverse logistics

3.2. Theory of social development

Development is defined as an upward directional movement from lesser to greater levels of awareness, efficiency, quality, productivity, complexity, comprehension, creativity, mastery, enjoyment, and accomplishment.[209] Theory of social development is a conglomeration of theories about how desirable changes in society are to be best achieved. Development needs to begin not with goals and policies to promote development, but with knowledge of the essential nature and characteristics of development itself, for development is not a set of policies or programs or results. It is a process, not a program. Many factors influence and determine the outcome of this process. There must be a motivating force that drives change, some essential preconditions for the change to occur, or barriers that obstruct the process, a variety of resources such as capital and technology, which contribute to the process, along with several types and levels of infrastructure that support the development.[210] This study uses theory of social development as a theoretical base to explain the nature of reverse logistics development in Europe that originated from the process of sustainable development.

[207] See Rubio/Antonio/Franciso (2007), p. 20

[208] See Lee/Lings (2008), p. 117

[209] See Cleveland/Jacob (1999), p. 2; Cf. also Asokan (1997), p. 1

[210] See Jacobs et al. (1997), p. 3

Sustainable development is a process that embodies the promise of societal evolution towards a more equitable and wealthy world in which the natural environment and cultural achievements are preserved for generations to come. Progress toward sustainability can be observed as the changes of society awareness and its concerns and actions in environmental protection, eco-efficiency, and environmental-friendly operations. Many governments have initiated programs toward national sustainability since the 1990s. Sustainable cities have also been the focus of a European Commission (1996) expert panel.[211] Sustainable development is affected by many factors, e.g. the increasing awareness, the law and regulation framework, the integration of economic and ecological goals, and the advances in technology and knowledge. So much effort from many countries in the world has motivated the evolution of sustainable development such as setting law framework, increasing awareness of different stakeholders, and investing in infrastructures and technology. The legal environment has been regarded as the main driver for sustainability to direct the awareness of individuals and organizations, and to support them in implementing the strategy of sustainable development. The orientation of sustainable development has also been adopted at the firm level. Whereas in the mid-1990s local authorities were probably the most active players trying to implement sustainable development, the focus has recently shifted strongly towards business as a major actor since 2000s. Firms today have increasingly been accepted their responsibility for environmental and social issues as a precondition for doing business,[212] especially in the implementation of corporate social responsibility and sustainable supply chain management.

Infrastructures and instruments are the supports for the main structure of development in physical, social, mental, and psychological forms. Infrastructures are needed to make the activity possible.[213] For example, the development of sustainability is supported by various infrastructures such as the approaches of closed-loop economy, the different framework of legislation, the principles of extended producer responsibility, the awareness of society, and the investments of technologies and resources at different levels (see Figure 17). They are all means for the process of sustainable development. Reverse logistics in Europe has emerged in the approach of closed-loop economy as an important operational instrument to maintain sustainable development and ensured that the economic and ecological objectives will be well aligned.

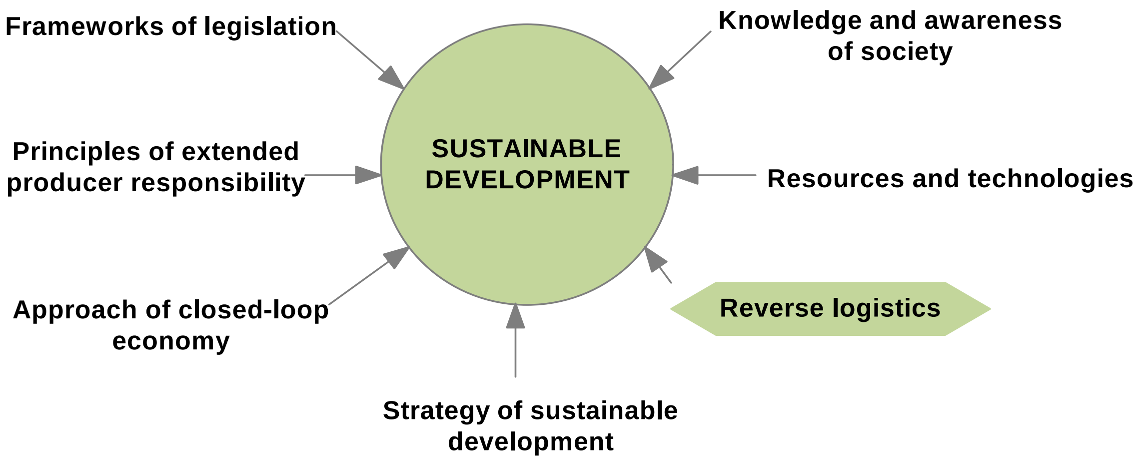

Figure 17: Means of sustainable development

Source: Own illustration

In a specific perspective of development, the existence and changes of reverse logistics is also a sub-process of sustainable development influenced by many factors from both external and internal environment. The factors affect the development of reverse logistics with different level not only by their nature but also up time change. For instance, the awareness of reverse logistics in Europe has moved forward from no clear understanding to solid knowledge of reverse logistics processes, needs and benefits in the period of 1970s –

211 See Dyllick/Hockerts (2002), p. 130

212 See Dyllick/Hockerts (2002), p. 131

213 See Asokan (1997), p. 4

2010s through the increasing concerns in environmental issues, resource scarcities, and social responsibilities. The rapid technological advances have contributed to developing various infrastructures facilitating for the development of reverse logistics, e.g. containers and bins for separation and collection, specialized trucks and vehicles for transportation, and modern techniques for recovery and recycling. Moreover, the changing requirements of consumer awareness and demands, information technology and sharing, and relationships networks have also driven and supported the development of revere logistics over the last decade.[214]

Theory of social development also emphasizes the explanation of the development process by which these influential factors are identified and their roles in the process of development are evaluated. It is necessary to explain how influential factors combine and interact to determine the direction and speed of the progress.[215] This argument plays an important role in analyzing the factors influencing the development of reverse logistics and their interaction because the interrelation between external and internal factors affects the performance of reverse logistics in particular, therefore weakening or strengthening the development of reverse logistics in general. For example, the enforcement of laws may create the positive changes in companies' policies of environmental management and returns management. Customer awareness and demands have put more pressures on firms in European electronics industry for dealing with handling EoL products and customer returns. Moreover, sustainable business practices in many sectors indicate that OEMs are working closely with suppliers, distributors, and service providers because many of them are small and medium-sized enterprises and are not aware of environmental, legislative and eco- design issues. The legal environment has highlighted the importance of network-level approach in the process of reverse logistics development.[216]

In theory of development, an organization is the collective subconscious knowledge becoming an instrument of work through the pioneering conscious individuals. The growth of that organization is defined as the development, in which it converts its resources, powers, capabilities, and skills into social and economic results with higher performance and innovations.[217] For example, developing the necessary organizational knowledge to adopt and implement environmental initiatives has motivated the improvement of management skills, innovative capabilities, and specialized operations for sustainable supply chain management throughout the organizations.[218] The investments in eco-design in combination with product lifecycle analysis in many European electronics firms have helped them develop sustainability strategies in making business to get the long-term achievements and profits. Research on organizational structure has also indicated that logistics innovations and capabilities play an important role in business performance of firms.[219] Thus, efficiency and effectiveness of reverse logistics may have important impacts on firms' strategic performance in term of customer satisfaction, cost reduction, and improved profitability. It has occurred in practice because of firms' changes of awareness, strategies, and resource investments for environmentally oriented reverse logistics management and customer services in doing business.[220]

3.3. Theoretical foundations for the adaptability to reverse logistics at firm level

3.3.1. Institutional theory

The institutional environment is defined as an entity that lies outside the boundaries of the organization. It influences organizational outcomes by imposing constrains on firms' operations and demanding adaptation of firms' processes in order to survive.[221] Institutional theory is recognized through the pressures of social, cultural, political, and legal sector as main factors influencing the operation of organizations. Institutional theory is an important sub-theory of organizational theory, which analyzes how external pressures influence organizations and force them to become more similar. It describes the process by which organizations be-

[214] See Breen (2006), p. 5; Cf. also Oom/Reis (2007), p. 1; Janse et al. (2009), p. 1: Olorunniwo et al. (2010), p. 454; Hsiao (2010), p. 70

[215] See Jacobs et al. (1997), p. 5

[216] See Winkler/Kaluza/Schemitsch (2006), p. 4

[217] See Jacobs et al. (1997), p. 4

[218] See Winkler et al. (2006), p. 20

[219] See Germain (1996), p. 130

[220] See Richey/ Genchev/ Daugherty (2005), p. 831

[221] See Scott/Meyer (1994), p. 1

come institutionalized. In particular, institutional theory emphasizes homogeneity and it argues that forces exist in the environment that would encourage convergent business practices.[222] The term that best describe the homogeneity is called isomorphism, which is a constraining process forcing one unit in a population to resemble other units that face the same set of environmental conditions.[223] According to the institutional approach under organizational field, there are three mechanisms of pressures by which imitations (isomorphism) in structure and processes between organizations are motivated: coercive, mimetic, and normative. Coercive isomorphism derives from formal and informal pressures carried out on organizations by other organizations upon which they depend. Such forces can be exerted through persuasion, invitation to join shared behavioral models, laws and regulations, and government mandates. Coercive forces are typically given to governmental authorities by issuing laws and regulations.[224] Mimetic isomorphism is a firm's standard response to environmental uncertainty by imitating themselves as other organizations, e.g. using lean or agile manufacturing in production, Just-In-Time in sourcing, and Efficient Customer Response in distribution. Normative isomorphism arises from the high degree of socialization and interaction that often occurs between members of the same organizational environment. When these members interact, they reinforce and spread norms of behavior among themselves.[225]

Researchers have increasingly used institutional theory to study how a company addresses green and environmental issues due to external pressures and it has become a major theoretical direction to explain the response of firms to environmental related practices,[226] e.g. green logistics, reverse logistics, and sSCM. For example, government agencies with laws enforcement are an example of powerful institutions that may coercively affect the environmental awareness and the actions of organizations toward environmentally oriented reverse logistics management. Specifically, the European Directive on WEEE requires all manufacturers/importers in the electronics industry to take back and recover their EoL products discarded. Despite the proactive activities of firms in product recovery and pollution controls, the application of the EU environmentally policy in Europe with the orientation of sustainable development has been faster and increasingly obligatory with stricter regulations of controlling take-back and recovering EoL products. Practices of EoL management are an evident example for coercive pressures when most firms in the European electronic industry support and join collective take-back systems to implement their extended responsibility.[227] The homogeneity of behaviors in EoL management and the development of inter-organizational networks such as producer consortia, producer responsibility organizations, and take-back systems providers of large recycling companies and logistics service providers have demonstrated the achievement of isomorphism in compliance with WEEE legislation. Increasing collaboration in networks for managing EoL products has provided examples of behavior imitated by other network members.

Consumers in Europe countries have increasing environmental awareness and are willing to pay more for environmentally friendly products.[228] The increasing environmental awareness and expectation of green products from consumers and society have led to normative pressures for firms. Normative pressures have made firms be more aware of developing environmentally oriented business management, e.g. eco-designing of products, using recyclable materials, and reducing CO_2 emission. Moreover, the more powerful customers, the changes of their behavior and demands in returning and exchanging products have also affected firms by sharing norms of customer orientation through the imitation of customer services initiatives, e.g. more liberal returns policy and extended warranty services, and dedicated after-sales services, in many European electronics firms. Firms, especially for small and medium-sized ones, can model themselves on other organizations by interacting with other supply chain partners to respond to the uncertainty from customer demands.

[222] See DiMaggio/Powell (1983), p. 253; Cf. also Gobbi (2008), p. 200; Yang/Sheu (2011), p. 10611

[223] See Hawley (1968), p. 328

[224] See Hoffman/Marc (2002), p. 151

[225] See DiMaggio/Powell (1983); Cf. also Scott (2001); Yang/Sheu (2011), p. 10611

[226] See Lounsbury (1997), p. 467; Cf. also Zhu/Sarkis (2004), p. 5; Clemens/Douglas (2006), p. 484; Sarkis/Zhu/Lai (2010), p. 9 Connelly/Slater (2011), p. 90

[227] See Herold (2007), p. 54

[228] See Sarkis/Zhu/Lai (2010), p. 10

When large or leading firms have established industry benchmarks for environmental management and sustainable practices through their both operations and products, e.g. energy consumption reduction, CO_2 emission, usage of recyclable materials, waste handling, and voluntary take-back programs, other competitors often follow or do the similar things, leading to "mimic" pressures. The successes of large or leading firms have been typically defined as competitive benchmarking in operations and manufacturing.[229] Mimic pressures play a significant role of motivating many companies in the European electronics industry to develop a formal reverse logistics program, especially for customer returns and EoL product management.[230]

This study uses institutional theory as a theoretical background of management insights to explain how external pressures promote reverse logistics management practices of firms in the European electronics industry. Dimaggio and Powell (1983) state that institutional environments affect a firm's adaptability behavior through its adjustments of company strategies, policies, and processes. Oliver (1991) also indicates institutional pressures factor into companies' decisions.[231] However, institutional theory has not explained clearly how external and internal factors interact to promote the practices of reverse supply chain management. In fact, both external drivers and internal resources were proved to have influences on RSCM practices.[232] There are more factors influencing and motivating the practices of RL operations in an extended supply chain, e.g. customers, competitors, suppliers, service providers, and technological advances. Moreover, the relationships of external pressures from institutional theory with the internal resources and adjustments proposed by the resource-based view need to be further investigated in RSCM practices.

3.3.2. Resource-based view

The Resource-based View (RBV) is considered as one of the most influential theories in strategic management.[233] The term ''resource'' is broad in nature, in that it refers to not only physical (tangible) assets, such as equipment, plants, and location, but also to intangible assets, such as management skill, knowledge, and organizational assets.[234] Resource-based theory views the firm as a bundle of idiosyncratic resources and assets, which emphasizes the use of rate, valuable, in-imitable and un-substitutable resources to gain sustainable competitive advantage.[235] The resource-based view (RBV) investigates the importance of internal resources in determining firm actions to create and maintain a competitive advantage and improve performance.[236] However, only possessing such resources does not guarantee the development of competitive advantage or the creation of value. To obtain superior performance, firms must effectively manage, allocate, and exploit resources.[237]

More specifically, firms that are able to correctly match resources to specific programs and events or to environmental opportunities are more likely to develop capabilities that result in better performance.[238] Differences in allocating strategic resources of the firms are positively associated to differences in providing products and services, therefore leading to core competencies and competitive advantages. Firms' resources can come from different sources, and the challenges for firms are to identify and to manage them for their best strategic usage. There are always problems with the lack of management information that does not provide a complete view of resources of a firm to make allocation and exploitation. The effective and efficient allocations and management of resources are asserted to be a key factor influencing firm performance (see Figure 18).[239]

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[229] See Sarkis/Zhu/Lai (2010), p. 11; Cf. also Connelly/Slater (2011), p. 91

[230] See Bansal/Roth (2000), p. 717; Cf. also Miemczyk (2008), p. 275

[231] See Oliver (1991), p. 145

[232] See Clemen/Doughlas (2006), p. 487; Cf. also Rahman/Subramanian (2011), p. 8

[233] See Barney/Wright/Ketchen (2001), p. 625

[234] See Zacharia/Sanders/Nix (2011), p. 41-42

[235] See Wernerfelt (1984); Cf. also Barney (1991); Conner (1991); Grant (1991)

[236] See Barney (1991), p. 99; Cf. also Hart/Academy/Oct (1995), p. 986; Clemens/Douglas (2006), p. 483

[237] See Sirmon/Hitt/Ireland (2007). (2007), p. 273

[238] See Daugherty et al. (2005), p. 79; Cf. also Ainuddin/Beamish/Hulland/Rouse (2007), p. 49

[239] See Daugherty et al. (2001), p. 107; Cf. also Zott (2003), p. 97; Simon et al. (2007), p. 274; Taylor et al. (2012), p. 5

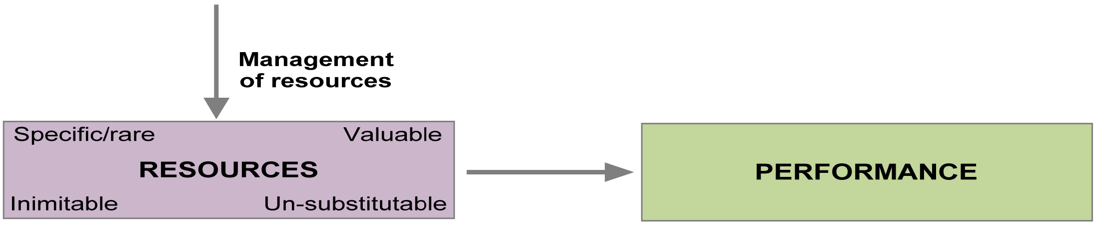

Figure 18: Basic framework of the resource-based view

Source: Own illustration

Some new literature approaches have extended the theoretical framework of the RBV. Grant (1991) distinguishes between resources and capabilities, and identifies the relationship between them as the foundation for a long-term strategy. Capabilities are complex bundles of skills, assets, and accumulated knowledge exercised through organizational processes, which enable firms to coordinate activities and make use of their resources.[240] Firms compete based on their resources and capabilities, and distinctive capabilities of firms are critical resources of sustained competitive advantage and superior performance.[241] The internal resources and capabilities provide the basic direction of a firm's strategy and are the primary sources for the improved profitability.[242] In addition, some researchers extend the RBV to the "dynamic resource-based view" and reflect a firm's abilities to respond effectively to external opportunities/threats based on its internal strengths of resources and capabilities.[243] Simon et al. (2007) argue that resources are only useful to a firm to increase value if the resources are used in a way that takes into account the dynamic external business environment.[244] Many researchers also explore the relationship between resource and strategy, and their influence on business performance.[245] They highlight the key role of strategic management in appropriately adapting, integrating, and reconfiguring company resources and strengths towards changing environments. They argue that the potential value of resources can be exploited by proper strategies of a firm and the strategies in conjunction with a firm's resources base determine firm performance (see Figure 19).

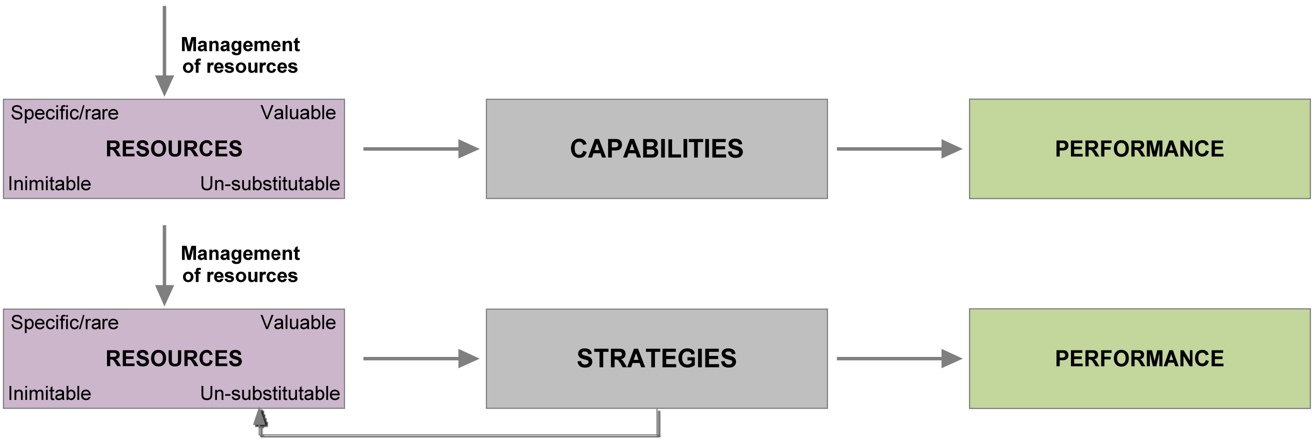

Figure 19: Chain of influences following the resource-based view

Source: Own illustration based on Grant (1991);Cf. also Barney (1991); Teece et al. (1997); Edelmann et al. (2005)

Hart (1995) extends the RBV to a nature-resource-based view of the firm and states that environmentally oriented resources may be deemed as valuable to firms in the future. Business and market has today been potentially constrained by and dependent on ecological systems that are firstly due to a legal requirements and then become a physical necessity. It suggests that strategies and competitive advantages are obtained

[240] See Barney (1991), p. 99; Cf. also Daugherty et al. (2001), p. 110; Grant (1991), p. 114

[241] See Oliver (1997), p. 697; Hsiao (2010), p. 70

[242] See Grant (1991), p. 114

[243] See Teece/Pisano (1997) p. 509: Cf. also Helfat (2000), p. 955; Peteraf/Helfat (2003), p. 997

[244] See Sirmon/Hitt/Ireland (2007), 273

[245] See Barney/Zajac (1994), p. 233; Cf. also Chandler/Hanks (1994), p. 331; Brush/Chaganti (1999), p. 233; Edelman et al. (2005), p. 359; Newbert (2007), p. 121

from capabilities and resources nowadays have facilitated environmentally sustainable economic activities. Hart (1995) links the RBV with natural environment and identifies three related strategies including pollution prevention, product stewardship, and sustainable development. The requirements of resources and capabilities are outlined for each strategy. For example, pollution prevention strategy can be achieved by two primary means of control (waste and emissions are trapped, stored, treated, and disposed of using "end-of-pipe" pollution-control technology) and prevention (e.g. housekeeping, material substitution, recycling or process innovation). Pollution prevention has raised challenges for firms by requiring the voluntary involvement of large numbers of people, especially company employees, in continuous improvement efforts. The easy and inexpensive behavioral and material changes that result in large waste reduction relative costs frequently occur in the early stages of pollution prevention. However, it will become more capital intensive and may require broader changes in product design and technology when a firm's environmental performance improves.[246]

Product stewardship (in USA) or extended responsibility (in Europe) implies that producers of products or services are responsible for taking care of their environmental impacts throughout the product's entire lifecycle. Product stewardship strategy requires an organizational ability to not only coordinate cross-functional groups within a firm, but also integrate the external stakeholders' perspectives into product design and development process.[247] Lifecycle thinking through lifecycle analysis and the implementation of take-back laws have motivated firms worldwide to learn to design products and packaging that could be easily composted, reused, or recycled. However, "greening" products and implementing take-back responsibilities is rather expensive and lucrative early on. Establishing rules, regulations, or standards of "design for disassembly" andconducting voluntary take-back programs requires both uniquely tailored firms' capabilities and increased collaboration with other external stakeholders, e.g. customers, suppliers, service providers, regulators.

For firms pursuing a sustainable development strategy, it requires both substantial investments and a long-term vision to leverage an environmentally conscious strategy of pollution prevention and product stewardship. They must work over a long time and be dedicated to a shared management vision within not only their firms but also with their stakeholders. Given the difficulty of generating a consensus about objectives in a sustainable development strategy, shared vision is a rare (firm-specific) resource, and not so many companies have been able to establish or maintain a shared management vision of sustainable development.[248]

Today, the RBV and its extended approaches are the most recent and fastest growing theoretical foundation to explore strategy of sustainable development and green issues.[249] The RBV, in the context of environmental responsibility, suggests that firms recognize and apply strategic resources and capabilities to imitate practices that simultaneously reduce the impacts of firms' operations on the natural environment and create value for the firm. Managing resources for green logistics operations is nowadays critical for most firms,[250] especially for RL because its complexity and uncertainty requires more concerns and resource investments. This study uses the RBV and its extended approaches to explain how firms in the European electronics industry adapt to reverse logistics by using their resources to improve reverse logistics performance. The RBV has significant potentials for evaluating the influence of investments on reverse logistics capabilities and performance.[251]

Resources to RL may be given more priority because resource allocations may influence firms' strategy formulation and internal capabilities for reverse logistics operations, which results in the differences of adaptability, innovations, and effectiveness and efficiency in reverse logistics performance.[252] For example, increasing resource investments in management and coordination skills, centralized return centers, compute-

[246] See Hart (1995), p. 993

[247] See Hart (1995), p. 1001

[248] See Hart (1995), p. 1002

[249] See Christmann (2000), p. 663; Cf. also Dowell/Hart (2000), p. 1059

[250] See Zacharia/Sanders/Nix (2011), p. 41

[251] See Daugherty et al. (2001), p. 108

[252] See Autry (2005), p. 749; Cf. also Richey/Genchev/ Daugherty (2005), p. 830; Miemczyk (2008), p. 274

rized returns management and tracking system, bar-coding equipment, and radio frequency technology, has improved the capabilities of returns handling.[253] However, not many firms allocate the sufficient resources and capabilities for reverse logistics because it is not the core business activity creating the differentiation and profitability for firms. Therefore, it is necessary for firms to identify which internal capabilities should be developed and who within an inter-organization network has the required resources and associated capabilities collecting, sorting, inspecting, dismantling, and recovering. Depending on resource allocations, firms may have strategies to improve capabilities, or develop relationships (e.g. outsourcing, strategic alliance, or joint venture) to implement reverse logistics efficiently.

3.3.3. Performance of reverse logistics

Over the last two decades, the RBV has been asserted by many studies as a very popular theoretical perspective for explaining firm performance.[254] Research in logistics has examined the influence of high-performance logistics practices and capabilities on organizational performance.[255] Mentzer and Konzard (1991) define logistics performance as effectiveness and efficiency that create value for firm performance. For instance, value can be created through customer service elements such as product availability, timeliness, and consistency of delivery, and ease of placing orders.[256] Increasing customer demands, short product life cycles, rapid technological changes, globalization, and the requirements of sustainability and social responsibilities, may in fact demand break-through thinking to simultaneously develop highly efficient and effective logistics performance.

Efficiency is defined as a measure of how well resources are utilized, which aims at reducing the total cost of logistics performance and efficiency improvement. Specifically, measuring logistics efficiency refers to the comparison of the resources that are used for logistics operations, against the outcomes that are derived and expected from the resource usage.[257] Improving logistics efficiency is accomplished through the reduction of operating expenses, the efficient use of fixed capital, and the efficient use of working capital, while meeting or exceeding a necessary level of customer service. For example, reverse logistics efficiency can be enhanced by proper allocation of current resources to handling of customer returns and EoL products because reverse logistics is further complicated and resource intensive. Firms can achieve lower compliance costs with environmental regulations due to the optimization of using their resources.[258] Efficiency of reverse logistics can also be achieved by reducing the waste, recapturing recovered value, reducing inventory investments, and optimizing the collection networks. These contributions may help firms reduce the costs of reverse logistics (e.g. waste disposal costs, material costs, transportation costs, warehousing costs, and redistribution costs), decrease investments, and therefore improve the profitability. Therefore, the dimensions of reverse logistics efficiency in this study are defined as cost reduction, decreased investments, and improved profitability.

Effectiveness is described as the ability to achieve pre-defined objectives, for example meeting customer service demands, creating customer satisfaction, and improving company competiveness. Effectiveness mentions the extension that the processes achieve the need and expectation of the customers; therefore, a better evaluation of the effectiveness is the satisfaction of the customers with the results. Improving effectiveness equates to the focus of overall revenue enhancement, which is reliant on serving customers at the highest level possible, given strategic goals and cost constraints.[259] Customer service objectives are accomplished through the impact on product availability, fulfillment time, cycle time, convenience, and the ability of the firm's supply chain to handle difficult or nonstandard orders and emergencies.[260] Effectiveness is

[253] See Jack et al. (2010), p. 232

[254] See Newbert (2007), p. 121; Cf. also Crook/ Combs/Todd (2008), 1141

[255] See Fugate/ Mentzer/Stank (2010), p.43

[256] See Mentzer/Konrad (1991), p. 33

[257] See Mentzer/Konrad (1991), p. 35

[258] See Richey et al. (2005), p. 835

[259] See Defee/Stank (2005), p. 28

[260] See Langley/Holcom (1992), p. ; Cf. also Mentzer/Min (2004)

considered a customer-centric performance goal, where the firm and its supply chain are able to deliver products to the end customer in a manner that creates customer value and satisfaction.[261]Reverse logistics effectiveness allows companies an opportunity to improve their competitiveness by building consumer confidence in company brand and image through quick handling of returned products, liberalized returns policies, operations of take-back networks, and green aspects of performance. Firms that are able to provide products that are designed, manufactured and supplied to the end customer through processes that are less impactful on the environment may differentiate themselves from the competitors.[262] Therefore, customer satisfaction and improved competitiveness are defined as main indicators of reverse logistics effectiveness in this study.

Based on the previous studies of logistics performance and some research works of reverse logistics, we suggest that reverse logistics performance at firm level is measured as a multi-dimensional variable with varying degrees of efficiency and effectiveness. It is the upward movement from lesser to greater performance in term of efficiency and effectiveness, demonstrating the development of reverse logistics, specifically the adaptability to reverse logistics at firm level. Effectiveness and efficiency of reverse logistics in this study can be evaluated through improved customer satisfaction, improved competiveness, cost reduction, improved profitability, and reduced inventory investment.[263] In this study, performance of RL is regarded as the important criteria evaluating the adaptability of RL at firm level. Figure 20 presents reverse logistics performance with its two main dimensions.

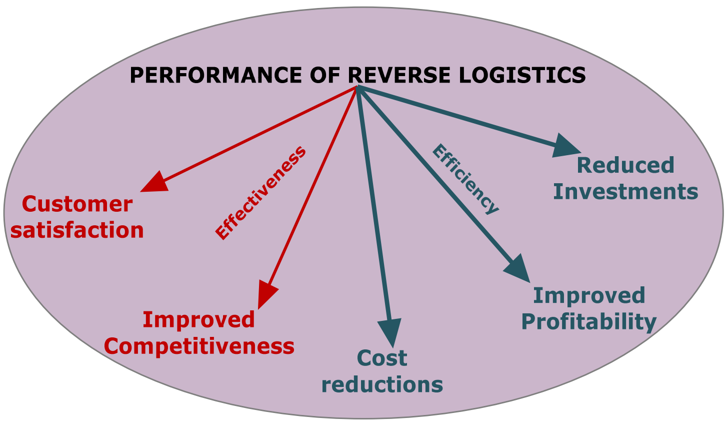

Figure 20: Reverse logistic performance

Source: Own illustration

3.3.4. Strategic formulation of a formal reverse logistics program

Strategic management is the set of decisions and actions that result in the formulation and implementation of plans designed to achieve a company's objectives.[264] Strategy formulation is an ongoing process to develop and revise future-oriented strategies under consideration of its capabilities, constraints and environment in which it operates.[265] Strategy formulation helps organizations to identify the clear options to improve their competitive capabilities in highly dynamic as well as highly hostile environments.[266] In strategy formulation, it is necessary to modify the current objectives and strategies so that firms may adapt to the ongoing challenges to perform more effectively. Reviewing current key objectives and strategies of a firm is necessary to identify a rich range of strategic alternatives to address the new challenges of external environment.[267] Among the components of strategic management, content and quality of strategy formulation process,[268]

[261] See Walters (2006), p. 75

[262] See Reinhardt (1998), p. 43

[263] See Andel (1997), p.61; Daugherty/Autry/Chad/Richey (2001), p. 109; Richey et al. (2005), p. 830; Mollenkopf et al. (2007), p. 568

[264] See Pearce/Robinson (2011), p.3

[265] See Harrison (1999); Cf. also Porter (1985)

[266] See Nandakumar (2008), p. 23-24

[267] See Andrews (1980), p. 12

[268] See Mintzberg (1990), p. 37

business-level strategies,[269] and strategy implementation[270] play an important role in improving competitive capabilities of firms, and therefore lead to superior performance. According to Quinn (1981), a well-formulated strategy in turn helps a firm to bundle internal and external resources into a unique position based upon its relative internal competencies and shortcomings, anticipated changes in the environment, and contingent moves by intelligent opponents.[271]

Presently, firms in the European electronics industry are facing increased pressures from sustainable supply chain management because of growing environmental concerns, stricter take-back regulations, and increasing customer demands. They have expanded their supply chain management from its traditional roles on the forward flow of materials, components, and products to explicitly address the disposal, reconditioning, remanufacturing, and recycling of returned products. The changes of awareness and the increasingly strategic role of reverse logistics have resulted in the increased trend of formulating a separate strategy for reverse supply chain management.[272] For example, Davey et al. (2005) indicate how HP Europe manages reverse supply chain to streamline the process to refurbish existing printers or buy new components. With integrated supply chain in the support of information systems, HP can understand the reasons of the majority of their returns and therefore can quantify the benefits of improving the installation routines of returned printers or the shadow costs of liberal product returns policy accorded to the retailers.[273] Revere logistics programs of IBM Europe have also integrated reverse supply chain practices to enhance environmental performance, recapture the value or components from returned and discarded products to increase revenue or supply for spare part business.[274]

To date, dealing with the issues of reverse flows may require complete attention from management at varying levels, from a firm' strategic to operational level as well as from increased cross-functional integration to intensified inter-organization collaboration. A lack of strategic formulation of a reverse logistics program may be construed as a critical barrier to reverse logistics implementation.[275] Many companies nowadays have formulated specific strategy of reverse logistics, especially for EoL management and customer returns management. Croxton et al. (2001) develop the procedures of returns management at the strategic level with the objectives of constructing a formalized structure through which the operational process is executed. By exploring the development of reverse logistics under strategic considerations, strategic formulation of a reverse logistics program is extracted from strategic returns management process of Croxton et al. (2001) to develop policies, processes, and structures to handle the reverse flow of product, information, and finance.

Based on strategic returns management process, main activities for formulating a RL strategy are identified in this study including developing goals and product recovery strategies, developing gate-keeping and disposition policies; developing RL networks and transportation options, developing returns policies and credit rules, and determining appropriate metrics for RL performance (see Figure 21).

- Determining goals and product recovery strategies is very important in strategic management of reverse logistics because firms should understand the main drivers and objectives to conduct different options of product recovery, e.g. environmental and legal compliance, customer pressures, or economic benefits. For example, innovative ways of reusing, reselling, and refurbishing products, through primary or secondary channels, may create competitive advantages, increase sales, and reduce waste for firms.[276]
- Developing gate-keeping policies refers to screening procedures to identify which products can enter the return stream. Different policies should be developed to screen the returns from different sources such as returns from forward stream, market-driven stream, and waste stream. Developing disposition policies help

[269] See Parnell/ Regan (2004), p. 6-7

[270] See Galbraith/Kazanjian (1986), p. 65

[271] See Quinn (1981), p. 43

[272] See Janse et al. (2009), p. 9

[273] See Davey et al. (2005), p. 87

[274] See Fleischmann et al. (2004), p. 7; Cf. also Flesichmann et al. (2002), p. 5

[275] See Ravi/Shankar (2005), p. 7

[276] See Roger et al. (2006), p. 154

firm enable quick routing solutions for products entering the return stream to the most appropriate destination. Making decision of centralization or decentralization of disposition process also should be considered due to its trade-off of the cost efficiency and responsiveness of RSC.[277]

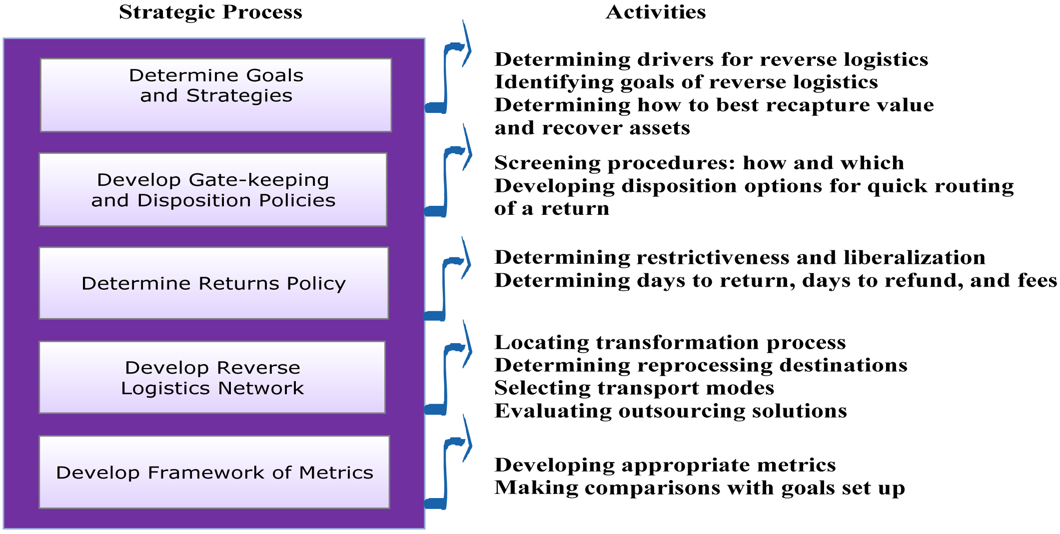

Figure 21: Strategic formulation of a formal reverse logistics program

Source: Adaption from Croxton et al. (2001), p.19; Cf. also Stock/Lambert (2001), p. 153 with modification

- Developing returns policies and credit rules identifies the restrictiveness or liberalization of returns rules, e.g. returns authorization, days to returns, days to refunds, responsibility of restocking fee and returns shipping fee.
- Developing revere logistics network relates to strategic decisions of locating transformation processes, e.g. distribution centers, sorting centers or returns centers, determining reprocessing destinations, selecting modes of transportation, and evaluating if it is appropriate to outsource RL operations to third parties service providers.
- Developing framework of metrics pertains to measuring performance of reverse logistics in comparison with goals set up, e.g. costs of managing returns, revenue recovered from product returned and recovered, and value added benefits.

This study attempts to investigate the level of firms' adaptability to reverse logistics, especially to what extent strategic management is concerned with reverse logistics, because the strategic consideration gives the strong impetus for the successful operations of RL. This study examines the process of strategy formulation as a part of developing a formal reverse logistics program (FRLP), which is extracted after reviewing different literatures and case studies.[278] A formal reverse logistics program is defined as a strategic returns management process that is obtained the commitments and allocations of resources, specifically formulated with strategy, carefully developed with written policies and procedures, and clearly assigned with RL operations.

3.3.5. Adaptability to reverse logistics at firm level

In recent years, increasing environmental dynamism and the adaptability of firms have attracted new academic interest in how firms adapt to changes and obtain their business objectives.[279] Adaptability is known as a key prerequisite for good business performance. However, there are inconsistencies in describing or defining the construct of adaptability, e.g. context, content, and outcome of adaptability.[280] Wiendahl (1999) states that a firm is adaptable if it is possible to accomplish reactively or pre-actively the changes of the transfor-

[277] See Roger et al. (2006), p. 156; Cf. also Mollenkopf et al. (2007), p. 578; Fleischmann et al. (2004), p. 12; SCMR (2011), p. 1

[278] See Autry (2005); Cf. also Croxton/Dastugue/Lambert,/Rogers (2001); Genchev (2009); Richey/Chen/Genchev/Daugherty (2005); Herold (2007); Janse et al. (2009); Genchev/Richey/Gabler (2011)

[279] See Tuominen/Rajala/Moeller (2004), p. 495

[280] See Andresen/Gronau (2005), p. 2; Cf. also Tuominen et al. (2004), p. 495

mation objects (personnel, organization, technology).[281] Verweij et al. (2008) cleverly utilize 3As to realize an agile and efficient reverse chain within the Consumer Electronics industry including agility (the ability to respond to market changes), adaptability (the ability to adjust strategy, products and, technologies), and alignment (the ability to align your organization, processes and systems).[282]

Adaptability is also defined as the capability to adapt to the changing requirements and uncertainties of external environments, which can be described with two main levels of the capability of development (proactive action) and capability of survival (reactive action) (see Figure 22).[283] Proactive action is different from reactive action by the capabilities of forecasting and making scenario to adapt faster than the changing requirements of environment. Both proactive and reactive action of adaptability mentions flexibility as a central element with the changes of activities, structures, and processes.[284] Flexibility is understood as an extension of space for action, which includes the possible alternatives in a decision situation, as well as in reducing the time required to implement specific strategies and actions. To adapt quickly and efficiently to changes in the environment, many companies have increased the flexibility of their supply chains to exploit external opportunities and determine the priorities in resource allocations. [285]

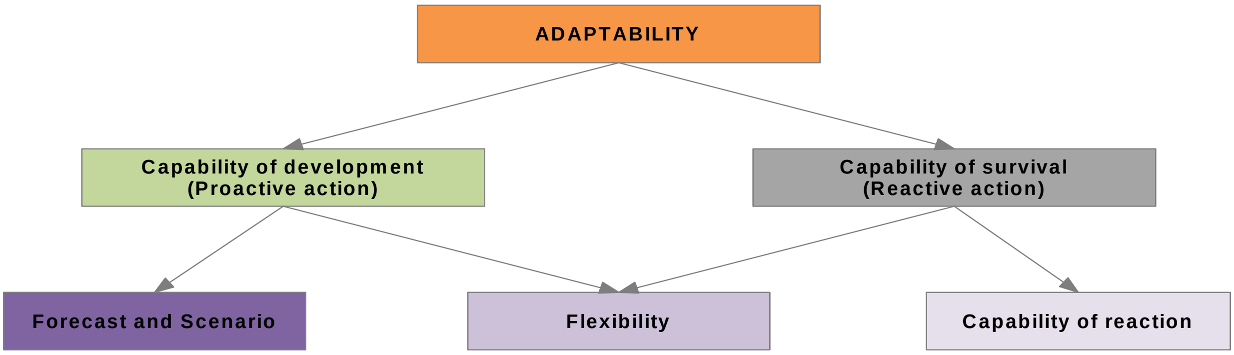

Figure 22: Elements of adaptability

Source: Spath/Baumeister/Dill (2001), p. 235; Cf. also Spath/Becker/Koch (2005), p. 3; Sommer-Dittrich (2009), p. 72

Flexibility of activities lets a firm the open degree of freedom to act differently to meet the external fast-changing environments. Certain decisions can be made before or later when environment conditions change based on the level of adaptability, e.g. proactive, reactive or passive. For example, resource allocations and strategy adaptations to reverse logistics often lag behind the environment changes of regulatory requirements, society pressures, and customer demands due to its complexity and cost burdens.[286] The proactive and flexible adaptability may result in a more effective and efficient reverse logistics program.

Flexibility of structure is the capability of organizational structure adapting to the transformed conditions. The enforcements of laws and the fast changing environments, e.g. the advance in information technology, the involvement of many stakeholders, and the globalization, have forced firms to increase cross-functional integration and inter-organizational collaboration to handle their EoL and consumer returns. These conditions have required firms to have changes and innovations in their specific structure to adapt, e.g. the functional integration of marketing, logistics, and operations for returns management, the development of call centers, and the emergence of corporate environmental affairs unit.[287]

Flexibility of process is the capability of changing and modifying the current processes adapted to new requirements or new business activities. Reengineering the existing process may identify the possibilities of process integration or making changes to adapt to managing return flows.[288] There are more firms making

[281] See Wiendahl (1999), p. 2

[282] See Verweij et al. (2008), p. 25

[283] See Spath/Baumeister/Dill (2001), p. 235; Cf. also Spath/Becker/Koch (2005), p. 3; Sommer-Dittrich (2009), p. 72

[284] See Ivisic (2002), p. 87

[285] See Drucker/Beinhocker (2007), p. 452; Cf. also Swafford/Ghosh/Murthy (2006), p. 170

[286] See Teece/Pisano (1997), p. 510; Janse et al. (2009), p. 7

[287] See Mollenkopf et al. (2011), p. 398; Cf. Also Herold (2007), p. 188; Baumgarten/Sommer-Dittrich (2003), p. 235

[288] See Mollenkopf (2007), p. 568; Cf. also Richey (2011), p. 242

minor changes their existing supply chain strategy to integrate forward and reverse logistics into a closed-loop supply chain. For example, they manage customer returns in coordination with functions of after-sales services and spare part operations. End of life management is controlled by developing new functions for environmental management. Operations of returns handling are frequently integrated cross-different functional departments, e.g. marketing, sales, accounting, operations, and logistics.[289]

Firms can develop and maintain different degrees of adaptability responding to environment uncertainty and leading to varying performance results.[290] While institutional theory considers external forces as the major motives for changes, the RBV considers internal forces as the roots of adaptive capabilities.[291] Strategic analyses rely on institutional environment perspectives focusing on pressure forces and external fit (i.e. looking at the external business environment) to understand performance differences.[292] However, many scholars argue for the need to look at the inside of a firm, e.g. resources, strategies, and capabilities for superior performance drivers and adaptability to fast changing environments.[293] In this study, adaptability is therefore defined as the ability to change or to be changed regarding resource allocation, strategy formulation and development of internal capabilities inside a firm to match with changing requirements and uncertainty of external environments *(Unit is a firm)*. When a firm is required to implement new responsibilities, they have to make questions of whether they possess the necessary resources (e.g. management skills and knowledge, finance, and technology) to comply with the new regulations and to ensure that new responsibilities can be met without damaging their current competitiveness.[294]

Therefore, the adaptability to reverse logistics at firm level in this study is investigated by incorporating the changing requirements and uncertainty of external environments (external factors as context of adaptability), the organizational adaptive capabilities (internal factors as content of adaptability), and the performance (outcome of the adaptability) under two paradigms as follows:

- The adaptability to reverse logistics emphasizes the influence of external factors and the response of organizational-related factors to the changing requirements of external environments in the implementation of reverse logistics. Therefore, we develop the first conceptual model exploring the current influences of external and internal factors, as well as the effect of their interaction on performance of reverse logistics (see Figure 23). The hypothesis development of this conceptual model and the empirical testing thorough internet-based survey are provided in chapter 4. The first conceptual model acts as a general framework to develop the second and third model exploring the adaptability to reverse logistics at firm and network level.

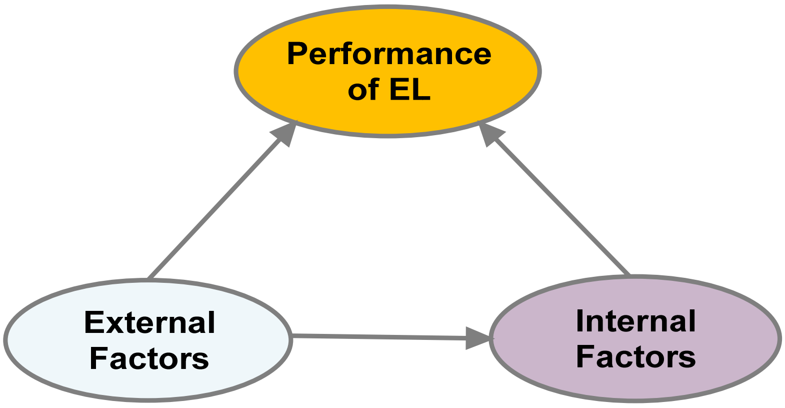

Figure 23: A conceptual model of factors influencing the development of reverse logistics
Source: Own illustration

[289] See Janse/Schuur/Brito (2009), p. 9-10
[290] See Oktemgil/Greenley (1997), p. 447
[291] See Sanchez/Mahoney (1996), p. 63
[292] See Ainuddin/Beamish/ Hulland/Rouse (2007), p. 47
[293] See Rouse/Daellenbach (1999), p. 485; Cf. also Rugman/Verbeke (2000), p. 3
[294] See Walley/Whitehead (1994), p. 46; Cf. also White/Masanet/Rosen/Beckman (2003), p. 445

- The adaptability to reverse logistics also emphasizes the degree to which a firm commits, allocates, and uses a variety of company resources to formulate strategy, to improve internal capabilities, and to achieve a desired end,[295] e.g. effectiveness and efficiency of reverse logistics performance. Therefore, this study develops the second conceptual model investigating the adaptability to reverse logistics at firm level by analyzing the causal relationships of allocating resources, formulating strategy, and developing capabilities on performance of reverse logistics (see Figure 24). We develop the related hypotheses and obtain the empirical findings through internet-based survey in chapter 5.

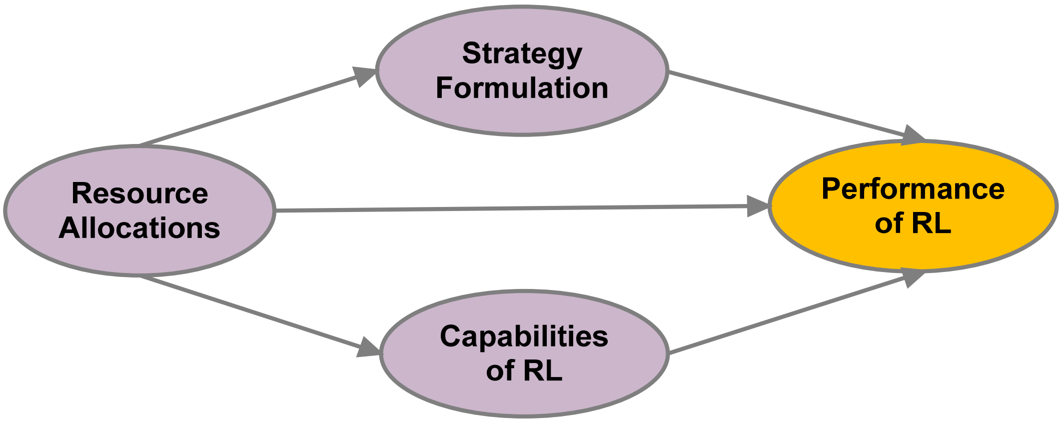

Figure 24: A conceptual model of adaptability to reverse logistics at firm level

Source: Own illustration

However, adaptability is also defined as the ease with which a system or parts of the system may be adapted to the changing requirements.[296] The legal requirements, the society pressures and the economic benefits have motivated inter-organizational collaboration in reverse logistics operations to adapt to the challengeable environments and to get the effectiveness and efficiency of the whole system. Chapter 3.4 develops the theoretical foundation to analyze the adaptability to reverse logistics at network level that primarily features the development of inter-organizational networks in reverse logistics system.

3.4. Theoretical foundations for the adaptability to reverse logistics at network level

Over the last thirty years, organizations around the world have responded to an increasingly turbulent and competitive global business environment by moving away from functionally inclusive, centrally coordinated, multilevel hierarchies toward a variety of more flexible and adaptive structures.[297] Firms have increasingly cooperated with their partners because they acknowledge the competitive advantages and strategic roles of cooperation, e.g. faster coordination, better exchange information, fast decisions, cost reductions, sharing of resources, and improved profitability. Cooperation is defined as "socially contrived mechanism for collective action, which are continually shaped and restructured by actions and symbolic interpretations of the parties involved."[298] The growing collaboration between firms under various forms of inter-firm agreements, inter-firm relationships, and strategic alliance has shifted the collaborative types from single firm to business partnerships and networks over the last decades.[299]

Borgati and Foster (2003) define that "A network is set of actors connected by a set of ties, in which the actors (often called "nodes") can be individuals, work units, teams, organizations, etc. Networks of organizations or inter-organizational networks - clusters of firms or specialized units coordinated by market mechanisms or relational norms rather than by a hierarchical chain of commands - have evolved over the last dec-

[295] See Pfohl/Bode/Nguyen (2012b), p. 92

[296] See EC96 (1996), p. 3

[297] See Walker (1997), p. 75

[298] See Sydow (1992), p. 54-56; Ring/Van de Ven (1992), p. 483; Cf. also Freund (2007), p. 22

[299] See Borgatti/Forster (2003), p. 991; Cf. also Freund (2007), p. 24

ade.[300] Inter-organizational networks in form of a dyad or a network is regarded as a complex arrangement of reciprocal, cooperative, rather than competitive, relationships between legally independent but economically interdependent firms.[301] Inter-organizational networks have become a fashionable description for organizational forms characterized by repetitive exchanges among semi-autonomous organizational forms that rely on trust and embedded social relations to protect transactions and reduce the costs.[302] The case studies of collaborative networks are very popular in the automotive industry,[303] and in the electronics industry,[304] in which firms have made business relationships with various suppliers and subcontractors to produce a complete product. Due to increasingly dynamic, hypercompetitive, complex environments, inter-organizational networks offer a high degree of structural or strategic flexibility to enable adaptation to rapid and extensive changes, as well as to access critical resources.[305]

Studies on inter-organizational networks use a variety of theoretical perspectives of economics and organization to explain the collaboration between firms, the formation of network, the competitive advantages of network relationships, and the network outcome as a whole. However, little theoretical and empirical work exists documenting the adaptability at network level, especially in the fast-changing environments. The transaction cost economics (TCE) developed by Williamson (1981) is one of the fundamental theories for the explanation of the reasons for strategic decisions of transaction level between firms,[306] and can be therefore regarded as one basic background for network formation. Dyer and Singh (1998) postulate the "relational view" (RV) with four determinants of relation-specific assets, knowledge-sharing routines, complementary resources and capabilities, and effective governance to understand the competitive advantages achieved from the relationships between firms. The RV of Dyer and Singh (1998) can be used in this study to explain the adaptability behavior of firms in inter-organizational routines and processes to obtain relational rents and competitive advantages. Provan et al. (2007) have expanded the collaborative approach of supply chain management by broadly discussing inter-organizational collaboration at network-level to explain how the network as a whole is formed, governed, and developed. Network-level approach of Provan et al. (2007) can be used to explain the adaptability at network-level through the capabilities of coordinating network members, governing network relationships, developing network resources and capabilities, and obtaining network outcome.

3.4.1. Transaction cost economics

Transaction Cost Economics (TCE) developed by Willamson (1975) focuses on the role and effects of transaction costs on the economic behavior of individuals and organizations.[307] The basic unit of analysis is the economic transaction: a transfer of a good or service from one party to another rather than the unit of analysis used in neoclassical theory of a price and output of a good, service or resource.[308] Transaction cost economics determines the conditions under which a firm should manage an economic exchange internally within its boundary or externally through inter-organizational arrangements.[309] It focuses on reducing the total transaction costs of producing and distributing a particular good or service. These costs consist of the costs for initiation, negotiation, execution, monitoring, and adjustment, which are determined by frequency, uncertainty, and asset specificity involved in the transactions.[310] Williamson (1989) identifies three types of asset specificity including site specificity (e.g. location), physical asset specificity (e.g. machines, equipment, and tools), human asset specificity (e.g. know-how, management skills). The dimensions of asset specificity

[300] See Walker (1997), p. 75; Cf. also Gulati (1999), p. 4; Borgatti/Forster (2003), p. 995

[301] See Olesch (1995); Cf. also Sydow (1992), p.65; Pfohl (2008), p. 286

[302] See Walter/Powell (1990), 295; Cf. also Borgatti/Forster(2003), p. 995

[303] See Womack et al. (1992), p. 164

[304] See Wildemann (1994), p. 7

[305] See Sydow (1992), p. 23; Cf. also Gulati/Gargiulo (1999), p.4

[306] See Teece/Pisano (1989), p. 32; Cf. also Freund (2007), p. 23

[307] See Williamson (1981), p. 548; Cf. also Holland (2000), p. 5

[308] See Williamson (1981), p. 564

[309] See Lau/Yang (2009), p. 450

[310] See Williamson (1981), p. 548

(the level of investment supporting a transaction), frequency (e.g. one time, occasional, and recurrent), and uncertainty (e.g. the availability of the product or the service exchanged in the transaction) are used to make decision of a transaction, affecting the strategic options of in-house operation, outsourcing or strategic alliance (see Figure 25).

Attributes	Transaction costs	
Frequency of transaction	Low frequency => High cost	High frequency => Low cost
Uncertainty	Low uncertainty => Low cost	High uncertainty => High cost
Asset specificity	Low specificity => Low cost	High specificity => High cost

Figure 25: The transaction cost economics and its attributes

Source: Adapted from Williamson (1981); Cf. also Lau/Wang (2009); Gibbo (2008)

According to the TCE, managers are primarily motivated by efficiency considerations to choose governance forms that make the sum of production and transaction cost lower. Governance is defined as the combinations of legal and social control mechanisms for coordinating and ensuring the collaboration partners' resource contributions, administrative responsibilities, and division of rewards from their joint activities. Governing collaborations can be institutionalized in different forms with three main options of governance structure: hierarchy form, hybrid form and market form based on the degree of inter-organizational relationships. Hierarchy form can be illustrated as vertical integrated or self-management when the operation and control of processes remain within the company itself and with little or no interaction with external partners. Increasing the level of vertical integration means to increase the number of value chain activities performed internally.[311] The forms of internal operations can be organized following functional or profit-center organization. Firms also acquire another company to improve their internal capabilities by merging their resources and capabilities. Hierarchical coordination can reduce transaction costs of firms to a minimum, but require a substantial resource investment at the first stage.

At another extreme, firms in relationship networks can assess the resources, capabilities, and synergy effects through pure market transaction or straightforward contractual relationship. Relational contracting may range from "arm's length transaction" in the form of supply contracts, service contracts, and swapping contracts. Firms can avoid substantial resource investments and focus on core activities of their main business by outsourcing some business processes to other partners. The interchangeability of business partners provides flexibility and enables companies to choose service providers offering the lowest price by hard bargaining.[312] Market transactions are governed by formal terms and interpreted in a legalistic way, but the identity of transacting parties is unimportant and no dependency exists between them. The key hazard of transacting via markets occurs when one party must invest in transaction specific assets to conduct the transaction efficiently, and may become easily dependent on other party because such investments value when applied to other transactions. Therefore, it may lead to "hold-up" risks for the party who made the investments.[313]

In between the extreme of hierarchical and pure market are many hybrid forms of inter-organizational collaboration that are referred to strategic alliances such as joint venture, equity investments, consortia, strategic cooperative agreements, cartels, franchising, licensing, and long-term contract. The common features of these collaborative arrangements are that the relationship is not fully determined by ownership or formal contract. In comparison to hierarchical relations, these relationships are more loosely coupled and stay market sensitive. Hybrid collaboration as "quasi firm" combines some of the incentive structures of markets with the monitoring capabilities and administrative controls associated with hierarchy (internal organization). In addition, an alliance can provide a superior means to gain access to information, resources and other com-

[311] See Todeva/Knoke (2005), p. 2; Saccani et al. (2007), p. 53

[312] See Picot/Reichwald (2003), p. 23

[313] See Toffel (2004), p. 127

plex capabilities that require coordinated responses.[314] Figure 26 presents three main options of governing inter-organizational collaborations at different levels.

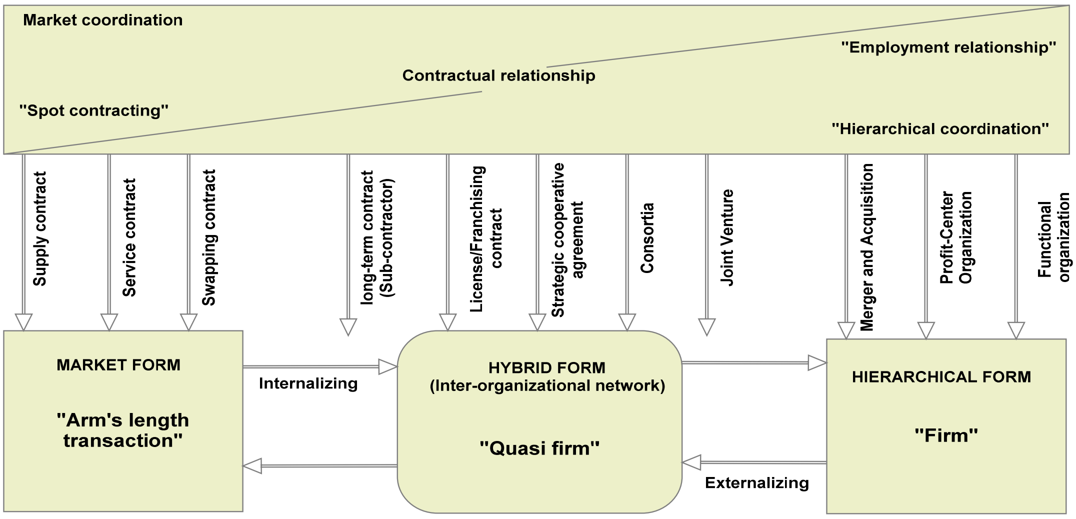

Figure 26: Transaction levels of inter-organizational collaboration

Source: Sydow (1991), p. 15; Cf. also Todeva/Knoke (2005), p. 3 with modification

This study uses the TCE as a theoretical base for explaining the formation of inter-organizational collaboration in reverse logistics operations. The TCE can explain the strategic decisions of make-or-buy, outsourcing or joining inter-organizational cooperation for product take-back and recovery based on its assumptions and its key concepts of asset specificity, uncertainty, and transaction frequency. For example, Toffel (2003, 2004) uses the TCE to explain OEMs' strategic decisions of engaging in EoL product recovery. The specificity of recovered components (e.g. recovered value used for new products) and the asset specificity of human resources and physical assets in reverse logistics process (e.g. investments in skilled labors, specialized equipment, and technology) are some of important criteria in selecting inter-organizational collaboration in reverse logistics operations. When the specificity of the recovered component through reuse for new production and the capabilities of utilizing the current assets (e.g. human resources and physical assets) for recovery process are high, firms should be integrated internally within company by in-house operation.[315] Due to the complexity of reverse logistics and high uncertainty environments, Toffel (2004) indicate that product recovery transactions, e.g. refurbishing and remanufacturing are more efficient by having OEMs vertically integrate, or develop hybrids such as consortia, alliances, or joint ventures to gain better access to information and mitigate hold-up risks.[316]

In addition, the TCE argues that in a situation of low strategic importance of the transaction and low asset specificity, cooperation is still considered advantageous even if environmental complexity and uncertainty exist. In this situation, partners benefit from the possibility of close coordination while saving monitoring costs because the task's low strategic importance does not require the extensive control mechanism.[317] Although reverse logistics has increased its roles in business performance over the last decade, reverse logistics operations of acquisition, handling, testing, recovering and recycling have not been regarded as strategic means of differentiations and cost reductions. Reactive compliance with the laws through collective participations in producer consortia or producer responsibility organizations for EoL management can help many OEMs in European electronics industry reduce the costs of EoL management and still keep corporate image. Kocabasoglou et al. (2007) find a greater likelihood of joint investment in reverse logistics between firms for lower value recyclables and activities classified as waste management. Gobbi (2008) also uses the TCE to explain the transaction and the degree of inter-organizational collaboration between different stakeholders in

[314] See Magail (1999), p. 639; Cf. also Todeva/Knoke (2005), p. 3 for more explanation

[315] See Toffel (2003), p. 118

[316] See Toffel (2004), p. 126

[317] See Williamson (1981), p. 553; Cf. also Wolff/Neuburger (1995), p. 85

reverse logistics networks for EoL management, e.g. OEMs with collective take-back systems, OEMs with service providers, and collective take-back systems with service providers.

Although the TCE provides the possible explanation for strategic decisions of transaction and collaboration, the TCE does not explain comprehensively how firms adapt to participating in an inter-organizational network, especially in hybrid forms with alliances for transactions involving idiosyncratic assets in competitive environments marked by rapid change.[318] The TCE has not provided the arguments for exploring how firms in a dyad or a network adapt to get competitive advantages from network relationships. The relational view of Dyer and Sign (1998) is used in this study to complement the TCE for explaining the behaviors of adaptability between firms in the network.

3.4.2. The relational view

Dyer and Singh (1998) emphasize that the (dis)advantages of an individual firm are often linked to the (dis)advantage of the network of relationships in which the firm is embedded. The relational view postulates four potential sources of inter-organizational competitive advantages: (1) relation-specific assets, (2) knowledge sharing routines, (3) complementary resources/capabilities, and (4) effective governance. Therefore, the adaptability behaviors of firms at dyad/network level to seek competitive advantages are characterized by their willingness and abilities to make investments in relation-specific assets, and their availability of sharing and exchanging the related information and knowledge, as well as their absorptive capacity.[319] Moreover, they are also demonstrated through identifying and evaluating potential values of combining resources and capabilities, and selecting governance structure that minimize the costs and thereby enhance efficiency.[320]

The RV emphasizes the adaptability of firms in strategic alliances to get the competitive advantages and postulates that alliances generate the benefits only as they move the relationships away from the attributes of market relationships, e.g. nonspecific asset investment, minimal information exchange, low level of interdependence of resources, and minimal investment in governance mechanism.[321] The RV focuses on the generation and development of inter-organizational resources and capabilities through alliance, which are particularly difficult to replicate by rivals due to their idiosyncrasy.[322] Firms in inter-organizational collaboration can may adapt and gain the competitive advantages quickly when potential alliance partners have necessary complementary resources and available relational capabilities. Firms therefore try to seek advantages by creating assets that are specialized in conjunction with the assets of an alliance partner.[323]

Due to the complexity and uncertainty of RL, strategic alliance and cooperative agreements between companies taking part in the reverse logistics initiatives are required, and this involves specific investments of assets and commitments of a business, organizational and relational nature.[324] In reverse logistics management for customer returns (e.g. warranty returns, defect returns, remorse returns) and B2B returns (e.g. leasing contracts, trade-in, buybacks), many firms in the European electronics industry are able to utilize their existing resources and capabilities, and develop new capabilities with their partners by combining the complementary resources, e.g. IBM Europe and Geodis, BSH and DHL. For EoL management, since the development of legislative frameworks of waste electrical and electronic equipment directives, firms in the European electronics industry have increasingly involved themselves in the process of identifying the required resources and associated capabilities to comply. They have decided whether to integrate these activities and have identified potential firms with whom to develop relationships (contractual or hybrid forms) to manage reverse flows. Partners are selected in the implementation of RL due to their existing capabilities for product recovery and potentials to develop capabilities in line with OEMs, producer consortia or take-back

[318] See Magail (1999), p. 636

[319] Partner-specific absorptive capacity refers to the idea that a firm has developed the ability to recognize and assimilate valuable knowledge from a particular alliance. It allows collaborating firms to systematically identify valuable know-how and then transfer it across organizational boundaries.

[320] See Williamson (1981), p. 548; Cf. also North (1990); Teece/ Pisano (1997), p. 509; Dyer/Singh (1998), p. 676

[321] See Dyer/Singh (1998), p. 662

[322] See Gold/Seuring/Beske (2010), p. 230

[323] See Dyer/Singh (1998), p. 662; Cf. also Teece (1989), p. 509

[324] See Gil et al. (2006), p. 2

system providers. Combining resources and developing capabilities for reverse logistics operations are specific to members in RL networks and have the potential at least to provide competitive benefits such as lower costs for recovery and higher revenues from parts and material sales.[325] Moreover, by collaborating and sharing information with retailers, OEMs in the European electronics industry can have better forecasting of returned products, especially for sales information, returns rates, and inventory level of slow-moving products.[326] Through knowledge sharing and management with other network members, firms in the networks, especially OEMs, distributors, and LSPs, can design and distribute new, innovative products and processes to increase customer satisfaction, decrease the returns rates, and handle the returns more efficiently.[327] The effectiveness and efficiency of reverse logistics operations can also be improved in the process of product design and material selection by considering the requirements of the customer's post consumption and the comments of service providers or partners, e.g. logistics providers, remanufacturers, dismantlers, and recyclers, related to collecting, sorting, recovering, and recycling.

Although the RV frequently explains for the adaptability behaviors of firms in a dyad, it has not provided the arguments for exploring the adaptability of a network as a whole. Sydow (1992) also emphasizes that "the evolution and effects of relationships between two or more organizations can only be understood in the context of their embeddedness in the entire network."[328] Christopher (1998) states that supply chains could be viewed as networks and a network view may complement the common collaborative approach in supply chain management.[329] According to Stock and Lambert (2001), a network must be viewed as a whole where all activities are to be understood by how they affect/are affected by other activities with which they interact. Network-level approach of Provan (2007) can support additional foundations for analyzing the adaptability at network level.

3.4.3. Network-level approach

While dyads are the basic building blocks of networks, focusing on most cases limited as a collection of two-party relationships, specific connections and collaborations of a number of companies (or company units) form a network of enterprises as a unique, multi-organizational social structure or even a social system in its own right.[330] Networks of enterprises allow relations to be established in all possible directions including horizontal, vertical, and lateral and diagonal relations.[331] Provan et al. (2007) postulate that an inter-organizational network at network level consists of multiple organizations linked through multilateral ties, which refers to a group of three or more organizations connecting in ways that facilitate achievement of a common goal.

Many types of connections flows including direct ties, indirect ties and structural holes exist in networks of organizations in form of information, materials, financial resources, technologies, and services, can link relationships among network members, in which connections may be informal and totally trust-based, or more formalized with a legally binding contract.[332] The number of direct ties a firm maintains can affect its business performance by providing substantive benefits such as resource sharing, combination of knowledge, skills and physical assets, and taking advantage of scale economies. Indirect ties are relationships that a firm can reach in the inter-organizational network through its partners and their partners. A number of indirect ties that are maintained by a firm also provide access to knowledge spillovers because a firm's partners bring the knowledge and experience from their interaction with their other partners to their interaction with the focal firm, and vice versa.[333] Firms are connected indirectly across their partners through multiple chains of al-

[325] See Miemczyk (2008), p. 280

[326] See Olorunniwo/ Li (2010), p. 460

[327] See Hsiao (2010), p. 72

[328] See Sydow (1992), p. 75

[329] See Christopher (1998); Cf. Also Malmborg (2004), p. 1

[330] See Schubert (1994), p.9

[331] See Kaluza et al. (1999), p. 3

[332] See Provan/Fish/Sydow (2007), p. 7

[333] See Gulati/Gargiulo (1999), p. 16; Cf. also Ahuja (2000), p. 430

liances that together form the network as a whole. The analysis of network as a whole is more complex than blocks of network. Through indirect ties of inter-firm network, each additional node that a firm has access to can serve as an information-gathering device, information processing, or screening device for ensuring the quality of products and services, developing of new technologies, processes, and know-how.[334] The strength of ties can be measured by the frequency of interaction between partners and their level of resource commitments to the relationships.

Structural holes indicate gaps information flows between a firm's partners linked to the same firm but not linked to each other.[335] It means that a direct relationship is missing between two firms that are not indirectly tied by other firms in the network. When a third firm allies with both firms, the hole is filled, and network connectivity is increased.[336] Burt (1992) argues that a firm filling a structural hole benefits from acting as a broker that ties together other organizations because the firm can access diverse resources and sources of information to set the favorable trading terms over its partners.[337] Walker (2005) indicates that a completely closed structure of a whole network means that all a firm's alliance partners are also partners of each other, while a completely open network is one where the partners have no alliances among themselves. The structure of inter-organizational networks can frequently be observed are somewhere between two extremes of these two networks.[338] An open inter-organizational network is good for the central firm because it inspires entrepreneurship and arbitrage with disconnected partners.[339] Networks of organizations with indirect ties and structural holes may be a typical feature of network-level approach. Structural holes and the large number of indirect ties may be an effective way for actors to enjoy the benefits of network size without paying the costs of network maintenance.[340]

The centrality of network members and or of the network overall is calculated by considering the extent to which an organization's position in the network lies "between" the positions of other organizations, which is regarded as "betweeness centrality." Betweeness centrality is considered a useful index of the potential of a point for control of communication in the network.[341] The centrality of an entire network signifies the tendency of a single point to be more central than all other points in the network, indicating the centralization of the network.[342] The measure of centrality identifies the role of central firms that have relationships with other firms that are themselves central,[343] emphasizing the role of brokering and information availability. Firms with central owners apparently had better access to information and opportunities related to restructuring and coordinating the network memberships. In addition, the centrality of the network as a whole evaluates the closeness between network members, suggesting the higher degree of closeness in the network. It implies that a firm can reach or be reached by other firms more quickly or more efficiently in terms of the number of links taken (see Figure 27).[344]

Firms that establish their cooperation networks depend on their efficiency considerations of transaction costs and how they are structurally involved themselves in the network.[345] While the transaction cost perspective stresses the efficiency benefits from reducing the governance cost of a transaction, a network approach allows consideration of the strategic benefits from optimizing not just a single relationship but also the entire network of relationships.[346] Therefore, inter-organizational networks can obtain their competitive advantages

[334] See Freeman (1991), p. 499; Cf. also Leonard-Barton (1984), p. 101; Ahujia (2000), p. 430

[335] See Ahuja (2000), p. 431

[336] See Walker (2005), p. 118

[337] See Burt (1992), p. 18

[338] See Walker (2005), p. 118

[339] See Burt (1992), p. 23

[340] See Ahuja (2000), p. 425

[341] See Freeman (1979), p. 224; Cf. also Provan et al. (2007), p. 11

[342] See Freeman (1979), p. 227

[343] See Bonachich (1984), p. 1170

[344] See Freeman (1979), p. 225; Cf. also Walker (2005), p. 122

[345] See Rowley/Behrens/Krackhardt (2000), p. 370-371

[346] See Gulati/Nohria/Zaheer (2000), p. 4

through the combination of complementary resources, the share of information and knowledge, the development of capabilities, and the effective governance.[347] The necessity for complementary resources is a key driver of inter-organizational cooperation. For example, trust, commitments, and shared values of knowledge, information, advanced technology, and learning between supply chain members are regarded as examples of strategically important resources in inter-organizational collaboration.[348]

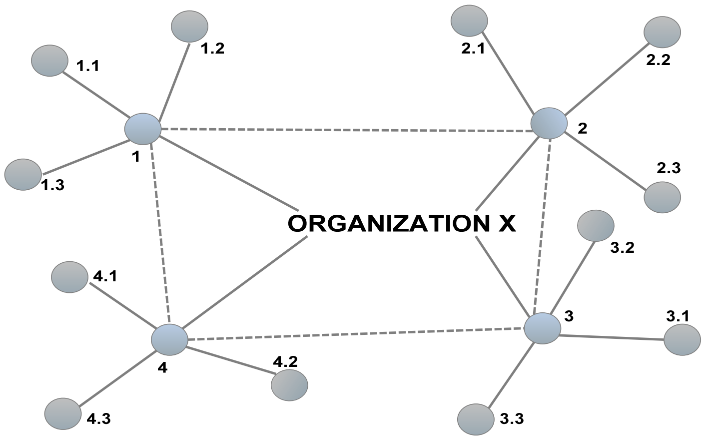

Figure 27: Direct ties, indirect ties, and structural holes in an inter-organizational network
Source: Ahuja (2000), p. 449 with modification

The examination of whole network can explain why the performance of a firm is influenced by multilateral collaboration of the networks to which it is embedded. Based on these perspectives, the network-level approach can be organized along two dimensions including the independent variable (organizations or networks) and the dependent variable (focus on organizational outcomes or on the outcomes of collectivities of organizations). Figure 28 demonstrates the possibility of four different types of network interactions.[349]

Dependent variables/Outcome focus

Independent variables /Input focus

	Individual Organizations	Collectivities of Organizations
Organizational variables	Impact of organizations on other organizations through dyadic interactions	Impact of individual organizations on a network
Network variables	Impact of a network on individual organizations	Whole networks/Network level interactions

Figure 28: Interactions in an inter-organizational network
Source: Provan et al. (2007), p. 51

Many variables can be used to explain the creation and design of inter-organizational networks, which indicate the network-level properties and processes associated with the whole network such as network structure, network development, network governance, and network outcome.[350] Network structure refers to the overall pattern of relationships within which an organization is embedded. The structural properties are aggregated across an entire network focusing mainly on the centralization, the types of collaboration, and geographic dimensions. Network development may be seen as the result of the development of not only resources and capabilities, but also objectives, rules, and norms produced as steering and motivating mechanisms to drive development of the network.[351] Mechanism used to govern and/or manage the overall network signifies the

[347] See Dyer/Singh (1998), p. 660
[348] See Gulati/Gargiulo (1999), p. 13; Cf. also Carter/Roger (2008), p. 374; Gold/Seuring/Beske (2010), p. 233
[349] See Provan/Fish/Sydow (2007), p. 8
[350] See Provan et al. (2007), p. 20
[351] See Sydow/Windeler (1998), p. 266

features of network governance. Types of network governance for the entire network can vary considerably and range from self-governance, to hub-firm or lead-organization governed, to a network administrative organization. Provan and Kennis (2007) identify that for goal-directed organizational networks with a distinct identity, some form of governance is necessary to ensure that participants engage in collective and mutually supportive action, that conflict is addressed, and that network resources are acquired and utilized efficiently and effectively. Although the network covers a range of interactions among network members, a focus on governance involves the use of institutions and structures of authority and collaboration to allocate resources and to coordinate and control joint action across the network as a whole.[352] Network outcome measures the effectiveness and efficiency of the whole network performance that can mean different things to each network[353] and to each member in the network.

This study uses network-level approach to support the arguments of the adaptability to reverse logistics at network level because a reverse logistics system encompasses networks of providing logistics and processing services for collection, transport, sorting, and recovering products returned and discarded. Inter-organizational cooperation for the development of intra and inter-organizational product recovery and recycling has gained increased theoretical and practical importance over the last decade.[354] Therefore, the network-level approach may gain significant importance as a newly comprehensive approach to reverse supply chain management because the implementation of take-back and product recovery involves numerous multilateral ties operating in the system. Relationships with customers, retailers and logistics service providers for handling product returns, the coordination with government bodies, industrial organizations and non-governmental organizations (NGOs), the integration with suppliers for eco-design development, and the collaboration with service providers for dismantling, repair, remanufacturing and recycling are typical network relationships in an inter-organizational reverse logistics system. These network relationships are basically established to share information and knowledge to obtain a set of closely connected resources from their members for cost-effective reverse logistics operations.

Due to the enforcement of take-back laws, producers in the European electronics industry must implement their task nationwide. Disassembly and recycling contracts are now no longer operated in a decentralized ways by every single public management company. However, they are centralized by producers, producer consortia, and take-back system providers.[355] Therefore, reverse logistics operations are frequently organized in the form of highly centralized networks with a Hub-and-Spoke pattern. Inter-organizational reverse logistics system is also characterized by networks with indirect ties and structural holes. The existence and developments of many take-back system providers such as producer responsibility organizations, large third party logistics services providers, and large recycling companies operating as brokering agents have connected service providers to each other. Service providers, in turn, have strongly linked them to other blocks of the whole network in inter-organizational reverse logistics system. Therefore, the RL networks coordinated and governed by hub firms is today one of the salient features of the adaptability to reverse logistics at network level.

3.4.4. Adaptability to reverse logistics at network level

In the 1980s, the increase in cooperation activities was mainly observed as a reaction to changes in the dynamics of the business environments.[356] However, firms has been more proactive in increasing their relationship networks with strategic motives and implications of cooperation since the late 1990s due to an increasingly complex and uncertain environment with the changes in economy, politics, legislation, and technology. The main strategic motives for developing collaboration networks are driven by increasing competitiveness and improving profitability of firms.[357] Many strategic advantages can be obtained through

[352] See Provan/Kennis (2007), p. 231

[353] See Provan et al. (2007), p. 27

[354] See Kaluza et al. (1999), p. 1; Cf. also Kumar/Malegeant (2006), p. 1127

[355]See Walther et al. (2010), p. 465

[356] See Freund (2007), p. 35;

[357] See Kogut (1988), p. 322

cooperation including realization of economies of scales and learning curve effects, assess to partners' technologies, and know-how, risk reductions, and positive influence on the structure of the competitive environment.[358] The new approaches to network collaboration, e.g. the relational view and network-level approach, under the strategic perspective have explained the achievement of competitive advantages from external resources and capabilities by exploiting the networks of relationships in which firms are embedded. The evolution of strategic network relationships has partly signified the development of inter-organizational cooperation over time, specifically the adaptability of inter-firm networks.

Firms have involved adapting to changes in a complicated network of organizations for seeking better integration of resources as well as a higher flexibility in the supply chain networks.[359] Network decisions often require consideration of a large number of factors from multiple dimensions and perspectives, e.g. network structure, network resources and capabilities, network governance, and network effectiveness. Network managers, e.g. hub firms, frequently encounter two main issues when making these decisions are (i) the structural intricacies of their interconnected networks[360] and (ii) the need to adapt the network in a constantly changing environment to ensure its long-term survival.[361] Although there are more interests focusing on identifying and developing the networks that offer a high degree of structural or strategic flexibility[362] and enable adaptation to rapid and extensive changes,[363] the concept of adaptability of an inter-organizational network, e.g. strategic network, has not been defined clearly in the studies of network organization.

The understanding of adaptability at network level is mainly explored through the adaptation and adaptability of logistics networks,[364] the flexibility of networks,[365] the effectiveness of network,[366] the complexity and adaptivity of networks.[367] Malmborg (2004) states that adaptability of logistics networks is the flexibility or the capacity to adapt to face future changes. Logistics and SCM seek better integration of resources as well as a higher flexibility in the chains. Integration means a closer adaptation facilitating the coordination of activities and leading to performance that is more efficient. However, too much adaptation can lead to less adaptability or harder to change because more elements are adapted to each other. Lee (2004) refers to adaptability as a willingness to reshape supply chains when necessary, without ties to legacy issues or the way the chain has been operated previously. Choi et al. (2001) define the adaptability of supply networks as Complex Adaptive System that is an interconnected network of multiple entities exhibiting adaptive action in response to changes in both the environment and the system of entities itself. Grandori and Soda (1995) indicate that the flexibility of a network needs more efficient and effective forms of governance to coordinate the disparate networks members who are disaggregated across the network through the combination of market and hybrid form. In spite of the emergence of new governance mechanisms, multilateral forms of relational governance, based on high levels of trust and commitment among the parties and reliance on mutual adjustment based on relational norms can provide the essential foundation for network adaptability.[368]

Based on analyzing the theoretical foundations and some literature of adaptability, this study defines the adaptability at network level as the capabilities of controlling network relationships, coordinating network partners, combining network resources and developing network capabilities to respond to the fast changing environments and to obtain the competitive advantages of the whole network (Unit is a network).[369] The conceptual model of adaptability at network level is instituted with five dimensions as shown in Figure 29.

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[358] See Porter/Fuller (1989), p. 375-376; Cf. also Freund (2007), p. 36 - 39 for more detail analysis

[359] See Walker (1997), p. 75; Cf. also Malmborg (2004), p. 5; Pathak et al. (2007), p. 548

[360] See Choi/Hong (2002), p. 469

[361] See Brown/Eisenhardt (1998)

[362] See Sydow (1992), p 78

[363] See Pfohl/Buse (2000), p. 388

[364] See Malmborg (2004), p. 5

[365] See Grandori/Soda (1995), p. 5

[366] See Lee (2004), p. 102

[367] See Pathak et al. (2007), p. 547

[368] See Williamson (1991), p. 269; Cf. also Morgan/Hunt (1994), p. 20

[369] See Pfohl/Bode/Nguyen (2012a), p. 9

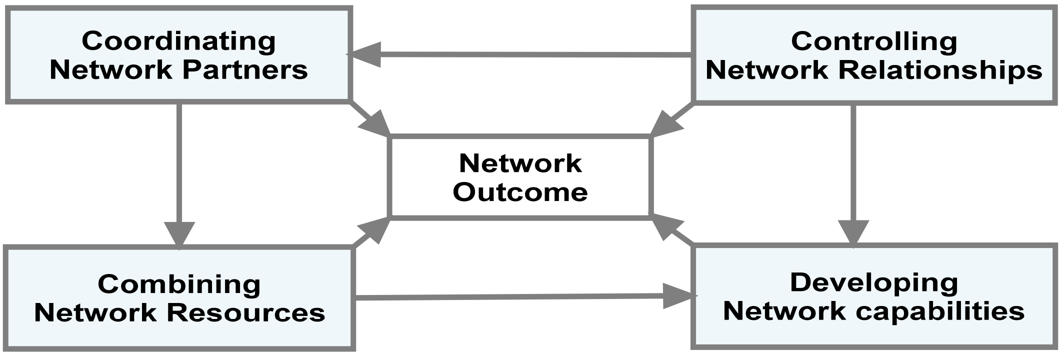

Figure 29: A conceptual model of adaptability at network level

The capabilities of coordinating network members emphasizes the level of connectedness in networks through direct and indirect ties in the form of diversified collaboration types, e.g. market form and hybrid form. Coordinating network members also highlights the relational capabilities (RC) between network members to share information and knowledge to identify the potentials of combining resources and developing capabilities. Governing network demonstrates the adaptability through the role of network members in shared governance or governance with brokers to minimize transaction costs and enhance efficiency. The organizational capabilities (OC) are emphasized in governing network relationships including defining rules, selecting monitoring mechanism, creating common goals and culture, contracting and negotiating, and building networks. Governing network relationships affects the capabilities of coordinating network members and the abilities to develop network capabilities. Network capabilities of specific asset investments show the physical capabilities (PC) of identifying potential values of resources from network members and motivating the integration and investments of resources to improve the capabilities of the whole network.[370] The network outcomes of effectiveness and efficiency are affected by four above-mentioned determinants and can be observed at network level as a whole.

Strategic networks with the salient feature of "hub-firm" are the focus for analyzing the adaptability at network level in this study. A so-called "hub-firm" or a large focal company standing in the centrality of the network provides the strategic lead for the overall entirety of network, determines the relevant market and network objectives, coordinates the partners involving in the networks, distributes the resources of network, and evaluates network performance.[371] An important factor for understanding the adaptability of a strategic network is how a hub firm, via coordination and governance mechanism, to ensure that network members can contribute to the augmentation of network resources and effectiveness.[372] The capabilities and performance of network depend on how much network resources are available to a hub firm to coordinate and govern network members,[373] and to the entire network for operating the tasks and objectives of networks, e.g. trust, commitments, accessibility to relations with other partners, knowledge and information, information technology, and equipment and facilities. The analysis of adaptability to reverse logistics at network level is carried out in chapter 6 through the method of content analysis of case study literature.

The evaluation of adaptability at network level is observed through network operations and outcomes which are affected by sets of rules and resources used in the process of managing and organizing network relationships.[374] Evaluating outcomes of a RL network is a special case of inter-organizational networks because the performance of the whole network is influenced by many stakeholders, e.g. government body, NGOs, industrial organizations, customers, OEMs, distributors, and service providers. They participate in the network, play diverse roles, and differently influence the outcome of network as a whole. Therefore, it appears to be rather complicated to give out a full range of related indicators to evaluate efficiency and effectiveness of an

[370] See Dyer/Singh (1998), p. 662; Monnet (2008), p. 13

[371] See Sydow/Windeler (1998), p. 267

[372] See Sydow/Windeler (1998), p. 268

[373] See Sydow/Windeler (1998), p. 272

[374] See Sydow/Windeler (1998), p. 275

inter-organizational reverse logistics network. Traditionally, organizational effectiveness is defined in terms of achieving goals such as a certain degree of productivity or profitability. Most of the studies give out criteria to assess effectiveness and efficiency of RL performance at firm level including improved customer satisfaction, improved competiveness (corporate image), cost reduction, improved profitability, and reduced inventory investment.[375]

Based on the network-level approach, the outcome can be observed from two level of analysis: the individual network firm and the total inter-organizational network.[376] On the level of individual network, network effectiveness and efficiency results from the partial network effect that a particular firm can appropriate and eventually represent in its accounts, which bring them individual outcomes, e.g. cost reduction as well as the volume of products collected and recovered. On the level of the total inter-organizational network, network outcome depends upon the effectiveness and efficiency of all single network firms and upon the augmentation of resources to be achieved by the differentiation and integration of the entire network.[377] Every network member can contribute to better network outcomes. For example, a recycling network can ask the collaboration from its network members in sharing resources, capacity, and technology to increase collection volume and reduce recycling costs. Baumet al. (2003) found that the stability of the whole network is in part dependent on the types of relationships occurring within sub-networks, based on their "small world" properties. As sub-networks evolve, the stability of the network can be determined by the nature of the organizations' status within the network.[378]

Network outcomes can be assessed in the light of system requirements (e.g. production volume, costs of management and operations, and profit), powerful stakeholders (e.g. customers, shareholders, authorities, employees, NGOs, and other organizations (e.g. government body, paying-fee member). Sydow and Windeler (1998) indicate that stakeholders or strategic constituencies which may be either internal or external to a focal organization or network. External stakeholders, investors in particular, are likely to determine the criteria of how network effectiveness is measured, but less likely to decide concrete calculating practices. Hence, network firms, and possibly the entire network, have to act in a way that is not only systemically viable but also acceptable to external stakeholders, the most powerful of which are likely to use financial criteria, e.g. operating costs and member fee, to evaluate the performance of the system.[379] Sydow and Windeler (1998) also point out that in case of strategic networks the hub firms more than any external or internal stakeholders are likely to influence the evaluation of concrete inter-organizational practices and the overall effectiveness and efficiency of the network.

A common goal of a reverse logistics network, especially for EoL management, is to bring benefits to both society and its members in terms of the reduction of environmental impacts and operating costs. Outcome of a reverse logistics network is firstly measured by increasing collection amount annually.[380] An effective take-back system starts with the effective acquisition of products returned and discarded from generators (end-consumers and business customers). If the generators are willing to participate consistently, this behavior can be stimulated by assuring that a collection program delivers good services and these services are convenient and consistent in time. At best, it leads to the high volume of collection and lower cost solutions for take-back system. Fleischmann et al. (2001) conclude from a numerical study that the overall network structure of a reverse logistics system is robust with respect to variations in the collection volume and recovery volume.[381] The second requirement for effectiveness is the collection and transport system in view of the targeted reprocessing application. Reuse naturally requires that products are returned in the best possible conditions and are shielded from any sort of (weather) damage. Material recovery, however, can often bear less

[375] See Guiltinan/Nwokoye (1975), p. 28; Cf. also Andel (1997), p. 61; Daugherty/Autry/Chad/Richey (2001), p. 109; Richey/Chen/Genchev/Daugherty (2005), p. 830

[376] See Sydow/Winder (1998), p. 274

[377] See Sydow/Windeler (1998), p. 274

[378] See Baum/Shipilov/Rowley (2003), p.697

[379] See Sydow/Windeler (1998), p. 274

[380] See Sanborn (2007), p. 9

[381] See Fleischmann et al. (2001), p. 13

careful handling. If the products are also transported and stored in a cost-efficient way to the facilities of the reverse logistics network (logistics costs), take-back system can obtain cost efficiency in transport and temporary storage. Efficiency may also call for the lower costs in sorting, dismantling, remanufacturing and recycling.[382] Some studies analyzing a comparative overview of some take-back systems for discarded products emphasized the criterion of cost efficiency in collecting and recovering, the effectiveness of collection and treatment (the volume of discarded products collected and recovered per head of population).[383] Based on distilling the major literatures related to the performance of RL network, network outcome, especially network effectiveness and efficiency, in the conceptual model is examined through four main criteria: the volume of discarded products collected, the volume of discarded products recycled, cost of logistics (collection, transport and storage), and cost of treatment (dismantling, recycling).

[382] See Beullens (2005), p. 299

[383] See DIT (2003), p. 22; Savage (2006), p. 60

4. Factors Influencing the Development of Reverse Logistics

The renewed interests in reverse logistics in the European electronics industry over the last decade are mainly driven by the stricter enforcement of laws, the increasing customer demands, and the economic benefits. This chapter explores the critical factors driving and facilitating the implementation of reverse logistics from both external and internal environments, and identifies the response of organizational-related factors inside the firms to the changes of external environments. The effect size and the mutually interrelated relationships of these factors are also determined by analyzing mediation effect with bootstrapping method. In this chapter, the literature review is introduced in chapter 4.1 as one of the theoretical bases for developing the hypotheses. Chapter 4.2 and Chapter 4.3 analyze the influence of external and internal factors supporting the development of reverse logistics in practice. Chapter 4.4 develops hypotheses based on the first conceptual model to explore the influences of factors through empirical study with internet-based survey. Chapter 4.5 explains the foundations of empirical study and statistical techniques used for investigating research models. Chapter 4.6 presents the results of empirical study with some managerial and research implications.

4.1. Literature review of factors influencing the development of reverse logistics

There are many external and internal factors influencing the implementation and development of reverse logistics. The major reason for this growth is social concerns based on industrial environmental degradation and the desire to achieve sustainable development. Included in these factors are regulatory issues, market and customer pressures, and ethical motivations to improve environmental performance.[384] From a marketing and business perspective, the development of reverse logistics has resulted from the increased focus on customer orientation by developing customer service initiatives and using more lenient returns policies to improve competitive advantages of firms. These factors have become drivers and facilitators to stimulate reverse logistics implementation, which therefore influence the development of reverse logistics. Many authors have mentioned factors influencing the existence and performance of reverse logistics from different perspectives and methodologies. We found out some common factors addressed in many previous studies and divided them into two groups of external and internal factors (see Table 4 and Table 5). Many previous studies exploring the factors influencing the implementation of reverse logistics were conceptual and focused on descriptive anecdotal analysis, which were based on the qualitative approach with case study and literature review.

Stölzle (1993) presents the fundamental concept of environment-oriented business management, develops the roles and relationships of reverse logistics in logistics system, and analyzes the practical implementation of reverse logistics inside the firms by literature review and case study analysis. The author mentions the requirements for environment-oriented management from external context factors including governmental authority, policy makers, customers, and society. Legislation is regarded as the important factor for the direction of environment-oriented business management, especially with environment policy and waste management, and the principle of extended producer responsibility. The author also discusses the roles of stakeholder groups involved in implementing environmentally oriented business management, particularly with the increasing awareness and demands of customers.[385]

Carter and Ellram (1998) based on reviewing literature to develop a conceptual framework of identifying the critical factors influencing reverse logistics operations. The study illustrates four main external factors including input (suppliers), regulatory (governments), output (customers), and competitive (competitors) in the business context of firms, directly affecting the reverse logistics activities. Regulatory factor is found to have greater influence on reverse logistics activities than others are, and customer affects the changes to reverse logistics to a significantly greater degree than do the input and competitive factors. Some internal factors supporting reverse logistics operations are also proposed in which company policies, top management sup-

[384] See Presley/Meade/Sarkis (2007), p. 4607

[385] See Stölzle (1993), p. 2-7

ports, and functional integration are necessary to the continued success of reverse logistics.[386] Carter and Ellram (1998) also propose that the greater the level of cooperation between buyers and suppliers, the greater level of reverse logistics.

Roger and Tibben-Lembke (1998) indicate that the overall amount of reverse logistics operations in the economy is large and still growing. Some main factors analyzed in this study range from external ones such as public awareness, legislations, and support of supply chain partners to internal considerations including significance of RL to other issues, company policies, strategic planning, top management commitments, information and technological system, financial resources, personnel resources, performance metrics and quality of returned products. For many companies at that time, it was difficult to successfully execute reverse logistics because of different internal and external barriers such as awareness of importance of reverse logistics relative to other issues, company policies, and lack of systems, competitive issues, management inattentions, company resources, and legal issues.[387] However, the authors also forecast that there would be more interests and concerns in reverse logistics in the future because of the changing requirements of environments and the proactive efforts of firms.

Stock (1998) recommends that factors related to management and control, measurement, and finance may determine the success of reverse logistics implementation. In his study, the increasing allocation of resources towards environmental programs may lead to the direction to sustainable activities and reverse logistics management, especially for management resources. Organizations have also realized that a better understanding of product returns and efficient management of reverse logistics can provide them with a competitive advantage.[388]

Dowlatshahi (2000, 2005) identifies specific internal and external factors that influence the ability to successfully design and implement reverse logistics by reviewing literature and analyzing case study. The author formulates the propositions for strategic factors of implementing successful reverse logistics, e.g. strategic costs, strategic quality, customer service, environmental concerns, and legal concerns, and investigates the critical strategic factors needed in developing an effective reverse logistics system. The author emphasizes that the utilization of current equipment, labor and facilities is one of the optimal solutions in order to minimize the overall costs of RL operations. Therefore, the author states that success of RL implementation can be obtained through the effective use of current resources, methods, and technologies that demonstrate the strategic costs of RL.[389]

Daugherty et al. (2001) emphasize the importance of company resource commitments and allocations for the implementation of reverse logistics because reverse logistics programs are resource intensive and managing reverse flows are complex and uncertain. Increased management resources, e.g. management attention, top management supports, increased management skills, to the development and implementation of reverse logistics programs, have strong impacts on RL performance. Based on the findings, firms that commit more management resources to reverse logistics are doing a better job operationally on a day-to-day basis.[390]

Ivisic (2002) identifies the strategically successful factors with the orientation of closed-loop economy and environment considerations influencing the success of firms in the area of reverse logistics through expert and case study analysis. The author indicates that related laws and regulations represent an important factor for reverse logistics operations for firms in the electronics industry because they are obliged to take back and recover their EoL products to recapture value. Firms have to develop collecting systems for their discarded products and find the ways to reduce costs of EoL management, and they therefore become more proactive in increasing the awareness of reverse logistics and operating efficiently their reverse logistics networks. The study also emphasizes the contribution of information technology and customer integration to the success of reverse logistics operations because they can reduce the uncertainty of return flows. Horizontal and vertical

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[386] See Carter/Ellram (1998), p. 91-97

[387] See Roger/Tibben-Lembke, p. 47-49

[388] See Stock (1998), p. 158

[389] See Dowlatshahi (2000), p. 150; Cf. also Dowlatshahi (2005), p. 3459

[390] See Daugherty et al. (2001), p. 119

collaboration between supply chain partners is also presented as the important factors to optimize operations of machine, equipment, and people in reverse logistics networks, which therefore lead to cost reduction.[391] The author also highlights the usage of current infrastructures and resources for reverse logistics operations, e.g. integration between forward and reverse logistics, as a successful factor for RL performance.

External Factors	Researcher	Main Influences
Laws and regulations	Stölzle (1993), Carter and Ellram (1998), Roger and Tibben-Lembke (1999), Dowlatshahi (2000, 2005), Knemeyer et al. (2002), Ivisic (2002), Mollenkopf (2007), Jose Alvarez Gil et al. (2007), Miemczyk (2008), Rahman and Subramania (2011)	Drivers for reverse logistics implementation in the European electronics industry; Supports for efficient reverse logistics operations
Customer awareness and demand	Stölzle (1993), Stock (1998), Calter and Ellram (1998), Roger and Tibben Lembke (1999), Dowlatshahi (2000, 2005), Knemeyer et al. (2002), Ivisic (2002), Toffel (2003), Mollenkopf (2007), Jose Alvarez Gil et al. (2007), Kapetanopoulou and Tagaras (2010), Rahman and Subramania (2011)	Drivers and supports for environmentally oriented business management, EoL management, and customer returns management
Information technology	Roger and Tibben-Lembke (1999), Ivisic (2002), Wee et al. (2003), Kokkinaki et al. (2003), Zuidwijk and Krikke (2008), Dwight Klappich (2008), Janse et al. (2009), Olorunniwo and Li (2010), Hsiao (2010)	Supports for effective and efficient RL operations from collection, recovery to redistribution
Collaboration	Kaluza and Blecker (1996), Roger and Tibben-Lembke (1999), Ivisic (2002), Spicer and Johnson (2004a), Winkler et al. (2006), Kumar and Malegeant (2006), Janse et al. (2009), Olorunniwo and Li (2010), Melacini et al. (2010), Hsiao (2010), Rahman and Subramania (2011)	Increased share of information, knowledge, resources and capabilities for effective and efficient RL operations
Globalization	Mollenkopf (2007), Pollock (2008)	Cost savings due to standardization and centralization reverse logistics services

Table 4: Literature review related to external factors

Wee et al. (2003) analyze the reasons for the increasing concerns of RL because of shortening product life cycle with many technology innovations. Information technology supports handling with returns more automatically and flexibly, especially for the increases in customer returns and unsold products. The development of e-commerce with the support of internet provides customers with quicker access to products and easier ways to return the products that are beyond their expectation. Supports from tracing and tracking system, barcode system, radio frequency identification or return claim processing system help firms not only remove their reluctance to deal with returns but also encourage them to be willing to quickly resolve the issues associated with returned products.[392]

Mollenkopf et al. (2007) through cross-case analysis discuss the external factors influencing the way the firm perceives, strategizes, or manages returned products, e.g. customers, competitions, and regulatory enforcements. The authors give the propositions for future research related to the awareness of these external factors in which the external factors is positively associated with the effectiveness of returns management of firms. They also emphasize the trend of integration among different functions and the shift to inter-organizational collaboration for RL implementation. The study also suggests that the impacts of globalization on returns

[391] See Ivisic (2002), p. 244

[392] See Wee et al. (2003), p. 66

management should be considered and the management processes need to be put in place to manage across the globally extended supply chain.[393]

Hsiao (2010) identify key factors that drive and support the innovations of enhancing a firm's reverse logistics capabilities. The findings from case study analysis reveal that information technology, knowledge sharing, and relationship networks have positive impacts on a firm's reverse logistics capabilities, and consequently on reverse logistics performance to increase its competitive advantage.

Rahman and Subramania (2011) identify critical factors for implementing EoL computer recycling operations and investigate the causal relationship among the factors influencing the operations in reverse supply chains by using the cognition mapping process with six managers in a single case study. The results indicate that the effective use of resources, coordination and integration of recycling tasks, and the volume and quality of recyclable materials are critical for computer recycling operations. Factors such as government legislation, economic benefits, and customer demands are found to be the major drivers.[394] The study concludes that appropriate allocation and effective utilization of available resources for reverse supply chain operations along with appropriate strategy can lead to profitability.

Internal Factors	**Researchers**	**Main influences**
Company policy	Carter and Ellram (1998), Roger and Tibben Lembke (1999), Daugherty et al. (2001), Ivisic (2002), Jose Alvarez Gil et al. (2007), Janse et al (2009)	More strategic focus on RL and specific policies of returns management make RL operations more effective and efficient
Top management support	Stock (1998), Calter and Ellram (1998), Roger and Tibben Lembke (1999), Dowlatshahi (2000, 2005), Daugherty et al. (2001), Jose Alvarez Gil et al. (2007), Janse et al (2009)	Increased awareness of strategic importance of RL, supports for strategic decisions of resource allocations for RL operations
Cross-functional integration	Roger and Tibben Lembke (1999), Dowlatshahi (2000, 2005), Mollenkopf et al. (2007)	Create value, competitive differentiation, and efficiency in returns management
Utilization of current resources	Stock (1998), Roger and Tibben-Lembke (1999), Dowlatshahi (2000, 2005), Daughterty et al. (2001), Ivisic (2002), Rahman and Subramania (2011)	Cost reductions for RL operations, integration and supports between forward and reverse logistics

Table 5: Literature review related to internal factors

There are a few studies in topic of reverse supply chain management moving beyond case study and literature review to explore the factors affecting to reverse logistics performance by using survey methodology. Alvarez-Gil et al. (2007) determine that the interaction of external, organizational and individual factors has influence on the implementation of RL because the activities of RL involve multiple relationships between different stakeholders (e.g. customers, governments and shareholders). By implementing the survey with 200 companies in automobile industry in Spain, the study affirms that the probability of firms implanting RL systems depends on the stakeholder salience, the availability of resources of firms, and progressive strategic posture of managers. According to their empirical results, behaviors of customers, employees, and governments have positive influences on the final decision of implanting programs of RL with different levels, while shareholders' impact is negative. Availability of resources is vital for the development of reverse logistics system because it can enhance the innovative capabilities of firms and their proactive strategies. Moreover, the individual strategic support of top management is also an important factor influencing the implementation of RL.

Janse et al. (2009) carry out a survey to identify key reverse logistics trends, facilitators, and barriers mainly in Western Europe such as in Belgium, Germany, Spain, and the Netherlands. The research group finds that

[393] See Mollenkopf et al. (2007), p. 2-3

[394] See Rahman und Subramania (2011), p. 1

the vast majority of producers (82%) have a specific sustainability program in place, in which RL has played important roles in environmentally oriented recovery and recycling. Such programs are mainly driven by competitive advantages (41%) and legislations (23%). 45% of producers experienced the burden of take-back laws as important motivation for them to operate reverse logistics more efficiently.[395] From empirical results, top management awareness, strategic partnership with supply chain partners, detail insight of costs and performance, and strategic focus on avoiding returns are mentioned as the main facilitators for managing reverse logistics operations.

Olorunniwo and Li (2010) in their empirical studies through survey with 600 companies in USA indicate that the type of information technology used per se did not have a differential impact on a firm's performance in RL. However, IT operational attributes positively affected RL performance e.g. computerized returns merchandize authorization, effective integration with the whole supply chain, and efficient product tracking system. Moreover, information sharing and collaboration are found to be critical to RL performance.[396]

Chapter 4.2 and Chapter 4.3 discuss the influences of external and internal factors on reverse logistics development in European electronics industry in practice. This study focuses on analyzing positive influences of the major factors that facilitate and motivate the development of reverse logistics.

4.2. External factors influencing the development of reverse logistics

The best possible way to motivate the development of reverse logistics is to collect and then remanufacture or recycle the electronics products that are no longer useful.[397] For these objectives, related take-back laws and regulations in Europe with EPR-based principle have played an important role in making fundamentals for developing a formal reverse logistics system for EoL management in the European electronics industry. However, the development of reverse logistics in the European electronics industry is also motivated and the fast-changing environments in the extended supply chain e.g. the increased customer demands and awareness, the advanced information technology, the more intensified collaboration with supply chain partners, and the globalization. Figure 30 illustrates generally the external factors influencing and facilitating the development of RL.

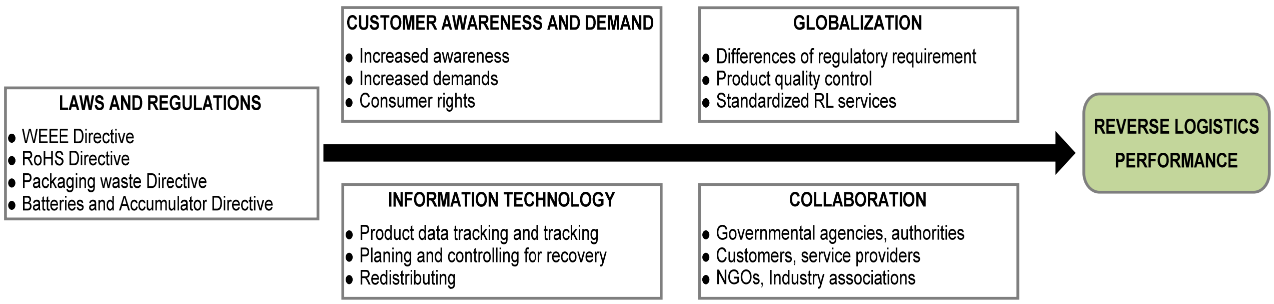

Figure 30: External factors influencing the development of reverse logistics

Source: Own illustration

4.2.1. Laws and regulations

4.2.1.1. Overview of laws framework on waste management in Europe

European environmental policy has evolved significantly since the 1970s.[398] It is one of the policy areas most supported by European citizens, who recognize that environmental problems go beyond national and regional borders and can only be resolved through concerted action at European and international level. Climate change, nature and biodiversity, environment, health and quality of life, and natural resources and waste management are identified as four environmental areas for priority actions. The last forty years have seen a revolution in the way that waste is handled and it is increasingly under control with regulatory structures.

[395] See Janse et al. (2009), p. 42

[396] See Olorunniwo/Li (2010), p. 460

[397] See Knemeyer/Ponzurick/Logar (2002), p. 466

[398] See Europe Commission (2006), p. 4

The framework legislation for the prevention and management of waste has been passed with different directives since the 1970s (see Figure 31). For example, the EU Landfill Directive requires Member States (MS) to reduce landfill waste by 50% from 1995 levels by 2013 and 65% by 2020. A tightening of environmental regulations in European countries has resulted in a dramatic rise in the costs of waste disposal. However, the systematic solutions of waste directives have helped European countries improve the management of waste, and in particular to promote recycling, reuse and energy recovery over the disposal of waste. The EU policies on waste management have also been in transition, in which some issues related to the distinction between waste and recovered materials, waste for recover versus waste for disposal are continuously addressed.[399]

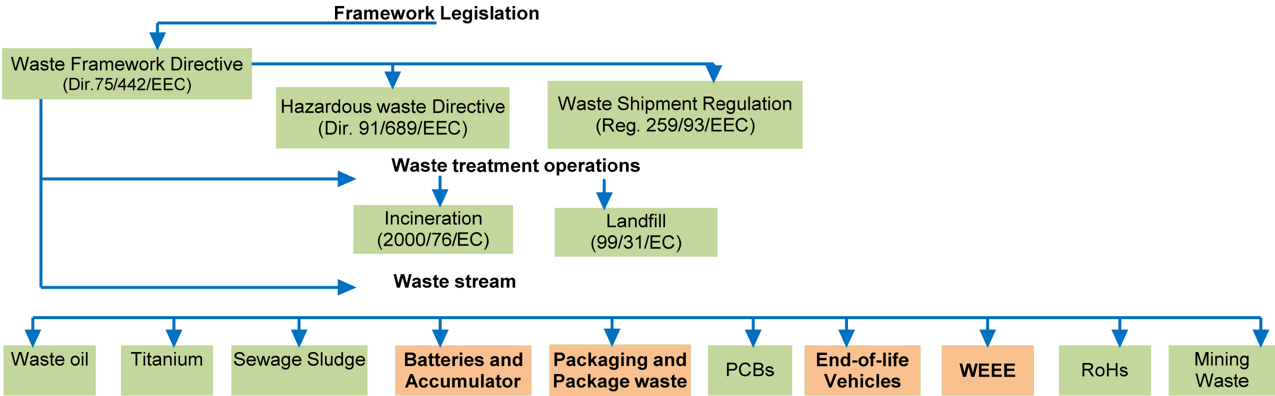

Figure 31: European waste legislation framework

Source: Adapted from Europe Commission (2006), p. 10

There has been a change in perception towards viewing waste as a resource, especially for product at the end of its useful life. Waste streams that businesses would have had to pay to be taken away a decade ago, are now being collected, recycled, and resold for increasing amounts of money.[400] Waste reduction, followed by product reuse, recovery and recycling has been popular practices for EoL products of EEE in almost all European countries.[401] These options make waste minimization and disposal to landfill avoidable. Some special waste streams that have a high environmental impact, or that are difficult in terms of organizing the funding of recycling and recovery are regulated based on the principle of extended producer responsibility of closed-loop economy. This has resulted in legislations of take-back responsibility on packaging and packaging waste, on end-of-life vehicles, and on waste of electrical and electronic equipment since the mid-1990s. These regulations have motivated product reuse and recovery, which resulted in drivers and proactive activities for developing a formal reverse logistics system in Europe for used electronic and electrical equipment discarded.

The principle of extended producer responsibility inspired the European take-back laws for packaging waste, end-of-life automobiles, and waste of electrical and electronic equipment.[402] EPR is firstly defined as an environmental protection strategy to reach environmental objectives of source reduction, waste prevention, design of more environmentally compatible products, and closure of material loops to promote sustainable development.[403] EPR supports the polluter pay principle and shifts the burden from consumer and local authority to producers who have much more knowledge about the environmental impacts of their products at the end of life phase and capabilities to prevent these problems at the design stage. Thus, producers' responsibilities for a product are extended to the post-stage of a product's lifecycle. EPR places the intervention focusing on changes within product design development, delivery, and collection systems, rather than on manufacturing facilities and waste disposal methods. EPR is aimed at closing the material cycle by the

[399] See Europe Commission (2006), p. 6

[400] See Wilson/Dougall/Willmore (2001), p. 328 – 330; Cf. also Europe Commission (2006), p. 6

[401] See Kumar/Malegeant (2006), p.1129

[402] See Short (2004), p. 1-2

[403] See Lindhqvist (2000), p. 2-3; Cf. also OECD (2000), p. 5

involvement of producers at the EoL phase, in which producers have to take extended environmental responsibility including financial responsibility, physical responsibility, ownership responsibility, and informative responsibility to achieve the principle goals of EPR.[404]

The first EPR policy and product take-back program was the Ordinance on Avoidance of Packaging Waste in Germany in 1991. The European Packaging Directive came into force in 1994 and set boundary conditions and objectives that were transposed into national legislations. The Directive requires the MS to set up appropriate collection, reuse and recycling system. Packaging should bear appropriate marking that facilitate source separation as well as reuse, recycling and recovery. Consumers must be informed about the collection and recovery system, their roles in contributing to the reuse, recycling, and recovery of packaging waste.[405] Collective producer responsibility schemes have been popularly implemented in most European countries, in which manufacturers, distributors, and importers of packaging and packed goods are responsible for the collection and recovery of their resulting packaging waste, e.g. Duales System Deutschland (DSD). The responsibility in take-back system for packaging waste is shared in the majority of countries between municipalities and the manufacturing industry in the cooperation between collective take-back systems, municipalities, private collectors, and recyclers.[406]

Waste of electrical and electronic equipment is the most frequent target of take-back regulations because it is the fastest growing waste stream, and often contains hazardous materials and potentially recyclable materials such as metals.[407] Electronics take-back legislation was under consideration in many European countries since the mid-1990s. Take-back regulations on WEEE have a long history in northern European countries. The Netherlands (1999), Belgium (2002) and Sweden (2002) had already adopted producer responsibility legislation for WEEE before EU-level intervention. The Europe Directives on WEEE (2002/96/EC) and on the Restriction of the Use of Certain Hazardous Substances (RoHS) in EEE (2002/95/EC) adopted in 2003 target ten categories of products concerning both B2B and B2C market, with the primary goal of reducing the quantity and environmental impact of WEEE and increasing its reuse, recovery, and recycling.[408] The WEEE Directive in the EU required producers/importers officially responsible for taking back and recycling EoL products in 2005, and set mandatory target rates for the recycling and recovery of WEEE with minimum 4 kg/capita/annum in 2006. However, the decisions regarding the allocations of physical responsibilities, the organization and logistics arrangement of take-back schemes are left to member states.[409] The target set, as well as the degree of freedom of setting logistics for take-back systems have created the legal compatibility and flexibility in controlling the reverse flows of WEEE in each country. Figure 32 presents the chronological overview of WEEE Directive progress in EU.

More EU countries have realized that EPR principle has driven both ecological and economic efficiency. When producers are made responsible for the extended end-of-life phase of products, they have the opportunities to make the process more effective and cost efficient.[410] The take-back regulations have increased the number of firms adopting and implementing their reverse logistics programs for EoL products. For example, more companies in the European electronics industry have provided trade-in rebates in new equipment in their voluntary take-back programs. Furthermore, more manufacturers of EEE today have discovered that if they design their products for easy disassembly and remanufacturing, large cost savings or revenues can be generated by collecting EoL products from customers and refurbishing them for resale, or by reusing parts in new products. Cost savings and increased revenues can be found through the reuse of components, casings, and subassemblies because it is often cheaper to reuse than to produce from virgin materials.[411]

[404] See Lindhqvist (2000), p. 17-19

[405] See Tojo (2008), p. 36

[406] See Jordan/Gonser (2001), p. 2-3

[407] See Europe Commission (2002), p. 1-2

[408] See Sander et al. (2007), p. 2-3

[409] See Savage (2006), p. 7-11

[410] See Kumar/Putnam (2008), p. 307

[411] See Doppelt/Nelson (2001), p. 6-8

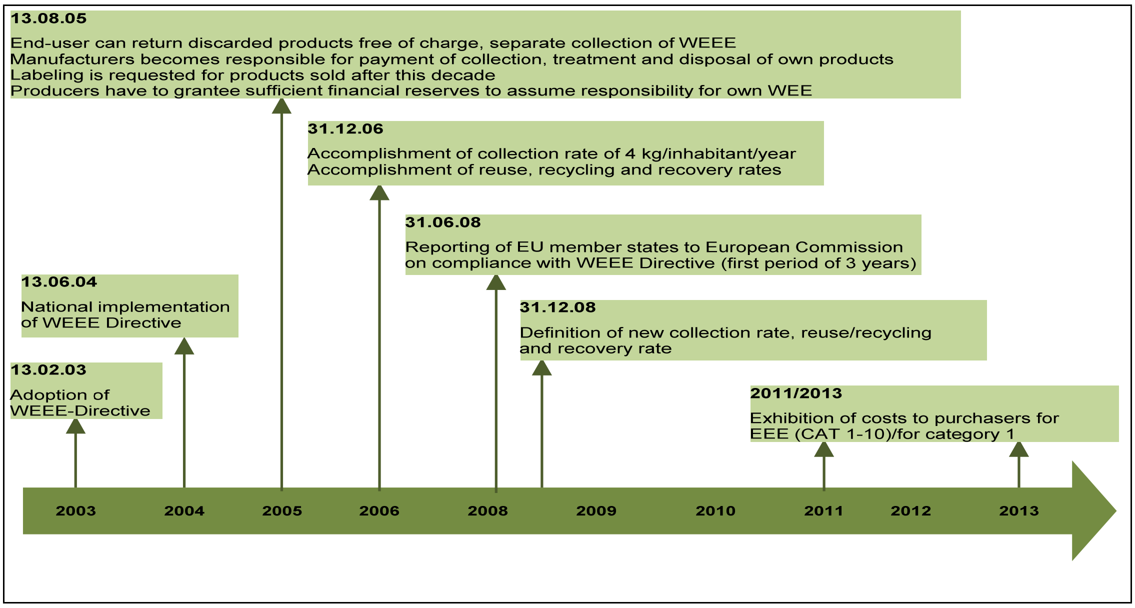

Figure 32: Chronological progress of WEEE Directive in EU

Source: Adapted from Walther/Spengler (2005), p. 340

4.2.1.2. Influences of WEEE Directive on development of reverse logistics

The official deadline for having WEEE handling systems in Europe was 2005; however, at that time many MS had not yet published clear guidelines of their requirements for the treatment of WEEE. Its transposition into national laws and its implementation differs within each MS because they faced significantly greater problems in developing the required legal and operational infrastructures. Several countries such as Belgium, Denmark, the Netherlands, and the Nordic countries have been ranked among the most advanced nations in terms of single take-back system for WEEE because they have developed electronics take-back regulations earlier than other European countries and reached the achievements in WEEE minimization and recycling. Different systems have been developed in recent years in the efforts of applying more market-based approaches with multiple providers of take-back services in Germany, Austria, France, Italy, Portugal, Spain, and United Kingdom. The different transpositions and interpretations of WEEE Directive (see Table 6) and the different implementations of take-back schemes have created some obstacles and gaps for firms in the European electronics industry in consistently managing their reverse supply chain management for EoL products.

Country	Regulation	Responsibility	In effect
Switzerland	Ordinance on the Return, Take-back and Disposal of Electrical and Electronic Equipment	Manufacturer Importer	July, 1998
Denmark	Statutory Order from the Ministry of Environment and Energy No. 1067	Local municipalities	December, 1999
Netherlands	Disposal of White and Brown Good Decree	Manufacturer Importer	January, 1999
Norway	Regulations regarding Scrapped Electrical and Electronics Products	Manufacturer Importer	July, 1999
Belgium	Environment Policy Agreements on the take-back obligation for waste from electrical and electronic equipment	Manufacturer Importer	March, 2001
Sweden	The producer Responsibility for Electrical and Electronic Products Ordinance	Manufacturer Importer	July, 2001
Germany	Act Governing the Sale, Return and Environmentally Sound Disposal of Electrical and Electronic Equipment	Manufacturer Importer	March, 2005
Austria	Ordinance on Waste Prevention, Collection and Treatment of Waste Electrical and Electronic Equipment	Manufacturer Importer	April, 2005
Romania	Regulation of HG 448/2005 regarding WEEE	Manufacture Importer	November, 2006

Table 6: Transposition time and implementation of take-back laws in Europe

Waste of electronic and electrical equipment is a major focus of EPR-based policy around the world, especially in Europe where the production and consumption of EEE accounts for a large proportion compared with the rest of the world. EPR principle has been implemented through a mixture of regulatory, economic, and voluntary policy instruments.[412] The intent behind this regulation is to reduce environmental impact under the greater proportions of EoL electronic and electrical products, components, and materials that are reused, recycled and recovered.[413] WEEE Directive imposes various combinations of economic, physical, informative, or liability responsibilities upon manufacturers. Imposing the costs of collecting, recovering and recycling EoL products on producers in the electronics industry is intended to encourage them modifying product and package design for more easily collecting, dismantling and recycling. Therefore, it may help firms setting up an effective and efficient reverse logistic system to implement their responsibilities. According to the EU WEEE Directive, producers are collectively responsible for collecting and recycling historical waste[414] and individually responsible for future waste.[415] In practice, the management of take-back system for discarded UEEE has mostly been conducted by the collective responsibilities of historical wastes. Take-back regulations have initially created incentives for manufacturers in the European electronics industry through sustainability programs of eco-design to decrease the cost of collection, disassembly, remanufacturing, and recycling because they can incorporate EoL concerns and lifecycle analysis into product design by selecting materials used in products and package, increasing the durability of products, components, and materials.[416] Moreover, due to the enforcement of take-back laws and the desire of cost minimization, producers also have more motivation to facilitate and call upon other members of the supply chain, e.g. customers, distributors, service providers, and other stakeholders for their active participation in collection and end-of-life processing. Walker et al. (2008) therefore argue that environmental regulations can be seen as a motivator to innovate and reduce the environmental impact at low cost rather than cause for litigation.[417]

Allocations of physical and financial responsibilities have received increasing interests in take-back regulations with different versions existing in MS legislations. Concerning collection, the WEEE Directive does not specify the entity responsible for the collection of WEEE from private households. In the EU, physical and financial responsibilities for waste collection and treatment are divided among consumers, municipal waste management companies (municipalities), distributors, and producers. However, the requirements on consumers are limited to paying front-end fee upon the purchase of new equipment, and discarding used electronic and electric equipment at the proper collection points. Most of the financial and physical responsibilities are shared among municipalities, distributors, and producers. In many European countries, municipalities and retailers (on 1:1 principle)[418] finance and organize waste collection from households to local collection points that they maintain; meanwhile, producers are responsible for financial and physical responsibility from that point forward. Municipalities are allowed by law in the majority of the MS to access discarded products from private households and to collect them (see Appendix 1). Moreover, even in cases where municipalities are not responsible according to the national legislation, in practice they become partially responsible for collecting illegally dumped appliances.[419]

Some models of responsibility allocations for collection are conducted in Europe with more requirements thrust on producers. For example, producers are required to fund the local collection activities performed by municipalities in Germany (e.g. providing empty containers for pick-up and collection), Hungary, Austria, Spain, France and the Netherlands. In case of no collection infrastructure in place, such as in Latvia and

[412] See Lindhqvist (2000), p. 5-6

[413] See Mayer/France/Cowell (2005), p. 172

[414] Historical waste is waste from product put on market before August 13th, 2005

[415] Future waste is waste from products that are put on market after August 13th, 2005

[416] See Toffel (2003), p. 104; Cf. also Krikke/Bloemhof-Ruwaard/Wassenhove (2003), p. 3692; Walther/Spengler (2005), p. 349; Verweij et al. (2008), p. 42

[417] See Walker/Sisto/McBain (2008), p. 69

[418] 1:1 principle means that the retailer must take back an old equipment when he sells a new one

[419] See Tojo/Neubauer/Braeuer(2008), p. 41

Slovenia, responsibility for developing the collection infrastructure sometimes belongs to producers.[420] The requirements of the Directive are also imposed on producers for collecting discarded products from business customers (B2B returns) in some European countries such as the Netherlands, Denmark, Switzerland, and Sweden. These stricter requirements of laws have made producers more responsibilities and have paid increasing costs in managing EoL returns. Take-back requirements that are more stringent have forced OEMs to make strategic decisions of establishing their reverse logistics networks that allows them to fulfill their responsibilities efficiently and improve company image.

Following economic principles, the incentive for producers to be involved in EoL management depends on whether the cost is large enough and the price elasticity of the demand for goods.[421] Producers can transfer the internalization of costs for EoL responsibilities by means of producer's reduction of sales margin or an increase of sales prices. The choice between these two means and the proactive response of firms to regulatory requirements depends on each producer's strategy and product portfolio. Therefore, if producers can transfer the costs to customers via the product price without a substantially negative influence on demand, there is little incentive for them to innovate to reduce the costs of collection and treatment. However, due to the high saturation, the fiercer competition, the dynamic substitutes in the electronics industry, as well as increasing awareness and demand from customers, the pressures on price of EEE has dramatically influenced the direction and strategy of firms regarding EoL management in recent years.[422] Costs of EoL management have increased the total business costs of many electronics producers.[423] For example, Electrolux estimates that the WEEE Directive could add over €18 to the price of a new washing machine;[424] and in average, the cost to producers of complying with the pending WEEE Directive is approximately 1-2% of the revenue of Sony Europe.[425] Table 7 presents different types of business costs associated with producer responsibilities in EoL management to comply with WEEE legislation.

Cost categories	**Key cost drivers**
Transaction cost	Identifying appropriate solutions for EoL management, selecting contractual partners, and negotiating contracts;[426]Fees for administrative management of governmental bodies;[427] labor costs for controlling, planning and management[428]
Collection	Costs of container rental and other equipment at collection points, labor costs, and transport costs; Costs of warehouse, sorting and storage in the case of retailer take-back or operating return centers[429]
Recycling	Cost of labor (e.g. sorting and disassembly), costs of equipment and facilities for manual or automated sorting/dismantling, costs of treatment (e.g. shredding, granulation, incineration)[430]
Reporting	Costs of information sharing between different partners, costs of reporting with governmental bodies

Table 7: Reverse logistics costs in managing EoL returns

The WEEE Directive allows each MS the degree of freedom of managing take-back system by providing the options of collective and individual responsibility for EoL products. The Directive allows the MS to select their formal reverse logistics system for collecting and recycling, which enables producers to pursue various strategies of operational reverse logistics that are most cost effective with respect to their circumstances.[431]

[420] See Herold (2007), p. 21-23
[421] See Tietenberg/Lewis (2003), p. 192
[422] See Verweij et al. (2008), p. 25; Cf. also Mayers (2007), p. 118-119
[423] See Gottberg et al. (2006), p. 4-6
[424] See Sundberg (2002), p. 5
[425] See Mayers (2002), p.7-8
[426] See Lipsey/Chrystal (1995), p. 13; Cf. also Mayers (2007), p. 118-119
[427] See Führ/Roller/Smidth (2008), p. 40-43; Cf. also Mayers (2007), p. 118-119
[428] See Mayer (2007), p. 118-119
[429] See Theisen (2002), p. 18; Cf. also Führ/Roller/Smidth (2008), p. 40-43
[430] See Leverenz/Tchobanoglous/Spencer (2002), p. 45; Cf. a lso Führ/Roller/Smidth (2008), p. 40-43
[431] See Toffel/Stein/Lee (2008), p. 15-16

Therefore, many companies have made strategic decisions of a proactive rather than a wait-and-see approach to EPR compliance scheme. Many producers in the European electronics industry have joined collective take-back schemes for EoL collection from households rather than individual solutions[432] due to their perceptions of relative costs and practicability. However, they have strategies to proactively manage and control EoL products by formulating EoL management strategy. They make agreement at firm level for EoL management by implementing different activities such as legal tracking, selection and development of take-back system providers, investments of time and resources for measuring and reporting, and accounting for take-back and recovery costs.[433] OEMs have increasingly established individual product recovery programs by setting up their own recovery networks and individually contracting to service providers for collection and treatments, especially for firms in European countries with competing take-back systems. These programs have been applied more commonly for customer returns and leased products that are quite often refurbished or taken back to recover components and spare parts.[434]

Although there are many arguments related to influence of institutional environments on operations of reverse logistics, especially the pressures of environmental legislations and take-back laws, the institutional constraints on the individual network structure and internal capabilities of collection and product recovery of firms in the European electronics industry are found less evident than in other industries.[435] The empirical research of Miemczyk (2008) indicates that the case of a firm in the electronics industry is relatively free to choose structural options of reverse logistics networks and to use existing capabilities that balance competitive and legitimacy priorities, suggesting the supports of laws and regulations for the development of reverse logistics in European electronics industry to some extent. Recently, Rahman and Subramanian (2011) state that proactive efforts towards environmental regulations and take-back laws are likely the facilitators for successful reverse supply chain management.[436] Moreover, the impacts of WEEE and RoHS Directives, if implemented effectively or otherwise, can shift to suppliers, customers, and service providers in a supply chain, indicating that the bullwhip effect of the successful adoption of the take-back laws can bring benefits to the entire supply chain.[437]

4.2.2. Customer awareness and demands

4.2.2.1. Consumers' environmental awareness

At the beginning of 1970s, Ronald Inglehart developed the sociological theory of post-materialism and stated that there was the transformation of individual values in Europe, switching from materialist values, emphasizing economic and physical security, to a new set of post-material values, which focused on autonomy and self-expression.[438] The transformation results in "New Age" social values about the well-being and inter-relationship of the individual and the environment, have led to mounting consumer supports for green and environmental issues.[439] Consumers have also become more aware of environmental issues because of the increasing exposure of environment related topics such as acid rain, greenhouse effect, and desertification.[440] Empirical researches also support the fact that "green consumers" emerged and green consumerism has become increasingly important.[441] "Green consumers" have a new set of green demands such as green products, preference of pro-green firms, and increased acceptance o products with recycled materials. The appearance of eco-certificates (eco-label) helps these consumers to identify eco-friendly products.

[432] See Herold (2007), p. 64-70

[433] See Mayer (2007), p. 118-119

[434] See Herold (2007), p. 169-190

[435] See Miemczyk (2008), p. 278

[436] See Rahman/Subramanian (2011), p. 4

[437] See Koh/Gunasekaran/Tseng (2011), p. 3

[438] See Inglehart (1971, 1977), p. 2 & 5

[439] See Vandermerwe/Ollif (1990), p. 11; Cf. also Benedikter (2002), p. 34

[440] See Neto et al. (2008), p. 4

[441] See Gerbens-Leenes/Moll/Schoot-Uiterkamp (2003), p.237; Cf. also Kumar /Malegeant (2006), p.2

Doonan (2005) through his survey results argues that while in the 20th century it was government regulation that put most external pressure on firms' environmental performance it is now consumer demands that play the most important role.[442]As the awareness of environmental issues and environmentally friendly products has increased, so too has the need to implement effective RL and the handling of waste and hazardous materials.[443] Certainly, it has resulted in the trend of environment-oriented business management, which has increased the roles of logistics in product recovery and recycling programs, hazardous material programs, and obsolete equipment disposition,[444]therefore simulating the development of reverse logistics in the overall supply chain. Kapetanopoulou and Tagaras (2010) through their empirical results of case study indicate that the main factors influencing product recovery activities in SMEs in Greek manufacturing industry are the customer awareness and the demand for recovered products and components.[445]

Customers are the unique independent actors in the network of reverse logistics who decide whether products are returned and disposed appropriately.[446] The awareness and attitudes of consumers toward environmental issues is further explained by the theory of planned behavior, the model of altruistic behavior, the model of environmental behavior, and the model of environmental concern.[447] More specifically, perceived behavior control firstly reflects the external conditions of individuals that may moderate their ability to adopt certain behavior, and secondly the perceived ability of individuals to carry out the behavior.[448] With respect to environmental issues, waste disposal and recycling, the participation of individuals in proper collecting and recycling programs relies on the perceived performance or convenience of logistics afforded by the selective collection programs, and on the specific knowledge about the behavioral task required to participate. According to the empirical results of the study conducted in Portugal by Valle et al. (2005), the general environmental awareness and attitudes determined by personal values has a direct positive and significant influence on the specific attitude toward recycling. The study also suggests that consumers with a stronger social conscience report a higher awareness level toward environmental problems, sense greater responsibility in participating in the selective collection programs, and give less importance to difficulties associated with recycling.

Reverse logistics systems for WEEE management begin with the consumer and finishes with the end market. The entire scope of RL ranges from end-consumers as the source of product returns (supply side) to the future market for these products (demand side). The consumer is supposed to take an active part in the recycling process by not only separating and bringing the discarded products to appropriate collection points but also reusing and repurchasing the recovered products/materials.[449] As observed analysis, many countries in Europe have the high level of reuse, recovery, and recycling for EoL products, especially WEEE.[450] Reverse logistics system for WEEE has varied with different collection channels that provide customer with different ways to discard their used products, e.g. curbside collection, unmanned drop-off sites, and staffed and smart drop-off sites.[451] For all collection methods, consumers are required to have direct interaction with some processes of reverse logistics such as storing in house, separating at source, and then delivering to collection points.

All consumers are expected to act homogeneously as suppliers or co-producers of input for reverse logistics system.[452] Therefore, consumers' awareness and attitudes as co-manufacturers in high-contact service system has imposed numerous challenges and opportunities on establishment and management of collection net-

[442] See Doonan/Lanoie/Laplante (2005), p. 74

[443] See Presley/Meade/Sarkis (2007), p. 4607

[444] See Rogers/Tibben-Lembke (1998), p. 18

[445] See Kapetanopoulou/Tagaras (2010), p. 105

[446] See Ivisic (2002), p. 43; Cf. also Patricia/Menezes/Reis/Rebelo (2009), p. 2

[447] See Valle et al. (2005), p. 367

[448] See Valle et al. (2005), p. 390 - 391

[449] See Anderson/Brodin (2005), p. 81

[450] See Zoeteman/Krikke/Venselaar (2009), p. 415 – 416; Cf. Also Tojo/Frischer (2011), p. 14

[451] See Beullens (2005), p. 299 - 300

[452] See Soteriou (1998), p. 495; Cf. also Anderson/Brodin (2005), p. 77

works. If the consumers supply material for recycling in high and even volumes, the possibilities for take-back systems to increase their efficiency and hence their profitability can be enhanced, compared to the consumers' low and uneven supply of scrap volume.[453] The external conditions, perceived convenience and specific knowledge toward environment and recycling have direct and significant impacts on consumers' behaviors and participation (see Figure 33). The facts show that municipalities, retailer stores, OEMs, and take-back system providers in many European countries have increasingly developed and invested in collection points and collection methods to make consumers perceive the conveniences to disposal,[454] which improves the collection volume of discarded UEEE.[455] In addition, the higher frequency of collection and clearer instructions for sorting and disposing have encouraged consumers' willingness to separate their discarded products, which has helped to reduce the uncertainty of quality from products discarded. For example, in countries with long-term environmental policies and green culture such as Belgium, Germany, Sweden, and the Netherlands, the higher level of awareness and perceived convenience leads to the higher collection volume of EoL products and the greater efficiency of reverse logistics system.[456]

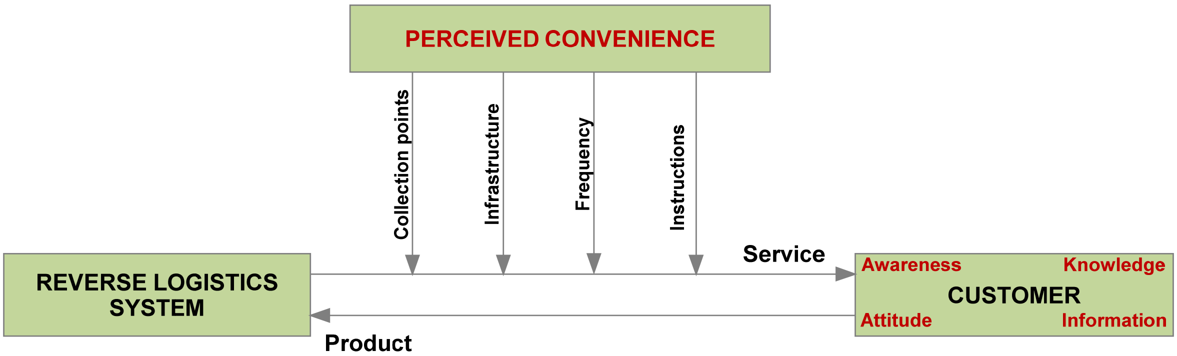

Figure 33: Customer interaction with reverse logistics system

Source: Own illustration

4.2.2.2. Increasing customer demands

Product returns originate from two main sources including consumer returns to retailers or producers during a 14, 30, 60, or even 90 day return period, and product overstock/unsold returned from retailers to manufacturers.[457] There was a time when customers rarely returned technical consumer goods unless they did not work. Today, however, many customers have increasingly accustomed to return unwanted product to retailers or manufacturers for just any reasons because of the increase in customer demands and rights.[458] In the consumer electronics industry, most product returns were because consumers did not get products as anticipated, did not understand how to use them, or regretted impulsive purchases; in fact, only about 5% of consumer returns were truly defective.[459] The returns rate for technical consumer electronics has been around 5% to 20% in different sectors, or even higher with electronic retailing and catalogue sales. The return rate is increasing in Europe[460] because of shifts in multichannel distribution, shorter lifecycle products, and growing customer demands that emerge from dramatic expansion of product choices; and especially more powerful customers.

In recent years, customers have become more powerful because they can have unlimitedly access to product information of any EEE, easily switch between brands, and simply compare the prices.[461] Consumers can

[453] See Brodin (2002), p. 3

[454] See DIT (2003), p. 13-44; Fleischmann et al. (2004), p. 7; Verweij et al. (2008), p. 64

[455] See Eurostat (2010), p. 5; Cf. also BMU (2010), p. 3; Zoeteman et al. (2010), p. 420

[456] See Eurostat (2010), p. 5; Cf. also BMU (2010), p. 3; Sander (2007), p. 14-18; DIT (2003), p. 6

[457] See UK Department of Transport (2004), p. 17: Cf. also Guide et al. (2006), p. 4; Fergusson et al. (2006), p. 1

[458] See Thrikutan/Kumar (2004), p. 1

[459] See Lawton (2008), p. 2

[460] See Barry/Bauer/Marcus (2003), p. 3; Cf. also Toktay (2003), p. 204; Guide/Souza/Wassenhove/Blackburn (2006), p. 4; Mollenkopf et al. (2007), p. 584

[461] See Janse et al. (2009), p.

easily go online and rail against poor aftercare service and tarnish firms' reputations, and today 60% of consumers search the Internet before going to a store to purchase electronic goods.[462] Moreover, EU-wide rights of consumer protection have extended the minimum days of returning from 7 days to 14 days with regulations for distance selling (e.g. online retailing or catalogue shopping).[463] Customers therefore can demand more support services after purchasing such as extended warranties, in-warranty repair, out-of-warranty repair, maintenance, upgrade and retrofits, end-of-life asset recovery, and hazardous material disposal.[464] Customers have also required more communication of returns issues with manufacturers/distributors through different channels by phone, on-line, and at customer service centers. Therefore, customer returns management represents a growing management attention and financial concerns for firms in the European electronics industry.

Due to increasing returns rate and customer demands, reverse logistics has increased its roles in supporting after-sales services including customer care, field technical assistance, operations of repair, maintenance, and overhaul, and spare part management by the cross-functional integration within a firm and inter-organizational collaboration across the entire supply chain with different partners. For example, field technical assistance encompasses installation, repairs (warranty work and out-of-warranty repairs), check-up, and product disposal. Spare part management covers operations for inventory management, delivery of spare parts, direct and reverse flows, and customer order management. Customer care provides technical and commercial information and services such as product registration, warranty extension, returns authorization, and complaint management to end users.[465] Departments of operation, marketing, logistics, and accounting are motivated and required to closely integrate to streamline the services and reduce the costs. Firms also have increased collaboration with local service providers, especially carriers, repair centers, and recyclers to meet customer demands. Decision-making of centralized or decentralized disposition options, in-house operations or outsourcing for repair, maintenance and refurbishing services is also a strategic focus on RSCM for after-sales services.[466] The fierce competitive pressures and increasing customer demands have urged companies in the European electronics industry to improve their after-sales services, invest more in reverse logistics, and to adapt their existing supply chain to reverse supply chain management.

Product unsold, slow-moving stocks or end-of-season inventory adjustments are not directly related to the problem of customer product returns because overstocks encompass units that were never sold to the final customers and are only returned at the end of the product lifecycle. The returns from retailers due to marketing reasons are also increasing due to the changes in distribution channels in Europe during the last decades. For example, many non-specialist distributors, such as hard discounters (e.g. Aldi, Lidl, and Pennymarkt) and supermarkets also have the power to sell technical consumer electronics products in high volumes at relatively low prices.[467] The development of multichannel retailers in distribution of EEE including catalogue retailers and online shops has increased the number of online shoppers due to the lower price and convenient delivery service. Furthermore, the shift from many small specialist shops in Europe electronics industry to a relatively limited number of large retailers, e.g. MediaMarkt/Saturn, Euronics and Kesa, implies that certain retailers have become more powerful and require specifically favorable sales conditions from OEMs. European retailers, exercising their growing channel power, are using liberal returns policies to enhance their competitiveness.[468] OEMs are being asked to bear an increased responsibility for taking back unwanted retail-level inventory as a means to release capital so retailers can buy more from them.[469] Retailers have also demanded manufacturers to have looser concessions for returns and credit policies because they have extended increasingly favorable returns rules to their customers to gain competitive advantages and satisfy their

[462] See Haymon (2010), p. 1

[463] See Willliams (2011), p. 1

[464] See Saccani/Johansson/Perona (2007), p. 57; Cf. also Dowlatshahi (2005), p. 3460

[465] See Saccani/Johansson/Perona (2007), p. 57

[466] See Amini/Retzlaffroberts/Bienstock (2005), p. 7

[467] See Janse et al. (2009), p. 28

[468] See Mollenkopf et al. (2011), p. 400

[469] See SCMR (2011), p. 1

demands. Returns problems have gradually crept across the Europe electronics industry with more lenient returns policy.[470] Many OEMs have set up more specific returns policy, gate-keeping rules, and return authorization processes as well as an effective network of reverse logistics (e.g. collection, returns centers, service partners) to efficiently manage the reverse flows of products to meet customer demand, increase competiveness, and reduce costs,[471] motivating the development of reverse logistics in practice.

The growth of the European electronics industry is partly motivated by the shift to customer orientation showing a continuous and proactive disposition toward identifying and meeting customers' expressed and latent needs.[472] When customer needs change rapidly, customer orientation makes firms to recognize those changes and guides them to invest necessary resources to develop new products and customer services. The changes of customers' awareness and demands therefore have required greater attention to reverse logistics implementation with both EoL and customer returns management. Consistent with Tibben-Lembke and Rogers (2002), it can be said that the closer a company is to the end customer, the greater the size and scope of reverse logistics issues are. This also means that customers, due to their proximity and accessibility, have more of a direct, positive impact on the performance of reverse logistics. These changes and requirements from customers have forced companies to be more proactive in returns management and to respond to reverse logistics quickly.[473] In the extant environments, the alternatives of customers' attitudes and behaviors towards returning and disposing products have made firms consider customers as an important partner in developing effective reverse logistics networks and programs.[474]

4.2.3. Information technology

Information Technology (IT) refers to "the hardware, software, and network investment and design to facilitate processing and exchange."[475] IT has been widely described as a critical tool for effective logistics and supply chain management to create efficient business processes.[476] Most IT is designed and installed for forward logistics in mind. However, due to the increased number of returned products and the complex nature of reverse flows, information technology is being used increasingly in reverse logistics management.[477] During the beginning period of implementing reverse logistics, it was operated with a labor intensive, manual, and often undisciplined and inefficient returns management process, which increased the costs of returns management and made many companies reluctant to involve themselves in managing reverse logistics. A very serious problem faced by the firms in the implementation of reverse logistics is the dearth of good information systems.[478] For example, due to the technology gaps for reverse logistics, there are a number of critical challenges for reverse logistics management such as no single source of visibility from initiation of return to ultimate disposition, inadequate collaboration with and lack of monitoring and control of service providers, and highly labor-intensive orchestration of returns processes.[479]

IT makes transaction of returns flows more fluid and transparent than paper-based methods for both firms and customers involved in RL operations, especially with the application of Internet and techniques of barcode scanning, electronic data interchange (EDI), and radio frequency identification (RFID). For example, companies proceeding automatic electronic return authorization and following up with electronic credit refund to their customers often offer better customer services and obtain higher competitive advantages than others do.[480] According to the survey conducted by Verweij et al. (2008) with different supply chain partners in pan-Europe, 95.5% of producers and 80% of retailers evaluated the importance of IT support for manag-

[470] See Mollenkopf et al. (2007), p. 584

[471] See Brito/Dekker (2002),p. 9; Cf also Veweij et al. (2008), p. 28

[472] See Han/Kim/Srivastava (1998), p.30; Cf. also Janse et al. (2009), p. 8

[473] See Haymon (2010), p. 1

[474] See Sciarrota (2003), p. 35; Cf. also Bowman (2006), p. 2

[475]SeeGlobal Logistics Research Team (1995), p. 137

[476]SeeForman/Lippert (2005), p. 5

[477] See Daugherty/Richey/Genchev/Chen (2002), p.90

[478] See Roger/Tibben-Lembke (1998), p. 34

[479] See Dwight (2008), p. 1

[480] See Ravi/Shankar (2005), p. 3-4

ing reverse logistics in their companies. Most of the companies state that there has been lack of integration between IT systems among supply chain partners for reverse logistics. There has been more great need for coordination between the parties to remove the hurdle and ensure maximum efficiency for returns management in recent years. Moreover, the cross-functional information sharing for returns management has been an increasing concern in almost companies with the application intranet technology and decision support system.[481]

IT supports the whole processes of reverse logistics from collecting and recovering the returned products, and to redistributing them into market. IT applications for reverse logistics aim at obtaining product data (quantity, return time, quality, and location), facilitating product recovery (processing time, disposition options, and administration information), and redistributing to the market (finding potential markets, regulating rules for second hand trading). IT has been used to trace the required information through the systems that are used in the original production phase of each return or to retrieve these critical data through monitoring and, in some cases, reverse engineering methods.[482] These functions of IT for reverse logistics have partly decreased the problems of uncertainty and complexity in reverse flows. They support a firm in planning and estimating the actual returns at the early stage of acquisition process. IT is also developed for the control and coordination of reverse logistics processes. It assists decision-making processes for the recovery options of returns (reuse, remanufacturing, recycling) and support administrative tasks related to returns handling that contribute to more efficient returns management. Moreover, the expansion of e-commerce applications and several attempts have been made to consolidate markets for returns through the creation of specialized e-marketplaces. Some information and communication technologies being used popularly today for reverse logistics management in electronics companies in Europe are presented and ranked in Figure 34.

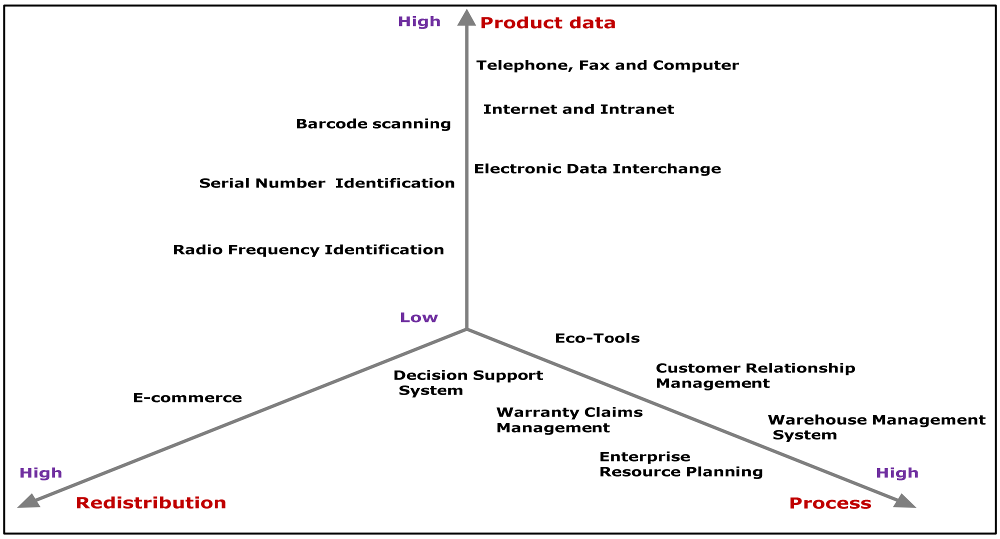

Figure 34: Ranking of IT support for reverse logistics management

Source: Adapted from Kokkinaki et al. (2002), p. 2 with modification; Cf. also Daugherty/Myers/Richey (2002), p.86; Dwight Klappich (2008), p. 1; Verweij et al (2008), p. 55-57; Olorunniwo/Li/Olorunniwo/Li (2010), p. 457

For management of physical flows of returns processes, the application of real time information system with the support of barcode scanning, serial number identification, electronic data interchange, and radio frequency identification are used more popularly in Europe It is the key to the success of reverse logistics operations in many companies in European electronics industry.[483] Distribution by electronic product catalogue can offer a multimedia representation of product information as well as retrieval, classification services and guides for handling a return. Technologies like two-dimensional barcodes and RFID allow sellers to embed much information in the product. RFID tagging improves the accuracy and timeliness of information about

481 See Verweij et al. (2008), p. 55-56

482 See Kokkinaki et al. (2002), p. 2

483 See UK Department of Transport, p. 17; Cf. also Verweij et al. (2008), p. 55-56

the movement of goods in supply chains. Consumers could return items without receipts because RFID tags would act as indices into database payment records, and help retailers track the pedigrees of defective or contaminated items.[484] In addition, on-line tracking and tracing of orders controlling forward logistics also supports to minimize returns because they are interfaces that interact with customers to address aspects of returns uncertainty. Therefore, they can support manufacturers/distributors in examining the condition of a returned product, the time when a product returned to the point of sale (POS), and the reasons why the product enters reverse flows. However, the investment for RFID technology has been under consideration for electronics consumers because of its higher cost than other technologies such as barcodes, magnetic strips, and vision system.

The integration of information technology for both forward and reverse chain has been increasingly applied to reduce the uncertainty and complexity of reverse flows. It is a greater awakening and realization with the entire supply chain by leveraging data exchange.[485] For example, Philips has a more effective and cost-efficient method for handling returned goods by applying ECN's innovative web-based ERL solutions (Enterprise Reverse Logistics) to more than 100 store outlets. With ERL, the system prompts the retail returns clerk for all of the pertinent information and will not allow them to proceed until all fields are filled in correctly. Customers are happy as the decision-making process is immediate. Sales employees are also happy because ERL minimizes the time they have to spend on returns management, and thus allowing more time for sales. The retailer is certainly happy as it means that any credit due is processed and applied to their account much faster.[486]

In forward logistics, Enterprise Resource Planning (ERP), Warehouse Management System (WMS), and Customer Relationship Management (CRM) are used popularly for planning, administrative tracking, and handling support. However, ERP, WMS, and CRM have been initially developed and extended to share information between forward and reverse flows for supporting reverse logistics processes.[487] Moreover, warranty claim management system (WCM) is also designed to specialize in releasing the issues related to consumer returns in warranty period. By the support of WMS, either returns from consumers and retailers can be gathered to conventional distribution centers or specialized warehouses called "returns centers" where information of returns is unified and shared with other actors involved in reverse logistics operations. IT systems therefore are very important in operating returns centers because they consolidate and provide information about the source, quantity and quality of products to be returned, e.g. customer number, product code, return reason code, and conditions into the system.[488]

For redistribution of recovered products, e-commerce has also become the useful tool for defragmentation of reverse logistics market and facilitated remarketing of recovered products to the markets. As of now, there have three main e-commerce models supporting reverse logistics: electronic marketplaces used for both new and used products, separate websites offering used parts or remanufactured products, and internet-based web incorporating collection, selection, reuse and redistribution.[489] Moreover, many manufacturers and retailers in the electronics industry have used e-commerce for trading new products and spare part business for years and supporting returns management because of the shifts in distribution channel.[490] Customers can easily find in online stores of electronics products the instructions for RMA process, services of free return shipping, and rules of credit refund. E-commerce can bring some benefits for a company in implementing reverse logistics such as acting as a consolidation channel for the collection of returns, receiving information from the users about the incoming returns, motivating users to follow optimal returns policy for their products, facilitating better planning, and control of returns management. However, not so many manufacturers/retailers in the European electronics industry have invested in e-commerce for redistributing recovered

[484] See Juels (2006) , p. 1

[485] See Mehrmann (2008), p. 1

[486] See ECN (2009), p. 2

[487] See Kokkinaki et al. (2002), p. 10; Cf. also Verweij et al. (2008), p. 56

[488] See Enarsson (2002), p. 7

[489] See Kokkinaki et al. (2002), p.470

[490] See Verweij et al. (2008), p. 29-30

products due to cannibalization fears for selling their new products. For example, Bosch Power Tools restricted remanufacturing to products where the firm had less than a 50% market share and did not officially operate websites for refurbished/remanufactured products.[491]Meanwhile, many third-party firms as returns aggregators have found it profitable to handle reused, refurbished, and remanufactured products by operating e-commerce for selling them and connecting with buyers and sellers for auction. Some internet-based websites used for e-commerce of electronics products in Europe are provided in Appendix 2, partly reflecting the actual involvement of firms in European electronics industry and third party service providers in e-commerce for returns management and redistribution of recovered products.

Information technology and its attributes have played an increasingly important role as a facilitating factor in reverse supply chain management. The effective integration of IT usage between forward and reverse logistics may improve the efficiency and effectiveness of the whole supply chain.

4.2.4. Collaboration among supply chain partners

Actors in reverse logistics networks can be divided into internal actors (e.g. OEMs, suppliers, distributors, customers, and service providers) and external actors (governmental, non-governmental, and industry organizations).[492] Each actor has varying degrees of power in reverse supply chain. The roles and degree of participation of different actors in reverse supply chain are characterized with three main levels: managing level, operating level, and market level (see Figure 35).[493] Any party can be a returnee including customers, distributors, and even OEMs that are preventative for supply side of returned products in reverse logistics network. Receivers that can be found in the whole supply chain present the demand side of recovered products/materials including customers, suppliers, OEMs, and distributors. Collectors are involved in reverse logistics with functions of collecting and transporting to return centers or regional collection points, including local waste management entities, retailers, OEMs, and logistics service providers. Processors participating in repairing, refurbishing, remanufacturing, and recycling may be manufacturers if they set up their own recovery systems, or independent third-party services providers offer recovery services, e.g. repair centers, logistics service providers, remanufacturers, dismantlers, and recyclers.

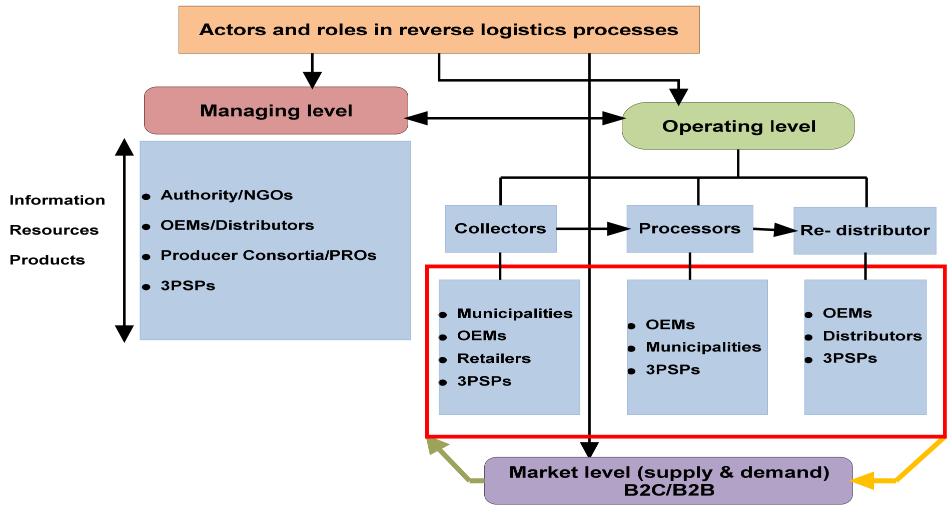

Figure 35: Actors in reverse logistics networks

Source: Adapted from Brito (2003), p. 67-70 with modification; Cf. also Krikke (1998), p. 5

Independent organizations join reverse logistics networks with different degrees of efforts to obtain their own objectives of being more effective and efficient in making business. The level of collaboration depends on different features such as the frequency and intensity of communication, the share of information and knowledge between firms, the trust and win-win spirit, the opportunities of combing resources and develop-

[491] See Ferguson (2004), p. 3

[492] See Krikke (1998), p. 3-4

[493] See Brito (2003), p. 66-67

ing capabilities, as well as the competition between the players of the system.[494] Collaboration with supply chain partners in reverse logistics processes can be seen from the stage of eco-product design, product take-back and collection, to product recovery. For example, many companies such as Canon Europe, Océ, Philips, and Electrolux have co-operated with co-developers and suppliers, thus strengthening the technology base to enable a higher-level recovery of products and components.[495]

In order to reduce logistics and treatment costs, strategic alliances have been increasingly established among chain actors in RL operations due to the complexity and uncertainty of reverse flows. For example, the increasing outsourcing of collection, transport and recovery to third-party service providers in forms of short-term service contract have partly demonstrated the increased collaboration with supply chain partners. In addition, many OEMs and distributors have increased their strategic partnership with service providers by long-term contracts of logistics, recovering and recycling. Many of them have also engaged in a joint venture with a recycling company to share information, combine resources, and develop capabilities to obtain an efficient reverse logistics system. To reduce collection and treatment costs, manufacturers have strengthened collaboration with its competitors to gain economies of scales in RL operations, e.g. volume of returned products collected and recycled, minimization of management and operation costs.[496]

For example, Kodak Europe is a typical case that tries to achieve transportation economies by aggregating the reverse flows of used product from several companies. In each country or geographic region in Europe, Kodak appoints a different manufacturer to coordinate the collection and transportation of used cameras from photo development laboratories. The cameras are delivered to independent separation warehouses where they are sorted and sent to appropriate remanufacturers. With ready-to-use cameras in Europe, Kodak has made a creative way of collaborating with similar companies, competitors, and third party providers, which supports the company in obtaining economics of scale and developing their inter-organizational reverse logistics system.[497] The typical example of intensified collaboration in RL operations is the case of manufacturers in the European electronics industry who work together to establish consortia of implementing take-back and recovery responsibilities to comply with the laws and to develop a cost-effective product recovery system.

Today, the increasing collaboration in reverse logistics processes can be seen more popularly through the relationship between producers and distributors. In retail industries, a returned item is handled differently depending on the status of the product and the relationship between retailers and manufacturers. Increasingly, they support each other in sharing knowledge and information about returned products to make quick decisions for disposition options and provide better after-sales customer service to end customers. The increasing cooperation between them also helps to reduce the cost of handling returns at retailers' sites, and supports OEMs to recapture the maximum value from the returns. Koster et al. (2001) argue that retailers are not as good in performing reverse logistics compared to their ability in handling forward flows. Therefore, partnerships with manufacturers and logistics service providers can support them in dealing with returned products more effectively and efficiently. For example, closer collaboration with manufacturers in gate-keeping and testing the returned products can reduce delays in making disposition options, especially for products with a high marginal value of time. If returned products are processed at points closers to customers, the time lag is shorter as product avoid traveling up the distribution channel to the manufacturer and then back down to the wholesalers and retailers. Quicker processing and turn-around help both distributors and OEMs save costs, satisfy customers, and recover greater value from returned products, especially for non-defective customer returns.[498]

In addition, many logistics service providers such as DHL, GLS, and Hermes Logistics offer services designed to collaborate with multichannel retailers deal with the trend of distant selling and the increased

[494] See Freires/Guedes (2008), p. 58

[495] See Krikke/Harten van/Schuur (1999), p. 387; Cf. also Herold (2007), p. 165

[496] See Krikke (1998), p. 5; Cf. also Toffel (2003), p. 120

[497] See Toktay/Wein/Zenios (2000), p. 1412

[498] See Roger/Tibben-Lembke (2001), p. 129

returns rate. For example, these carriers make partnership agreements with many retailers to become collection-and-delivery points for receiving and returning products purchased online. Two carriers (DHL and GLS) rapidly established their own networks of service points through cooperation with Praxis and Videoland, two large chains of do-it-yourself stores and video rental shops for their parcel delivery and returns service in the Netherlands.[499] Other examples of the collaboration can be referred through case studies of Hermes Paket-Shop and PickPint in Germany, CollectPoint and MyParcel in United Kingdom, and Kiala and TNT Post in The Netherland.[500] These logistics service providers also offer value-added plans for returns processing, and they provide technology that supports OEMs and retailers to generate postage-paid labels to facilitate easier customer returns. The labels also enable visibility into goods being returned to retailers in advance of the shipment, thus enabling them to achieve better distribution resource planning.

The increased collaboration among manufacturers, distributors, and service providers in the implementation of reverse logistics depends on both to what extent each partner wants to participate and also the level of information sharing between them to hand over products returned and discarded. Information sharing with the support of information technology leads to the greater collaboration in RL and directly by itself results in greater RL performance. Properly applying and managing information technology effectively improves the visibility of return flows, increases the collaboration between actors in the implementation of reverse logistics, and therefore leading to cost reductions, customer satisfaction, and profitability.

4.2.5. Globalization

Globalization is not merely an economic process; moreover, it is the process of change, from which it brings together places and people in order to achieve the economic principle of efficient usage of resources and economies of scale.[501] It is the combination of technological changes and the opening up of regional and global markets that have been the primary cause of the reconfiguration of the kind and range of value added activities undertaken by firms, their spatial dimensions, and their organizational forms.[502] At a global level, the drivers for environmental issues, e.g. sustainable development, lowered CO_2 emission, and the requirements of 3Rs are hybrids of regulatory, company, and global market forces.[503]

Today, sustainable practices that are legally imposed by governments in many countries are based on the principle of EPR.[504] For management of WEEE, different national recovery systems have been established for years including the systems in European countries where WEEE Directive has been taken into effect since 2003; in Asia countries like South Korea, Japan, and Taiwan; and in the USA.[505] Each country often has different requirements on recovery quota and imposes strong constraints on the disposition decisions. Therefore, firms making business globally have faced the issues of environmentally oriented reverse logistics management and adapted their business to meet global sustainability criteria. In the 21st century, many globally operating companies, e.g. Nokia, Electrolux, Fujitsu Siemens, and HP, are adopting EPR worldwide by offering free recycling services, even when not mandatorily prescribed by the regional authorities.[506] However, they have dissimilar EoL management strategies in each country because of the differences in legislation requirements and national recovery systems (see Table 8). For example, BSH has been as a member of more than 20 national take-back systems to draft and encourage the adoption in practice of voluntary industry standards for the collection, transport, storage, handling and processing of refrigerators and freezers in the EU. The company has been involved in recycling operations in Europe for years, but is only monitoring the situation in China and USA where the laws and regulations have not been specifically enforced.[507]

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[499] See Weltevreden (2008), p. 646

[500] See Esser/Kurte (2005), p, 126; Cf. also Weltevreden (2008), p. 645

[501] See Santiago (1999), p. 17

[502] See Dunning (1999), p. 47

[503] See Koh/Gunasekaran/Tseng (2011), p.2

[504] See Zoetema/ Krikke/Venselaar (2010), p. 415-416

[505] See Khetriwal et al. (2007), p. 2; Cf. also Chung/Rie (2008), p. 126-127; Kumar/Putnam (2008), p. 306-307

[506] See Zoeteman et al. (2010), p. 416

[507] See BSH (2009), p. 20-22

Company	EoL management in EU	EoL management in USA	EoL management in Asia
BSH	Collective system	No involvement in EoL management, but keep tracking the legislation development	Only monitoring and supporting for draft legislation and collective compliance
Electrolux	Collective system	No involvement in EoL management. Control End-of-lease returns with business customers	No involvement in EoL management.
Fujitsu Siemens	Individual recovery system (B2B); collective system (B2C)	No involvement in EoL management	Join take-back initiatives in Korea, Taiwan and Japan
HP	Individual recovery system (B2B); Collective system (B2C)	Individual recovery system	Individual contracting system

Table 8: Examples of EoL management in global scope

Source: Herorld (2007), p. 165-201

Globalization is also a business trend that has become a way of life for businesses of all types or sizes. Supply chain is continuing to globalize to take advantage of resource efficiency and labor costs because of tighter profit margins and increasing competition. The increased usage of offshore and global manufacturing contracts has caused many manufacturers of electronic and electrical equipment in Europe to move their production locations to other countries. For instance, Asia Pacific's share of global electronics production increased from 20% to 40% between 1995 and 2005 due to the increased foreign investments and outsourcing contracts from foreign countries.[508] However, global supply chain causes some challenges and trade-off for managing the integrated networks because of the increasing logistics costs, the increasing uncertainty of material flows, and the less control of product quality. Certainly, these lead to the increased returns rate and the difficulties of managing reverse flows.[509]

As supply and demand market is becoming more global, it has provided sales opportunities for new and recovered products. For example, the global supply of products and services has increased the management attention to spare part services worldwide, which requires more investments in regional consolidation centers, information technology systems for sharing information and knowledge, and standardizing returns policy. Moreover, there have been growing customer demands for a consistent source of global services and support capabilities across all of their geographic areas that would result in greater uniformity in the service delivery and support to customers regardless of where they are located all around the world.[510] The requirements for supporting customer returns are becoming increasingly standardized both on a local/regional and global basis, e.g. call centers, returns authorization process, and online supports. It is more necessary to fit a multitude of geographically decentralized functions into a global capability for both providers and their customers. Moving to a global reverse logistics model may not only allow companies to perform efficiently on a global basis but also help them to remove an inefficient way of conducting business in their own front yard. In any case, ongoing improvements in technology and communications will allow new opportunities to control globally the returns flows in a cost-effective manner. Therefore, globalization may potentially become the norm for reverse logistics. Globalization may bring both forward and reverse logistics great opportunities for cost savings thanks to the centralization and more consistent operational approaches (see Figure 34).[511]

[508] See Verweij et al. (2008), p. 28

[509] See Janse et al. (2009), p. 7

[510] See Pollock (2008), p. 1

[511] See Pollock (2008), p. 2

Figure 36: Global integration of reverse logistics management

Source: Pollock (2008),p. 2

Although OEMs in the European electronics industry today operate more globally, they have preferred to manage their reverse logistics for EoL products on a regional level due to the complex nature of reverse flows and the differences in national legislation and recovery systems. Moreover, the reduced transport costs, the elimination of complex outsourcing operations, and the treatment capacity problems are also reasons for regional recovery options. For WEEE management in Europe, a regional approach has improved controllability and reduces illegal practices, e.g. Basel Convention, as well as unnecessary transportations. However, it requires the high investments and costs at the first stage of operating reverse logistics for EoL management.[512] For customer returns management, due to the issues of complexity and increased costs in dealing with reverse flows in the case of far distances, as well as the desire to ensure customer proximity, companies in the European electronics industry tend to manage reverse logistics on regional, national and international scope rather than globally. In survey conducted by Verweij et al. (2008), at European level, 90.5% of producer respondents have centralized their management for reverse logistics activities. For regional and national levels, these rates are 41% and 50% respectively. For LSP respondents 60% have centralized management at European level and 80% at national level.[513]

4.3. Internal factors influencing the development of reverse logistics

Companies have engaged in reverse logistics operations, especially with closed-loop supply chain management, mainly due to economic motives, customer orientations, and legislation drivers.[514] In fact, both external and internal factors today are found to drive and facilitate the practices of reverse supply chain management.[515]Especially, the level of involvement of firms in European electronics industry in the management of reverse logistics and the level of outsourcing of reverse logistics activities are affected by many organizational-related factors inside of the firms. Internal factors interacting together with external factors[516]may have important impacts on RL operations. The factors including the utilization of current resources, internal information exchange and cross-functional integration, definite company policies, and top management supports are observed in many previous studies as the main internal factors influencing the implementation of reverse logistics (see Figure 37). Firms' adjustment of these factors may regarded as the organizational adaptive capabilities to the changing requirements of external environments, which can improve RL performance.

[512] See Zoeteman et al. (2010), p. 416

[513] See Janse et al. (2009), p. 49

[514] See Brito/Dekker (2002), p. 2; Cf. also Guide et al. (2003), p. 1; Fleischmann et al. (2004), p. 2

[515] See Clemens/Douglas (2006), p. 485

[516] See Hemel/Cramer (2002), p. 440

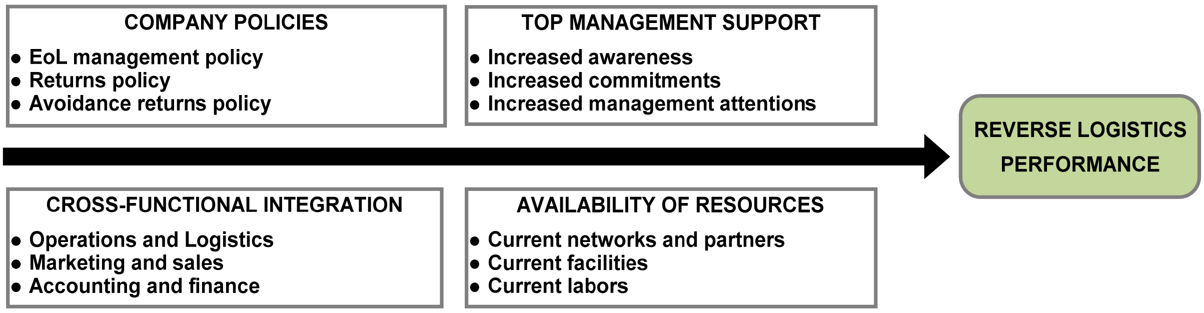

Figure 37: Internal factors influencing the development of reverse logistics

Source: Own illustration

4.3.1. Company policy

Company policies can directly influence the allocation of personnel, financial, and technological resources within an organization, and dictate a firm's specific organizational objectives.[517] At the beginning of the 1990s, reverse logistics was not an important weapon for achieving competitive advantage and differentiation, and company policies did not support these operations. Company policy ignoring the strategic role of RL was the second most commonly cited barrier to good RL programs at that time.[518] The lack of awareness of strategic importance of reverse logistics led to the management inattention to the policies related to reverse flows such as unclear returns policy and warranty conditions, no concrete directions for EoL management, and no guidelines for disposition options of product recovery. With such viewpoints, firms focus on cost minimization at an operational level, missing chances to recapture value for themselves and to create value for their customers' satisfaction.[519]

Since the 2000s, many companies in the European electronics industry have increasingly aligned their company policies with more strategic focus on reverse logistics, especially for OEMs. The advent of extended producer responsibility seems to be a paradigm shift to make them change their rigid company policy to incorporate the returns of the products to recover value ecologically and efficiently. They think strategically about returns management within their broader supply chain strategy.[520] Many manufacturers in the electronics industry have regarded reverse logistics as part of sustainability programs.[521] For example, some manufacturers such as Miele, Philips, and Electrolux are pioneers in EoL management policy by their innovations from product development policies in the complete product life cycle by using secondary materials, eco-design in term of high recyclability to offering customers the possibility of returning product at the end of life through voluntary take-back.[522] Specifically, Miele has formulated their clear policies for returns management with both strategic and operational considerations, e.g. identifying the roles of different kinds of returns in its strategy, reviewing environmental and legal compliance issues, developing product recovery strategy for diverse returns, and developing network relationships with different partners to implement its strategy of reverse logistics.

In addition, many companies in the European electronics industry have launched policies and programs for customer relationship management that encompass the issues of customer returns to make their returns handling better. A comprehensive and horizontally integrated returns management with the supports of different functions can dovetail with policies of customer relationships management to take customer retention and loyalty.[523] For example, developing return avoidance policies can help firms manufacturing and selling products in a friendly manner to minimize the returns. Return avoidance policies are frequently carried out by improved quality and better instructions through written papers and technical helplines to the

[517] See Peterson (2005), p. 17

[518] See Rogers/Tibben-Lembke (2001), p. 145

[519] See Mollenkopf et al. (2011), p. 391

[520] See Janse et al. (2009), p. 6; Cf. also Herold (2007), p. 165-201; Fleischmann et al. (2004), p. 6; Miele (2008), p. 23

[521] See Presley et al.(2007), p. 4595

[522] See MIELE (2008), p. 23; Cf. also PHILIPS(2010), p. 3; ELECTROLUX (2010), p. 35

[523] See Janse et al. (2009), p. 17

customer as how to properly operate the product.

The impact of increasing customer demands is felt equally by manufacturing and retail business.[524]Although returns are not much welcomed by both OEM and retailers because of the high costs related to logistics, sorting, storing, and other indirect costs, they are required to offer returns policies that protect customers' rights. Both OEMs and retailers in the European electronics industry have paid more attention to developing returns policy with different levels (see Appendix 3). Customers' returns are not avoidable and more lenient returns policies can strengthen relationships with customers, increase firms' sales by repetitive purchases, and improve their friendly image.[525] Many OEMs have collaborated with their distributors to keep their products fresh in the marketplace and increase their mutual benefits by setting up as suitable plan for taking away any surplus stock at the end of each catalogue. They have also requested their distributors to inspect and sort products returned from customers to avoid "No fault found" returns. For example, Philips Global was highly successful in reducing the number of returns from 1.2 million per year to less than 500,000 through the collaboration with their retailers.[526]

Many consumer electronics retailers such as Mediamarkt/Saturn, Euronics, Datart, and Otto have been highly successful by offering online shops with a returns management program and various after-sales services for different kinds of electronics products.[527] For example, the delivery of online order, especially with heavy and bulky items, can be arranged with the take-back of old products for customers. Firms in the European electronics industry have analyzed on cross-index data on product life cycle and service contracts with customers to develop special returns policies for customer replacement-purchase patterns for fast-depreciating products like PCs and IT equipment, and link it to their reverse-logistics processes, e.g. buy & try, trade-in, buyback, and rebate. This allows them to offer timely customized promotions to individual customers, sell a replacement product with a turnkey offer to provide credits value on the product customers currently own, and handle their program of recovery and recycling proactively.[528]

Company policies for managing product returns are being changed with both OEMs and distributors in the European electronic industries to adapt to the requirements of laws, the increasing customer demands, and the potential economic value of returned products.[529] The proactive efforts towards managing reverse flows through understanding the importance of product returns, more strategic focus on reverse logistics, and adjusting company policies are more likely to be important factors of successful reverse supply chain management.

4.3.2. Top management support

Top management support is arguably one of the most critical factors in the success of corporate programs. To ensure the progress for sustainability programs in business, e.g. eco-design development, voluntary take-back, and recovery operations, top management support should be fully committed.[530] Therefore, lack of commitments and supports from top management is a main barrier for the implementation of reverse logistics. The study of Daugherty et al. (2001) supports this viewpoint, indicating that firms who pay more managerial attention to reverse logistics often have better overall business performance, and that a reluctance to change from top management is often a barrier to the development of effective RL programs. Lack of a clear focus and commitments from the top management of firms have led to unclear return policies, shortage of product recovery strategy, and unspecified assignment of human resources to RL. These make many companies resistant to change to reverse logistics or reengineer their supply chain process to fit with reverse flows.[531] In order to conduct an effective reverse logistics program, senior management's confidence and

[524] See Rahman/Subramanian (2011), p. 4
[525] See Saibani (2010), p. 116
[526] See Sciarrotta (2003), p. 34
[527] See Mediamarkt (2012), p. 2; Saturn (2011), p. 3
[528] See Ostlin/Sundin/Bjorkman (2008), p. 344
[529] See Herold (2007), p. 158-201; Cf. also Ostlin/Sundin/Brojkman (2008), p. 340; Janse et al. (2009), p. 6; Saibani (2010), p. 109-116
[530] See Zsidisin/Siferd (2001), p. 67
[531] See Ravi/Shankar (2005), p. 6; Cf. also Gonzalez-Torre/Alvarez/Sarkis/Adenso-Diaz (2009), p. 892

commitments are required for successful implementation.[532]

In recent years, with increased competition in the market and shrunk profit margin, companies in the electronics industry are increasingly interested in managing the used and returned products. 92% of best-in-class companies in Aberdeen survey (2006) state that they have a senior service director or executive overseeing all aspects of product/part return exchange, repair and refurbishment. Top managers are increasingly awareness of complexity and risk for commercial, repairable, end-of-use, and end-of-life returns.[533] More importantly, there have been more companies in the European electronics industry instilling their environmental and sustainable consciousness into their corporate vision and culture. In these cases, top management demonstrates their support for reverse logistics on par with other organizational goals by integrating all members in the supply chain.[534] They structure their reverse chain with organizational logic, establish the right level of control, and make strategic decisions for committing and allocating company resources for RSCM. The increase in management attention toward reverse logistics has resulted in supports for RL through strategic and operational policies for different kinds of returns.[535]

4.3.3. Cross-functional integration

Personal commitments and impetus have not necessarily resided at only top-management level. The existence of upper management support is a necessary but insufficient condition for the implementation of environmentally friendly reverse logistics practices across a wider range of value chain activities. The operations of sustainable supply chain management cross all departmental boundaries within and between organizations. Rogers et al. (2002) also argue that returns management is an important SCM process spanning functional and firm boundaries across supply chain. Within a firm, activities related to return authorization, collection, gate-keeping, avoidance, product recovery, disposition, processing, and credit refunding are interfaced with many cross-functional processes.[536] Therefore, cross-functional integration is important to successful RSCM implementation.[537]

RSCM involves different staff from marketing and sales, operations, logistics, and accounting and finance. According to Aberdeen survey (2006), 52% of best-in-class companies capture and analyze customer- and product-specific returns and repair data, and systematically share these insights with value chain counterparts in design, manufacturing, and sales and marketing functions.[538] If firms recognize the cross-functional nature of returns, they can more effectively integrate forward and reverse flows. The degree of cross-functional integration in logistics, operations, and marketing supports firms in managing return flows smoothly and efficiently. Mollenkopf et al. (2011) through a qualitative research methodology relying on individual managers' perception indicate that functional integration at the marketing-operation interface can lead to a better alignment of company resources for returns management, and thus create higher levels of customer value.[539] Moreover, the integration enables firms to leverage the knowledge of lifecycle analysis into design improvements and product development, which supports them in collecting and recovering the returned products easily and economically.[540] Activities of refurbishing and remanufacturing that are co-located with the original manufacturing sites can ensure "used inventory" into "sellable inventory." The intra-firm integration may improve firms' control of recaptured parts for use in new products, or repair/service parts in field support operations.[541]Developing a returns policy relates to information about how long a product can be returned without reasons, how a product can be returned, how returned merchandise will be valued, and how

[532] See Zhu/Sarkis (2008), p. 3

[533] See Aberdeen Group (2006), p.1; Cf. also Janse et al. (2009), p. 8

[534] See Kumar/Putnam (2008), p. 308 - 309

[535] See Verweij et al. (2008), p. 35-38 ; Cf. also Ravi Shankar (2005), p. 6

[536] See Croxton et al. (2002), p. 29; Cf. also Mollenkopf et al.(2011), p. 392

[537] See Sarkis/Zhu (2008), p. 3; Cf. also Sarkis (2007), p. 4606

[538] See Aberdeen Group (2006), p. 2

[539] See Mollenkopf et al. (2011), p. 391

[540] See Toffel (2004), p. 120-121

[541] See Mollenkopf (2011), p. 2

credit authorization guidelines will be developed.[542] These policies and regulations relating to invoicing cycle time of return material authorizations directly influence cash position of a company.

Firms with closer cross-functional integration may be better at facilitating the internal knowledge and sharing information, which create continuous innovation capabilities in reverse logistics management.[543] For example, sharing cost information about returning and processing the stock across marketing, operations, and logistics may help the operations and logistics group to avoid the related costs by encouraging customers or retailers to keep products via promotional supports. The more share of information among functional departments regarding returns issues is, the better aligned cross-functional integration will in terms of managing company resources for RL implementation.

4.3.4. Utilization of current resources

The effective utilization of current resources is a key organizational factor that determines the pursuit and successful implementation of business opportunities. This condition is of special importance to reverse logistics operations because RL is resource intensive and economic investments are vital for the development of reverse logistics systems.[544]

Stock (1998) states that the full utilization of current equipment, labors, and facilities should be given first priority in order to minimize the total costs of RL operations. Therefore, the overall success of a RL system in terms of strategic cost under internal consideration is largely determined by the effective utilization of current resources.[545] This factor is especially important for OEMs because they can use current facilities in manufacturing and distributing operations to set up a closed-loop supply chain for their returns management and product recovery. The costs of acquiring new facilities and customer service centers for remanufacturing operations and returns management may be prohibitive, which hinders them from implementing reverse logistics economically. More OEMs in the European electronics industry have collected, repaired, and refurbished old appliances in an ecologically friendly and economically-viable way by trying to utilize their current equipment, labor, facilities, and particularly their logistics networks and partners.[546] Firms have been more likely to vertically integrate into activities that require knowledge similar to that which they already possess. Therefore, companies with extensive manufacturing, service, and repair experiences may be more likely to vertically integrate into EOL product recovery.[547] For example, Rank Xerox, which leases a significant share of its copiers, has succeeded in its remanufacturing operations thanks partly to an efficient pre-existing logistic system.[548] Electrolux can obtain economic benefits from its remanufacturing facility in Sweden by putting the remanufacturing process in a seldom used warehouse near an ordinary manufacturing plant for stoves and using old machines that are no longer useful in ordinary manufacturing.[549]

Dowlatshahi (2005) through case study analysis also points out that the strategic fit of reverse logistics in a firm's business strategy is based on its ability to use the existing resources, technologies, and knowledge for reverse logistics activities. The current facilities, e.g. customer service or call centers, warehouse or distribution centers, and transportation modes, have been partly utilized for reverse logistics operations in both distributors and manufacturers of EEE in Europe based on the volume of returns and business size.[550] The use of current personnel is possible and essential in making RL viable. The personnel should also have the necessary skills and be trained to undertake RL operations with minimum of additional costs, especially with gate-keeping and inspection technique, dismantling and remanufacturing works. The lack of adequate per-

[542] See Lambert (2006), p. 145

[543] See Daugherty/Myers/Richey (2002), p. 83; Cf. also Mollenkopf/ Gibson/Ozanne (2000), p. 92: Saibani (2010), p. 102

[544] See Daugherty et al. (2001); Cf. also Roger/Tibben-Lembke (2001); Alverez-Gil et al. (2007)

[545] See Dowlatshahi (2005), p. 3459

[546] See Herold (2007), p. 68; Cf. also Kumar/Putnam (2008), p.311; Miemczyk (2008), p. 280; Kapetanopoulou/Tangaras (2010),381 p. 95;

[547] See Krikke (1998), p. 390; Cf. also Toffel(2003), p. 129

[548] See Ayres et al. (1997), p. 558

[549] See Sundin (2004), p. 151

[550] See Flesichmann (2004), p. 3; Verweij et al. (2008), p. 65; Janse et al. (2009), p. 15-16

sonnel could seriously undermine the success of any RL system. Therefore, effective utilization of existing resources can minimize the strategic costs involved in EoL and customer returns management.[551]

4.4. Hypothesis development

Based on framing the theoretical foundations, reviewing the related literatures, and analyzing factors influencing the implementation of reverse logistics in practice for the adaptability to reverse logistics, this chapter aims at investigating the adaptability to reverse logistics regarding the relations between the changing requirements of external environments (external factors), the organizational adaptive capabilities (internal factors), and RL performance. It answers the question of how external or internal factors above-mentioned currently constitute the supports and motivations for firms in the European electronics industry to implement reverse logistics. More importantly, this chapter also addresses which factors are currently most critical for the development of reverse logistics in the European electronics industry and the response of organizational-related factors to the changes of environment.

The above-mentioned analysis of influences of external factors indicates that the requirements of laws and regulations have not only driven OEMs in the European electronics industry to formally implement reverse logistics programs but also facilitated them to accomplish their responsibility, e.g. free choice of extended producer responsibility and supporting mechanism for collective take-back. The WEEE Directive legislation has actually encouraged firms to innovate and discover unsuspected and profitable business opportunities obtained from EoL product recovery. The WEEE Directive also motivates the collaboration in the entire reverse supply chain to improve bottom-line profits by some limitations for individual producer responsibility through financial guarantee. Increased customer awareness and demands have increased the collection volume of used products discarded properly and required firms to conduct formal reverse logistics programs. Intensified collaboration and information technology have made conditions for firms in the European electronics industry to conduct reverse logistics program smoothly and efficiently, increase their flexibility in confronting with reverse flows, and especially reduce the costs of logistics, management, and treatment. The pressures and supports of external factors have made companies change their strategy, align their policies, adjust business models, and reallocate their company resources for reverse logistics. The regulations can bring increased awareness to managers with respect to the benefit of enhancing cross-functional integration to better achievement the alignment of company resources for reverse logistics management. For example, redesigning products in compliance with regulatory standards may lead to the increased integration between the marketing and operation department in a firm, which may bring potentials for more easily recycling, disposing, and therefore reducing operating costs.

However, there has not been an empirical research conducted by survey methodology to explore the influence of these external and internal factors, and their interaction on performance of reverse logistics. Exploring their interaction may allow us to evaluate whether there is a causal relationship between external factors and internal factors affecting the development of reverse logistics. It is very necessary to determine how these factors interact and influence the performance of reverse logistics because the result will likely demonstrate the counterbalance of two factor groups to the development of reverse logistics. It also supports the study in explaining the response of organizational-related factors inside the firms to the changes of external environments, indicating the organizational adaptive capabilities.

Based on the first conceptual model, this study develops some hypotheses to investigate the influences of the changing requirements of external environments (external factors), the organizational adaptive capabilities (internal factors), and their interaction on RL performance. It answers the question of how external and internal factors currently constitute the supports and motivations for RL implementation. More importantly, this study also addresses which factors are currently most critical for the development of reverse logistics in the European electronics industry and the response of organizational-related factors to the changes of environment. Exploring their interaction may allow this study to evaluate whether there is a causal relationship between external and internal factors affecting the development of reverse logistics

[551] See Dowlatshahi (2005), p. 3459

In applying this focus, four hypotheses are developed to explore the direct and indirect effect of these factors on RL performance (see Figure 38).

Hypothesis 1a: The changing external environments have positive influences on the performance of reverse logistics

Hypothesis 1b: The adaptation of organizational-related factors inside a firm has positive influences on performance of RL

Hypothesis 1c: The adaptation of organizational related factor inside a firm related to reverse logistics mediate the indirect positive effect of the changing external environments on RL performance

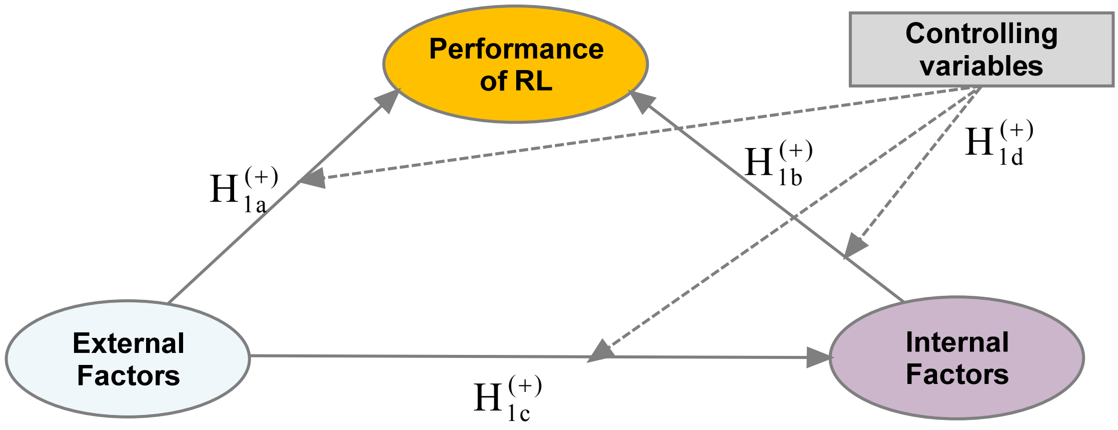

Figure 38: Hypothesis development of factors influencing reverse logistics development

The effect of external factors and internal factors on performance of reverse logistics may vary in different contexts according to the level of firm size, the type of firm, the location of firm, and the implementation time of a formal reverse logistics program. There have been different arguments related to the impact of firm size on business performance.[552] Some researchers state that smaller firms are more flexible and more innovative in performing their business by taking advantage of their size.[553] Meanwhile, others suggested that larger firms, in general, have more resources to carry out their business activities proactively. They often have sufficient financial and technological resources to invest in new methods of managing integrated supply chain.[554] Larger firm may have more advantages of implementing reverse logistics efficiently due to the availability of resources for RL operations and the economies of scale gained from the large volume of returns.

The practices of RL operations of OEMs reveal that OEMs may be more proactive in implementing reverse logistics than retailers due to the extended responsibilities of take-back and recovery for their EoL products, and the pressures of their end-consumers and distributors. Dekoster et al. (2001) indicate that retailers were not as good in performing reverse logistics compared to their ability in handling forward flows.[555] In contrast, the findings of Stock and Mulki (2009) suggest that retailers handle significantly more returns than manufacturers or wholesaler because they have in close proximity to end-consumers than OEMs. Nowadays, the retailers have more complex returns processing since there could be multiple reasons for product returns and they want returns handled more expeditiously compared to manufacturers and wholesalers.[556]

Location of firms may also influence performance of reverse logistics due to the differences of law enforcement, customer awareness and demand, and economic development. In addition, this study regards the implementation time of a formal reverse logistics program as a moderating variable for the reason that adaptability is a time-sensitive process and the alignments to reverse logistics may take time to perform effectively. The implementation time may influence the proactive efforts of a firm to RL. Considering the above

[552] See Freel (2000), p. 197

[553] See Olavarieta/ Ellinger (1997), p. 562

[554] See Grover/Gosla (1993), p. 145

[555] See DeKoster/Rene/De Brito (2002), p. 11

[556] See Stock/Mulki (2009), p. 49

arguments, the study also investigates whether firm size, firm type, firm location, and implementation time of a FLRP moderate the hypothesized links in theoretical model of factors influencing development of reverse logistics.

Hypothesis 1d: Firm size, firm type, firm location, and implementation time moderate the relationships mentioned in the theoretical model.

This study is based on an empirical study through internet-based survey with the statistical technique of structural equation modeling to test the hypothesized links. Explanations and applications of these tools for evaluating are further discussed in Chapter 4.5

4.5. Empirical study and statistical techniques

This section discusses the statistical techniques used in this study for data collection and model estimation. It includes the foundations of empirical investigation, the procedures of test and analysis, and the analytical technique of Partial Least Square Path Modeling.

4.5.1. Foundations of empirical study

As explained in chapter 1.3, case study is commonly used in many studies on RSCM. However, the major disadvantage of case study is lack of generalizability due to small sample sizes. Therefore, this study overcomes this limitation by conducting an internet-based survey to empirically test the theoretical models proposed. A quantitative method is based on the measurement theory that is rooted in the philosophy of science in the two linguistic theory of Carnap (1966).[557] According to Carnap (1966), a linguistic framework for scientific theories is distinguished between questions of reality and existence, or internal and external to a linguistic framework.[558] Carnap (1966) divides the language of scientific theory into two parts:

- The theoretical language or theoretical laws
- The observation language or empirical laws

According to Carnap (1966), the observation language or empirical laws are laws that can be confirmed directly by empirical observations that contain terms or phenomenon either directly observable by the senses or measurable by relatively simple techniques. Theoretical laws concern non-observables and are more general than empirical laws. Theoretical laws are related to empirical laws in a way somewhat analogous to the way empirical laws are related to single facts. An empirical law helps to explain a fact that has been observed and to predict a fact not yet observed. In similar fashion, the theoretical law helps to explain empirical laws already formulated, and to permit the derivation of new empirical laws. It means that a theory is taken to be the conjunction of theoretical postulates (T) to the empirical observations as correspondence rules (C). Theoretical postulates present the fundamental laws about a certain domain of phenomena and contain as theoretical concepts or variables. Meanwhile correspondence rules contain at least one observation term coming from the observation language and one theoretical term, which interpret the theoretical terms of the theory and facilitate its applications to the phenomenon observed.[559]

Bagozzi and Philipps (1982) develop the boundaries of theoretical postulates and correspondence rules that contain three different types of concepts: theoretical concepts, empirical concepts, and derived concepts. Theoretical concepts are abstract and elude direct observations of properties or attributes of a social unit of entity. Empirical concepts refer to properties or relations whose presence or absence in a given case can be inter-subjectively determined under suitable circumstance by direct observation (observation language). Derived concepts are unobservable (like theoretical concepts), but unlike theoretical concepts must be tied directly to empirical concepts.[560] Using these arguments of theory and observation language of Carnap and Bagozzi, a research model can be constructed that represent the theoretical implications by converting theoretical and derived concepts into unobservable (latent variables), and empirical concepts into indicators (or

[557] See Fassott / Eggert (2005), S. 34
[558] See Irzik/Gryenberg (1995), p. 287-288
[559] See Carnap (1966), p. 1-5; Cf. also Irzik/Gryenberg (1995), p. 287-288
[560] See Bagozzi/Philipps (1982), p. 465; Cf. Also Haenlein/Kaplan (2004), p. 286

observable variables). The relationships of these concepts are linked by a set of hypotheses. Non-observational hypotheses link theoretical concepts with other theoretical concepts, theoretical definitions connect theoretical and derived concepts, and correspondence rules link theoretical or derived to empirical concepts and serve to provide empirical significance to theoretical terms.[561]

In terms of empirical measurement, the estimation of a network of causal relationships of latent variables defined according to a theoretical model is named structural equation models.[562] The basic idea implies that complexity inside the network of relationships can be studies by taking into account causality links among latent concepts, called Latent Variables, each measured by several observed indicators usually defined as Manifest Variables. By assessing the model, a high degree of generalizability is obtained because the cause-effect relationships are considered for the underlying general population.[563] Moreover, the predictive relevance of the so-determined relationships and the difference of effect size are also investigated.

Figure 39 introduces the foundation of empirical study by using two constructs of theoretical terms ξ_1 and ξ_2, which illustrates a relationship between them β. These latent constructs are not directly observable and are interpreted through the indicators of x_1, x_2, and x_3. To measure these unobservable constructs empirically, observable indicators are used to facilitate their application to phenomena in the real world. For example, in this study on the topic of development of reverse logistics, the main theoretical concepts are ascertained by the concepts of adaptability to reverse logistics and transferability of reverse logistics. The theoretical concept of adaptability to reverse logistics at firm level is defined with some concrete derived concepts of the response of organizational-related factors to the external fast-changing environments, e.g. the commitments of resource, the formulation of RL strategy, the formalization of returns policy, the development of RL capabilities, and the performance of RL.

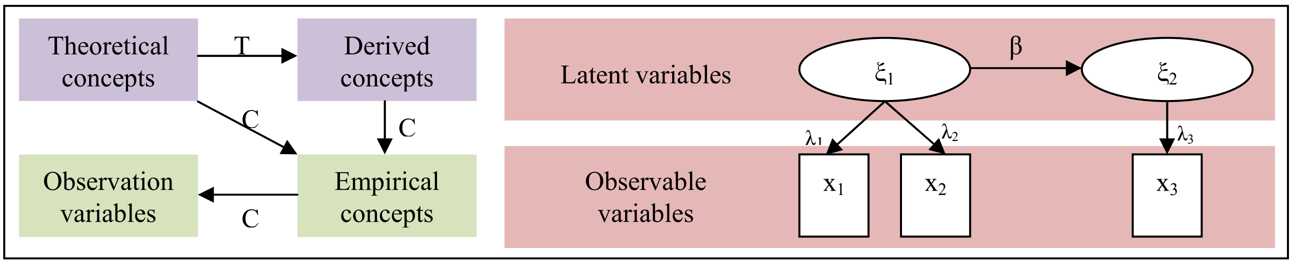

Figure 39: Foundations of empirical study

Source: Bagozzi/Philips (1982), p. 465; Cf. also Bagozzi (1984), p. 13

Test procedures and statistical techniques are designed accordingly to estimate the network of these relationships

4.5.2. Test procedures

The data collected is tested with SPSS 17[564] and SmartPLS 2.0 M3.[565] Initially the data is coded in numerical order in an excel spreadsheet for easy data entry purposes before it is transferred to the SPSS spreadsheet. All data are first scanned and treated for errors and missing values, in which the data is visually scanned for errors in data entry and amended accordingly.

Prior to assessing the measurement scales, descriptive statistics is conducted with the assistance of SPSS 17. The mean and standard deviation are initially tested to identify the central tendency and dispersions of the variables. Furthermore, skewness and kurtosis were tested for normal data distribution.

Subsequently, this study conducts reliability tests and exploratory factor analysis (EFA) by SPSS 17 to initially purify the scale measurement and check the unidimensionality of each construct. Scale reliability refers to the proportion of variance attributable to the true score of latent variables, which can be defined as

[561] See Bagozzi (1984), p. 17; Cf. also Haenlein/Kaplan (2004), p. 286

[562] See Wold (1975); Cf. also Bollen (1989); Chin (1998), p. 295; Tenehaus et al. (2005), p. 159

[563] See Lohbeck (2009), p. 79; Vinzi et al. (2010), p. 48

[564] See SPSS (2007), p. 12

[565] See Ringle/Wende/Alexander (2005), p. 1

the internal consistency reliability. The internal consistency of a scale is an important measurement property as it implies that items of the scale, notwithstanding their distinctiveness and specificity, share a common core and measure the same concept.[566] This study evaluates the internal consistency reliability of scales by testing their coefficient alpha (Cronbach α) and item-to-total correlation for each construct in the theoretical model. Theoretically, the coefficient alpha is concerned with the degree of interrelatedness among a set of items designed to measure a single construct.[567] Items with a corrected item-to-total correlation above 0.35 and constructs with a coefficient alpha about 0.7 are accepted for scale reliability.[568]

The primary objectives of an exploratory factor analysis are to determine the number of common indicators influencing a set of measures and the strength of the relationship between each factor and each observed measure in this research.[569] The method of principal component analysis with varimax rotation to evaluate the unidimensionality of the latent variables is used in EFA. According to Hair et al. (2006), there are some rules to drop off the items in factor analysis such as eigenvalue less than 1.0, factors with only one item in them, items without loading factors, items with similar or near loadings to more than one factor, and items with item communality greater than 0.4.[570] EFA is used to ensure that the manifest variables are loaded on their intended construct and items loading on other factors are eliminated from further consideration. The remaining items are then used to estimate in structural equation models.

Finally, we use the measurement scales refined in reliability tests and EFA as input for simultaneously estimating the measurement and structural models by applying structural equation modeling. Structural equation modeling (SEM) is a statistical methodology used by many researchers from different scientific fields because SEM provides researchers with a comprehensive method for the quantification and testing of substantive theories.[571] SEM enables a series of observable variables or items to be directly or indirectly linked with factors, and takes into account measurement error that is ubiquitous in most disciplines. The classical statistic techniques, e.g. multiple regression analysis, analysis of variance, and logistic regression, are only significantly applicable where there is neither a systematic nor a random error (so-called a certain measurement error) - a rare situation in practice.[572] Structural equation models provide a powerful framework for estimating causal models by means of latent variables and their manifest indicators with the true score of the variable, random error, and systematic error. Moreover, SEM can estimate causal relationships by simultaneous equations. Some main types of commonly used structural equation models include:

- path analysis models (only in terms of observed variables)
- confirmatory factor analysis models (patterns of interrelationships among several latent constructs without specific directional relationship)
- structural regression models (like confirmatory factor analysis with particular explanatory relationships among constructs)
- and latent change models (latent growth curve model to study change over time).[573]

There are two types of SEM techniques encompassing:

- covariance-based structural equation modeling (CBSEM) as represented by linear structural relations (LISREL) and Analysis of Moment Structures (AMOS)
- and variance-based techniques that combine theoretical and empirical knowledge to maximize the variance explained, e.g. Partial Least Squares (PLS).[574]

[566] See Churchill (1979), p. 64

[567] See Cronbach (1951), p. 297; Cf. also Netemeyer/Bearden/Sharma (2003), p. 46-49

[568] See Nunnally (1978), p. 226

[569] See Decoster/Hall (1998), p. 3

[570] See Hair et al. (2006), p. 125

[571] See Razkov/Marcoulides (2006), p. 1

[572] See Haenlen/Kaplan (2004), p. 283-284. Random error is caused by the order of items in a questionnaire or respondent fatigue. Meanwhile, systematic error occurs due to variance attributable to the measurement method rather than the construct interest.

[573] See Razkov/Marcoulides (2006), p. 4

[574] See Fornell/Larcker (1981); Cf. also Henseler et al. (2009), p. 227

The PLS approaching to Structural Equation Models is popularly known as PLS Path Modeling. This study selects PLS path model analysis to test and quantify the plausibility of hypothetical assertions about potential relationships among the constructs because of some main reasons, e.g. small sample size, complex models with many latent variables and manifest variables, and the appropriateness of prediction-oriented research. Otherwise, PLS has and combines features from factor analysis and multiple regression. The next section provides the overview of statistical technique of PLS path model analysis and its functions to validate and estimate the proposed theoretical models.

4.5.3. Partial Least Squares Path Modeling

PLS Path Modeling (PLS-PM) has been used by a growing number of researchers from various disciplines such as strategic management,[575] management information system,[576] organizational behavior,[577] and marketing.[578] PLS is far less restrictive in its distributional assumptions in comparison with CBSEM. Moreover, the PLS technique is justified where theory is insufficiently grounded and the variables or measures do not conform to a rigorously specified measurement model, or fit a certain distribution.[579] Using PLS is particularly suitable to the studies such as this, where the measures of factors influencing the development of reverse logistics and adaptability to reverse logistics are new, and the relationships have not been previously tested. In addition, PLS-PM can estimate complex models with small sample size. This feature is very important to this study as only 102 valid responses are used for model testing.

PLS-PM aims at estimating the relationships among Q (q = 1,...,Q) blocks of variables, namely unobservable constructs that can be exogenous and endogenous latent variables (i.e. as independent and dependent variables in classical statistic techniques).[580] The network of causal relationships can be estimated based on interdependent equations of simple and multiple regressions. PLS-PM is formally defined by two sets of linear equations: the inner model and the outer model, or commonly named as measurement model and structural model (see Figure 40).[581] The measurement model identifying the relationships between a latent variable and its observed variables focuses on the reliability and validity of the item measures used. If the measures are proved to be adequate, then the validity and results of the structural model are confirmed.[582] The structural model constitutes a causal chain system that represents the relationships between constructs or latent variables that are hypothesized in the research model.

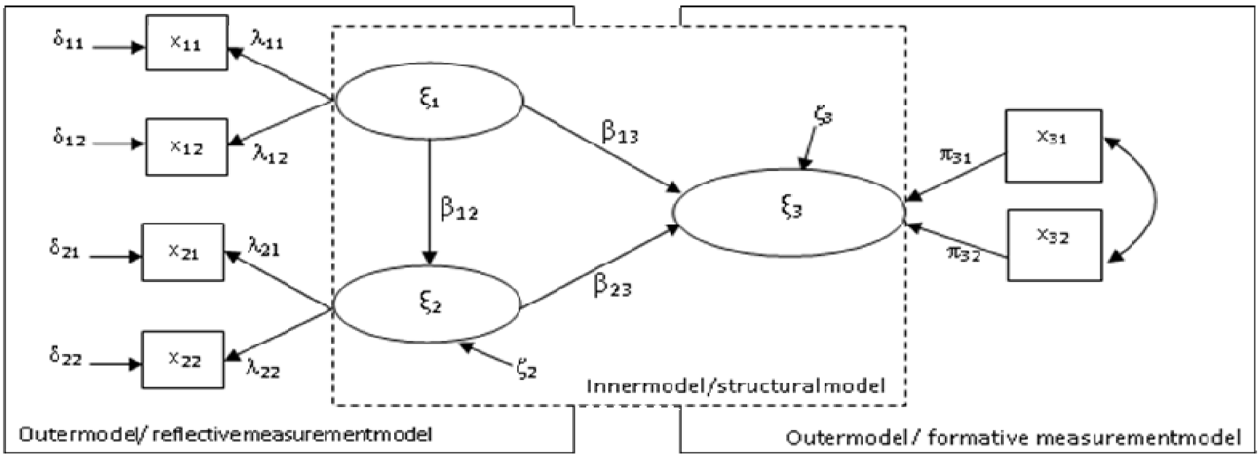

Figure 40: Illustration of path model for structural analysis of variance

Source: Bagozzi/Philipps (1982), p. 465; Cf. also Haenlein/Kaplan (2004), p. 287; Nitzl (2010), p. 4

[575] See Hulland (1999), p. 47

[576] See Dibbern et al. (2004), p. 7

[577] See Higgins/Duxbury/Irving (1992), p. 51

[578] See Reinartz/Krafft/Hoyer (2004), p. 295

[579] See Fornell/Robinson (1983), p. 42

[580] See Vinzi/Trinchera/Amato (2010), p. 57-58

[581] See Chin (1998), p. 296

[582] See Henseler et al (2009), p. 277; Cf. also Vinzi et al. (2010), p. 277

Note: *ξ (xi) = latent variable, x = indicator for latent variable, δ (delta) = measurement error for indictor x, ζ (zeta) = measurement error for latent endogenous variable, β (beta) = standardized path coefficient between latent variables, λ (lamda) = outer loading of indicators of reflective measurement model, π(pi) = outer weight of indicators of formative measurement model.*

In the PLS-PM framework, the structural model can be written as follows:

$$\xi j \quad = \beta_{0j} + \sum_{q:\xi_q -> \xi_j} \beta_{qj}\xi_q + \zeta_j \qquad (1)$$

Note: *ξ_j (j = 1, ..., J) is the generic endogenous latent variable, β_{qj} is the generic path coefficient interrelating the q-th exogenous latent variable to the j-th endogenous one, and ζ_j is the disturbance term in the prediction of the j-th endogenous latent variable from its explanatory latent variable.*

The formulation of measurement model in PLS-PM depends on the direction of the relationships between the latent variables and the corresponding manifest variable that can be modeled as either reflective or formative. In a reflective model, each manifest variable reflects the corresponding latent variable and plays a role of endogenous variable in the block of a specific measurement model. Thus, the changes of a latent variable or a construct are expected to be manifested in the changes all of its indicators. It means that in the reflective case all indicators measure the same thing and should correlate at a high level if they are good measures of the underlying variable. Therefore, internal consistency has to be checked and each construct is assumed to be homogenous and unidimensional.[583] In a reflective measurement model, each observed variables is related to the corresponding latent variable by a simple regression model:

$$x_{pq} = \lambda_{p0} + \lambda_{pq}\xi_q + \delta_{pq} \qquad (2)$$

Note: *P variables (p = 1, ..., P) are observed in N units (n = 1,...., N), λ_{pq} is the is the loading associated to the p-th manifest variable in the q-th block, δ_{pq} represents the residual value in measurement process of the p-th manifest variable in the q-th block.*

In contrast, the formative measurement model determines the causality from the measures to the construct, which means a change in the indicators results in a change in the construct under study.[584] Unlike the reflective model, the formative does not assume homogeneity or unidimensionality of the block. The latent variable is computed as a linear combination of the corresponding manifest variables, and each manifest variable is an exogenous variable in the measurement model. In this study, all the latent variables are formulated in reflective measurement models because relatively high and positive correlations between the indicators of constructs. In addition, the measures are effects of the latent constructs and share the common theme. Therefore, dropping an indicator does not alter the conceptual meaning of the construct.[585]

Independently from the type of measurement model, but upon on the convergence of the algorithm of PLS-PM, the standardized latent variable scores ($\hat{\xi}_q$) associated to the q-th latent variable (ξ_q) are computed as a linear combination of its own block of manifest variables by means of the so-called weight relation to define the role of manifest variables in the construct.[586] By running an iterative procedure in PLS-PM, outer weights and the standardized latent variable scores can be estimated for further structural equation analysis of the overall model.

$$\hat{\xi}_q = \sum_{p=1}^{P_q} w_{pq} x_{pq} \qquad (3)$$

Note: *x_{pq} are standardized indicators and w_{qp} are the outer weights*

In PLS-PM, the estimation procedure is named "partial" because it assesses blocks one at a time by means of alternating single and multiple linear regressions. Afterwards the path coefficients (β_{qj}) are estimated by

[583] See Vinzi/Trinchera/Amato (2010), p. 49

[584] See Henseler et al. (2009), p. 289

[585] See Jarvis/MacKenzie/Podsakoff (2003), p. 199

[586] See Vinzi et al. (2010), p. 51

means of a regular regression between the estimated latent variable scores in accordance with the specified network of structural relationships in the proposed theoretical models.[587] Therefore, the analysis and interpretation of a PLS model consists of two-stage process. Firstly, the reliability and validity of the measurement model (outer model) is evaluated; then the assessment of relationships of latent variables in structural model (inner model) is followed. This procedure ensures that the constructs' measures are valid and reliable before attempting to draw conclusions regarding the relationships in the research model.[588] The regression framework of PLS-PM is defined as a predictive path model for the endogenous latent variables than only a causality network because it focuses on the accuracy of predictions than on the accuracy of the estimation. However, PLS path modeling does not provide any common criteria to evaluate the overall model. It lacks a well-identified global optimization criterion to access the goodness of the model like CBSEM. Therefore, each part of the model should be validated including the measurement model, the structural model, and the overall model.[589]

4.5.3.1. Evaluating reflective measurement models in PLS path modeling

A reflective measurement model in PLS is assessed in terms of reliability (individual item reliability, internal consistency of all indicators), and validity (convergent validity and discriminant validity). For assessing reliability, individual item reliability should be firstly evaluated to identify whether a latent variable can explain a substantial part of its indicator's variance (usually at least 50%). It is examined by the absolute correlations between a latent variable and each of its manifest variables (i.e. the absolute standardized outer loadings). If the correlation is greater than 0.7 ($0.7^2 \approx 0.5$), individual reflective items are considered to be reliable. However, in the early stages of scale development, loading of 0.6 to 0.7 is considered acceptable if there are additional indicators in the block for comparison purposes.[590]

Construct reliability can be examined by two measures: Cronbach alpha and composite reliability. Coefficient alpha of Cronbach (1951) tends to be a lower bound estimate of reliability and provides a severe underestimation of the internal consistency reliability of latent variables in PLS path modeling because it assumes that all indicator loadings are equally reliable.[591] The composite reliability, ρ_c[592] takes into account of different indicator loadings, resulting in a more reliable composite.[593] A composite reliability that is regarded as satisfactory should be above 0.7 in early stages of research and values above 0.8 or 0.9 in more advance stages of research.[594]

$$\rho_c = \frac{\left(\sum_i \lambda_i^2\right)}{\left[\left(\sum_i \lambda_i\right)^2 + \sum_i Var(\varepsilon_i)\right]} \qquad (4)$$

Note: *λ_i is the outer loading to an indicator, $Var(\varepsilon_i) = 1 - \lambda_i^2$ in case of standardized indicators*

For assessing validity, two validity subtypes are usually investigated including convergent validity and discriminant validity.[595] Convergent validity specifies that a set of indicators represents the same underlying construct, which can be demonstrated through unidimensionality. This study assesses convergent validity of constructs in a reflective measurement model through average variance extracted (AVE) suggested by Fornell and Larcker (1981). The AVE estimate is the average amount of variance that a latent construct is able to explain in the observed variables to which it is theoretically related. If individual item reliability gives the amount of variation in each observed variable that the latent construct accounts for (i.e. shared variance), AVE is the variance averaged across all observed variables that relate theoretically to a latent construct.[596]

[587] See Vinzi et al. (2010), p. 52
[588] See Acedo/Jones (2007), p. 238
[589] See Vinzi et al. (2010), p. 56
[590] See Chin (1998), p. 295
[591] See Chin (1998), p. 135
[592] See Wert/Linn/Joreskog (1974), p. 26; Cf. also Nunnaly (1978), p. 56
[593] See Henseler/Ringle/Sinkovics (2009), p. 299
[594] See Nunnaly/ Bernstein (1994), p. 34
[595] See Farrell (2010), p. 325; Cf. also Henseler et al. (2009), p. 296
[596] See Farrell (2010), p. 324

Fornell and Lacker (1981) suggest an AVE value greater than 0.5 as sufficient convergent validity to ensure that more than 50% of the variance of the factor is due to its indicators.

$$AVE = \frac{\left(\sum_i \lambda_i^2\right)}{\left[\sum_i \lambda_i^2 + \sum_i Var(\varepsilon_i)\right]} \qquad (5)$$

Discriminant validity is the extent to which a latent variable is different from other latent variables. Discriminant validity means that a latent variable is able to account for more variance in the observed variables associated with it than measurement error or similar external, unmeasured influences; or other constructs within the conceptual framework.[597] Discriminant validity of measurement model is examined by the method of Fornell and Lacker's (1981) "AVE test." The Fornell-Larcker criterion evaluates discriminant validity on the construct level. It postulates that a construct should share more variance with its own measures than it shares with other constructs in a model. In other words, the correlation of a construct with its indicators (i.e., the square root of AVE) should exceed the correlation between the construct and any other construct.[598]

4.5.3.2. Evaluating the structural model in PLS path modeling

For assessing the structural model and examining the proposed hypotheses, the important fit indexes for explanatory power of a PLS model are the coefficient of determination (R^2) of the endogenous latent variables, the estimate for path coefficients, the effect size by means of Cohen's (1988) f^2, and Q-square statistics.[599]

The quality of each structural equation in PLS-PM is normally measured by a simple assessment of the R^2 fit index. R^2 indicates the explained variance in the endogenous variables, demonstrating the predictive power of the model. The determination coefficient (R^2) reflects the share of the latent constructs' explained variance and therefore measures the regression function's "goodness of fit" obtained by manifest items. The value of multiple R^2, in the case of standardized variables, may be decomposed in terms of the multiple regression coefficients and correlations between the dependent variable and the explanatory ones. This decomposition allows understanding the contribution of each explanatory variable to the prediction of the dependent one and it makes sense only when the regression coefficients and the related correlations have the same sign.[600]

$$R^2 = \sum_{q:\xi_q -> \xi_j} \beta_{qj} cor\left(\xi_q, \xi_j\right) \qquad (6)$$

According to Chin (1998), R^2 values of 0.67, 0.33, and 0.19 are described as the substantial, moderate, and weak variance explained. Besides testing the R^2 for each endogenous variable, the change in the determination coefficient also reflects whether an independent latent variable has a substantial influence on the dependent latent variable. Cohen (1988) developed the so-called "effect size" f^2 to examine the change in the endogenous variable's determination coefficient in case of with and without the exogenous latent variable. According to Cohen (1988), f^2 value of 0.02, 0.15, and 0.35 can be viewed as a gauge for whether an exogenous latent variable has a weak, medium, or large effect on the particular endogenous variable.[601]

$$f^2 = \frac{\left(R^2_{included} - R^2_{excluded}\right)}{\left(1 - R^2_{included}\right)} \qquad (7)$$

However, the R^2 fit index is not sufficient to evaluate the overall structural model because the R^2 values only take into account the fit of each regression equation in the structural model.[602]

Considering all structural equations simultaneously by path analysis on the latent variable scores through path coefficient is a wise choice. The path coefficient is estimated by optimizing a single discrepancy function based on the difference between the observed covariance matrix of the latent variable scores and the

[597] See Farrell/Rudd (2009), p. 2

[598] See Fornell/Larcker (1981); Cf. also Anderson/Gerbing (1988), p. 415

[599] See Geisser (1974), p. 101; Cf. also Stone (1974), p. 111

[600] See Tenenhaus et al. (2005), p. 178-179

[601] See Henseler et al. (2009), p. 303; Cf. also Cohen (1988)

[602] See Vinzi et al. (2010), p. 57

same covariance matrix implied by the model estimation.[603] The path coefficients indicate the strengths of relationships between constructs. The estimated value of path coefficients in the structural model is evaluated in terms of sign, magnitude, and the significant value of standardized beta loadings resulting from the least squares. The goodness of the path coefficients estimated in PLS is often tested by means of asymptotic t-statistics through bootstrapping method.

The Q-square statistics developed by Stone (1974) and Geisser (1975) is used to assess the predictive relevance of the endogenous constructs. It measures how well the observed values are reproduced by the model and its parameter estimate. A cross-validated redundancy (CV Red Q^2) is obtained if prediction of the omitted data points is made by constructs that are predictors of the blindfolded construct in the PLS model. The cv-redundancy measures the capacity of the model to predict the endogenous manifest variables using the latent variables that predict the block in question, and serve as a sign of the quality of the structural model.[604] The PLS calculates this index by a blindfolding procedure that omits a part of the data for a particular block of indicators during parameter estimations then tries to estimate the omitted part using the estimated parameters. The procedure is repeated until every data point has been ignored and estimated. Omission and estimation of data point for the blindfolded construct depend on the chosen omission distance (D). A Q^2 is greater than zero, indicating that the model has predictive relevance, especially for cross-validated redundancy approaching and above 0.5 thresholds.[605]

$$Q^2 = 1 - \frac{(\sum_D SSE_D)}{(\sum_D SSO_D)} \qquad (8)$$

Notes: *D is the omission distance, SSE is the sum of squares of prediction errors, and SSO is the sum of squares of observations*

4.5.3.3. Evaluating the overall model in PLS path modeling

As above-mentioned, there is officially no overall fit index in PLS-PM to assess the research model as in the covariance-based techniques like AMOS or LISREL. However, a global criterion of overall predictive relevance and goodness of fit has been proposed by Tenenhaus et al. (2005). The global criterion of goodness of fit recommended by Tenenhaus et al. (2005) takes into account the model performance in both the measurement and the structural model, namely Goodness of Fit index (GoF).[606] GoF is the geometric mean of the average communality index and the average R^2 of dependent latent variables. Hence, it provides a single measure for the overall prediction performance of the model with the cut-off value between zero and one, in which the GoF values of 0.1, 0.25, and 0.36 represent as small, medium, large, respectively.

$$GoF = \sqrt{\overline{Com} \times \overline{R^2}} \qquad (9)$$

4.6. Results of empirical study

4.6.1. Sample and information collection

Using the secondary resource from public domain of DIGITALEUROPE, the database of the study is established with a sample frame of 650 companies with the following characteristics:

- manufacturers and distributors located in Europe,
- of medium and large size according to EU criteria, and
- doing business in the electronics industry.

We received 102 valid responses and used them in the analysis. This survey obtained the response rate of nearly 15.6%. Among them, 65 firms are manufacturers and 37 firms are distributors. 68.6% of respondents completing the questionnaire are in related departments such as marketing and sales, customer service, logistics, and operations. Respondent companies dealing with manufacturing and distributing products in electronics industry are mostly located in Western Europe (66.7%). Most respondent companies belong to

[603] See Vinzi et al. (2010), p. 57

[604] See Tenenhaus et al. (2005), p. 174

[605] See Chin (2010), p. 679 - 680; Cf. also Geisser (1974), p. 101; Stone (1974), p. 111

[606] See Tenenhaus (2005), p. 159

medium and large size with the average annual turnover from €10 - €500 million (87.3%) and the number of employees more than 250 (84.2%). Around 79.4% of companies replied as being active participants in reverse logistics programs in their companies. Response breakdowns are presented in Table 9.

Phase of survey	*Number of mail invitation*	*Number of respondents*	*Number of valid respondent*	*Response rate*	*Cumulative response rate*
First mailing invitation	150	20	15	10%	10%
Second mailing invitation	200	30	26	13%	23%
Third mailing invitation	300	65	61	20.3%	43.3%
Total	**650**	**115**	**102**	**15.6%**	

Table 9: Breakdown of responses

Checking non-response bias with online survey in the research

Using the web as an alternative to other survey modes such as mail or telephone is becoming increasingly accepted[607] because of cost-effective options, increasing speed of data collection, and increasing response rates with the hope of decreasing the amount of non-response error.[608] To reduce the threat of non-response bias, the method of time trend is also conducted to access differences between the late and early respondents following recommendations of Armstrong (1977).[609] We divide the data set into two groups of equal size, one group with earlier respondents and the other group with later respondents. This study identifies statistically significant differences between two groups by running t-test on group responses. The t-tests ($p>0.05$) result in no statistically significant mean differences among all items in the models. Otherwise, some additional demographic and database statistics (implementation time of a formal reverse logistics program, number of company employees) are used to examine non-response rates over different sub-groups of the population. This study uses the criteria used in the research's database (i.e. type of company) to compare between the sample with the chi-square test. The chi-square tests show that there are no significant differences between the sample in terms of implementation time of a formal reverse logistics program ($\chi^2=0.038$, df=2, $p=0.981$) and in terms of number of company employee ($\chi^2=2.244$, df=4, $p=0.691$). Therefore, non-response bias may not be an issue for the current research.

Common method variance

Common method variance refers to variance that is attributable to the measurement method rather than to the constructs that the measures are supposed to represent. Method biases are one of the main sources of measurement error, and most researchers agree that common method variance is a potential problem in behavioral research. Common method bias occurs in quantitative research when the measured relationship between two constructs either inflated or attenuated compared to the true value because of covariance caused by the measurement approach, rather than by the measured trait.[610] We use the PLS marker variable approach suggested by Ronkko and Ylitalo (2011), and Gaskin (2010) to diagnose and control for common method variance in this study because the approach is directly proposed and applicable to quantitative research conducted by PLS path modeling. The marker indicator (MI) is developed to draw out the common variance with theoretically unrelated constructs, which would point to some systematic variance explained by an external factor. For testing common method variance, we select a MI that includes items collected in the same survey but are not included in the model being tested.[611] In addition, the MI should have minimal correlation with the indicators of the study variables but must be subject to the same measurement effects as the study constructs. The results from the test show that all the correlations are different from zero and the correlations between the MI and the study constructs less than 0.3. The maximum percentage of shared variance between the MI and other constructs in the test is less than 5% (0.225 squared), which means that 5% of the variance in the data is method variance. Otherwise, the significance of path coefficient is still

[607] SeeCouper (2000), p. 472

[608] See Dillman (2000), p. 24

[609] See Armstrong (1977), p. 397

[610] See Ronkko/Ylitalo (2011), p. 2

[611] See Gaskin (2011), p. 5

remained in the base model and the model with MI. Therefore, common method variance is unlikely to be a serious concern for this study.[612]

Control variable

To access the role of moderating variables (Hypothesis 1d), this study uses number of employee as measure of organizational size because it is a commonly used measure of organizational size in management research.[613] The sample is divided into two groups: smaller firms having less than 500 employees (medium-sized firms), and larger firms being those with more than 500 employees (large-sized firms). This study assigns a value one for larger firms, and zero for smaller firms. Among respondent firms, 39 firms (38.2%) have smaller size, and 63 firms (61.8%) belong to larger firms. Firm type is a dummy variable that one indicates manufacturing firm (65 cases) and zero presents distributors (non-manufacturer - 37 cases). Firm location is also a dummy variable after recoding, and takes the value one for firms in Western Europe (66.7%) and zero for firms in other regions of Europe (33.3%). In addition, this study splits respondent firms into two main groups regarding the implementation time of a formal RL program, which zero includes firms that have not implemented a RL program, and one mentions firms that have conducted a RL program. Table 10 presents the breakdown of sample characteristics.

Firm type	***N***	***%***
Manufacturer	65	63.7
Distributor	37	36.3
Firm location	**N**	**%**
Western Europe	68	66.7
Non-western Europe	34	33.3
Firm size (Employee)	**N**	**%**
Medium size (smaller firms)	39	38.2
Large size (larger firms)	63	61.8
Implementation time	**N**	**%**
Implemented	81	79.4
Not implemented	21	20.6

Table 10: Breakdown of sample characteristics

4.6.2. Descriptive statistics and measurement scale

The final questionnaire is composed of multi-item reflective measures either adapted from existing scales or developed as necessary to evaluate the constructs of related research objectives. All survey items are measured on a five-point Likert-type scale with different content related to factors influencing the performance of reverse logistics, which include the three main constructs of external factors, internal factors and reverse logistics performance. With respect to the measurement of the model variables, the multi-item scales are used as suggested by consideration of the related literatures. Some existing scales for effectiveness and efficiency of reverse logistics performance are utilized for capturing the influence of internal and external factors and their interactions associated with reverse logistics program. Some new scales developed in this research measure for different components of external and internal factors that are extracted from the previous studies mentioned and analyzed in the first part of this chapter. We conduct reliability test and EFA to evaluate factorial solutions of each construct. Any item whose communality is less than 0.4 or whose loadings are less than 0.5 is dropped out. Table 11 provides descriptive statistics of the items including mean, standard deviation (SD), and results of reliability test and EFA for each construct.

External factor (EF) is developed from the related literatures as a new construct including the important indicators influencing the performance of reverse logistics. These items are anchored at 1=very important, 5=unimportant. The results of EFA indicate two factors containing these manifest variables of EF. The first

[612] See Ronkko/Ylitalo (2011), p. 5; Cf. also Gaskin (2011), p. 5

[613] See Liang et al. (2007), p. 67; Cf. also Maiga/Jacobs/Koufteros (2010), p. 24

factor contains variables of laws and regulations, customer awareness and demands, and information technology and collaboration. The second factor includes only one observed variable of globalization that has the corrected item-total correlation (0.219) less than 0.35. According to drop-out rules, this variable should be removed out of the construct of external factor. Therefore, EF construct obtains the unidimensionality measurement after dropping the indicator of globalization. The coefficient alpha and item-to-total correlations of the remaining four items are subsequently recalculated and are found to meet the criteria (Cronbach α = 0.754). The mean score of variables measuring the importance of external factors influencing RL performance has average difference from 2.68 to 3.01.

The results of reliability test and EFA shows that internal factor (IF) arrives at the unidimensionality measurement with four manifest variables including company policies, top management support, company resources, and cross-functional integration. The assessment of internal consistency reliability shows an acceptable level of coefficient alpha (0.805). All of the item-to-total correlations are found to be greater than the threshold value. The mean score ranges from 2.08 to 3.89, which denotes the considerable difference in evaluating the importance of internal factors. Company policies towards reverse logistics are ranked with the top mean score in supporting reverse logistics operations effectively (2.08).

For RL performance (EFF), the company respondents are asked to evaluate their company's effectiveness and efficiency in implementing RL following different criteria with a five-point scale (1=very effective, 5=ineffective). The results of EFA show that there is only one clear factor on which all items loaded. The reliability test presented a relatively high coefficient alpha (0.858). Construct of EFF is a one-dimensional measurement scale with five manifest variables including customer satisfaction, improved competitiveness, cost reduction, improved profitability, and reduced inventory investment. Mean scores of RL performance range from 2.17 to 3.06, indicating the average efficiency and effectiveness in implementing reverse logistics at firm level.

Construct and measurement items *(Scale 1-5)*	***Mean***	***SD***	***Item-Total correlation***	***Communality***
Requirement level			***≥ 0.35***	***≥ 0.4***
External factor (EF), Cronbach α = 0.754				
Please rate the importance of the following external factors influencing the development of reverse logistics				
EF1: Laws and regulations	2.98	0.901	0.489	0.492
EF2: Customer awareness and demands	2.73	1.055	0.535	0.557
EF3: Information technology	2.85	1.019	0.558	0.594
EF4: Collaboration among supply chain partners	2.68	0.956	0.625	0.667
EF5: Globalization(*)	3.01	0.873	**0.219**	-
Internal factor (IF), Cronbach α = 0.805				
Please rate the importance of the following internal factors influencing the development of reverse logistics				
IF1: Company policies	2.08	0.713	0.642	0.655
IF2: Top management support	3.89	0.795	0.592	0.600
IF3: Cross-functional integration	2.49	0.941	0.613	0.623
IF4: Utilization of current resources	2.46	0.804	0.655	0.671
Reverse logistics performance (EFF), Cronbach α = 0.858				
Please evaluate your company's effectiveness and efficiency in implementing reverse logistics				
EFF1: Customer satisfaction	2.27	0.785	0.744	0.718
EFF2: Improved competiveness	2.79	1.102	0.752	0.739
EFF3: Cost reduction	3.06	0.830	0.616	0.561
EFF4: Improved profitability	3.02	0.933	0.654	0.610
EFF5: Reduced inventory investment	2.17	0.868	0.640	0.598

Note: *(*) Items denoted with an asterisk is dropped out from the study because of drop-out rules*

Table 11: Descriptive and scale statistics of three constructs

4.6.3. Measurement model

In order to test the substantive hypotheses following PLS path model analysis, the study firstly examines measurement model that links a set of observed variables to a usually smaller set of latent variables. The measurement model is tested by identifying the reliability, convergent, and discriminant validity of the reflective constructs in the model. For assessing individual item reliability, we examine the loadings of the measures with their respective constructs generated by PLS (i.e. outer loadings). Each loading is reviewed to verify whether the individual items are reliable. All measurement items with loadings greater than 0.6 are retained due to the exploratory nature of this study. A lower threshold is employed with cut-off value of 0.6 lower than 0.7 as some studies.[614] Consistent with reliability test and EFA results, factor loading of globalization is 0.349, less than the minimum a cut-off value of 0.6, asserting that manifest variable of globalization currently contributes very little to the explanatory power of the external factors influencing the performance of RL in the European electronics industry. Therefore, removing the indicator of globalization in the construct of external factors is proved to have logically statistic bases.

We analyze reliability, convergent and discriminant validity based on the modified measurement model without the item "globalization" to identify the data fit for running the structural model. As shown in Table 12, the item loadings for all measurement indicators are approaching to and greater than 0.7. Standardized outer loadings range from 0.664 to 0.861 on their respective factors, which is a good signal of indicator reliability. The data in Table 12 shows that the measures are robust in terms of their internal consistency reliability as indexed by the composite reliability. The composite reliabilities of the different measures range from 0.84 to 0.90, which is greater than the recommended threshold value of 0.8 or 0.9 of Nunnally and Bernstein (1984).

Measurement items	**Initial loading**	**Final loading**	**CR**	**AVE**
Requirement level	***≥ 0.60***		***≥ 0.70***	***≥ 0.50***
External factors (EF)			**0.844**	**0.576**
EF1: Requirements of laws and regulations	0.639	0.664		
EF2: Increasing customer awareness and demands	0.757	0.767		
EF3: Support of information technology	0.786	0.774		
EF4: Collaboration among supply chain partners	0.816	0.822		
EF5: Globalization *(*)*	***0.349***	-		
Internal factors (IF)			**0.874**	**0.635**
IF1: Company policies	0.825	0.826		
IF2: Top management support	0.796	0.797		
IF3: Cross-functional integration	0.762	0.763		
IF4: Utilization of current resources	0.805	0.802		
Performance of RL (EFF)			**0.900**	**0.645**
EFF1: Customer satisfaction	0.846	0.846		
EFF2: Improved competiveness	0.861	0.861		
EFF3: Cost reduction	0.754	0.754		
EFF4: Improved profitability	0.779	0.780		
EFF6: Reduced inventory investment	0.769	0.768		

Note: (*) *Items denoted with an asterisk is dropped from the study because of drop-off rules*

Table 12: Statistics results of measurement model

For assessing validity, this study examines the convergent validity and discriminant validity. The AVE of all constructs exceeds the minimum threshold value of 0.5, indicating that convergent validity requirement is totally met. It means that all latent variables have explained more than 50% of the variance in their observable measures. For testing discriminant validity, we calculate the correlation between the constructs in the

[614] See Ainuddin et al. (2007), p. 57; Cf. also Walker et al. (2010), p. 667

model (represented by the off-diagonal elements in the matrix), and the square root of the AVE for each construct (shown by the diagonal elements). The results for each construct in the measurement model demonstrate that in all cases the square roots of AVE values are greater than the corresponding off-diagonal correlations (see Table 13). The results suggest that the discriminant validity is supported in this study.

Model	AVE	EF	IF	EFF
EF	0.576	**0.759**	0	0
IF	0.635	0.482	**0.797**	0
EFF	0.645	0.717	0.683	**0.803**

Table 13: Construct correlation and AVE

The analysis of the modified measurement model shows good quality indexes and obtains the values of reliability and validity greater than the suggested threshold values, representing an acceptable model fit and suggesting the suitability for the continuous analysis of structural model.

4.6.4. Structural model

In PLS-PM analysis, a structural equation model is used to simultaneously test all the multiple relationships among independent and dependent variables proposed in the theoretical model. In this study, the structural model is firstly assessed with main effects to explore the critical factors driving and facilitating the performance of reverse logistics. The indirect effect and the model with moderating variables are separately approached by the analysis of mediation effect and moderated mediation effect. For the theoretical model in chapter 4, the structural relationships are constructed by three latent variables: External factor (ξ_1), internal factor (ξ_2), and RL performance (ξ_3).

To test the substantive hypotheses H_1 - H_3, the bootstrap procedures with 1000 resamples is used to determine the significance of item loadings and path coefficients. T-statistics are calculated for each parameter. As SmartPLS computes all coefficients from standardized manifest variables, for this reason, there are no intercepts to be reported in the results of structural relationships run by SmartPLS.[615] After testing simultaneously all the multiple relationships, we obtain the standardized path coefficients to demonstrate the results of hypothesized links. The results are shown in detail with other fit indexes in Table 14.

Hypothesized Links	Criteria				
	Path coefficient	**t-value**	**Contribution to R^2**	**Effect size f^2**	**Final results**
Requirement level		***≥ 1.96***	***≥ 0.30***	***≥ 0.02***	
EF-EFF (H_1)	0.505***	7.635	55%	0.571	+ → Large
IF-EFF (H_2)	0.439***	6.239	45%	0.432	+ → Large
Prediction-oriented measurement			***R^2 = 0.662***	***Q^2 = 0.414***	***GoF = 0.526***

Note: t-values are calculated through bootstrapping routine with 102 cases and 1000 samples; t-values with 2-tail test include p-value <0.001 (t^{****}>3.290), p-value < 0.01 (t^{***}>2.576), p-value <0.05 (t^{**}>1.960), p-value <0.1 (t^{*}>1.645)

Table 14: Structural model results

The results provided in Table 14 suggest that both external factors and internal factors are significantly associated with performance of reverse logistics. Especially, the effect size of these factors on performance of reverse logistics is relatively large with R^2 of EFF obtaining the value 0.662, demonstrating that the changes of external environments and the organizational adaptive capabilities can explain 66% of the variance of RL performance.[616] The large variance explained indicates that the selected indicators from both

[615] See Ringle/Wende/ Alexander (2005), p. 1.

[616] See Henseler et al. (2009), p. 304

external and internal environments are likely the most important factors facilitating the performance of reverse logistics. An evaluation of effect size f^2 for the relative impact of IF and EF on the predictive relevance of overall model reveals that both of them have a substantial influence on the performance of reverse logistics, especially for the key role of the latent variable “external factor” on the performance of reverse logistics ($f^2_{EF} = 0.571$, $f^2_{IF} = 0.432$). The EF is more important variable in the prediction of performance of reverse logistics, contributing to nearly 55% of the R^2. Meanwhile, the contribution of internal factors accounts for nearly 45% of the R^2 that is not far less than EF. It means that there has been increasing adaptability to reverse logistics at both network and firm level.

The Q^2 cross-validation redundancy tested by means of blindfolding procedures with omission distance D = 10 in PLS-PM have the values greater than the threshold value of zero, suggesting the predictive relevance of the structural model. A GoF value of 0.526 exceeds the cut-off value of 0.36 for large effect size, indicating that the structural model with main effects performs well and relatively fits in the data collected. The results show that the structural model has an acceptable predictive relevance for the network of causal relationships proposed in the theoretical model. The analysis of main effects provides in detail the influences and the predictive relevance of the latent variables in the model.

4.6.5. Main effects

As demonstrated in Table 14, the main effects of external factors and internal factors on performance of reverse logistics are both positive and significant. Both hypotheses H_{1a} (β=0.505, t=7.635, p<0.001) and H_{1b} (β=0.439, t=6.239, p<0.001) are positively supported, indicating that the higher supports of external and internal factors are, the better implementation of reverse logistics is. External factors including laws and regulations, customer awareness and demands, collaboration among supply chain partners, and information technology are today key facilitators for the implementation of reverse logistics. The changing awareness of top management, the adjustment of company policies, the increasing cross-functional integration, as well as the availability of company resources are objectively ascertained to have positive impacts on the implementation of reverse logistics. The influences of these external and internal factors have currently motivated and facilitated the performance of reverse logistics, indicating that reverse logistics in the European electronics industry is in the period of development with more proactive activities.

As specifically shown in Table 15, the statistics results indicate that the adjustment of company policies in the firm with respect to RL performance is the item that best explains the internal supports, with variance explained of 0.682 (68%), then followed by the utilization of current resources (64%), top management support (63%), and cross-functional integration (58%). The item that best explains the external supports for reverse logistics performance is the collaboration between supply chain partners (68%), then followed by the support of information technology (60%), and the increasing customer awareness and demand (59%). Laws and legislation can explain only 44% of the variability of external factors, indicating that the supports from regulatory factors are not highly appreciated by firms. Many firms perceive that the government actors through administrative instruments have not dynamically encouraged and supported the implementation of reverse logistics,[617] especially for EoL management due to its complexity. For example, the current registration and reporting systems for EoL collection and recovery to governmental agencies in some European countries present several weaknesses and involve different actors that are not properly interfaced and connected.[618] The computation of standardized latent variable score of internal factors and external factors through outer weights also presents the weight relation with their manifest variables.

There have been changes in the counterbalance among external factors influencing the development of reverse logistics in this period. It is different from the beginning of the 2000s when laws and regulations were major factors driving the compliance on the implementation of reverse logistics. Today, customer awareness and demands, especially the trend of “green consumers” and increasing customer requirements of after-sales services, warranty services, and exchanging and returning products after sales have driven the

[617] See Sarkis et al. (2009), p. 899

[618] See Gobbi (2008), p. 137

organizational adaptive capabilities to reverse logistics of many company respondents. Moreover, intensified collaboration with supply chain partners and the increase of IT usage are the important external factors supporting the implementation of revere logistics. These factors may have helped many company respondents to operate returns management smoothly and efficiently. Moreover, company respondents in the European electronics industry appear to pay more strategic management attention on EoL and returns management by adjusting company policies, increasing top management support, improving cross-functional integration, and utilizing the available company resources effectively for reverse logistics operations. The empirical results of this study have not coincided completely with previous studies that emphasized the important role of laws and regulations. However, the results partly reflect the changes in the factors influencing the development of reverse logistics.

Constructs	Outer weight	Variance explained
External factors (EF)		
EF1: Laws and regulations	0.244	44%
EF2: Customer awareness and demands	0.364	59%
EF3: Information technology	0.337	60%
EF4: Collaboration among supply chain partners	0.362	68%
Internal factors (IF)		
IF1: Company policies	0.357	68%
IF2: Top management support	0.347	63%
IF3: Cross-functional integration	0.262	58%
IF4: Availability of company resources	0.286	64%

$$\hat{\xi}_{EF} = 0.244EF_1 + 0.364EF_2 + 0.337EF_3 + 0.362EF_4$$
$$\hat{\xi}_{IF} = 0.357IF_1 + 0.347IF_2 + 0.262IF_3 + 0.286IF_4$$

Table 15: Critical factors influencing the development of reverse logistics

The analysis of mediation effect in the next section can explain more clearly the influence of the casual effect of external factors on performance of reverse logistics through internal factors on performance of reverse logistics.

4.6.6. Mediation effects

This study accesses the internal factor as a mediating variable to analyze factors influencing the development of reverse logistics because the origin of mediation effect is the historical dominance of the stimulus organism response model.[619] Mediation effect is one way that researchers can explain the process or mechanism by which one variable affects another.[620] There are many statistical tests of mediation effect including causal steps, product of coefficient approach, distribution of the product, and bootstrapping.[621]

The most important requirement for trustworthy conclusions about a population is still that the collected data can be regarded as random samples from the population. Bootstrapping method treats observed samples as if they represent the population. Therefore, this study uses bootstrapping methods to test the mediation effect and effect size of external factors through internal factors (a^*b) on RL performance due to small sample size. Bootstrapping is a non-parametric method based on resampling with replacement, which is done many times (e.g. 500, 1000, 2000 or more). A sampling distribution based on many random samples from the population helps us to know what would happen if we take very many samples under the same conditions. By repeating this process thousands of times, an empirical approximation of the sampling distribution of a^*b is built and used to construct confidence interval (CI).

[619] See Hebb (1966), p. 67

[620] See MacKinnon/Fairchild/Fritz (2007), p. 594-595

[621] See Preacher/Hayes (2008), p. 880

This study sets the number of bootstrap samples at 1000 and uses the results of the bootstrap to calculate indirect effect, standard error, t-value, and confidence interval following some procedures. First, SmartPLS 2.0 M3 conducts bootstrapping at 1000 samples. Second, indirect effects of 1000 resamples from bootstrapping is calculated by subtracting the bootstrap samples of the total effect and the direct effect, or by calculating $a_i b_i^*$ and $\sum_i(a_i b_i^*)$ ("*" denotes an estimate derived from the resampled data set). The mean bootstrap extracted from bootstrapping results of PLS model and standard error of indirect effect is calculated following the suggestions of Shrout and Bolger (2002) and Hesterberg (2008).[622] The bootstrap approach allows the distribution of a^*b estimate to be examined empirically. This study uses the percentile confidence interval defined by the cut-points that exclude $(\alpha/2)^*100\%$ of the values from each tail of the empirical distribution.[623] This study does not use Sobel test for calculating the indirect effect because the Sobel test is very conservative, has very low power with small sample size, and uses a normal approximation with assumption of a symmetric distribution.[624] The test results of mediation effect and size of indirect effect are presented in Table 16.

$$mean_{boot} = \frac{1}{B}\sum \overline{x^*}$$
$$SE_{boot} = \sqrt{\frac{1}{B-1}\sum(\overline{x^*} - mean_{boot})^2} \qquad (10)$$

Note: *B - The number of resamples,* $\overline{x}^*$ *- mean of these resamples,* $mean_{boot}$ *and* SE_{boot} *- the mean and the standard deviation of the mean of the B resamples (different from the mean* $\overline{x}$ *and standard deviation of original sample)*

Indirect Effect (H_{1c})	***Original Estimate***	***Mean-boot***	***SE_{boot}***	***95% CI***		***Mediation ratio***		
				Bootstrap percentile	t-value	P_M	$1-P_M$	R_M
EF-IF	0.4821	0.4945	0.0708	(0.343 -0.629)	6.981			
IF-EFF	0.4390	0.4394	0.0705	(0.299 - 0.570)	6.235			
EF-EFF	0.5052	0.5046	0.0656	(0.376 - 0.630)	7.692	***30.06%***	69.94%	42.98%
Indirect	***0.2116***	***0.2169***	***0.0451***	***(0.132- 0.306)***	***4.803***			
Total	0.7168	0.7215	0.0453	(0.622 - 0.803)	15.651			

Note: *Bootstraps with N = 1000 resamples. Bootstrap percentile 95% CI for distribution with the lower bound and upper bounds.* P_M *=ratio of the indirect effect to the total effect,* $1-P_M$ *= ratio of the direct effect to the total effect,* R_M *= ratio of indirect effect to the direct effect*

Table 16: Test results of mediation effect

The confidence interval with 95% significant level excludes zero for all direct and indirect effects, suggesting that H_{1c} is confirmed with a partial mediation effect. The bootstrap percentile demonstrates that 95% confidence interval of indirect effects are between the values of 0.132 and 0.306. It means that the effect size of indirect effect of external factors through internal factors (mediating variables) on performance of reverse logistics is significantly different from zero and slightly large as the value estimate of a*b is 0.216.[625] Figure 41 visualizes the value estimates of direct and indirect effects through bootstrapping method.

As all the effect size of direct effects is greater than 0.2, the mediation ratios can also be used to measure the relatively quantitative magnitude of mediation effects.[626] The quantitative measures in the final column of

[622] See Shrout/Bolger (2002), p. 426; Cf. also Hesterberg et al. (2009), p. 8

[623] See Bollen/ Stine (1990), p. 115; α is the desired nominal Type I error rate, α = 0.05 generate a 95% CI; t -1.96 and 1.645 with 0.05 and 0.1 significant value

[624] See Sobel (1982), p. 293; Cf. also MacKinnon et al. (2002), p.83; Shrout/Bolger (2002), p. 425

$SE_{ab} = \sqrt{a^2 s_b^2 + b^2 s_a^2}$ (a - the coefficient path from independent variable on mediating variable; b - the coefficient path from mediating variable dependent variable; s_a and s_b are standard error of a and b, respectively; Preacher/Hayes (2008), p. 883

[625] See Cohen (1998); Cf. also David (2011); Preacher/Kelley (2011); Cohen (1998) defines small, medium, and large effect size of indirect effect as 0.01, 0.09, and 0.25

[626] See MacKinnon et al. (2002); Cf. also Sobel, (1982); David (2011), p. 4

Table 16 have provided a good illustration of effect size of mediation effect. Internal factors mediate nearly one-third of the total effect of external factors on RL performance (P_M=30.06%). Therefore, it can suggest that organizational-related factors within firms have now increasingly contributed to supporting reverse supply chain management to some extent.

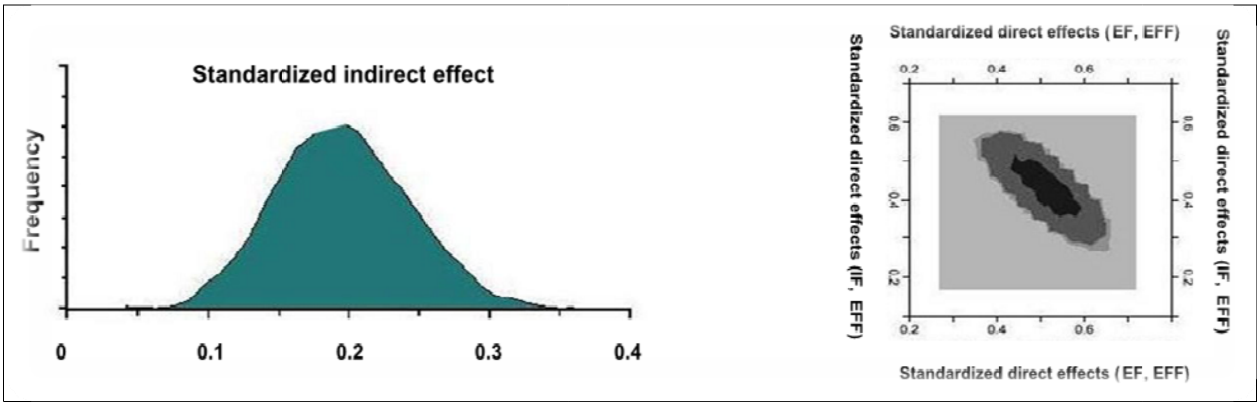

Figure 41: Value estimates of indirect effect and direct effect on RL performance

Meanwhile, the ratio of direct effect to total effect (1 - P_M) accounts for 69.94% with the value estimate of c'=0.5046 and bias-corrected 95% CI of 0.376 and 0.630. This indicates the important roles of external factors facilitating the development of reverse logistics in this period, especially information technology and collaboration among supply chain partners. The ratio of indirect effect to direct effect (R_M) shows more clearly the counterbalance effect of external and internal factors on performance of reverse logistics. R_M=42.98% shows that the indirect effect of external factors on RL performance is only nearly 0.43 times the size of direct effects. It means that the proactive efforts or organizational adaptive capabilities of company respondents for reverse logistics have been at the moderate level. The total effect of external factors on RL performance through a mediated causal process in this study is rather large and is temporally proximal,[627] in which the value of c is equal to 0.7215, and standard error is tantamount to 0.0453.

The empirical results of mediation effect suggest that external factors are currently major indicators motivating and supporting performance of reverse logistics. External factors including laws and legislation, customer awareness and demands, information technology, and collaboration among supply chain partners have created institutional pressures, resources, and facilitations for implementing reverse logistics in practice. Company respondents in the European electronics have highly appreciated the roles of network relationships and information technology that help them easily imitate other network members in the implementation of reverse logistics. The relatively moderate effect size of indirect effect of external factors through internal factors on performance of reverse logistics demonstrates that firms in European electronics industry are now also adapting positively to reverse logistic under the pressures and supports of external environments. Moreover, the significant and direct effect of internal factors on performance of reverse logistics partly signifies the changes and adjustments inside the respondent firms to reverse logistics. Internal factors, particularly with company policies, company resources, cross-functional integration, and top management support have stimulated the strategic considerations and management attention of firms in this industry to reverse logistics, potentially indicating the increase of organizational adaptive capabilities to reverse logistics. Otherwise, partial mediation effect indicates that there may be existence of other factors in the role of intervening variables in the relationships between external environments and performance of reverse logistics.

4.6.7. Moderated mediation effect

In order to evaluate the role of moderating variables in the theoretical model of factors influencing the development of reverse logistics, this study conducted PLS-based multi-group analysis (PLS MGA).[628] In multigroup analysis, a population parameter θ is hypothesized to differ for two subpopulations. The sample of

[627] See Hoyle/Kenny (1999), p. 34

[628] See Henseler et al. (2009), p. 309

each subpopulation is firstly divided into two subgroups and analyzed, resulting in group parameter estimates $\tilde{\theta}^g (g \in \{1, 2\})$. The significance of differences between groups is then evaluated. PLS MGA does not rely on distributional assumption but evaluates the observed distribution based on bootstrap outcomes. The bootstrap estimates are used to access the robustness of the subsample estimate.[629]

In order to determine the significant difference between groups, the study assumed that $\tilde{\theta}^1 > \tilde{\theta}^2$, meanwhile group 1 is equivalent to the group with the value of dummy coding as one (e.g. larger firms, OEMs, and firms in Western Europe, and firms with a RL program). Assessing the significant difference of group effect on conceptual relationships is to identify the conditional probability $P\left(\theta^{(1)} \leq \theta^{(2)} \middle| \tilde{\theta}^1, \tilde{\theta}^2, CDF(\tilde{\theta}^1), CDF(\tilde{\theta}^1)\right)$. The equation of determining the probability of significant difference at 0.05 level is calculated as follow:

$$P\left(\theta^{(1)} \leq \theta^{(2)} \middle| \tilde{\theta}^1, \tilde{\theta}^2, CDF(\tilde{\theta}^1), CDF(\tilde{\theta}^1)\right) = \frac{1}{J^2} \sum_{i=1}^{J} \sum_{j=1}^{J} H\left(\tilde{\theta}_j^{(2)\bar{*}} - \tilde{\theta}_j^{(1)\bar{*}}\right) \quad (11)$$

Note: *CDF - the empirical cumulative distribution function, $\tilde{\theta}_j^{(1)\bar{*}}$ - the centered bootstrap estimate, H(x) is Heaviside step function. Each centered bootstrap estimate of the second group is compared with each centered bootstrap estimate of the first group. The number of positive differences divided by the total number of comparisons (i.e. J^2) indicates how probable it is in the population that the parameter of the second group is greater than the parameter of the first group.*[630]

The measurement model for each sub-sample is also checked for the reliability and validity before running PLS MGA. Only the measurement model of sub-samples divided by the control variable of implementation time cannot meet the minimum requirements of validity and reliability due to the error of measurement variance and small sample size. Therefore, the study conducts bootstrap resampling analysis with 1000 bootstrap samples per group for each control variable of firm size, firm type, and firm location. Based on the bootstrap results of estimates and their standard deviations, we calculate p-values for group differences in the effects of external factors and internal factors on performance of reverse logistics. Moreover, the group differences for direct effects of external factors on internal factors is also investigated along with the group differences in indirect effect of external factors on performance of RL through internal factors. Table 17 presents the results of PLS MGA with three control variables with significant difference at 0.05 level.

Moderation effect (H_{1d})	**Firm size**			**Firm type**			**Firm location**		
	Larger	Smaller	p-value	OEM	Non-OEM	p-value	W-EU	Non W-EU	P-value
EF-IF	0.460***	0.318***	**0.039**	0.584***	0.569***	0.412	0.500***	0.492***	0.410
EF-EFF	0.440***	0.529***	0.825	0.520***	0.336***	**0.028**	0.402***	0.619***	0.993
IF-EFF	0.485***	0.368***	0.196	0.416***	0.551***	0.906	0.514***	0.341***	**0.031**
Indirect effect	0.222**	0.113**	**0.014**	0.242***	0.312***	0.840	0.256***	0.168**	**0.056**
Note: ****p <0.01, **p <0.05, *p <0.1*									

Table 17: Influences of moderating variables

The findings shown in Table 17 indicate that firm size moderates averagely the relationship of EF-IF and the indirect effect of EF on performance of RL through IF. The significant difference in strength of the effect of external factors on internal factors is found (p-value = 0.039), indicating that larger firms may be responsive to the external requirements faster and more proactively than smaller firms in managing reverse flows because of their corporate image, collaboration capabilities, and their abundant resources. Smaller firms seem to be reactive and lag their policies behind the environment changes due to their limitation of resources. Firm size also influences the relationship links of external factors (p-value = 0.196) and internal factors (p-value = 0.825) on performance of RL but without strong significant differences. Larger firms appear to be more adaptive to reverse logistics management at firm level with company policies, top management support,

[629] See Ringle/Henseler/Sinkovics (2009), p. 497

[630] See Ringle/Henseler/Sinkovics (2009), p. 498

company resources, and cross-functional integration. Smaller firms seem to take advantage of external resources to manage their reverse flows through outsourcing. Firm size strongly moderates the indirect effect between group (p-value = 0.014), indicating that the larger respondent firms may be more proactive at firm level in implementation of reverse logistics than smaller firms.

The results demonstrated in Table 17 also reveal that firm type weakly moderates the relationship links in the theoretical model. For OEMs, external factors have stronger impacts on performance of reverse logistics than retailers (p-value = 0.028). It properly reflects the current situation in which OEMs not only have to comply with the law enforcement of take-back responsibility but also to meet customer demands. Many OEMs in the European electronics industry have tried to take advantage of regulatory and authority supports, customer awareness, collaboration between supply chain partners, and information technology in order to operate reverse logistics efficiently. For instance, collaborating with distributors and service providers, and joining collaborative networks of producer consortia for collective take-back system for EoL products is regarded as one of the most important factors supporting reverse logistics operations of OEMs in the European electronics industry. For non-OEMs (wholesalers and retailers), internal factors have stronger impacts on performance of reverse logistics than OEMs but with weakly significant statistics (p-value = 0.094). Being closer to end-customers and the point-of-sale, distributors today have to face the increasing volume of returned products with different reasons and they increasingly understand the importance of customer returns management. Therefore, formulating a returns management strategy, setting up a formal returns policy, developing disposition options, and formalizing returns authorization process and the rules of credit refund have become popular with distributors of electronic and electrical equipment. The changes of strategic and operational policies have substantively affected the effectiveness and efficiency of RL performance at non-OEMs. For example, distributors often have more disposition options as well as shorter processing time with returned products, resulting in higher recovery rate than manufacturers.[631] Moreover, releasing the issues of customer returns management also requires more internal cross-functional integration than dealing with reverse logistics management of EoL products.

Firm location averagely moderates the relationships in the theoretical model, in which firm location significantly influences the group differences in the hypothesized links of EF-EFF, IF-EFF, and indirect effects. For firms located in Western Europe such as Germany, Belgium, the Netherlands, and France, the changes and adjustments of internal factors have stronger impacts on performance of reverse logistics than firms located in other regions of Europe (p-value = 0.031), indicating the higher adaptability to reverse logistics of firms in Western European countries at firm level. Meanwhile, for firms located in non-Western Europe, external factors have stronger impacts on performance of reverse logistics than firms located in Western Europe (p-value = 0.007). The indirect effect of EF on performance of RL through IF for firms located in Western Europe is also significantly greater than firms in other regions (p-value = 0.056). The economic development, the enforcement of laws, and the public awareness may result in the differences of influential factors on performance of RL between firms located in different regions.

The empirical findings extracted from the first theoretical model indicate that the organizational adaptive capabilities of a firm to the changing requirements of external environments in the implementation of reverse logistics improve the performance of reverse supply chain management. Today, companies can achieve superior performance because not only they have more resources, but also they can make better use of resources that they have[632] through careful selection of appropriate strategies and policies.[633] Proactive efforts to reverse logistics at firm level largely depends on how a firm commits and allocates their resources to formulate an appropriate strategy, to develop capabilities for reverse logistics operations, and to improve RL performance. Appropriate resource commitments and allocations, as well as the strategic focus on reverse logistics management may increase firms' RL capabilities, therefore increasing RL performance. In order to

[631] See Stock/Mulki (2009), p. 48

[632] See Penrose (1959), p. 71

[633] See Brush/Chaganti (1999), p. 233; Cf. also Chandler/Hanks (1994), p. 331

evaluate the development of reverse logistics in the European electronics industry, the analysis of adaptability to reverse logistics at firm level is comprehensively conducted in chapter 5.

5. Adaptability to Reverse Logistics at Firm Level

As analyzed in chapter 4, external factors have motivated the adjustment of firms and facilitated the performance of reverse logistics. However, the organizational adaptive capabilities of a firm to the changing requirements of external environment in the implementation of reverse logistics have improved the performance. Chapter 5 therefore evaluates the development of reverse logistics at firm level by comprehensively investigating the influences of organizational adaptive capabilities on reverse logistics performance through allocations and utilization of resources, the formulation of strategy, the formalization of returns policies, and the development of reverse logistics capabilities. Chapter 5.1 analyzes some changes of awareness, involvement, and strategy in the implementation of reverse logistics at firm level through the content analysis of published case studies in the European electronics industry. Hypotheses development for the second theoretical model of adaptability to reverse logistics at firm level is proposed in chapter 5.2. Chapter 5.3 analyzes the results of empirical study with discussions and implications.

5.1. Changes to reverse logistics at firm level

It is relatively subjective to analyze the organizational adaptive capabilities to reverse logistics only based on the empirical results from one data source (e.g. survey). This study cannot analyze the adaptability without understanding how firms deal with reverse flows in practice in each period and how firms involve themselves in RL operations. Literature of published case studies used by many previous researchers[634] together with other research methodologies is helpful to provide specific insights of RL practices. Over the last decade, there have been many articles focusing on the analysis of the practices of reverse logistics management in different industries under different perspectives including environmental considerations,[635] business and marketing aspects,[636] and operational management.[637] However, the number of case studies conducted in the European electronics industry is rather limited. Only 24 case studies collected from different sources since the late 1990s were used to analyze the practices of reverse logistics management under strategic considerations (See Appendix 4). Some information of related companies in case study literatures is also updated by their current reports of corporate society responsibility and sustainability.

This chapter therefore complements the empirical results through internet-based survey by reviewing and analyzing some published case studies in the European electronics industry to explore the changes of awareness, strategy, and operation in the implementation of reverse logistics. This study identifies the changes to reverse logistics management under strategic considerations by some evaluation criteria such as awareness, resource investments, RL capabilities (e.g. acquisition, returns management, and product recovery), levels of involvement, and levels of RL strategy. Information from case study literature and current empirical results from survey are extracted to provide evidences for the changes of and adaptability to reverse logistics.

5.1.1. Awareness, drivers and strategies for reverse logistics

The environment crisis became visible in the 1970s in many countries in the world, motivating an explosion of environmental awareness and regulations. ***From the early 1970s to mid-1980s***, the overall picture was that many firms resisted adaptation to growing regulatory and public pressures, especially with small and medium sized companies. Only limited large or multinational corporations formulated written statements of corporate environmental objectives and policies because these firms tended to incorporate environmental goals into long-term business management.[638] Some policies were set to take care of environmental problems, waste management, and management of their discarded products. However, the policies were only formally in place, and the implementation was extremely weak. Environmental issues were not perceived as

[634] See Brito/Dekker/Flapper (2003), p. 4; Cf. also Fleischmann (1997), p. 6; Saccani/Johansson/Perona (2007), p. 55

[635] See Kumar/Malegeant (2006), p. 1127

[636] See Mollenkof et al. (2007), p. 568; Cf. also Herold (2007), p. 166; Flesichmann et al. (2004), p. 3

[637] See Krikke et al. (1999), p. 381; Cf. also Spengler/Walther (2005), p. 337; Krikke/Zuidwijk (2008), p. 1206

[638] See Fischer/Schot (1993), p. 6

opportunities to gain competitive advantages.[639] At this time, the European companies were rather passive to the requirements from legislations and society related to environmental issues and waste disposal. Most small and medium sized companies probably did not formulate environmental policies at all, but instead dealt with environmental issues in an ad hoc way.[640] The dominant pattern of the period from 1970 to 1985 was a lack of willingness to internalize environmental problems and firms showed their apathy. These issues of waste disposal, pollution, and emissions control were to some extent accepted as problems that should be managed, but only in reaction to outside pressures, notably regulations and public pressures. During that time, manufacturers did not feel responsible for their products after they were sold to the consumers. Some of used electronic and electrical equipment discarded were at that time collected and recovered by municipalities and their subcontractors or traded by secondhand market due to its economic benefits. Retailers and producers collected only smaller amounts of discarded UEEE at this period.[641] Many of them were incinerated and landfilled.[642] In addition, the volume of products returned by customers due to quality and remorse issues in warranty time was limited during that time. The impact of returns was ignored, or at minimum, not well-understood at many firms.[643] There was no clear understanding of reverse flows, its benefits, and the need of managing discarded and returned products, indicating that no formal reverse logistics existed**.** Although reverse logistics was not formally existent or was poorly developed in this period, slender understanding of RL from environmental and marketing perspective was growing at the end of the 1980s (See Figure 42).

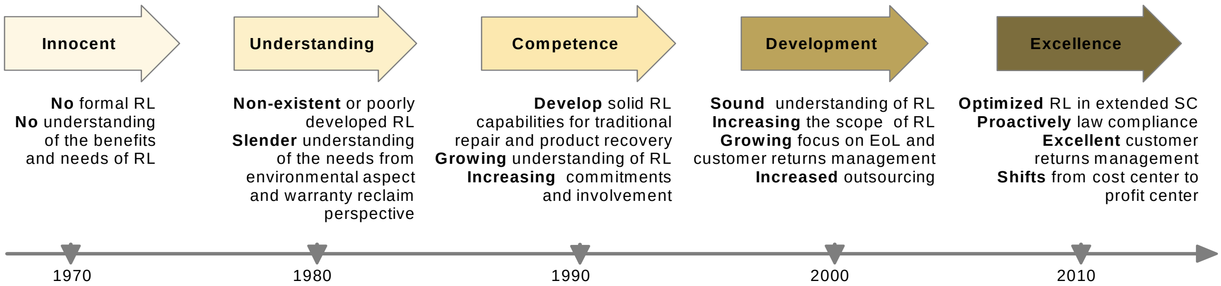

Figure 42: Levels of awareness of reverse logistics

Source: KOBIAN (2009), p. 1 with modification

In the 1990s, many firms steadily realized that the existing approach would no longer satisfy government regulators and the public pressures.[644] Society and authorities expected manufacturers to reduce the waste generated by their production activities and products through the increasing enforcement of laws. The orientation of sustainable development and the related principles of closed-loop economy emerging in Europe in this period have obtained the interests of many firms in manufacturing industries. Therefore, pollution prevention and extended responsibilities has received increasing attention from many companies. They primarily considered environmental aspects in their strategic decisions by formulating policies, strategies, and processing programs. Firms started defining environmental problems as their own responsibilities and as issues that they could not ignore because they would likely threaten their business performance in the long term. Moreover, the emphasis has been shifting toward strategic recovery due to the high cost of raw materials and the increasing disposal costs of production waste. Firms initially involved themselves in product recovery and remanufacturing to decrease the overall production costs. During the 1990s, in-house operations or vertical integration for traditional repair and product recovery, e.g. repair, maintenance, refurbishing and remanufacturing, were developed in many companies in the European electronics industry as pilot programs due to economics of remanufacturing.[645]

[639] See Fischer/Schot (1993), p. 8

[640] See Gladwin/Welles (1976), p. 162

[641] See Walther et al. (2010), p. 463

[642] See Thiery et al. (1995), p. 114

[643] See Haymon (2010), p. 1; Cf. also Mollenkopf et al. (2011), p. 391

[644] See Fischer/Schott (1993), p. 8

[645] See Ayres et al. (1997), p. 558; Cf. also Herold (2007), p. 166

In addition, there was a growing understanding of reverse logistics from the perspective of closed-loop economy in the European electronics industry due to the adoption of the European Packaging Waste Directive in 1994. Several European countries (e.g. Belgium, Denmark, the Netherland, and Sweden) also pioneered and defined national regulations for electronics take-back responsibilities since the mid-1990s. One of the comprehensive studies in the field of reverse logistics conducted by Kopicki et al. (1993) observed that in implementing used or end-of-life management program, companies typically reflect three phases: reactive, proactive and value seeking. Newly introduced environmental standard regulations usually force organizations to take a reactive response to them. These organizations may examine returns management issues from time to time, but they do not actively pursue competitive advantage through reverse logistics practices. Unlike reactive companies, proactive companies often implement reverse logistics programs, such as reuse and remanufacturing, and attempt to develop competitive advantages by designing effective returns management programs. Value-seeking companies, on the other hand, integrate reverse logistics programs into their business strategy. Most companies in this phase have advanced reverse supply chain management programs with extremely efficient reverse logistics systems.[646] For example, Xerox Europe (Rank-Xerox) has recovered used equipment since the 1960s, but developed a more formal remanufacturing system in the late 1980s and early 1990s to maximize the profitability of remanufacturing operations. The example of Xerox is frequently regarded as a typical case of how a company has saved hundreds of millions of dollars by applying reverse logistics for asset recovery and remanufacturing programs, while still having a significant positive effect on the environmental bottom.[647]

In this period, more companies that, previously, did not devote much time or energy to the management and understanding of return flows began to pay attention.[648] More commitments and positive involvements in product recovery occurred in practices, especially with medium and large-sized firms. Larger firms selected more proactive strategies by introducing voluntary take-back programs and focusing on product recovery.[649] They began to benchmark EoL management with best-in-class operators. For example, companies such as BSH, Electrolux, HP Europe, Motorola Europe, Nokia and Philips were involved in industry pilots to test different models for take-back and product recovery since the mid-1990s. They increasingly understood the role of reverse logistics management and had different voluntary take-back practices before extended producer legislation was passed. For example, Fujitsu-Siemens operated its recycling and remanufacturing operation for B2B used products in Germany from 1987; HP Europe conducted asset recovery and leasing services for its B2B customers since the 1990s; and Nokia has collected phones through its service network in the EU since 1999 without refurbishment.[650] They were more proactive and innovative in their reverse logistics management than other small-sized companies. However, their voluntary take-back and recovery program were mostly offered for business market (B2B customers). For example, returned products were collected, reused and recovered voluntarily mainly from the ending of lease contracts or active buy back in the cases of Océ, Acer Germany, IBM Germany, and Fujitsu-Siemens. Almost of the companies in the selected case study literature were not independently involved in EoL management of B2C products before the WEEE Directive was passed in Europe in 2003.

However, in practice, many firms in the European electronics industry adopted a reactive strategy, limiting themselves to the prevailing legislation due to the low rate of return of used equipment, the substantial resource investments, and the lack of experiences in managing reverse flows. There are so many issues of establishing successful reverse logistics operations for product recovery, e.g. the environmental legislation, the type of agreement between customers and manufacturers, cultural factors and environmental awareness, manufacturers' incentives, logistics and recovery costs, and the demand for recovered products/components.[651] Understanding of the need and benefits of reverse logistics from electronics firms during

[646] See Kopicki et al. (1993); Cf. also Rahman/Subramanian (2011), p. 2

[647] See Kerr/Ryan (2001), p. 77

[648] See Andel (1997), p. 61; Cf. also Krikke et al. (1999), p. 381; Philip (1999), p. 21; Toktay et al. (2000), p. 1412; Herold (2007), p. 68

[649] See Ayres et al. (1997), p. 558; Cf. also Meijer (1998), p. 1; Javier/Oscar (2004), p. 1; Toffel (2004), p. 124

[650] See Herold (2007), p. 57 - 59

[651] See Ayres (1997), p. 557-560

this time is mainly influenced by economics of remanufacturing, environmental considerations, and partly from warranty reclaim perspective due to increasing customer returns. In fact, return rates from forward flows were still low at that time and the value of the recovery asset was insignificant.[652]

In the period of 2000 - 2010, many companies increasingly realized that reverse logistics practices, combined with source reduction processes, could be used to gain competitive advantages while at the same time achieving sustainable supply chain management. The increasingly stringent laws and regulations, especially the adoption of WEEE Directive, have forced many firms in the European electronics industry to pay more attention to EoL management by different involvements in product take-back and recovery.[653] The increasing customer power motivated firms to develop solid reverse logistics capabilities to manage marketing returns, warranty returns, unexpected issues, and defective items. Increasing scope of reverse logistics includes a much broader range of parts from repair, spare part management, customer returns management, and EoL management. Using third party services for reverse logistics was also increasing in this period.[654]

During the 2000s, many companies, especially for medium and large-sized companies, have steadily used reverse logistics as a business strategy to create a distinctive competency in a very competitive market.[655] They also recognized the strategic value of reverse logistics management for the return of stale or obsolete goods so that they could maintain goods on the retail shelf fresh and in demand.[656] In this period, many companies in the European electronics industry conducted lenient returns policies to meet increased customer demands in exchanging and returning the products.[657] Customer can now frequently return a product within 30 days for any reason, including change of mind, and a full refund is given. The processes and procedures for returning goods became more formal and convenient for customers. Both OEMs and retailers in the European electronics industry proactively adjusted their supply chain to integrate the management of forward and reverse logistics because of not only legislation but also economic benefits and business requirements to satisfy customers and increase sales. Many firms that were previously in reactive phase of reverse logistics management had more proactive efforts by increasing knowledge of reverse logistics, formulating strategy, and developing capabilities to optimize the operations of collection and processing returned products.[658]

In the decade of the 2000s, firms in the European electronics industries also adapted to the implementation of reverse logistics by increasing outsourcing to third party service providers.[659] They conducted returns management, product take-back, and recovery programs by developing both internal capabilities and exploiting external resources from the collaboration with supply chain partners to manage reverse flows, especially for EoL management. This is due to the complexity of RL, the initially substantial investments, not being core competency of most firms, and the development of professional logistics service providers. Logistics service providers also changed to meet the greatly increased demands for reverse logistics operations.[660] Many LSPs increased their full package for the extended supply chain including forward and reverse logistics, and have higher availability of management system than OEMs and distributors.[661] Therefore, most of OEMs in the European electronics industry increasingly participated in producer responsibility organizations (PROs) instead of conducting their voluntary take-back initiatives for EoL management. Moreover, they also have increasingly contracted with different service providers to manage their products returned from business market and end-consumers.[662]

[652] See Haymon (2010), p. 1

[653] See Herold (2007), p. 159 – 252; Cf. also Gobbi (2008), p. 172; Miemczyk (2008), p. 279

[654] See Grabara (2004), p. 1; Cf. also Ordoobadi (2009), p. 832; Serrato/Ryan (2007), p. 21

[655] See Janse et al. (2009), p. 6

[656] See Wee et al. (2003), p. 60

[657] See Ferguson/Toktay (2004), p. 1-2; Cf. also Verweij et al. (2008), p. 65; Saibani (2010), p. 100 & 116

[658] See Savaskan/Bhattacharya (2001), p. 2; Cf. also Miele (2008), p. 23: Verwerij et al. (2008), p. 40 - 41

[659] See Verstrepen et al. (2007), p. 310; Cf. also Verweij et al. (2008), p. 49 & 65

[660] See Stock (1998), p. 146; Cf. also Wee et al. (2003), p. 60; Verwerij et al. (2008), p. 27 & 46

[661] See Setaputra/Grove (2006), p. 716; Cf. also Verweij et al. (2008), p. 46

[662] See Verweij et al. (2008), p. 64-65; Cf. also Erol et al. (2010), p. 49

Firms in the European electronics industry have currently seen environmental performance and the satisfaction of customer demands for returns as a source of competitive differentiation to some extent. However, the requirements and operations of reverse logistics for product take-back responsibilities have become standard everywhere in Europe, supporting firms easily joining PROs or contracting with service providers for managing their returned and discarded products efficiently. In our view, the changes in the ways of firms in the European electronics industry to implement reverse logistics have demonstrated their adaptability because they have changed the awareness and strategy for reverse logistics, and embedded themselves in the entire network to take advantages from both internal resources and network relationships.

In 2011, we conducted a survey to understand the current development of reverse logistics at firm level by asking firms in the European electronics industry about their awareness, drivers, and strategy for reverse logistics management. Company respondent were asked to indicate their agreements (1= strongly agree, 5=strongly disagree) of some statements related to conditions of implementing reverse logistics and drivers for their operations.[663] The significant majority of firms (78.4%) contend that they had enough information about laws and regulations (1.89) related to EoL management and returns management, e.g. WEEE Directive, RoHS Directive, and Laws on consumer rights. They also obtained sound awareness of reverse logistics (1.77), indicating that they well understood about the needs and benefits of reverse logistics in EoL and returns management. A specific strategy of reverse logistics is evaluated at 2.26 mean score, suggesting that company respondents (64.7%) paid attention to setting up a formal reverse logistics program for managing reverse flows and integrated them into overall business strategy. In comparison with the findings of Janse et al. (2009), some improvements were obtained in firms' awareness and strategy for reverse logistics (see Figure 43).[664]

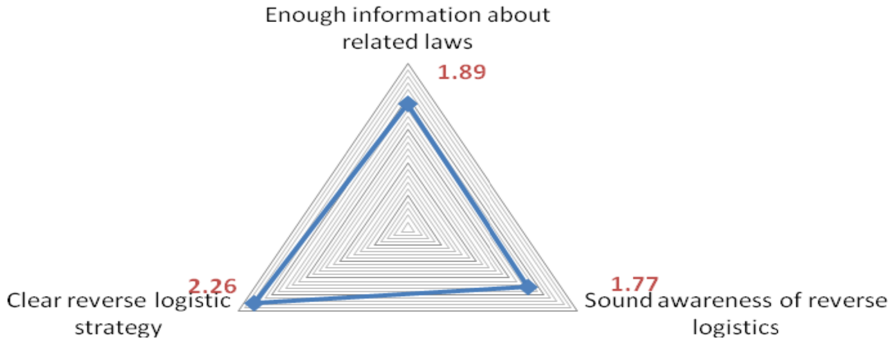

Figure 43: Current awareness of reverse logistics

Improved corporate image (1.95) and increasing customer satisfaction (2.04) are today the main drivers for respondent firms in implementing reverse logistics (see Figure 44). The changing awareness to green issues and the increased demands have stimulated firms in the European electronics industry to improve their reverse logistics operations to meet customer needs and to improve corporate image through the compliance with the laws and the environment-oriented business management. Compliance with the laws (2.67) and minimizing negative impacts on environment (2.47) rank at the second position in driving force for reverse logistics management. Economic benefits from product recovery to increase profit and reduce costs are evaluated at 2.54 and 2.8, respectively, indicating that reverse logistics operations are moving forward to becoming profit-centered instead of cost-centered.

Firms in the European electronics industry have been increasing integrated internal and external resources to optimize RL operations in extended supply chain. The enforcement of WEEE Directive has placed fewer burdens on the implementation of RL as in the early 2000s because many actors have been involved in RL processes and standardized the operations, e.g. collective take-back schemes, full packages of forward and reverse logistics services, and computerized and customized customers returns management. The constraints on the individual network structure and internal capabilities of collection and product recovery are found to

[663] A five-point Likert scale is used (1 = strongly agree, 2 = agree, 3 = partly agree, 4 = disagree, 5 = strongly disagree)

[664] See Janse et al. (2009), p. 8

be less evident than in other industries.[665] Therefore, firms in the European electronics industry seem to be relatively free to proactively invest resources and develop capabilities for RL operations that balance competitive advantages and legitimacy.

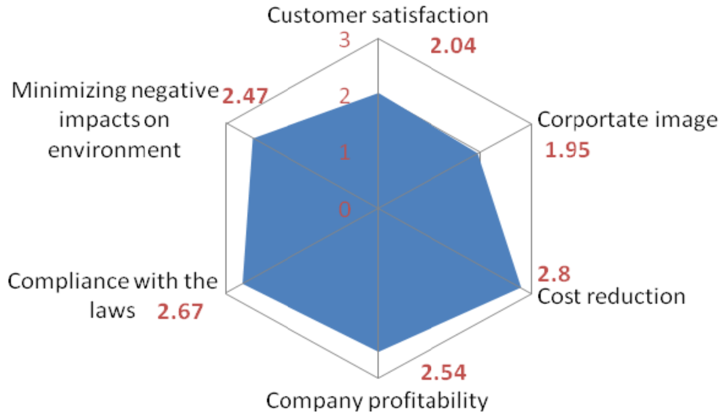

Figure 44: Current drivers for revere logistics

5.1.2. Resource investments and capabilities of reverse logistics

Although there has been increased awareness of reverse logistics and more strategic focus on confronting returned and discarded products, managers of firms have struggled with how to better manage their time and resources with these sometimes “pesky” activities,[666] which are different from the typical forward distribution activities. Many companies treated reverse logistics as a non-revenue-generating process that would often result in very few resources allocated to this part of the supply chain.[667] The decision of investing and allocating resources for reverse logistics operations, especially for closed-loop supply chain, is driven by economic analysis of the costs and benefits from product recovery activities. Investments in forward supply chain can be defined as investments of time, money, and people in inter-organizational relationships with customers and suppliers to directly influence operational performance.[668] Investments in RSC are more complicated and expensive due to additional challenges stemming from the uncertainty of reverse flows. Many firms faced the issues of balancing their resource commitments between forward and reverse supply chain.[669] The study by Rogers and Tibben-Lembke (2001) indicate that while managers are less likely to invest in the RSC than in the FSC, the investment is critical to the success of RSCM.[670]

The fast-changing environments as well as the increased understanding of the benefits and needs of reverse logistics, firms in the European electronics industry have increased their investments in RSCM that enable them to handle returns management and product recovery proactively.[671] When a firm takes back its own products and operates some or all of reverse logistic processes, there is the need to allocate internal resources to develop capabilities of reverse logistics. Resource allocations and developing appropriate take-back strategies have helped firms improve their capabilities of product acquisition, returns management, and product recovery to some extent.

Action of acquisition reflects the level of a voluntary take-back program, which shows the clear evidence of proactive efforts to reverse logistics implementation because the acquisition process consists of getting the product from the market to the point of recovery. As explained in the section of innovations of RSCM, sources for product acquisition originate from forward supply chain, market-driven stream, and waste stream. Product acquisition involves two core activities, which are the collection and the procurement. *Col-*

[665] See Miemczyk (2008), p. 278

[666] See Prahinski/Kocabasoglu (2006), p. 520

[667] See Setaputra/Grove (2006), p. 717

[668] See Kocabasoglu/Prahinski/Klassen (2005), p. 6

[669] See Prahinski/Kocabasoglu (2006), p. 523

[670] See Rogers/Tibben-Lembke (2001), p. 134

[671] See Roger/Tibben-Lembke (1998), p. 196; Cf. also Fleischmann et al. (2004), p. 4; Mollenkopf/Closs (2005), p. 578; Herold (2007), p. 62; Miemczyk (2008), p. 279-280; Saibani (2010), p. 97-106

lection, depending on the organization of a firm's reverse channel, partly demonstrates the reactive or proactive approach to return flows. The economically driven reverse logistics initiatives follow a twofold reactive approach: getting what firms want and avoiding what they do not want.

The collection integrating between forward and reverse distribution (on-site collection) is frequently conducted by OEMs themselves, their distributors, or their 3PLPs, reflecting a more proactive take-back strategy. In 24 case studies collected from published literature, many firms have paid more attention to returns from forward supply chain (19 cases) and market-driven stream (17 cases), rather than waste stream (13 cases). Respectively, they are collected by OEMs and their distributors (20 cases), LSPs (19 cases), and municipalities (11 cases). Firms in the European electronics industry have diversified their take-back strategies to obtain the efficiency of RL operations. They have used on-site services mainly for industrial and maintenance-intensive goods, especially for business market. Meanwhile, commercial returns are often reclaimed through their distributors' channel with the supports of LSPs. For example, France Télécome used their point of sale as point of returns and outsourced combination of forward and reverse logistics on both structural and institutional level to its service providers.[672] Its service providers stocked and distributed new products towards Télécom agencies, and sort, stock, and distribute returned products to repair companies or scrapper-shredders.

End-of-life products from households are often disposed to municipal waste system and are not often received the interest of manufacturers, especially for passive or reactive firms.[673] The voluntary-based take-back systems for EoL products from households are frequently implemented in some large OEMs in the European electronic industry such as Canon, Kodak Europe, HP Europe, Lexmark, and Nokia,[674] mainly for computers, printers, mobile phones, and camera due to economic benefits recaptured from recovering the discarded products. Normally, this system is based on take-back services provided to customer free-of-charge with a return box (e.g. prepaid mail boxes), "Goods Return" number, and the address to return product. Products discarded from customers are supplied at no charge; the costs for the company transportation and material handling costs. This voluntary take-back system motivates new purchase and may remain customers in buying remanufactured products after they supply the used ones to the firms. However, not so many companies have provided the cost-free take-back because of the relationships between customers and manufacturers, the issues of the uncertainty of returns, the substantial investments, and the limitation of logistics capabilities.[675] Strategic advantages and choices of product acquisition have driven the setup of closed-loop supply chains over the last decade including resources investments, the dynamics of collection channel, the costs of recovery, the benefits for a firm's shareholders, and the profitability.

Procurement is one way to approaching supply sources of products discarded at the end of their useful life proactively. Firms frequently buy back the used electronic equipment or pay to have the used appliances returned. It is often implemented when a firm is in the proactive and value-seeking phase because it finds the economic values and competitive advantages from product recovery programs. It is also implemented when OEMs want to protect their brand image and limit competition from remanufacturers for their new products.[676] There are many large-sized companies to invest resources for reclaiming valuable products by giving out appropriate financial incentives. Many cases could be found popularly in electronics firms operating in Europe:

- leasing or rental contracts (e.g. Siemens, IBM Europe, HP Europe, Océ, and Electrolux),
- trade-in returns (e.g. Siemens, HP Europe, Nokia)

[672] See Philip (1999), p. 19

[673] See Lebreton (2007), p. 4-5

[674] See Toktay et al. (2000), p. 1415; Cf. also Maslennikonva/Foley (2000), p. 227; Ferguson/Toktay (2004), p. 2; Verweij et al. (2008), p. 65; HP (2010), p. 5; NOKIA (2010), p. 6

[675] See Ostlin/Sundin/Bjorkman (2008), p. 345; Cf. also Lebreton (2009), p. 5

[676] See Ferguson/Toktay (2004), p. 2; Cf. also Toffel (2004), p. 123

- and buy-back options (e.g. Kodak Europe, Lexmark, Océ).[677]

By leasing or rental contract, OEMs have more possibilities to reduce the insecurity concerning the reverse flow structure (timing, quality, and quantity) as opposed to other methods and therefore may integrate their flows into business decision-making processes for overall supply chain.[678] The options of trade-in and buy-back provide customers with a high degree of flexibility to return products, but the control and predictability of reverse flows is more complex and uncertain with the firms because customers have rights to resell their used products on secondary market at a higher price than choosing the incentive reward.[679] For example, Lexmark proactively carried out a “prebate” program to give a discount on a new cartridge if customers return their empty cartridges after use. This program can prohibit partly customers to return or resell used products to other partners and therefore increase the return rates. However, no reports of the efficiency of the program are given.[680]

Firms in the European electronics industry are substantially increasing their investments in ***returns management*** for returns avoidance, gate-keeping, and return merchandize authorization to formalize an appropriate returns policy and reduce returns rates. Although reverse logistics issues are mainly driven by regulations in Europe, returns rate is increasing due to more powerful customers and the changes of distribution channel in the European electronics industry.[681] Attention to and focus on strategic level to prevent channel partners and end-users to return products are specific in reverse logistics strategy of many companies in European electronics industry.[682] Roger and Tibben-Lembke (1998) indicate that retailers have made larger investments in technology to improve their reverse logistics system than manufacturers in almost technology categories such as bar codes, computerized return tracking, EDI, and RFID due to the diverse multichannel distribution (e.g. e-commerce, mail-order, catalogue order, and retailer stores) and their close access to customer. However, in the decade of 2000s, both OEMs and distributors in the European electronics industry have increasingly invested in the usage of information technology to support customer returns management. They have provided technical helpline for a number of electronic and electrical products with a high number of returns to give customers detailed information on the use of their new purchase.[683] Verweij et al. (2008) in their survey indicate that producers and retailers have high investments in serial number identification and bar code scanning allowing tracking and tracing of products returned. Nearly 68% of producers actually have ERP technologies installed which cover reverse logistics operations. Radio frequency identification is in the infancy stage of use for reverse logistics with both producers and retailers. Retailers show lower investments in EDI and customer relationship management than manufacturers for reverse logistics. However, few companies invested in having end-to-end capabilities of reverse logistics, from return acquisition to redistribution.[684]

One of the important dimensions of adaptability to reverse logistics is the investments of resources and involvement of a firm in ***product recovery***. In the literature of 24 case studies, the most often described recovery options were in sequence with material level of recycling (15 cases), component level with refurbishing (11 cases) and remanufacturing (10 cases), and product level with reuse/resale (12 cases). The participation of manufacturers in recovering the value of returned products through reuse, refurbishing, remanufacturing and recycling has partly demonstrated the higher level of adaptability to reverse logistics.[685] Herold (2007) also examines five levels of involvement of OEMs in end-of-life management, especially for remanufacturing and recycling.

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677 See Krikke et al. (1999), p. 381; Cf. also Mayer (2001), p. 203-204; Ferguson/Toktay (2004), p. 2; Flesichmann et al. (2004), p. 4; Herold (2007), p. 94; Ostlin/Sundin/Bjorkman (2008), p. 340

678 See Guide/Wassenhove (2001), p. 35

679 See Fleischmann (2004), p. 5

680 See Toffel (2004), p. 124; Cf. also Ostlin/Sundi/Bjorkman (2008), p. 344

681 See Guide et al. (2006), p. 8

682 See Janse et al. (2009), p. 8

683 See UK Department of Transport (2004), p. 19; Cf. also Verweij et al. (2009), p. 54; Saibani (2010), p. 102-104

684 See Verweij et al. (2009), p. 55-56

685 See Fleischmann et al. (2004), p. 4

- ***Doing nothing*** means no involvement in any product recovery management processes and the existence of returns flows is completely ignored. There is widespread apathy among shareholders at firm level of returns management and product recovery, resulting in the lack of firms' activities related to reverse logistics.
- ***Collective contracting*** is the lowest level of involvement of a firm for EoL management, which is characterized by very limited organizational capabilities and the existence of collective take-back schemes or producer consortia. This level of involvement has been highly popular in the cases of firms in the European electronics industry for managing EoL products from households. Companies with this level of involvement invest the dedicated human resources for controlling the contracts with different collective take-back schemes, ensuring take-back, cost-effective compliance, and measuring and reporting the quantity of products sold.
- ***Individual contacting*** is characterized by a low level of organizational capabilities and no tangible assets, in which a company manages its EoL products independently or with selected partners. This involvement requires higher investments of management and human resources to select and evaluate different service providers to combine resources and develop capabilities of product recovery. Individual contracting ranges from arm's length transaction, long-term contracts to strategic alliance with different service providers, e.g. LSPs, remanufacturers, and recyclers.
- ***Individual recovery*** presents a high level of involvement and high organizational capabilities because firms treat their own returned and discarded products to some extent, take control over the return flows, and invest dedicated resources of management, labor, and specific equipment. However, their own recovery facilities are also limited because the majority of remanufacturing and recycling operations are still outsourced to third party service providers.
- **Vertical integration** is the highest level of involvement in RL operations because firms substantially invest in treatment facilities and vertically integrates into returns management and product recovery. This involvement is characterized by superior investments of management, labor, technologies, and equipment for in-house recovery capabilities, full-owned recovery facilities, or joint venture with service providers.[686]

In 24 published case studies, only eight firms (e.g. Acer Germany, Canon Europe, Kodak Europe, Xerox Europe, IBM Europe, Océ, Fujitsu Siemens, and SNI Germany) have substantially developed in-house operations for recovering product returned by their own investments. In the European electronics industry, OEMs that are also remanufacturers often have the large business scale in terms of sales and employment.[687] For example, Kodak Europe has decreased their costs of reverse logistics by operating some central Kodak returns depot for returns consolidation and evaluation, and then optimized their asset recovery and remanufacturing programs in multiple facilities owned by Kodak or Kodak partners to save transportation costs. The company has had to invest substantially over the last ten years to guarantee the viability of its remanufacturing processes.[688]

The majority of firms have limitedly invested in recovery facilities and increasingly outsourced their reverse logistics activities to service providers, and/or joined strategic alliance with some partners for combining resources and experiences to develop capabilities of product take-back and recovery, e.g. collective contracting (10 cases), individual contracting (20 cases), individual recovering (11 cases). The RL operations related to the product recovery is outsourced but with different levels following their resource allocations, recovery strategy, objectives of cost reductions and profitability, and the feasibility to set up an economical asset recovery operation.[689] Appropriate resource commitments and allocations for reverse logistics therefore have played an important role in developing capabilities and strategies for take-back and product recovery operations at firm level.[690]

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[686] See Herold (2007), p. 54 - 57

[687] See Johnson (1998), p. 226; Cf. also Toffel (2004), p. 121

[688] See Toktay (2000), p. 203; Cf. also Ferguson/Toktay (2004), p. 2

[689] See Herold (2007), p. 70; Cf. also Gobbi (2008), p. 173-178

[690] See Krikke/Harten van/Schuur (1999), p. 383

Based on the analysis of published case studies and some updated empirical results, the development of reverse logistics in European electronics industry under strategic consideration and supply chain perspective can be generally observed through a cubic model with three dimensions: RL operations, awareness and strategy of RL, and a strategic timeline of RL development (see Figure 45). Implementing reverse logistics through vertical integration has today not been existed absolutely because operations of reverse logistics in practice are very complicated and need the supports of different service providers. Moreover, the operations of reverse logistics have been increasingly standardized everywhere in Europe with the host of RL programs and take-back system providers.[691] Firms can adapt to reverse logistics with varying degrees from collective contracting, individual contracting to individual recovery. Therefore, the allocation and availability of internal resources may influence adaptability to reverse logistics through strategic decisions of developing internal capabilities and outsourcing to service providers.

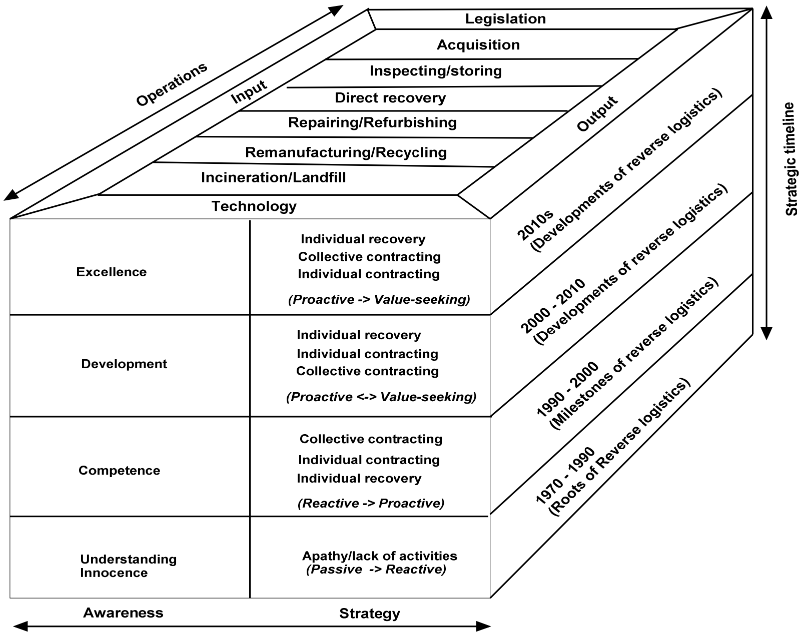

Figure 45: Cubic model of reverse logistics development under strategic considerations

Source: Own illustration

Although there are many studies conducted by qualitative method of case study to explore the changes of reverse logistics management, empirical evidences pertaining to adaptability to reverse logistics based on the relationships among organizational related factors, e.g. resource allocations, firm strategy, company polices, internal capabilities, and RL performance have been limited. This chapter contributes to this stream of literature with a broad-based empirical study through an internet-based survey to further theoretical understandings of the adaptability to reverse logistics in the European electronics firms.

5.2. Hypothesis development

This study uses the resource-based view, the viewpoint of adaptability, and the second conceptual model discussed in chapter 3.3 as theoretical bases to develop hypotheses investigating how a firm commits and allocates resources to formulate strategy, align returns policies, develop capabilities of reverse logistics, and achieve the effectiveness and efficiency of reverse logistics performance.

Resource commitments, capabilities, and performance of reverse logistics

Resource commitments relate to the allocation of "tangible and intangible" entities available to firms that enables them to make business efficiently and effectively.[692] In other words, resource commitments deal with how valuable resources are allocated and utilized to address rapidly changing environments. It means that

[691] See Fleischmann et al. (2004), p. 4; Cf. also Gobbi (2008), p. 123; Verweij et al. (2008), p. 65; Janse et al. (2009), p.15-16

[692] See Hund/Morgan (1996), p. 108

resources should be managed and used to develop capabilities that result in superior performance.[693] Resource-based theory suggests that efficient and effective resource configuration and deployment can be the most important strategy to achieve superior performance. Previous studies indicate that as a firm commits more resources to a program or a process, the results are more superior with better service and economic performance.[694]

Das and Teng (2000) suggest three main types of resources including financial resources, technology resources, and managerial resources that support and develop reverse logistics capabilities and enhance performance of RL. Managerial resources cover management supports and commitments from top and middle managers for strategic decisions of reverse logistics. Managerial resources also include the skills, experience, knowledge, and intelligence of the employees,[695] which influences cross-functional integration for reverse logistics operations. The allocation of sufficient financial resources is considered important for developing capabilities of reverse logistics because it requires investments for in-house operations, e.g. skilled workers, facilities and machines,[696] and for outsourcing RL operations to service providers. Technology resources may cover information technology for forecasting and planning, coordinating and tracking returned products; and equipment and machines for inspection, repair, recovery, and recycling.[697]

The effective allocation and utilization of resources is critical to a firm's success and is especially important for reverse logistics program due to its complexity and uncertainty.[698] Reverse logistics involves wide stages of processes including product acquisitions, returns handling and inspection, refurbishing, repair, remanufacturing, and recycling, which all require a high level of resource allocations to implement. Reverse logistics programs are resource intensive in terms of implementation, maintenance, and significant time. However, reverse logistics can be easily ignored because it is frequently not the core business of many firms and regarded as a cost-center than a profit-center. Resources therefore must be firstly committed for better performance of RL,[699] indicating the adaptability to reverse logistics. Daugherty et al. (2001) directly addressing resource commitments and performance in reverse logistics indicate that appropriate commitments and allocations of resources can increase the effectiveness and efficiency of RL performance. The empirical study of Taylor et al. (2012) indicates that resource commitments positively and significantly influence the economic and environmental performance of reverse logistics.[700] Therefore, this study explores the adaptability to reverse logistics through the dimension of resource commitments and its influence on RL performance with the hypothesis:

H*$_{2a}$*: Resource commitments are positively associated with performance of reverse logistics

Reverse logistics capabilities refer to "the internal capabilities and processes that a firm deploys resources to effectively implement its reverse logistics activities."[701] The reverse logistics capabilities can contain the accuracy and the availability of information, the process and timeliness of reverse logistics information, the internal and external connectivity, usefulness of information, the ability to recover returned products, and standardize processes and rules controlling the collection, sorting, and reprocessing of assets.[702] The resource-capability-performance relationship is confirmed in many researches relating to reverse logistics.[703] Closs et al. (1997) state that there may be differences in a firm's logistics competency because the differences in resource allocations. Daugherty et al. (2004) indicate a direct and positive impact of resource commitments on reverse logistics IT capabilities, and an indirect impact on RL performance. Richey et al. (2005)

[693] See Richey et al. (2005), p. 834

[694] See Daugherty et al. (2001), p. 107; Cf. also Daugherty et al. (2005), p. 79; Ainuddin et al. (2007), p. 49; Taylor et al. (2012), p. 4

[695] See Richey/Wheeler (2004), p. 89

[696] See Kaluza/Malegeant (2006), p. 1130

[697] See Daugherty et al. (2005), p. 83

[698] See Richey et al. (2005), p. 235

[699] See Daugherty et al. (2001), p. 110

[700] See Taylor et al. (2012), p. 1

[701] See Hsiao (2010), p. 71; Cf. also Jack et al. (2010), p. 230

[702] See Jack et al. (2010), p. 230-233; Pollock (2010)

[703] See Daugherty et al. (2004), p. 77; Cf. also Richey/Genchev/Daugherty (2005), p. 235; Jack et al. (2010)Jack et al. (2010), p. 240

also examine the relationships between resource commitments, innovative reverse logistics capabilities, and RL performance. Their findings demonstrate that commitments of resources have some positive impacts on a firm's ability to create a reverse logistics program, and therefore influence RL performance. Jack et al. (2010) through an empirical study also suggest a positive causal relationship between the deployments of resources and the improvement of reverse logistics capabilities. Reverse logistics capabilities, e.g. collection and gate-keeping, ease of credit refund, remarketability, product recovery, and recycling may significantly influence a firm's profitability by increasing customer satisfaction, improving company image, reclaiming value, reducing inventory cycle, and increasing asset recovery revenue. Autry (2005) indicates that returns handling capabilities and repair/rework capabilities have a significant positive impact on reverse logistics programs' effectiveness. In fact, the successful implementation of RL could result in making profits.[704] For example, a firm's ability to quickly and efficiently handle the return of products for necessary repair and refurbishing can be critical because it influences customer service/satisfaction, motivating the increased sales, and recapturing the recovered value.[705] Thus, this study evaluates the adaptability through the dimension of RL capabilities with two hypotheses related to the relationships between resource commitments, capabilities, and performance of RL.

H_{2b}**:** *Resource commitments are positively associated with capabilities of reverse logistics*

H_{2c}**:** *Capabilities of reverse logistics are positively associated with performance of reverse logistics*

Resource commitments, strategy formulation, and performance of reverse logistics

Strategies are the building blocks of managerial decisions and actions that determine the long-run performance of an organization. Strategies are also the ways in which firms relate to their environment in which they are embedded.[706] Strategic issues require large amounts of a firm's resources because they need certain commitments and allocations of people, physical assets, and money to set up specific strategic plans.[707] Resources enable firms to conceive and implement strategies, improving effectiveness.[708] Therefore, strategically matching or aligning company resources with the company's context and the opportunities or threats of external environments is a major task in strategic management. According to modern institutional approach of organizational theory and resource-based view, firms nowadays formulate their strategy depending on both interaction with external environments (external fit)[709] and co-alignment with internal resources.[710] Many researchers in strategic management recognize the competitive value of resources and identify how they combine with and influence the strategies pursued by the firm.[711] In other words, they argue that firm strategies in conjunction with the firm's resource base determine firm performance.

In a highly competitive industry like electronics industry, the commitment of resources is considered as an important base for formulating a specific strategy of RL because investments in RL are more complicated and riskier than in forward supply chain. Under pressure of regulatory factors and the requirements of customers, many companies have incorporated the strategy for reverse logistics in their overall business strategy at different levels. At level of corporate strategy, many companies have made changes in their growth objectives by introducing a sustainability strategy, e.g. Philips, Electrolux, Nokia and Miele. The orientation of sustainability development has been regarded as one of the strategic alternatives in strategy formulation of many manufacturing companies in the electronics industry in which they take extended producer responsibility for their products at the end-of-life with the objectives of remanufacturing, recycling, and waste disposal reduction. Moreover, the changes to customer orientation, especially for the growing multichannel retailers in the electronics industry, have made firms adjust their business strategy, e.g. dedicated after-sales services,

[704] See John (1997), p. 75; Cf. also Andel (1997), p. 61; Stock (1998), p. 63; Autry (2005), p. 754

[705] See Blumberg (1999), p. 141

[706] See Porter (1985), p. 23

[707] See Pearce/Robinson (2011), p. 4

[708] See Barney (1991), p. 99

[709] See Tuominen/Rajala/Moeller (2004), p. 495; Cf. also Ainuddin et al. (2007), p. 47; Zhou /Li (2010), p. 224

[710] See Edelman/Brush/Manolova (2005), p. 361

[711] See Chandler/Hank (1994), p. 335; Cf. also Brush/Chaganti (1998), p. 249

extended warranty, and increasingly lenient returns policy. Electronics manufacturers and other players in reverse supply chain consider what strategies to incorporate and how to structure their reverse logistics system.[712]

However, the selection of a suitable and profitable product recovery strategy, and the decisions of involvement level or outsourcing have not been an easy task because many factors have to be taken into consideration, e.g. internal resources, technical feasibility, the supply side of used products, the demand side for reprocessed products, and the economic and environmental costs. Dowlatshahi (2005) points out that the strategic fit of reverse logistics in a firm's business strategy is based on its ability to use the existing manufacturing resources, processes, technologies, and knowledge for remanufacturing purposes. Therefore, a lack of resources may make the strategic formulation of a formal reverse logistics program and the implementation of reverse logistics practices difficult,[713] and result in firms' reluctance to involve themselves in reverse logistics operations. Commitments of management supports, financial capital and technology competence may be evaluated as the most important internal factor[714] to formulate a specific strategy and policies for reverse logistics operations.

The strategic management literature suggests a firm that gives high emphasis to strategic planning and formulating are able to clearly identify its competitive advantages based on the interaction of internal resources and the context or environment in which firms operate to get best business performance.[715] Strategic formulation of a reverse logistics program facilitates a firm to deal with reverse logistics management more proactively. By developing a formal reverse logistics program, a firm can identify the ways to implement RL operations depending on the availability of company resources, the internal constraints, and the accessibility to opportunities of external environment and a wider range of external resources. According to Gooley (1998), a well-managed RL program could result in significant savings in inventory carrying cost, transportation cost, and waste disposal cost, which can create substantial benefits and positively affect bottom-line.[716] Therefore, this study assesses the organizational adaptive capabilities through the dimension of strategy formulation and proposes two hypotheses regarding the relationships between resource commitments, strategy formulation and performance of RL

***H_{2d}*: Resource commitments are positively associated with strategy formulation of reverse logistics**

***H_{2e}*: Strategy formulation of reverse logistics is positively associated with performance of reverse logistics**

Among the activities of strategy formulation, identifying an appropriate returns policy plays an important role in obtaining the competitive advantage with the rival in the same market, especially for highly competitive industries like electronics industry. Returns policies mention the degree of difficulty involved in exchanging and returning products,[717] which can be divided into liberalized and restrictive returns policies. Return rates in the European electronics industry are steadily increasing due to growing customer power and the stricter consumer protection laws. The regulations and the increasing power of customers have improved the awareness of firms related to the needs and benefits of a more lenient returns policy, which leads to more resource commitments to returns management. For example, European retailers, exercising their growing channel power, are using returns policies to enhance their competitiveness and are requiring manufacturing industry to ensure the benefits and value for them.[718] OEMs in European electronics industry have paid more management attention to acting together with retailers to determine appropriate terms and conditions for different kinds of returns. Both OEMs and retailers have increased the investment in technologies supporting

[712] See Yellepeddi (2006), p. 12

[713] See Gonzalez-Torre/Alvarez/Sarkis/Adenso-Diaz (2009), p. 3

[714] See Das/Teng (2000), p. 35

[715] See Tuominen/Rajala/Moeller (2004), p. 498; Cf. also Ainuddin et al. (2007), p. 50; Zhou/Li (2010), p. 226

[716] See Gooley (1998), p. 49; Cf. also Genchev/Richey/Gabler (2011), p. 257-258

[717] See Richey et al. (2005), p. 832

[718] See Mollenkopf et al. (2011), p. 400

for forecasting, tracking, RMA processes, and gate-keeping procedures to quickly handle returns flows and meet customer demands.[719]

Many consumers in Europe have grown accustomed to being able to bring electronics goods back to the store for just any reasons.[720] A liberalized returns policy appears to make it easier and quicker for customers to receive returns authorization and credit refund, as well as the extended days to return.[721] The days to return can be extended to 14, 30, 60 and 90 days instead of 7 days as before. Firms that offer customers more opportunities to return products discover that they must increase cross-functional integration for increased alignment of company resources for returns management, e.g. identifying return costs, sharing cost information to avoid returns and process returns efficiently.[722] By conducting a liberalized returns policy, firms have also increasingly offered their customers with more flexible after-sales services,[723] process quick returns authorization and credit refund, and provide the available solutions of returns shipping. Moreover, a liberalized returns policy also requires firm to develop their capabilities of inspection, repair, recovery, and redistributing due to the increasing return rates.

Therefore, this study addresses the adaptability to reverse logistics through the dimension of liberalized returns policies with two hypotheses demonstrating the relationships between resource commitments, liberalized returns polices and RL capabilities.

H_{2f}**:** *Resource commitments are positively associated with liberalized returns policy*

H_{2g}**:** *Liberalized returns policy is positively associated with capabilities of reverse logistics*

The previous studies show that improved capabilities produce the superior performance or effectiveness of business when firm resources are committed sufficiently to the program.[724] The previous studies also state that a fit between the corresponding internal resources and firm strategies leads to enhanced performance.[725] Therefore, if resource commitments are expected to impact strategy formulation and capabilities of reverse logistics, these dimensions are posited to influence RL performance and then an indirect effect can be explored. Therefore, it is likely to propose that:

H_{2h}**:** *Strategy formulation and development of RL capabilities mediate the effect of resource commitments on RL performance.*

Figure 46 describes the relationships of hypothesized links.

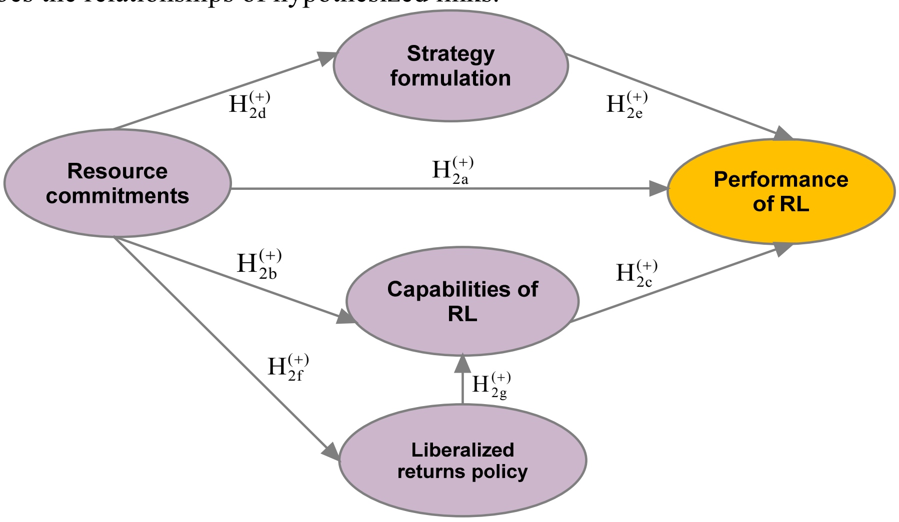

Figure 46: Hypothesized links of adaptability to reverse logistics at firm level

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[719] See Davey et al. (2005), p. 87; Cf. also Mollenkopf/Russo/Frankel (2007), p. 570; Verweij et al. (2008), p. 56

[720] See Lawton (2008), p. 1

[721] See Richey et al. (2005), p. 833. The days to return can be extended to 30, 60 and 90 days instead of 7 and 14 days as before.

[722] See Autry (2005), p. 751; Cf. also Mollenkopf (2011), p. 398

[723] See Saccani/Johansson/Perona (2007), p. 55

[724] See Ellinger (2001), p. 107; Cf. also Autry (2005), p. 749; Richey/Genchev/Daugherty (2005), p. 259

[725] See Chandler/Hanks (1994), p. 343; Cf. also Edelman/Brush/Manolova (2005), p. 364

5.3. Results of empirical study

5.3.1. Sample collection and data analysis method

This study tests the above-mentioned hypothesized links following the data sample as collected in chapter 4. The data collection procedures, the sample characteristics, the statistical data examination, and data analysis method are applied the same as in Chapter 4. The t-tests of non-response bias indicate that there are no significant differences between the late and early respondents (p-value > 0.05 for all constructs in the model). The examination of common method variance is within a rule thumb of 0.05 (e.g. maximum percentage of shared variance less than 5.8%) and the significant path coefficients are still remained, suggesting that method variance may not be the serious issue of this study.

5.3.2. Descriptive statistics and measurement scales

The proposed model of adaptability to reverse logistics at firm level is comprised of multi-item reflective constructs. These constructs are mostly derived from previous existing scales to evaluate the path coefficients of interests for research objectives. However, some constructs are developed for this study, especially with two latent variables of strategy formulation and capabilities of reverse logistics.

Resource commitments

Consistent with Das and Teng (2000), Daugherty et al. (2005), and Richey et al. (2005), a scale for resource commitments for implementing reverse logistics includes three items: management resource, finance resource, and technology resource. A five-point scale (1=very much, 5=not at all) is used to measure the level of resource commitments. The results of reliability test and EFA reveal that this construct has a clear factorial structure with an acceptable coefficient alpha and average corrected item-to-total correlation. The highest resource commitments to reverse logistics within respondent firms belong to management resource with mean score of 2.49. The results have partly reflected the increasing management attentions to reverse logistics in the European electronics industry. Company respondents seem to place more strategic focus on reverse logistics primarily by implementing a higher level of management attention. However, the average commitments of financial (3.12) and technological (3.05) resources indicate that reverse logistics has not obtained a high priority of investment as in forward supply chain.

Liberalized returns policy

The scale items for liberalized returns policy are adapted from Richey (2005) and Autry (2005) with two opposite statements and a five-point scale (1=strongly agree, 5=strongly disagree). Two items of this dimension are found to have satisfactory corrected item-to-total correlation and coefficient alpha ($\alpha = 0.825$). The mean score of restrictive and liberalized returns policy in the company respondents is 2.97 and 3.15, respectively, indicating that a less restrictive returns policy is being preferred in the European electronics industry. Firms in this industry have varied the number of days that a customer can return a product with full refund from 7 days to 30 days (see Appendix 3). Moreover, firms in the industry are now more flexible in interacting with customers for releasing the issues of returns through the supports of information technology.

Strategy formulation

As explained in chapter 3.3, strategy formulation refers to the degree to which a formal reverse logistics program is conducted including determining goals and strategies of product recovery, developing gatekeeping and disposition policies, developing returns policy and credit rules, developing RL networks, and developing a framework of metrics for RL performance. A formal reverse logistics program is formulated to direct and instruct intra-firm or inter-firm reverse logistics operations.[726] The items used in this study to measure strategy formulation of reverse logistics are adapted from Croxton et al. (2001) and Lambert (2006) with 5-point scale (1=strongly agree, 5=strongly disagree). The results of reliability test and EFA demonstrate that most of items assigned to this construct meet the item-to-total correlation threshold and all items are loaded on only one factor. Company respondents seem to have increasingly strategic focus on reverse

[726] See Croxton, et al. (2001), p. 19

logistics with a high mean score from 2.16 to 2.65. However the communality of item "determining the appropriate metrics for RL performance" (0.374) is less than the requirement level (0.4), suggesting the consideration in the measurement model.

Reverse logistics capabilities

Reverse logistics capabilities are developed in this study with six items emphasizing the capabilities of returns handling and reprocessing. Some of items are adapted from the previous research of Autry et al. (2001), Autry (2005), Richey et al. (2005), Lebreton (2009), and Genchev et al. (2011) while others are developed by suggestions from previous researchers and the popularity in reverse logistics operations. Autry (2005) indicates that future research should attempt to assess other relevant categories of capabilities, e.g. remanufacturing and recycling, which may affect reverse logistics effectiveness in larger scale. This study adds three capabilities that are increasingly popular in today reverse logistics operations: product recovery capability (repair, refurbishing, and remanufacturing), material recovery capability (Recycling), and marketability of recovered products (see Table 18). A five-point scale (1=very capable, 5=incapable) is used to measure RL capabilities. The results of EFA show that reverse logistics capabilities have structure of two distinct dimensions with acceptable level of cross-loadings. The first factor includes capabilities of product acquisition, ease of credit return to customers, and marketability of recovered products, which is labeled as return handling capabilities (TCAP1). The second factor is named reprocessing capabilities (TCAP2) that encompass the abilities of product recovery, material recovery, and quality of rework and repair. Coefficient alpha and corrected item-to-total correlations are also recalculated for two factors and are found to meet the criteria of unidimensionality measurement.

Returns handling capabilities are evaluated in terms of abilities for product acquisition (e.g. product collection and procurement of returned products), ease of crediting customers related to time, and procedures; marketability of returned or recovered products. Capability of product acquisition is reported with the highest mean score (2.80), and followed by ease of credit refund (2.98), and remarketability (3.21). It appears that respondent firms may be somewhat good at collecting and acquiring products from different sources with gate-keeping and testing capabilities.

Returns handling capabilities (TCAP1)	Source
Product acquisition (product collection and procurement)	Autry (2005), Lebreton (2009)
Ease of credit return to customers (time and procedures)	Autry et al. (2001), Richey (2005)
Marketability of recovered products	Suggested from the authors
Reprocessing capabilities (TCAP2)	**Source**
Product recovery capability (repair, refurbishing, remanufacturing)	Suggested from Autry (2005)
Material recovery capability (recycling)	Suggested from Autry (2005)
Quality of rework or repair	Autry (2001), Richey (2005)

Table 18: Scale of reverse logistics capabilities

Reprocessing capabilities refer to abilities of recovering the returned products, which include some items measuring the capabilities of product recovery (repairing, refurbishing, and remanufacturing), material recovery (recycling); and service quality of reprocessing (quality of rework and repair). The mean scores range from 1.98 to 3.69 means that the respondent firms have invested resources in developing reprocessing capabilities, especially for product recovery (2.46) with quality of rework and repair (1.98).

Reverse logistics performance

Scale measurement of reverse logistics performance is described the same as in chapter 4 with 5 items. Table 19 provides descriptive statistics and measurement scales of each construct including mean, standard deviation (SD), corrected item-to-total correlations, item communality, and coefficient alphas.

Construct and measurement scale (Scale 1-5)	Mean	SD	Item-Total correlation	Com-munality
Requirement level			***≥ 0.35***	***≥ 0.4***
Resource commitments (RC), Cronbach α = 0.730				
To what extent does your company make resource commitments to reverse logistics implementation?				
RC1: Managerial resource commitment	2.49	0.876	0.574	0.694
RC2: Financial resource commitment	3.12	0.787	0.662	0.768
RC3: Technological resource commitment	3.05	0.825	0.439	0.503
Strategic formulation (SF), Cronbach α = 0.738				
To what extent do you agree with the following statements related to activities of formulating a reverse logistics program in your company?				
SF1: We determine goals and strategies for product recovery	2.54	1.216	0.449	0.422
SF2: We develop gate-keeping and disposition polices	2.65	0.971	0.633	0.661
SF3: We develop reverse logistics network	2.48	0.982	0.485	0.479
SF4: We develop returns policy and credit rules	2.32	0.956	0.555	0.564
SF5: We determine appropriate metrics for reverse logistics performance	2.16	0.700	0.431	***0.374***
Liberalized Returns policy (LRP), Cronbach α =0.825				
To what extent do you agree with the following statements related to your company's returns policy				
RP1: Our returns policy is more restrictive than our competitors (r)	2.97	1.138	0.706	0.853
RP2: We carry out a liberalized returns policy	3.15	1.028	0.706	0.853
Return handling capability (TCAP1), Cronbach α = 0.825				
Please evaluate your company's internal capabilities in returns handling following the criteria				
CAP1: Product acquisition	2.80	1.063	0.707	0.767
CAP4: Ease of credit refund	2.98	0.944	0.648	0.705
CAP5: Marketability of recovered products	3.21	1.037	0.694	0.753
Reprocessing capabilities (TCAP2), Cronbach α = 0.705				
Please evaluate your company's internal capabilities in reprocessing following the criteria				
CAP2: Product recovery capability	2.46	0.864	0.551	0.663
CAP3: Material recovery capability	3.69	1.099	0.518	0.614
CAP6: Quality of rework and repair	1.98	0.771	0.538	0.646
Reverse logistics performance (EFF), Cronbach α = 0.858				
Please evaluate your company's effectiveness and efficiency in implementing reverse logistics following the criteria				
EFF1: Customer satisfaction	2.27	0.785	0.744	0.848
EFF2: Improved competitiveness	2.79	1.102	0.752	0.859
EFF3: Cost reduction	3.06	0.830	0.616	0.749
EFF4: Improved profitability	3.02	0.933	0.654	0.781
EFF5: Reduced inventory investment	2.17	0.868	0.640	0.773

Table 19: Descriptive and scale statistics of constructs in the theoretical model

5.3.3. Measurement model

This chapter also uses PLS path model analysis to explore the hypothesized links in the model. Use of PLS-PM is especially suited to the studies like this, where the measures of strategy formulation and capabilities of reverse logistics are new, and the relationships between resource commitments, strategy formulation, and performance of reverse logistics have not been explored. The research model is analyzed with two measurement models in which the first one contains relationships between capabilities of return handling (Model 2A) with other latent variables, and the second model shows the relationships between capabilities of processing (Model 2B) with other latent variables in the theoretical model. Table 20 presents the statistics of these two measurement models with standardized factor loading.

Measurement items (Scale 1-5)	**Model 2A**			**Model 2B**		
	Initial loading	Final loading	CR	Initial loading	Final loading	CR
Requirement level	***≥ 0.60***		***≥ 0.70***	***≥ 0.60***		***≥ 0.70***
Resource commitments (RC)			**0.8454**			**0.8449**
RC1: Management	0.8615	0.8632		0.8651	0.8667	
RC2 : Finance	0.8968	0.8967		0.8961	0.8959	
RC3 : Technology	0.6372	0.6344		0.6320	0.6294	
Strategic formulation (SF)			**0.8667**			**0.8667**
SF1: Product recovery strategy	0.7896	0.7825		0.7894	0.7823	
SF2: Gate-keeping & disposition	0.7712	0.7644		0.7713	0.7645	
SF3: RL networks	0.7725	0.7949		0.7725	0.7948	
SF4: Returns policy and credit rules	0.7818	0.8053		0.7820	0.8054	
SF5: Measurement of RL performance	***0.5339***	-		***0.5336***		
Liberalized returns policy (LRP)			**0.9203**			**0.9197**
RP1: Restrictive returns policy (r)	0.9329	0.9329		0.9397	0.9397	
RP2: Liberalized returns policy	0.9135	0.9135		0.9054	0.9055	
Return handling capability (TCAP1)			**0.8956**			
CAP1: Product acquisition	0.8808	0.8808				
CAP4: Ease of credit refund	0.8471	0.8471				
CAP5: Remarketability	0.8541	0.8541				
Reprocessing capabilities (TCAP2)						**0.8389**
CAP2: Product recovery				0.8499	0.8499	
CAP3: Material recovery				0.7143	0.7143	
CAP6: Quality of rework and repair				0.8214	0.8214	
Reverse logistics performance (EFF)			**0.9006**			**0.9005**
EFF1: Customer satisfaction	0.8514	0.8517		0.8526	0.8529	
EFF2: Corporate image	0.8629	0.8636		0.8634	0.8640	
EFF3: Cost reduction	0.7427	0.7424		0.7385	0.7387	
EFF4: Improved profitability	0.7768	0.7769		0.7773	0.7773	
EFF5: Reduced inventory investment	0.7747	0.7738		0.7761	0.7750	

Table 20: Measurement model results

Individual item reliability

The outer loading of indicators in the measurement models mostly ranges from 0.533 to 0.939, with most measures falling around or above 0.7 threshold value.[727] Many studies have also retained measurements with loading below the 0.7 threshold due to their significance to theoretical model.[728] Thus, the study eliminates only one indicator of strategy formulation construct (SF5) - due to its lowest reliability (0.533) and dropping this indicator goes along with a substantial increase of composite reliability and average variance extracted of SF construct. Activity of determining appropriate metrics for reverse logistics performance has initially attracted attention in RSCM; however, measuring and managing the true performance of reverse logistics is very hard because of the differences and uncertainty of RSC processes. Internal and operational metrics are in place, but metrics for end-to-end process performance are seldom used or available.[729] Nearly 60% of

[727] See Fornell/Larcker (1981), p. 39

[728] See Hulland (1999), p. 195; Cf. also Ainuddin/Beamish/Hulland/Rouse (2007), p. 57

[729] See Verweij et al. (2008), p. 36

retailers and manufacturers in the EU thought that reverse logistics is important in a 2008 survey, but only 13.6% of companies track the cost of returns completely.[730] In fact, many firms have not had a clear procedure in measuring the RSC performance.[731] The latent variable of strategy formulation explains only 28.4% of variance in the indicator of determining measurement metrics. The factor loadings from the final PLS measurement models excluding this indicator are presented in Table 20 above or approaching the common threshold 0.7, indicating that individual item reliability is totally met.

Composite reliability

The composite reliability values of all constructs studied in the research model are greater than 0.8, which exceed the recommended threshold value of 0.8 or 0.9. The results suggest that high internal consistency reliability is being regarded as satisfactory for construct reliability in the model.[732]

Convergent validity and discriminant validity

AVE values obtained by running PLS model with SmartPLS presented all values greater than the minimum value of 0.5, meaning that latent variables in measurement model can explain more than half of the variance of its indicators on average. Therefore, the results support the convergent validity of all constructs. Fornell and Larcker's (1981) test for discriminant validity signifies high square root AVE for each factor exceeding the inter-correlation of the construct with the other construct in the models (see Table 21). The results suggested that the discriminant validity is supported. Table 21 provides information for the test of sufficient discriminant validity.

#	Construct	Model 2A						Model 2B					
		AVE	1	2	3	4	5	AVE	1	2	3	4	5
1	LRP	0.85	**0.92**					0.85	**0.92**				
2	EFF	0.64	0.58	**0.80**				0.64	0.58	**0.80**			
3	RC	0.65	0.55	0.77	**0.81**			0.65	0.55	0.76	**0.81**		
4	TCAP	0.74	0.51	0.54	0.47	**0.86**		0.64	0.58	0.64	0.61	**0.80**	
5	SF	0.62	0.49	0.75	0.66	0.48	**0.79**	0.62	0.49	0.75	0.66	0.55	**0.79**

Table 21: AVE and inter-correlations matrix among study constructs[733]

Based on the reliability and validity tests across all constructs of two measurement models, it appears to be acceptable for further analysis with PLS structural model to explore the predicted-orientation power of the causal relationships of hypothesized links.

5.3.4. Structural model

PLS path modeling aims at explaining variances to give an evaluation of prediction-oriented measures. The explanatory power of a PLS model is evaluated by examining the extent of variance explained. Examining R^2 of the dependent latent variables in the theoretical model can interpret the results. As seen in Table 22, the R^2 values for performance of reverse logistics (R^2_1=0.727, R^2_2=0.731) indicate that the changes of resource commitments, strategy formulation and capabilities of RL have shown significantly substantial effect on performance of reverse logistics. Specifically, the effects of resource commitments, strategy formulation, and capability of reverse logistics have interpreted more than 70% of variance in performance of reverse logistics. Therefore, they appear to be important dimensions demonstrating the adaptability to reverse logistics at firm level. Among them, resource commitments to the implementation of reverse logistics and strategy formulation of a formal logistics program are the most important variables in the prediction of performance of reverse logistics, contributing to 48% and 42% of the R^2 in model 1, and 45% and 40% of the R^2 in model 2. On the contrary, internal capabilities of reverse logistics contribute only 10% and 15% of the R^2 in model

[730] See Greve/Herrin (2011), p. 2

[731] See Saibani (2010), p. 129

[732] See Nunnaly/Bernstein (1994); Cf. also Chin (1998); Fornell/Larcker (1981)

[733] Bold-faced elements on the diagonal represent the square root of the average extracted. Off-diagonal elements are inter-correlations between measures.

1 and model 2, respectively. Additionally, the R^2 for the constructs of strategy formulation, liberalized returns policy, and capabilities of reverse logistics in two theoretical models range from 0.298 to 0.459, suggesting that resource commitments can explain around 30% to 50% the variance in organizational-related factors inside the company respondents. Resource commitments to reverse logistics have moderately affected the adjustments and adaptability to reverse logistics at firm level.

Constructs	**R-square (≥ *0.30*)**		**Contribution to R^2**		**Q^2 (≥ *0.0*)**	
	Model 2A	Model 2B	Model 2A	Model 2B	Model 2A	Model 2B
RC	-	-	48%	45%	-	-
SF	0.436	0.436	42%	40%	0.267	0.249
LRP	0.298	0.302	-	-	0.248	0.250
TCAP1	0.317	-	10%	-	0.226	-
TCAP2	-	0.459	-	15%	-	0.274
EFF	**0.727**	**0.731**			**0.443**	**0.449**
GoF	**GoF_{2A} = 0.550**			**GoF_{2B} = 0.570**		

Table 22: Predictive relevance of structural models

This study conducts the blindfolding test with omission distance (D = 10) for two models. The results are presented in Table 22. It can be observed that for these two models all blocks have relatively high and satisfactory values for Q^2. These values are greater than the threshold value of zero and approaching to 0.50, suggesting satisfactory predictive relevance for the model constructs. Especially, the CV redundancy (Q^2) index for the construct of performance of reverse logistics has high value approaching to 0.5, indicating that the proposed model has good predictive ability for the effectiveness and efficiency of reverse logistics. Moreover, the GoF values of 0.550 and 0.570 for model 2A and model 2B, respectively, exceed the cut-off value of 0.36 for large effect size indicating that the theoretical model performs well compared to the baseline values and relatively fits in the data collected.[734] The adaptability to reverse logistics at firm level is more specifically described through the analysis of main and mediation effects in the following parts.

5.3.5. Main effects

As noted in Table 23, resource commitments have positive impacts on capabilities of reverse logistics (β_1=0.282, p_1<0.001; β_2=0.414, p_2<0.001). The hypothesis (H_{2b}) is significantly supported, indicating that more resources are committed and allocated to increase capabilities of RL, especially for capabilities of reprocessing. By using Cohen's (1988) f^2 test for effect size defined for R^2, this study finds small effect size of RC on the variance explained for capability of return handling (f^2_1=0.082), but the moderate effects on capabilities of reprocessing (f^2_2=0.218).[735] The results prove that the commitments and allocations of company resources have contributed to increasing RL capabilities of repair work, refurbishing operations, and remanufacturing, suggesting better adaptability to product recovery at firm level.

As demonstrated in Table 23, we also identify a significantly positive relationship between liberalized returns policy and RL capabilities. The hypothesized link (H_{2g}) is significantly supported (β_1=0.357, p_1<0.001; β_2=0.356, p_2<0.001), suggesting that customer returns are not avoidable and more lenient returns policies have forced respondent firms to enhance their capabilities of reverse logistics, therefore motivating the adaptability to reverse logistics with the focus on customer orientation. LRP has moderate impacts on capabilities of both processing and returns handling (i.e. f^2_1 = 0.130, f^2_2 = 0.164), suggesting that firms are concerned with improving their services for customer returns through the quality of repair/rework as well as increasing their capabilities of collecting, procurement and giving full refund to customers.

[734] See Tenehaus et al. (2005), p. 159

[735] See Cohen (1998), p. 8. According to Cohen (1998), f^2 values of 0.02, 01.5, and 0.35 signify small, medium and large effects, respectively

Hypothesized Links	Model 2A			Model 2B		
	β	t	f^2	β	t	f^2
RC - EFF (H_{2a})	0.454	5.327	0.399	0.421	5.164	0.316
RC - TCAP (H_{2b})	0.282	3.427	0.082	0.414	4.710	0.218
TCAP - EFF (H_{2c})	0.136	2.389	0.044	0.170	2.274	0.060
RC - SF (H_{2d})	0.660	12.951	0.773	0.661	12.561	0.776
SF - EFF (H_{2e})	0.393	4.496	0.300	0.386	4.471	0.290
RC - LRP (H_{2f})	0.546	8.780	0.424	0.550	8.533	0.432
LRP - TCAP (H_{2g})	0.357	4.167	0.130	0.356	3.862	0.164

Note: *t-values are calculated through bootstrapping routine with 102 cases and 1000 samples, t-values with 2-tail test include p-value <0.001 (t^{****}>3.290), p-value < 0.01 (t^{***}>2.576), p-value <0.05 (t^{**}>1.960), p-value <0.1 (t^{*}>1.645)*

Table 23: Structural model results

In comparison between RC and LRP on capabilities of reverse logistics, the results show that LRP has more influence on returns handling capabilities than resource commitments (i.e. f^2_{RC} = 0.082, f^2_{LRP} = 0.130). Meanwhile, RC has larger effect on reprocessing capabilities than LRP (i.e. f^2_{RC} = 0.218, f^2_{LRP} = 0.164), indicating the increased adaptability to RL by adjusting operational policies for returns management and increasing resource investments for product recovery. The variance explained by the models in terms of R^2 for capabilities of reverse logistics is 0.317 in model 2A and 0.459 in model 2B (see Figure 47 and Figure 48). The results suggest that the effect size of two dimensions of resource commitments, and liberalized returns policy on the variance explained by capability of reverse logistics can be classified as moderate.[736] Therefore, other factors also likely contribute to increasing capabilities of reverse logistics such as outsourcing and strategic alliance with supply chain partners. The empirical results of factors influencing the development of reverse logistics in chapter 4 also demonstrated the important roles of collaboration and information technology for the efficiency and effectiveness of RL operations.

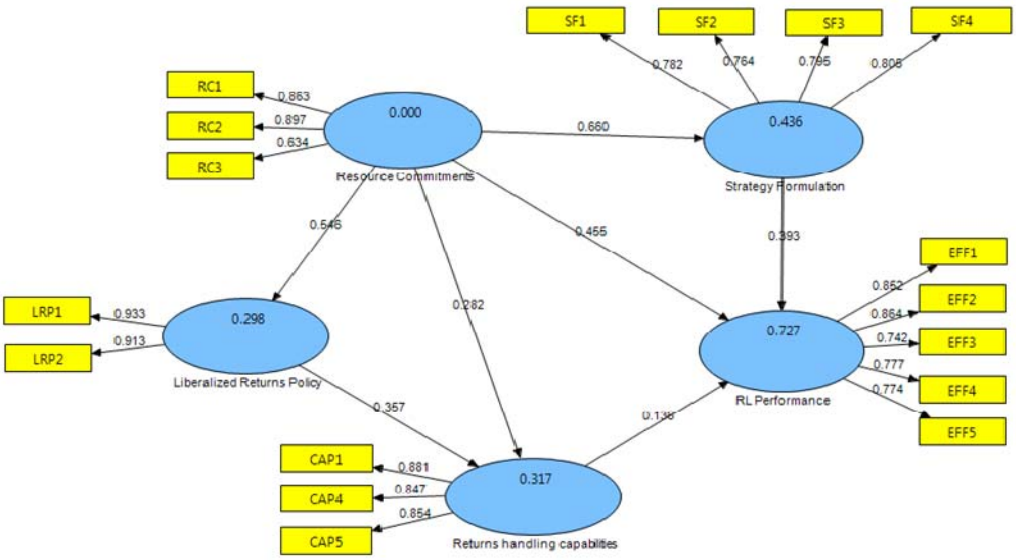

Figure 47: Results of hypothesis testing (Model 2A)

For exploring the relationship among adaptability dimensions, the large effect is shown through the coefficient path between resource commitments and strategy formulation (β_1 = 0.660, p_1< 0.001; β_2 = 0.661, p_2<0.001), suggesting that hypothesis H_{2d} is highly supported. More resources committed lead to more strategic focus on returns issues and RL management. Specifically, managerial resources (β=0.377, p<0.001) and financial resources (β=0.299, p<0.01) have significant impacts on formulating a RL strategy. The empir-

[736] See Chin (1998), p. 297. R^2 values of 0.67, 0.33, and 0.19 in PLS path model as substantial, moderate, and weak, respectively

ical results indicate that managers from company respondents have spent time and efforts to understand the importance of RL, formulate strategies and policies, and determine the capabilities required and the means necessary to implement them. These managerial resources play an important role in developing reverse logistics programs efficiently due to the inattention to reverse logistics in many firms for a long time.[737] This result coincides with the positive influence of top management support on performance of reverse logistics in chapter 4.

We also find that resource commitments have positive impacts on liberalized returns policy, suggesting that hypothesis H_{2f} is significantly supported ($\beta_1 = 0.546$, $p_1 < 0.001$; $\beta_2 = 0.550$, $p_2 < 0.001$). The empirical results show that increased resource commitments motivate respondent firms identify the roles and types of returns, and conduct a more lenient returns policy that adapts more easily to the issues of customer returns. Firms in the European electronics industry tend to commit more resources to customer returns management to provide less restrictive returns policies, offer better after-sales services for warranty claims for both B2B and B2C markets, and increase sales by satisfying customer demands in a highly competitive market. However, resource commitments can explain nearly 30% and 44% of the amount variance in the adjustments of returns policy and strategy for reverse logistics, respectively. The empirical results in chapter 4 also show that external factors, e.g. laws and regulation, customer demands, information technology, and collaboration with supply chain partners, have also contributed to the adjustments of company policies and strategies for the implementation of reverse logistics.

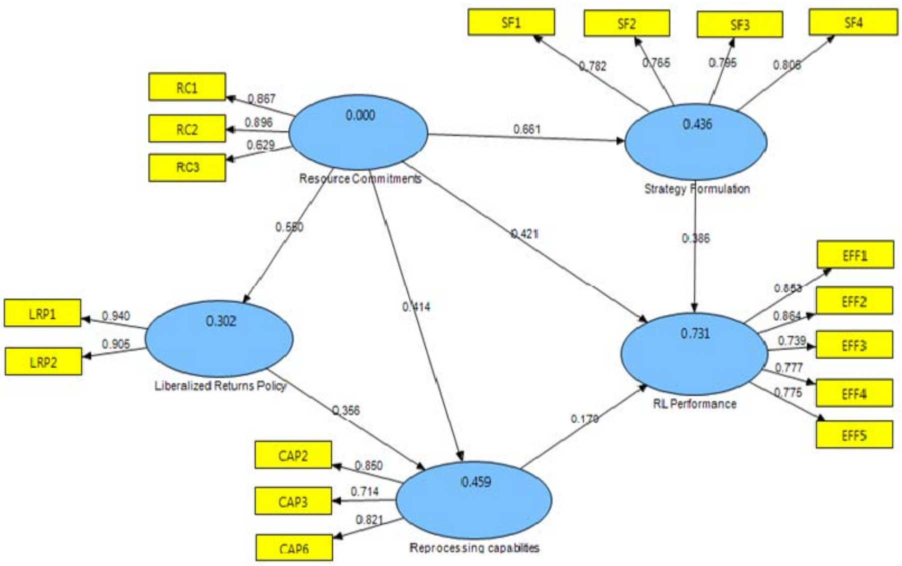

Figure 48: Results of hypothesis testing (Model 2B)

The empirical results shown in Figure 47 and Figure 48 also indicate that the hypothesis H_{2c} is completely supported ($\beta_1=0.136$, $p_1<0.05$; $\beta_2=0.170$, $p_2<0.05$). Both return handling capability and reprocessing capability have made importance influences on reverse logistics performance, but relatively small effect size (i.e. $f^2_1 = 0.044$, $f^2_2 = 0.060$). The small effect of internal capabilities on reverse logistics performance indicates that respondent firms have not been fully involved or completely proactive in reverse logistics operations. It appears that the integration between forward and reverse logistics into closed-loop supply chain has been limited. This coincides with the previous studies of Herold (2007) and Gibbo (2008) evaluating the involvement of firms in in-house reverse logistics operations. Respondent firms have constrained themselves to the development of internal capabilities to implement RL processes due to the complexity of reverse flows, their position outside of a firm's core competency, the unprofitable reverse chain, and the increasing outsourcing of RL operations to service providers specialized in product take-back, recovery, and recycling. Collaborating with supply chain partners was identified in the empirical results of chapter 4 to have substantial influences on performance of reverse logistics.

[737] See Richey et al. (2005), p. 247

Because the path coefficients at factor level are found to be statistically significant, we conduct regression analysis to explore the influence of indicators at item level (see Figure 49).[738] The capability of product acquisition is found to be significantly and positively associated with RL performance ($\beta=0.295$, $p <0.05$), suggesting that company respondents may perform rather well with reverse logistics operations in collecting and procuring the returned products , e.g. customer returns, trade-ins, buybacks, leasing and rental contracts, and voluntary take-back programs. The ease of credit refund also has positive impacts on performance of reverse logistics ($\beta=0.293$, $p <0.01$), suggesting that more lenient returns policies have made customer more satisfied, and therefore increase corporate image and sales. For customers, an effective RL program is also assessed by the number of days that the return is valid, the percentage of total expenses reimbursed, and the time to get the refund.[739] The more a specific returns policy is reported to customers with clear guidelines, the more satisfied customers feel when they have to deal with the products returned. Many companies in the European electronics industry offer more sufficient information regarding returns policies on their website to instruct customers and to improve their management of unwanted product coming back from the market.[740] Firms in the European electronics industry have developed their returns handling capabilities by standardizing processes and rules controlling the returns.

However, remarketability demonstrating the capability to put products rapidly back into the market is found to be insignificant with RL performance ($\beta=0.049$, $p >0.1$). The company respondents may have not performed effectively the redistribution of the recovered goods to market. They may be reluctant to develop the market for recovered products due to the cannibalization of the market for new products. They avoid eroding new products sales, preventing confusion regarding the company's main marketing message and avoiding ruining the company image.[741]

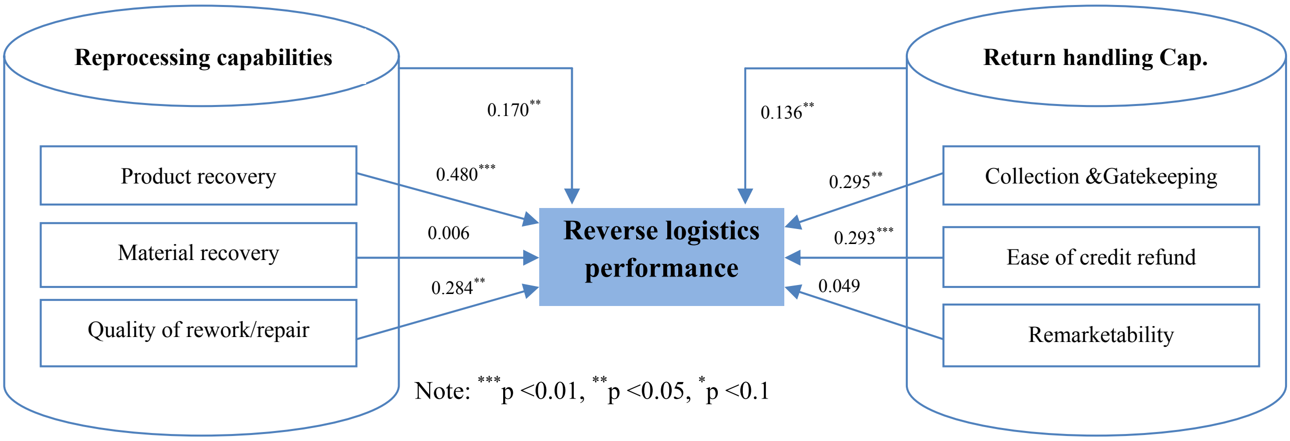

Figure 49: Impacts of RL capabilities on RL performance

The higher levels of reprocessing are positively associated with more efficient and effective performance of reverse logistics, especially for capability of product recovery (repairing, refurbishing, and remanufacturing) ($\beta=0.480$, $p <0.01$), and quality of rework/repair ($\beta=0.284$, $p<0.01$). The results point out that company respondents in the European electronics industry have partly developed capabilities of repairing and reconditioning for higher value components by individual recovery. However, capability of material recovery (recycling) has no significant implications with reverse logistics performance ($\beta=0.006$, $p>0.1$), indicating that internal capabilities of recycling is limited due to the unprofitable results and substantial resource investments.

Interestingly, as demonstrated in Figure 47 and Figure 48, strategy formulation has a statistically positive influence on performance of reverse logistics, suggesting that hypothesis H_{2e} is highly supported. Specifically, the higher level of strategic formulation of a reverse logistics program a firm has, the more effective

[738] See Barron/Kenny (1986), p. 1173; Cf. also Richey et al. (2005), p. 830

[739] See Posselt/Gerstner/Radic (2008), p. 209

[740] See Rupnow (2007), p. 1

[741] See Ferguson/Toktay (2004), p. 3; Cf. also Gobbi (2008), p. 175

performance of reverse logistics the firm can achieve (β_1=0.393, p_1<0.001; β_2=0.386, p_2<0.001). Developing a formal RL program gives rise to the large effect size on performance of RL (i.e. f^2_1 = 0.300, f^2_2 = 0.290). Specifically, identifying goals and strategy of product recovery has positively significant impact on RL performance (β=0.261, p<0.001), and 51% of company respondents formulated a strategy for product recovery. Developing specific returns and credit rules have largely significant impact on RL performance (β=0.311, p<0.001), and 63.7% of the firms indicated that their companies have specific returns policy and credit rules. Developing reverse logistics network and transport options related to locating transformation processes, and decision making of in-house operations or outsourcing have been paid more attention by 51% of company respondents, which contributes to increasing effectiveness and efficiency of RL performance (β=0.353, p<0.001). Developing gate-keeping and disposition policies is found to have positive impacts on RL performance but without significance (β=0.124, p>0.1), and 40.2% of the firms formulated these policies specifically. It may be due to the more lenient returns policies that lead to the easy acceptance of reported-defective returns by customers and respondent firms have not been fully proactive to conduct a responsive reverse supply chain management with decentralized disposition options for returned products. Figure 50 shows the statistical results at item level of strategy formulation latent variable.

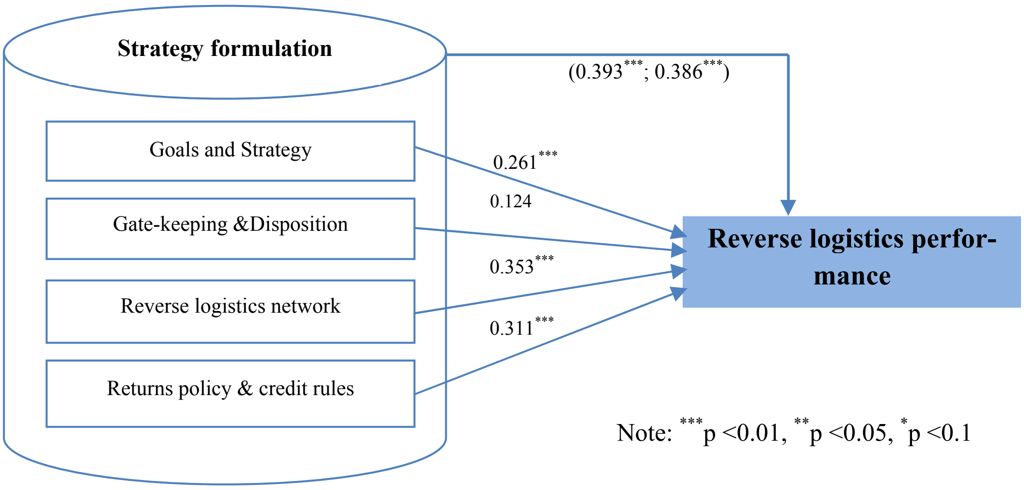

Figure 50: Impacts of strategy formulation on RL performance

The empirical results partly demonstrated that company respondents have different adaptability levels regarding reverse logistics strategy. However, the shift in strategic management of EoL returns and customer returns by interacting both external and internal resources has made substantial contributions to increasing customer satisfaction, improving company image, and reducing inventory, thus leading to increasing sales volumes and profitability. The results have clearly asserted the role of strategic formulation of a formal reverse logistics program.

The hypothesized link H_{2a} is found to be significant (β_1=0.454, p_1<0.001; β_2=0.421, p_2<0.001), indicating that committing and allocating more resources to reverse logistics operations directly influence performance of reverse logistics. As the implementation of reverse logistics is resource intensive, frequently under-funded and not given the priority as it deserves, appropriate commitments of resource lead directly to increasing awareness, strategic focus, and the adjustments of policies to adapt to reverse logistics management, which create the profitability and customer satisfaction. When firms invest considerable resources into RL operations, they can reduce inventory investments, reduce costs, improve profitability, increase customer satisfaction, and therefore enhance company competitiveness.[742] The results in Table 24 demonstrate the role of resource commitments to strategy formulation, capabilities, and performance of reverse logistics.

Technology resource commitments are not found to have statistically significant impacts on capabilities reverse logistics, likely suggesting the limitation of technology investments for in-house reverse logistics operations such as equipment and machines for comprehensive recovery and recycling. This study has found

[742] See Taylor et al. (2010), p. 10; Cf. also Daugherty et al. (2001), p. 119

the significant degree of management and finance resource commitments to the development and implementation of reverse logistics programs. However, the results also suggest that the commitment of management resources has more influence on the achievements of reverse logistics operations than financial resources. Specifically, management resource commitments have supported firms in identifying the roles of returns, setting up an effective product recovery strategy, developing an appropriate returns policy, giving clear guidelines and instructions for customers, and making decisions of in-house operations or outsourcing. Management resources are also invested directly through developing capabilities to select the service providers, and assigning the human resources to control the contracts and operations with service providers. The development of networks of service providers specialized in collecting, sorting, recovering, and redistributing the returned and discarded products have supported respondent firms to be more adaptable to the requirements of external environments for RL operations.

Constructs	TCAP1		TCAP2		SF		EFF	
	β	t-value	β	t-value	β	t-value	β	t-value
RC	0.289^{***}	3.298	0.424^{***}	5.154	Table 23 (Model 2A & 2B)		Table 23 (Model 2A & 2B)	
RC1	0.397^{***}	3.862	0.417^{***}	4.047	0.377^{***}	3.975	0.340^{***}	4.112
RC2	0.339^{***}	3.146	0.306^{***}	2.828	0.299^{***}	3.004	0.410^{***}	4.729
RC3	-0.132	1.482	-0.100	1.125	0.150^{*}	1.828	0.180^{**}	2.518

Notes: *$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$, In multi regression analysis, when factor level score are significant, item score should be reported for more specific results.*[743]

Table 24: Impacts of resource commitments

In comparison with strategy formulation and capabilities of reverse logistics, resource commitments account for a large effect on performance of RL (i.e. $f_1^2{}_{RC} = 0.399$, $f_1^2{}_{SF} = 0.300$, $f^2_{TCAP1} = 0.044$; $f_2^2{}_{RC} = 0.316$, $f_2^2{}_{SF} = 0.290$, $f^2_{TCAP2} = 0.060$), indicating that internal capabilities of reverse logistics operations have not been sufficiently invested in practice. The effectiveness and efficiency of RL performance primarily requires resource commitments, appropriate strategy formulation, and then operational capabilities of RL. From strategic policies to operational implementation, there have been some distances and no clear evidences to ensure that RL can be internally operated effectively and efficiently. Although many large firms in the European electronics industry have been involved in closed-loop supply chain for product acquisition and recovery, not many reports about the efficiency of the program are given.[744] In practice, the increased outsourcing and collaboration with supply chain partners have supplemented the lack of in-house RL capabilities because there has been the development of well-organized and dynamic networks for collecting, sorting, and recovering returned product.[745]

5.3.6. Multiple mediator effects

The multiple-mediator model is likely to provide a more accurate assessment of mediation effects in many research contexts because including several mediators in one model allows us to determine the relative magnitudes of the specific indirect effect associated with all mediators.[746] The total indirect effect for a model including two mediators is simply the sum of the specific indirect effects.[747]

$$f = a_1b_1 + a_2b_2 \qquad (12)$$

Evaluating the indirect impacts of resource commitments through strategy formulation and capabilities of reverse logistics may more clearly demonstrate the adaptability level of firms under strategic considerations. This study uses multiple mediator models for assessing and comparing indirect effects of resource commitments through two main mediators: strategy formulation and capabilities of reverse logistics. In order to test

743 See Barron/Kenny (1986), p. 1173; Cf. also Richey et al. (2005), 830

744 See Ostlin et al. (2008), p. 345; Cf. also Herold (2007), p. 89

745 See Gobbi (2008), p. 175

746 See Preacher/Hayes (2008), p. 881

747 See MacKinnon/Fairchild/Fritz (2007), p. 603; Cf. also Preacher/ Hayes (2008), p. 881

multiple mediator effect, we run two independent PLS models to test the significance of path coefficients related to direct and indirect effects. The first model includes all paths from independent variable to mediator variables and from mediator variables to dependent variables. The second model covers the path from resource commitments to performance of reverse logistics. All the path coefficients tested in two models arrive at statistically significant values, suggesting a partial mediation effect.

For assessing specific indirect effects in multiple mediator models, the study uses bootstrapping method suggested by Shrout and Bolger (2002), and Hesterberg et al. (2008) from PLS model analysis with 1000 samples to calculate the effect size, standard errors (SE), t-values, and confidence intervals of indirect effects. The bootstrapping method with related formula and explanations used in chapter 4 is also conducted in this chapter. The results of bootstrapping indirect effects shown in Table 25 indicate that the effect of resource commitments on RL performance is partially mediated by strategy formulation and capabilities of reverse logistics. The indirect effect of resource commitments on performance of reverse logistics though capabilities of reverse logistics is statistically significant ($\beta^1_{indirect}$=0.039, t=1.887, p <0.1; $\beta^2_{indirect}$=0.071, t=1.836, p<0.1) and excludes zero in the confidence interval. The effect size of indirect effect indicates that the influence of resource allocations through processing capabilities on the performance of RL appears to be more effective and efficient. However, the effect size is rather small in comparison with the indirect effect of resource commitments on performance of reverse logistics through strategy formulation ($\beta^1_{indirect}$=0.267, t=4.082, p<0.001; $\beta^2_{indirect}$=0.262, t=3.940, p<0.001).

Indirect effects	Model 2A			Model 2B		
	$Mean_{boot}$	SE_{boot}	95% CI Bootstrap Percentile	$Mean_{boot}$	SE_{boot}	95% CI Bootstrap Percentile
RC-TCAP-EFF	0.039 (1.887)	0.021	[0.006-0.084]	0.071 (1.836)	0.038	[0.002-0.150]
RC-SF-EFF	0.267 (4.082)	0.065	[0.148-0.399]	0.262 (3.940)	0.066	[0.134-0.395]
RC-LRP-TCAP	0.198 (3.784)	0.052	[0.101-0.310]	0.199 (3.361)	0.059	[0.088-0.326]
LRP-TCAP-EFF	0.050 (1.939)	0.026	[0.008-0.109]	0.058 (2.016)	0.028	[0.003-0.117]
RC-LRP-TCAP-EFF	0.027 (1.895)	0.014	[0.005-0.061]	0.032 (1.935)	0.016	[0.002-0.070]

Table 25: Indirect effects of resource commitments on performance of reverse logistics

As observed in Figure 47 and Figure 48, RC relates significantly to liberalized returns policy, in turn, LRP relates significantly to TCAP, and finally TCAP significantly relates to performance of RL. This causal chain manifests dual mediation effect between RC, LRP, TCAP and EFF, likely indicating significant indirect effect of RC on EFF through LRP and TCAP. We also use bootstrapping method to test for dual mediation effect. Two single indirect effects in this causal chain were tested independently to examine the significance of dual mediation effect. The results in Table 25 show that both of them are statistically significant and excludes zero in the confidence interval. Moreover, the dual mediation effect is significantly positive ($\beta^1_{indirect}$=0.027, t=1.895, p<0.1; $\beta^2_{indirect}$=0.032, z=1.935, p<0.1), indicating the adaptability to RL by committing and allocating internal resources have substantially influenced the performance of reverse logistics through both strategic and operational policies. Figure 51 visualizes the total value estimates of indirect effect of resource commitments on reverse logistics performance through multiple-mediator models.

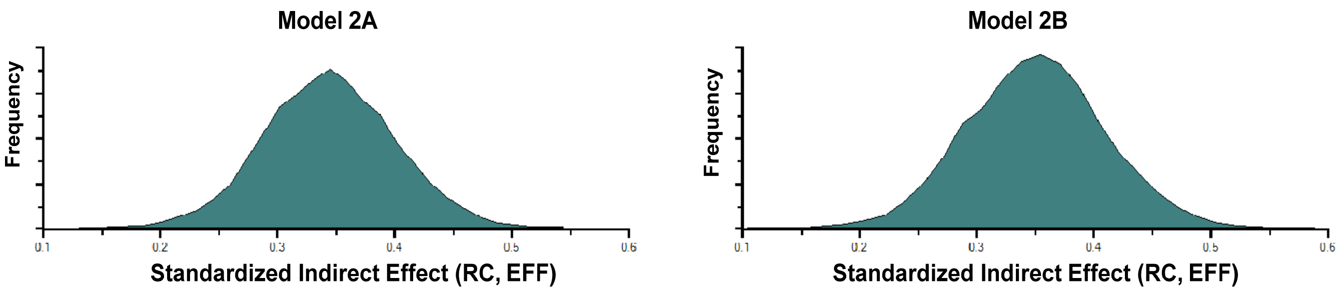

Figure 51: Value estimates of total indirect effect of resource commitments on RL performance

Developing liberalized returns policy is also examined to have significant impact on reverse logistics capabilities, which therefore in turn causes indirect effect on performance of reverse logistics. Company respondents have also commented that more liberalized returns policies have also created the development trend of reverse logistics in recent years because of more increasing customer power, the changes of multichannel distribution, and stricter laws on consumer rights. More lenient returns policies have significant influences on volumes of returns, therefore on capabilities of reverse logistics as explained in testing the theoretical model, which mediate the influence of liberalized returns policy on performance of reverse logistics. However, the effect size is relatively small to create competitive advantage for reverse logistics performance, indicating that liberalized returns policies in European electronics firms has still been limited and more restrictive than other firms in the USA.

Resource commitments have both significant direct and indirect effects on performance of reverse logistics. However, the indirect effect of resource commitments on RL performance through strategy formulation is greater than through capabilities of reverse logistics, indicating that firms have not been completely involved in reverse logistics operations by developing internal capabilities. It may indicate that the operative processes of reverse logistics have not obtained enough supports from firms in the European electronics industry. The requirements of substantial resource investments, the focus on core business activities, and the existence of well-organized networks for reverse logistics operations with specialized actors have motivated firms to develop a formal reverse logistics program by integrating both internal and external resources. Company respondents appear to limit themselves to the development of internal capabilities of managing and controlling the contracts, the processes, and the ways to take back and recover the returned products.

Increasing resource commitments and more concerns in formulating a formal RL program properly has manifested more adaptability to reverse logistics in today's fast-changing environments. Increasing resource commitments to reverse logistics operations is the key dimension of adaptability because implementation of reverse logistics is more complicated and resource extensive. Reverse logistics was regarded as a cost-center than a profit-center in many companies and they have not considered reverse logistics as a key supply chain driver for differentiation and cost reductions.[748] The increased influences of resource commitments on the formulation of strategy, the formalization of liberalized returns policies, the development of capabilities, and the performance of reverse logistics indicate that company respondents seem to be more proactive to manage return flows and regard reverse logistics as a tool for obtaining competitive advantages. Especially, the more strategic focus on managing reverse flows have supported firm in combining both external and internal resources to implement reverse logistics efficiently. As identified in chapter 4, collaboration among supply chain partners is the most important external factor facilitating reverse logistics operations. The trend of increased outsourcing and collaboration in the implementation of reverse logistics in the European electronics industry may reveal the adaptability to reverse logistics at network level, suggesting a salient feature of reverse logistics development in Europe. The analysis of adaptability to reverse logistics at network level in chapter 6 will provide more information regarding the development of well-organized and dynamic networks specialized in collecting, sorting, and recovering returned products in the European electronics industry.

[748] See Pan Theo (2009), p. 19

6. Adaptability to Reverse Logistics at Network Level

The wide stage processes of product recovery and the uncertainty of reverse flows require the intensive resources and the involvement of multiple supply chain partners for RL implementation. The increased outsourcing and dynamic collaboration have stimulated the development of specialized networks for collecting, sorting, and recovering product returns. Different inter-organizational networks of reverse logistics for managing the reverse flows of electronic and electrical products have been set up and developed over the last decades in Europe, especially for EoL management. Based on the third conceptual model developed in chapter 3.4, this chapter contributes to exploring the adaptability to revere logistics at network level in the European electronics industry by analyzing 15 published case studies. Chapter 6.1 investigates the practices of outsourcing in reverse logistics operations over the last decades. Chapter 6.2 examines types of inter-organizational reverse logistics networks developed in the European electronics industry over the last decades. The organizational types of inter-organizational reverse logistics networks are also analyzed in chapter 6.3. This study focuses on analyzing the adaptability of strategic networks in reverse logistics system in chapter 6.4 to explore the capabilities of coordinating network members, governing network relationships, combining network resources, and developing network capabilities to achieve network outcome and competitive advantages. This study discusses in short the adaptability of regional and operative networks in chapter 6.5 and chapter 6.6, respectively.

6.1. Outsourcing reverse logistics in the European electronics industry

The notable attention in the current reverse logistics management is the increase and diversification in outsourcing of reverse logistics operations to service providers such as service contracts, supply contracts, swapping contracts, long-term contracts, and strategic cooperative agreements.[749] Firms in the European electronics industry can delegate the implementation of product take-back and recovery to external service providers that are under their partial control, especially for EoL management. The analysis of outsourcing practices over the last decade partly demonstrates the adaptability to reverse logistics at network level through the types and degree of collaboration among partners.

6.1.1. Outsourcing in reverse logistics operations

A strategy commonly termed "outsourcing" is nothing more than subcontracting to specialized companies, a part of functions and processes previously performed on companies themselves. The scope of operations encompassed by outsourcing is becoming wider and wider because of increased focus on core competency, increased competition, and diversification and versatility of service providers.[750] A growth in the number of outsourcing partnerships has contributed to the development of more flexible organizations and based mutually beneficial relationships.[751] Across many industries, researchers have concluded that, in general, effective outsourcing processes of individual or multiple logistics functions with different partners have improved their network relationships, which therefore increase customer satisfaction and efficiency in business performance - in terms of time, place, quality and form utilities - and cost effectiveness.

Three main levels of outsourcing logistics frequently mentioned include transactional outsourcing, tactical outsourcing, and strategic outsourcing.[752] These three types demonstrate different degrees of collaboration with service providers. Transactional outsourcing is based on logistics transactions with no long-term contracts between LSPs and outsourcing companies. Tactical outsourcing takes place when logistics outsourcing reinforces and improves a firm's performance on a long-term basis with negotiated contacts and integrated IT systems to facilitate free information flow and create supply chain visibility. It may include transportation, inventory management, material handling, production planning, information processing, facility location, demand forecasting, and customer services. Strategic outsourcing is based on long-term relationships with

[749] See Janse et al. (2009), p. 8; Verweij et al. (2008), p. 65; Monnet (2008), p. 10

[750] See Grabara (2004), p. 1

[751] See Rabinovich/Windle/Dresner/ Corsi (1999), p. 353

[752] See Pinna/Carrus (2008), p. 105; Cf. also Sangam (2008), p. 15;

successful outcomes where LSPs business entities become partners with their clients in logistics network management and establish transactional transparency. Outsourcing reverse logistics operations incorporates the broad range of transactional, tactical, and strategic relationships, which have been largely based on the needs of obtaining cost savings, avoiding of risks and uncertainty, and focusing on the core competencies.[753]

Reverse logistics has increased its strategic importance in the European electronics industry over the last decade. However, one of the largest barriers to implement take-back programs and returns management is the increasing costs, the uncertainty and complexity associated with reverse logistics operations. For example, when dealing with some cameras that weigh only grams, reverse logistics appears to be simple. However, the logistics of collecting, sorting, and recovering the huge volumes that weigh tons and cannot be moved easily are much more difficult. Given the fact that RL functions are often considered as non-core operations for most manufacturing and trading firms, they are not always willing to involve themselves in all RL processes. Many organizations lack experiences, resources, and capabilities to manage reverse logistics as they desire. Some organizations lack physical capabilities and do not intend to spend extra money on buying resources and others lack the knowhow and will to carry out an effective reverse logistics program.[754] Firms handling product returns recognize the need to view third-party sources as a logical choice in the absence of separate functions and specialized capabilities within their own organizations for reverse logistics operations.[755] Due to the increasing enforcement of take-back laws and the fast-changing environments, many service providers, e.g. LSPs, repair service providers, dismantlers, and recyclers, have already developed their specialization in providing reverse logistics service packages.[756] They are rapidly becoming the preferred outsourcing alternatives for firms in the European electronics industry. Many manufacturers have contracted with third party providers in either short-term or long-term contracts to make nationwide sweeps to collect and retrieve their returned products. The approach to outsourcing is proven as a competitive strategy for business performance by capitalizing on economies of scale to reduce the costs of collection, transport, dismantling, and recycling per unit.

Making decision of outsourcing to third-party service providers has been gradually identified as one of the most important management strategies for managing return flows in recent years.[757] Some papers discuss strategic ways of developing capabilities of reverse logistics management, e.g. hierarchical form (in-house operation, or merger and acquisition), hybrid form (strategic alliances and joint ventures), market form (contractual extremes).[758] When manufacturers operate their returns management and product recovery internally, they have to invest themselves in infrastructures, technologies, and management skills required.[759] Companies with extensive experiences of after-sales services, repair, and spare part management may be more likely to internally develop capabilities of reverse logistics management.

Guide et al. (2001) describe several reasons why firms may choose to acquire their returned and discarded products from third parties, including buffering themselves against supply fluctuations to facilitate product planning and improve asset utilizations. Higher profitability is predicted for manufacturers who collect returned products through collaborative agreements with their distributor networks instead of collecting themselves or contracting to third parties because of mutual benefits and the capabilities of information sharing (e.g. cost reductions of transport, storage and inspection, increased sales, and customer satisfaction).[760] Collaborative agreements between manufacturers and distributors to manage product take-back have been found in many cases of the European electronics industry, e.g. Kodak Europe, Lexmark, IBM Europe, Canon, HP Europe). Some outsourcing to LSPs in practice leads to a substitution of coordination types of

[753] See Pinna/Carrus (2003), p. 105

[754] See Nawari (2006), p. 25

[755] See Meade/Sarkis (2002), p. 283

[756] See Setaputra/Grove (2006), p. 717

[757] See Serrato/Ryan (2007), p. 21

[758] See Janse/Schuur/Brito (2009), p. 9; Cf. also Williams (2005), p. 6 & 12; Toffel (2004), p. 125; Meade/Sarkis (2002), p. 283; Philip (1999), p. 19 - 21; Magail (1999), p. 638; Ayres/Ferrer/Carolina/Leynseele (1997), p. 571;

[759] See Toffel (2003), p. 121

[760] See Savaskan/Bhattacharya (2001), p. 1

more hybrid relationships likely arising in many cases.[761] However, the cases of hybrid forms of joint ventures are explored in automotive industry much more than in the European electronics industry, e.g. joint venture for used car recovery between manufacturers and the existing network of dismantlers.[762]

There are many factors influencing the increase in outsourcing reverse logistics operations (see Figure 52). Due to the risks and complexities of returns flows, it is rather difficult to coordinate all the activities involved in reverse logistics operations (collection, storage, inspection, recondition, disassembly, recycle, disposal and redistribution) by only one firm. The argument for such cooperation is lesser workload within a company so it can focus on its core activities as well as ease of flexible response to any changes within its environment.[763] Developing a reverse logistics system also depends on company policies and internal resources, the volumes and characteristics of product returns, and the conditions of returns. These characteristics play an important role in making strategic decisions regarding partially or completely outsourcing reverse logistics operations. For example, the variability in the rate of returns from retail and internet-based sales in consumer electronics in Western Europe has made manufacturers examine the considerable costs of establishing a separate reverse logistics system which includes the expense of materials handling systems, an information system, and a large workforce; or outsourcing returns management to a third-party service providers.[764] The bigger the uncertainty about volume and conditions of returns, the bigger the probability of outsourcing the recovering services and the related reverse logistics. Many firms in the European electronics industry have outsourced repair services and reverse logistics to local authorized service centers and contracted with third-party service providers for EoL management.[765] It is due to the economies of scale obtained from their large volume of products returned and thus leading to the minimization of costs for logistics and treatment.

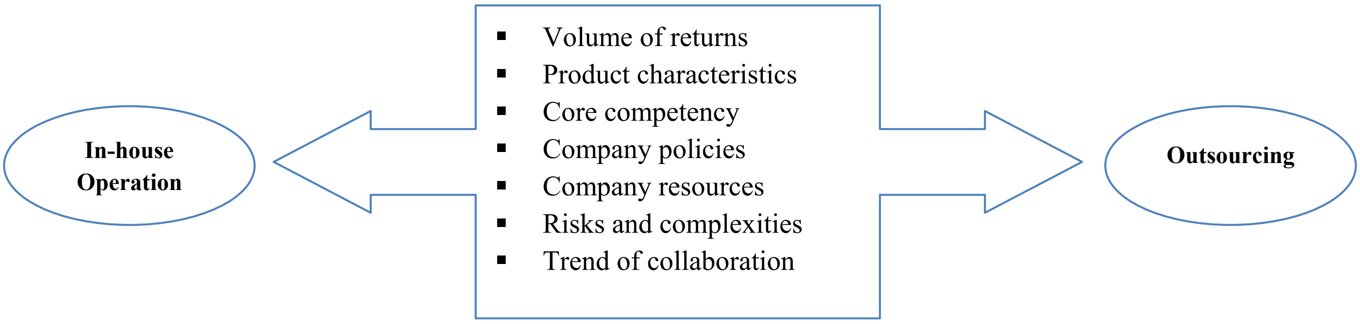

Figure 52: Factors influencing the increase in outsourcing RL operations

Source: Own illustration

6.1.2. Current development of outsourcing in reverse logistics

Throughout the 1970s and 1980s, it was quite normal to see a company doing its own repair, transportation, and warehousing because of the low volume of returns, no enforcement of take-back laws, and the low customer awareness and demands. If something broke down in the 1980s, it would be repaired because repair costs were relatively low and products were not overly complex.[766] However, it is now rather unusual if a company independently operates all the related works such as those due to increasingly complicated products, the need of specialized repair and diagnostic equipment, the regulatory enforcement of mass take-back of EoL products, and the growing customer demands. Over the last twenty years, thanks to the diversification and the versatility of service providers, companies have outsourced more processes of reverse logistics to minimize the costs of logistics and treatment, increase access to a wider range of resources for returns management, and therefore improve the efficiency of total business performance.

[761] See Sydow/Windeler (1998), p. 4; Cf. also Verweij et al. (2008), p. 65

[762] Some of the recently established joint ventures are: Volkswagen-Evert Heeren (Germany); Volvo and AB, Gotthard Nilson and Stena Bilfragmentering AB and Bildemontering AB (Sweden); Renault-BMW-Fiat and 100 licensed dismantlers (Europe)

[763] See Molinari (2011), p.2

[764] See Serrato/Ryan (2007), p. 22

[765] See Janse et al. (2009), p. 8; Cf. also Fernandez/Junquera (2003), p. 6

[766] See Haymon (2010), p. 1

In the period of 1990 - 2000, outsourcing RL was founded from the case of vertical integration and logistics-based strategic alliances.[767] Outsourcing RL to third parties was perceived at a low rate due to the small number of returned products. The findings of Ayres et al. (1997) through a number of specific cases in the European electronics industry indicated that reverse logistics operations in this period were either internally or cooperatively operated especially for reprocessing operations (recovery and recycling).[768] The research of Philip (1999) showed that a tendency to outsource reverse logistics operations was found, but the overall design of take-back and redistribution system (including the adequate selection of disposition options) was still considered as a strategic decision and rather internally operated. By analyzing different case studies in IT sector in Europe including IBM Europe, Acer, Siemens, and HP Europe, in-house operation and outsourcing were observed, concerning both logistical and reprocessing activities on design, control and operational levels of reverse logistics management.[769]

Since the 2000s, there has been an increase in outsourcing reverse logistics operations, especially for after-sales services and EoL management. The surveys of Vertrepens et al. (2007), Janse et al. (2009), and Erol et al. (2010) illustrated a high rate of firms in the European electronics industry having service contracts with third party service providers for collection, transport, repairs, and product recovery. It seems to be that market form and hybrid form are now more prevalent than hierarchical form in market of reverse logistics services (see Figure 53). In-house operation of EoL management has not been observed as popularly as before in the European electronics industry.

Figure 53: Development of outsourcing in reverse logistics
Source: Own illustration

For example, Electrolux, Fujitsu-Siemens Computers, and Philips ran their own recovery centers in the 1990s, especially for used product mainly from business customers. However, the recycling center of Philips for consumer electronics was closed and sold at the end of the 1990s because recycling was not its core competence. Electrolux has no longer remanufactured washing machine at a plant in Sweden. Electrolux joined a producer consortium and established a collective take-back scheme (European Recycling Platform) in 2002. For B2C products, Fujitsu Siemens has contracts with service providers or national collective take-back schemes that take care of collecting the product from municipal points and delivering them to their treatment facilities for dismantling, and recycling for material reclamation.[770]

[767] See Zinn/Parasuraman (1997), p. 137
[768] See Ayres/Ferrer/Carolina/Leynseele (1997), p. 571
[769] See Philip (1999), p. 19 - 21
[770] See Lebreton (2007), p. 9 & 124

In the analysis of reverse logistics in Flanders, Verstrepen et al. (2007) describe the outsourcing levels with different processes of reverse logistics. Approximately 25% of the respondents outsource one or more reverse logistics activities, and 75% of them still keep reverse logistics in house but have the intention and a positive attitude to outsource more in the future (60%). The activities involving customer contact (complaint handling, administration, and credit returns) are least outsourced because these operations are embedded in their own customer relationship management and finance controlling. Some operations of sorting, inspection and testing are still kept in house rather than outsourced. Meanwhile, many company respondents outsourced reverse logistics activities related to transportation, proper disposal, repair, recycling, refurbishing, and remanufacturing because collecting and recovery are not often regarded as their core competency.[771]

According to research of Verweij et al. (2008) in the European electronics industry, OEM respondents have already made broad use of third parties for reverse logistics. The operations of logistics (70%), testing (47%), reuse (55%), repair (60%), disassembly (66%), refurbishing (75%), remanufacturing (50%), recycling (76%), and waste management (80%) are further outsourced. Activities related to credit refund and financial procedures are mainly performed in-house (85%). Especially, activities related to customer services such as call centers are also increasingly outsourced by respondent companies (60%). The main reasons for outsourcing reverse logistics activities are observed in this study including the focus on core business, the reliance on technology and specialism of third parties, risk reduction, and improved control along the reverse supply chain. LSPs interviewed in this survey also tend to offer more laborious activities such as repairing and remanufacturing, aiming to provide full package of managing product returns.[772]

Erol et al. (2010) investigate the factors affecting outsourcing decisions of different companies for reverse supply chain operations in selected industries in Turkey. They report that in case of the electronics industry there are some main reasons for their extensive outsourcing of reverse logistics operations to third parties companies such as the increased costs of collection, recovery, and disposal, the intensified collaboration among supply chain partners, returns volume, and characteristics of products. In Turkey, operations of RL are increasingly outsourced to third parties providers such as recycling (50%), disposal (45.8%), and distribution and transportation (41.7%). Activities of logistics, warehousing, and repair are also increasingly outsourced to external providers by 58.3%, 50%, and 50%, respectively. Moreover, many companies suggest that they want to outsource more activities of reverse logistics operations to third party providers in the future.[773]

This study conducts our survey in 2011 to explore current outsourcing in reverse logistics in the European electrical and electronic industry. The empirical results are relatively in line with the previous studies, asserting that outsourcing reverse logistics services is on the rise (see Figure 54). Company respondents have outsourced with service providers in remanufacturing (56%), collecting and transporting (89%), recycling (90%), and waste management (94%), suggesting that network relationships for EoL management are intensively unified with close collaboration among partners. Strategic networks between manufacturers/distributors and their subcontractors are developed dedicatedly with specialized operations of reverse logistics. Meanwhile, reverse logistics networks for returns from forward flows are still characterized by more in-house operations at organization-level with the activities of inspecting and sorting (73%), and repairing (57%). However, the results also indicate that company respondents in the European electronics industry have the intention to outsource more with repairing, refurbishing and remanufacturing. Especially, they are increasingly outsourcing services of repackaging and redistributing to third party providers for remarketing recovered products (52%). IT management and consultancy for controlling different kinds of returns flows are also outsourced with high rates of 58% and 40%, respectively. Customer services with call centers, complaint handlings, returns authorizations, and finance arrangements have still obtained the highest involvement of many company respondents (84%), indicating that the majority of firms have management of customer returns done in-house.

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[771] See Verstrepen et al. (2007), p. 309 - 310

[772] See Verweij et al. (2008), p. 49 - 50

[773] See Erol et al. (2010), p. 48

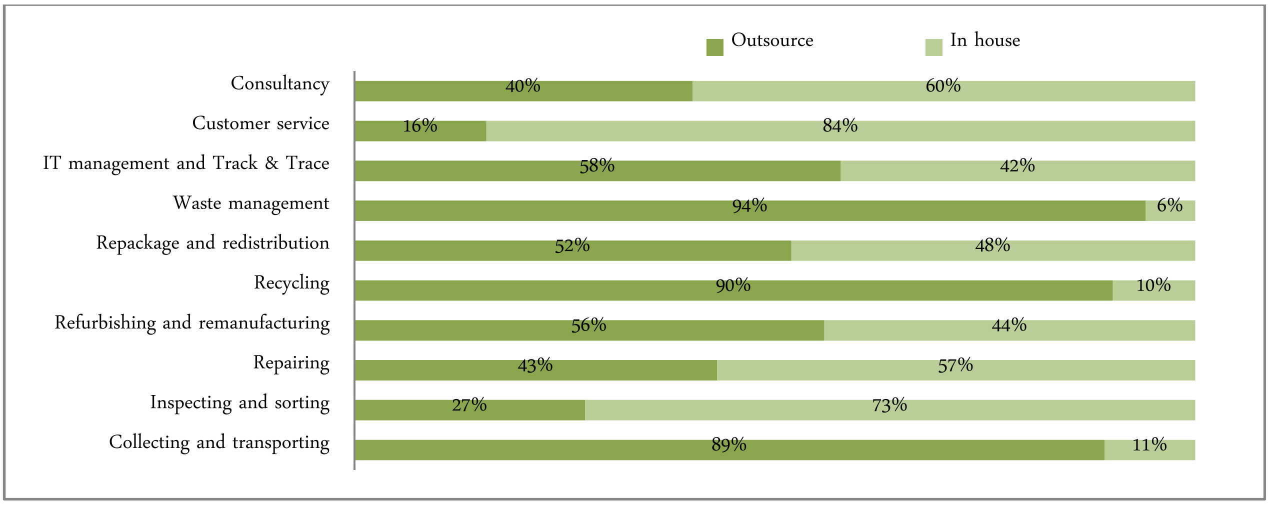

Figure 54: Outsourcing in reverse logistics

Our survey also asks company respondents about the importance of factors influencing outsourcing decisions. Figure 55 describes mean scores of factors influencing outsourcing decisions addressed in this study. In the viewpoint of manufacturers and distributors, the decisions to outsource are mostly determined because of their focus on core competencies in making their own business (1.67), companies' policies and resources (1.75), the complexity and uncertainty of reverse flows (1.78), increasing costs of returns management (1.85), and especially return volumes (1.58). Among the seven factors listed in the questionnaires, collaboration networks are also evaluated as important with a relatively high score (2.61), suggesting that collaboration among supply chain partners give opportunities for individual actors to obtain the benefits through outsourcing contracts.

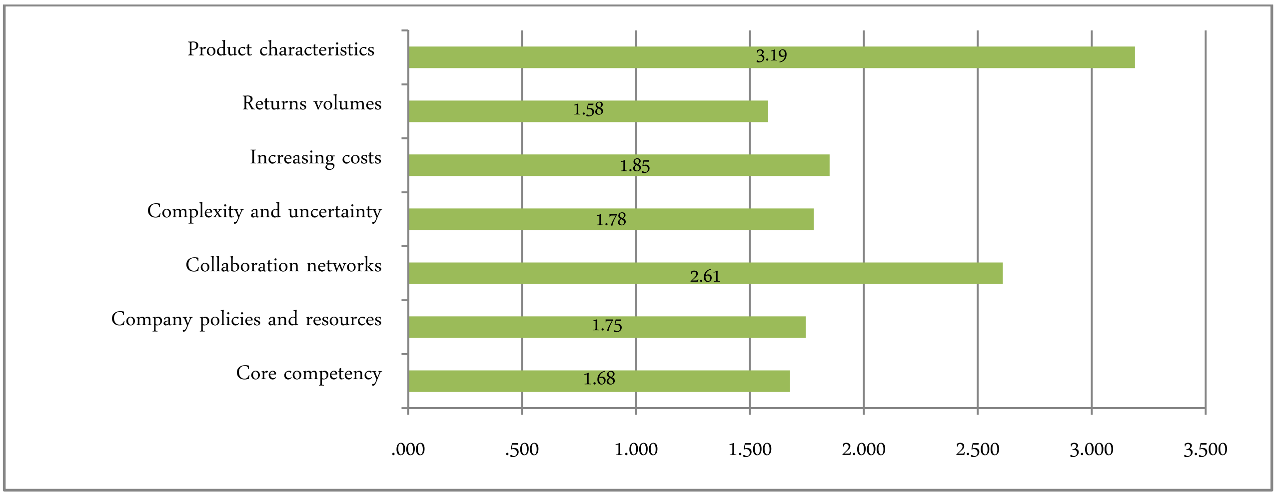

Figure 55: Factors influencing outsourcing decisions in reverse logistics

The increasing outsourcing of reverse logistics operations to third-party service providers have indicated that outsourcing has been regarded as the typical feature of structure of a reverse supply chain developed in the European electronics industry over the last decade.[774] The development of specialized third-party service providers and the adjustments of firms to rely on network relationships for RL operations have demonstrated the adaptability to reverse logistics at network level. However, firms subcontracting reverse logistics services to external companies realize that they have partial or total loss of information regarding the nature of returns and control over some processes connected with reverse logistics operations. Therefore, they have today paid more attention to coordinate with service providers to optimize their integrated supply chain. Successful collaboration between outsourcing companies and their service providers based on mutual trust and effective information sharing has played an important role in achieving the efficiency and effectiveness of RL perfor-

[774] See Bernon et al. (2011), p. 494; Cf. also Verweij et al. (2008), p. 49

mance. This collaborative behavior thus has developed different types of inter-organizational reverse logistics networks over the last decade in the European electronics industry.[775]

6.2. Types of inter-organizational reverse logistics networks

Reverse logistics deals with the organization of the various processes that are necessary for collecting used goods and returned products to the proper disposal points, then treating them to redistribute into a new economic cycle. In comparison with the traditional flow economy, reverse logistics operations focus on recovery and savings of raw materials and energy on the input and landfill capacity on the output side of the production process. Therefore, the economic and ecological benefits of the enterprises and of the economy as a whole can be improved.[776] Reverse logistics for traditional EoL management approaches focus on a single actor and on specific categories of discarded products and do not optimize the system as a whole.[777] Today, the concept of a reverse logistics system encompasses networks specialized in providing logistics and processing services for reuse, recovering, and recycling returned and discarded products, which includes the involvement of many stakeholders and their relationships.

The focus of an inter-organizational reverse logistics network is not only on individual organizations but also on explaining properties and characteristics of the network as a whole. However, the key point is the outcome for the network as a whole[778] rather than for individual organizations that the network is comprised of. The important indicators pertaining to the outcome of a revere logistics network are the collection volume, the number of products reused and recovered, the recycling volume, and the costs of logistics and treatment. Firms that are embedded in the network to conduct RL processes have looked for the ways to combine the resources of other firms and develop the capabilities to obtain the economic and ecological outcome. Due to the low profit from product recovery and recycling, the benefits through inter-organizational cooperation among firms for efficient RL operations are consequently higher than in production and distribution logistics.[779]

Firms in the European electronics industry have participated in inter-organizational networks for product take-back, recovery, and recycling with different goals. The common goals include accessing partners' resources, obtaining synergy effects of network relationships, increasing the specialization, minimizing costs of governance, logistics, and treatment, reducing the uncertainty of reverse flows, and improving the legitimacy. Joining inter-organizational networks has played a more important role in managing reverse flows of many companies because it provides an appropriate way to compensate for the disadvantages of firm size and regionalization, as well as to obtain the overall target of recycling and recovery for a closed-loop economy with the ecological and economic objectives.[780]

There are different types of inter-organizational networks developed for handling discarded and returned products over the last decades in the European electronics industry. It is based on the form and degree of the relationships between the involved firms, the relational capabilities, and roles of firms operating in each network,[781] such as strategic network, regional network, operative network, and virtual network. There was a time in Europe before the 2000s when a large number of small and medium-sized companies in logistics and waste management services operated efficiently, particularly at the regional level. Municipalities primarily organized collecting discarded UEEE, and retailers, producers or disassembly firms collected only smaller amounts. After collection, products were transported to municipalities' subcontractors to test for reuse or material recycling, which can be either private companies or socially subsidized firms.[782] However, the adoption of Europe WEEE Directive since the beginning of the 2000s has required producers in the Euro-

[775] See Olorunniwo et al. (2010), p. 460; Cf. also Currus/Pinna (2003), p. 109

[776] See Steven (2004), p. 167

[777] See Melacini/Salgaro/Brognoli (2010), p. 1

[778] See Provan et al. (2007), p. 12

[779] See Freires/Guedes (2008), p. 62

[780] See Pfohl (2008), p. 221; Cf. also Sarkis et al. (2010), p.6

[781] See Pfohl/Buse (1996), p. 391

[782] See Walther (2010), p. 463

pean electronics industry to implement nationwide the tasks of collection and product recovery for their EoL products. Public waste management companies and their regional partners have now no longer operated the contracts of collection and disassembly in decentralized ways. Producers or producer consortia and their take-back system providers have now centralized contracts of take-back and recovery for EoL products. Therefore, reverse logistics operations have been increasingly organized in the form of highly centralized networks with the strategic role of hub firms or lead organizations. The tasks of organizing and coordinating RL processes are mostly performed through a strategic network in the superstructure by hub-firms and a variety of regional networks in the substructure by network members.[783] Figure 56 presents four types of inter-organizational networks in reverse logistics system.

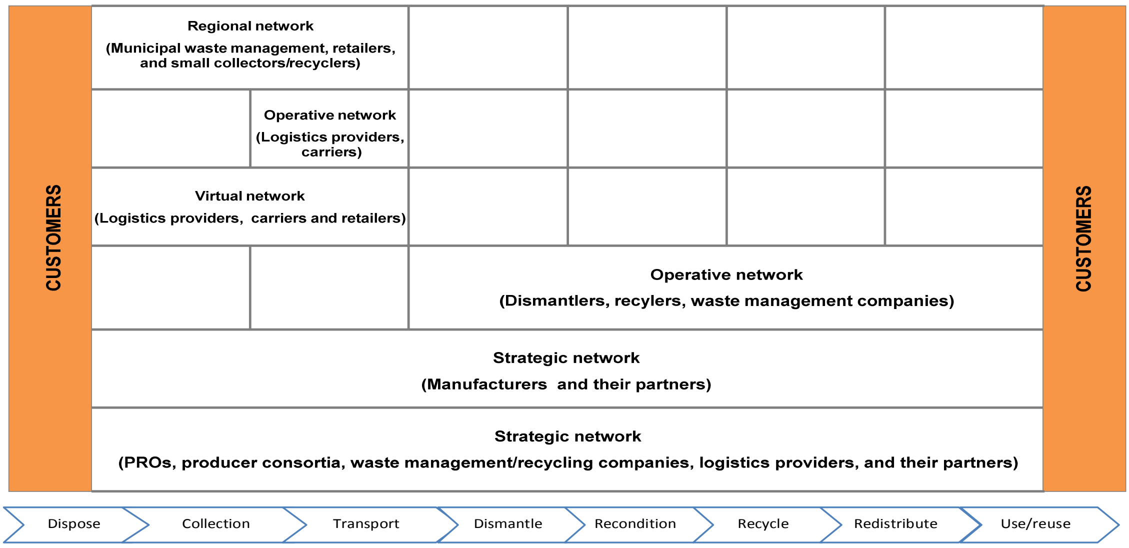

Figure 56: Four types of inter-organizational reverse logistics networks

Source: Baumgarten/Frille (1999), p. 78; Cf. also Waltemath (2001), p. 190; Ivisic (2002), p. 200 with modifications

6.2.1. Strategic network

The implementation of take-back responsibilities of returned and discarded EEE has nowadays experienced a nationwide phenomenon of being centrally organized by producers or producer consortia and their take-back system providers. The orders of transport, collection, dismantling, recovering, and recycling in practice are then forwarded and regionally decentralized through the collaboration with supply chain partners such as regional retailers, collectors, manufacturers, and recyclers. In order to ensure the efficiency of reveres logistics operated by all stakeholders involving in the network, the RL activities are tightly connected and controlled. The analysis of the provision of sub services has showed that the market requirements of take-back and product recovery are largely met by a two-stage organization of reverse logistics networks. On the one hand, activities of collection and allocation of aggregated orders are centrally carried out and recorded by primary service providers. On the other hand, the operations of take-back and product recovery are completed by the coordination between primary and secondary service providers.[784] Therefore, the emergence of strategic networks with the features of hub firms coordinating and governing the participants has been a salient feature of the adaptability to reverse logistics at network level.

Unlike other networks, a strategic network is distinguished by the fact that it is led by one or more major companies as lead organizations, or hub firms. The hub firms in a strategic network of reverse logistics operate in the form of inter-organizational collaboration with their partners. Therefore, a strategic network of reverse logistics is characterized by inter-organizational relationships that have more formally fixed goals, strategies, and responsibilities. The adaptability to reverse logistics within a strategic network is determined by the capabilities of hub-firms to coordinate network members, govern network relationships, motivate

[783] See Waltemath (2001), p. 191

[784] See Waltemath (2001), p. 191

inter-firm information and knowledge sharing, and identify and combine network resources to develop the capabilities in the networks, which results in the efficiency and competitive advantages of the whole network.[785] While network members regularly interact with each other, activities and decision making is coordinated through a single organization. At the mid-range, a single organization might take on some key governance activities while leaving others to network members, e.g. sub-networks. For example, in many inter-organizational reverse logistics networks, larger and more powerful organizations with substantial resources and legitimacy often play lead roles such as logistics service provider and recycling companies.

A strategic network is also externally governed by a unique network administrative organization (NAO), which may be either voluntarily established by network members or mandated as part of the network formation process.[786] Governance through NAO is similar to the lead organization model in that all activities and decisions are coordinated through one organization. However, NAO is not involved in collecting returned products and providing treatment services, but only overseeing, governing, and supporting the network, e.g. government bodies in the central clearing house centers allocating pick-up obligations; and producer consortia or producer responsibility organizations coordinating and controlling operations of take-back and product recovery on behalf of producers.

The strategic roles of key coordinators are extremely necessary in reverse logistics operations due to its complexity, the unpredictability of reverse flows, and the requirements of combining resources for RL implementation. Regarding the strategic tasks, some organizations can act as hub firms in inter-organizational reverse logistics networks in the case of the European electronics industry.

- OEMs/distributors can be lead organizations in their reverse logistics systems to collect and recover the products returned by customers, e.g. end-consumers and retailer customers, due to marketing, commercial, and environmental reasons. They often organize and control RL activities in collaboration with supply chain partners and service providers mostly due to economic benefits from returns management and product recovery, customer satisfaction, and improved corporate image. OEMs/distributors have increasingly configured processes that enable them to handle different types of returns and have provided integrated control to all orders related to the returns.[787] For example, OEMs/distributors can operate themselves or outsource nationwide call centers to ensure the direct contact with customers, bundle all decentralized return requirements, and then forward them to a central control point for disposition options.[788] OEMs/distributors can use centralized call centers for coordination of customer, retailers, and logistics partners to arrange a pick-up location and time.[789] The adaptability of firms in relationship networks, e.g. customers, OEMs, distributors, and service providers, for returns management may bring in both economic and ecological benefits for network members.[790]
- Non-profit organizations founded with the participation of manufacturers, distributors, and other stakeholders, e.g. producer responsibility organizations (PROs) or producer consortia, have become the primary coordinating actors to bundle take-back and recovery orders for EoL products from different members and then forward to their secondary partners. They normally have no physical assets of their own but develop organizational skills and relational capabilities in buying and coordinating logistics and treatment services to supply the full package of take-back and product recovery. PROs make contract with logistics service providers, dismantlers, and recycling and waste management companies to carry out day-to-day operations to ensure that EoL products are collected from designated retailers and municipal collection points and treated as required.[791]

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[785] See Pfohl/Bode/Nguyen (2012), p. 10

[786] See Provan/Kennis (2007), p. 236

[787] See Herold (2007), p. 178; Cf. Also Fleischmann et al. (2004), p. 8

[788] See Waltemath (2001), p. 192

[789] See Walthemath (2001), p. 170; Cf. also UK Department of Transport (2004), p. 17. In case of Safeway retailer, returned goods are then sent to the Central Hub near to Stoke in the Midlands via the appropriate Regional Distribution Centre. The Central Hub is a collaborative partnership between a third party supplier and the company.

[790] See Kumar/Malegeant (2006), p. 1131

[791] See Mayer (2007), p. 114 - 116

- Recycling or waste management companies operating nationwide or internationally want to secure a leading position in the growing market segment of remanufacturing and recycling EoL products, e.g. Alba, Remondis, and Suez Environment. They often act as key operators in adopting the aggregated contracts with manufacturers/distributors or their representatives. They frequently provide their operation services of reverse logistics by their direct implementation and partial cooperation with secondary service providers through subcontract agreements, strategic alliances, and joint-venture.
- Logistics service providers (LSPs) making business in nationwide or international areas have increasingly offered the full packages of reverse logistics services, e.g. DHL, CCR Logistics, and Geodis. They have participated in reverse logistics market as lead organizations to make contracts with manufacturers/distributors, involved themselves directly in operations, and coordinated with other partners to provide full services. In logistics service models, LSPs hubs have visibility of all transactions in the hub environment and allow LSPs to provide unique transaction processing to their customers (e.g. OEMs, distributors, and PROs).
- In addition, cooperation within the strategic networks for EoL management is often implemented by certain rules of physical and financial responsibilities that are both regulated by laws. The interference of governmental bodies through environmental policies and take-back laws has also created a differentiated mechanism in inter-organizational reverse logistics networks. In European countries, especially where are running collective competing take-back systems such as Austria, Germany, Spain, and the UK, governmental bodies, e.g. federal environmental agency, environment protection agency, are also established as an important part of a strategic network. They carry out the procedures of administration, register, and control of main actors' responsibility implementation. For example, "Stiftung Elektro-Altgeräte Register" foundation (EAR) in Germany acts as a neutral registration body with a clearing house center. EAR operates as a network administration organization to centrally coordinate pick-up obligations and allocations between manufacturers and municipalities, and to obtain the feedback from them for their responsibility implementation.[792]

The responsibilities and the paramount importance of hub firms are diversified depending on their roles of coordinating with and governing network members in a strategic network. Normally, they are responsible for setting the strategic directions of services offered from the network, defining technical and organizational interfaces between network levels, controlling cost and efficiency of the inter-organizational network, and making decisions for investments and collaborations. They also identify and standardize the quality of services offered through the network, select and audit service providers, and monitor the compliance with regulatory and competitive requirements. Furthermore, they frequently advance information and communication systems required for network management and development. They also ensure a unified marketing effort and marketing communications for operations of the reverse logistics network. Managing an inter-organizational network in the implementation of reverse logistics has required these hub firms to develop different capabilities such as organizational capabilities, relational capabilities, and physical capabilities to ensure the efficiency and competitive advantages of the whole network, indicating the adaptability at network level. The detail analysis of strategic networks led by these hub firms in chapter 6.4 may provide the evidence for the arguments. Figure 57 presents the overall responsibilities and relationships between primary and secondary service providers in the network of reverse logistics.

A strategic network of reverse logistics consists of different directions of cooperation. These forms of collaboration do not necessarily involve all network partners, but the influences of the cooperation should be understood in the context of their embeddedness in the entire network. In *vertical cooperation*, firms at different levels of value chain collaborate with each other with the objectives to obtain effectiveness and efficiency.[793] Examples of such vertical collaboration in reverse logistics networks can be commonly identified through the relationships of manufacturer-supplier partnerships (backward), manufacturer-distributor collaboration (forward) in the electronics industry, and the cooperation between firms and service providers. In backward networks, OEMs can develop product design for more efficient product recovery by cooperating

[792] See Savage (2006), p. 67; Cf. also Sander et al. (2007), p. 157
[793] See Kaluza et al. (1999), p. 17

with suppliers through supply and usage of recyclable materials. They also charge and return materials and components to the suppliers due to different causes such as defects, damage in delivery, or a lack of synchronicity with the main products. Suppliers can take over inspection, further dismantling and using for product recovery or material recycling. In forward collaboration, distributors and/or multichannel retailers today have close relationships with OEMs in dealing with returns of electronic and electrical products by sharing information and knowledge on returns management, e.g. instructions of returns avoidance, RMA processes, returns policies, and rules of credit refund. Vertical cooperation in reverse logistics networks have created different layers of value and benefits such as reducing the returns volume, recoverability of the returned products, increasing volume of recycling, and minimizing cost of reverse logistics.

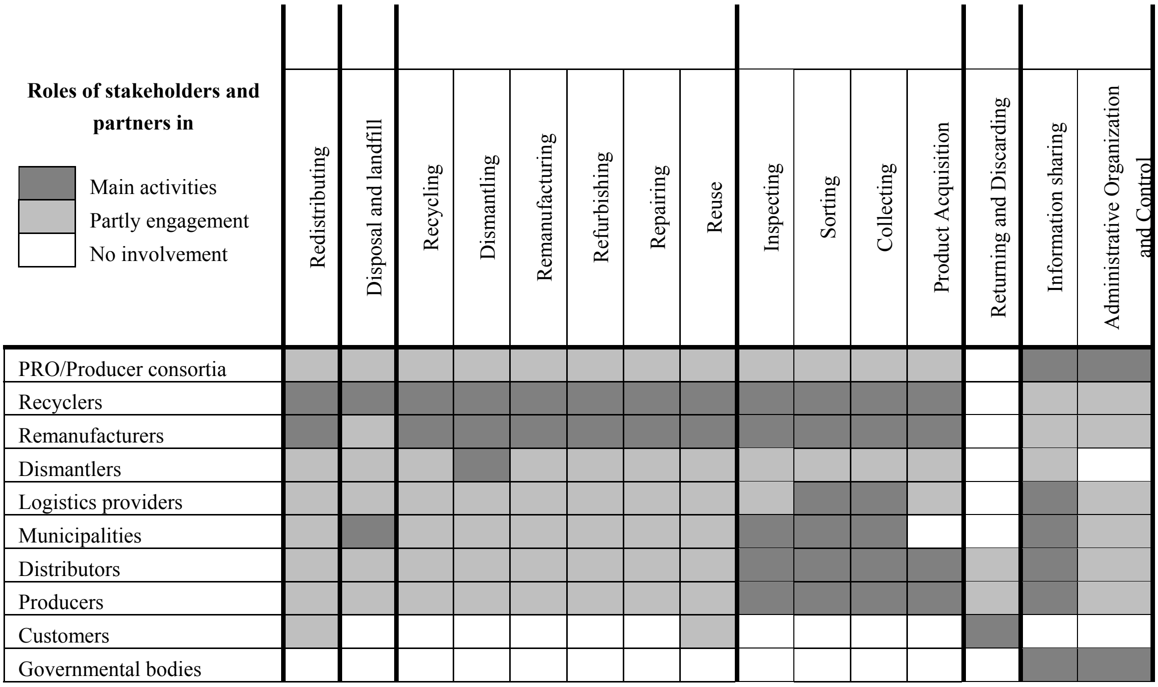

Figure 57: Actors' involvement in inter-organizational reverse logistics networks

Source: Own illustration

In contrast, horizontal relationships require companies to cooperate on the same level of the value chain.[794] *Horizontal collaboration* between service providers, e.g. LSPs, small dismantling and recycling companies, waste management companies, is not only quite useful for overall closed-loop economy but also necessary to develop dynamically specialized networks of reverse logistics. Especially, horizontal supply cooperation between manufacturers under purchasing consortia[795] has supported them to gain the increased pricing, quality, and services advantages associated with volume buying of reverse logistics services from different providers in the network. Therefore, manufacturers can obtain benefits from the economies of scale, and the availability of information related to their capacity and quality, as well as their competitive cost of transportation and recycling charges, which they cannot reach through the individual recovery model.[796]

Meanwhile, *diagonal and lateral collaboration* in inter-organizational reverse logistics networks can be determined through the cooperation between partners operating in different industries and at different production stages, sometimes referred to as inter-branch alliances, and on diverse levels of value chains. Partners are neither direct competitors nor actors up- or downstream the supply chain. Industrial recycling networks or industrial symbioses are samples of diagonal networks, in which firms in different industries can exchange their waste. Reconsidering the value, waste can be a source for new business opportunities and profits for a firm in an industrial ecosystem that proactively cooperates with its stakeholders in greening the

[794] See Kaluza (1999), p. 18

[795] See Hendrick (1997), p. 2

[796] See ERP (2009), p. 4

value chain.[797] The recycling network of Oldenburger Muensterland in Germany and Kalundborg in Denmark is one of the best-documented examples for diagonal and lateral collaboration in inter-organizational reverse logistics system. Oldenburger Muensterland recycling agency was institutionalized as a central agency responsible for network communication and coordination. In this network, twenty four companies are involved. A number of independent energy and waste exchanges between co-located companies and the local municipality result in both economic benefits for all parties involved and ecological benefits for the whole region (e.g. recycling materials and cascading energy, cost savings, minimization of waste and emissions).[798] This type of inter-organizational RL network involves different and separate industries in a collective approach to reach the outcomes of sustainability-oriented cooperation.

6.2.2. Regional network

A regional network encompasses small and highly specialized firms situated in spatial proximity of each other cooperating repeatedly.[799] A regional network is regarded as the sub-structural foundation of a national strategic network. Numerous regional networks are formed in each European country to manage and ensure the provision of RL services depending on the number of defined areas in RL management. Regional networks are formed due to territorial restrictions and the lack of resources for providing RL services across the country. A regional network is a collaboration of several small and medium-sized enterprises as spoke firms with the definite specialization of reverse logistics processes such as collection, transport, sorting, dismantling, remanufacturing, and recycling at regional level. Such companies seem to be suitable for the provision of collection and treatment services within a region where they have an extensive collaborative network with comprehensively exchanging of information and directly interacting with other partners. In comparison with a strategic network, members in a regional network do not provide their total capacity of RL operations, but cultivate their provision with other relationships. In this respect, the quantity and the regularity of contracts between service providers and customers in a regional network are not frequently continuous as in strategic network. However, the affiliation between network members is continuous, and the consequent transaction costs from the change of cooperation between partners attain little importance.[800]

A regional network frequently operates based on a decentralized coordination approach rather than a centralized approach as in a strategic network. It is a network of independent service providers that are responsible for regional operations of reverse logistic, e.g. municipal waste management companies (municipalities), operators of regional collection points, return centers, store retailers, logistics service providers, dismantlers, remanufacturers, and recyclers. Among them, operators of the regional collection points, e.g. municipalities and collection contractors, play important roles in preparing and planning the logistics processes of collection and return transportation. The operators directly involve themselves in the strategic network, as well as work directly as a control unit in the regional network. Like in a strategic network, the operator of regional collection points functions as a regional hub.[801] Public waste management companies have also continuously cooperated with regional and medium recyclers of discarded EEE in regional networks of reverse logistics systems in many European countries, especially in Germany, Denmark, and Romania.[802] Logistics service providers including small and medium-sized freight forwarders or trucking companies provide regional services of logistics and transportation for firms, municipalities and regional recyclers. Most of small and medium dismantlers, remanufacturers, and recyclers have become regionally active in providing collection in combination with their treatment services. In a regional network, many retailers offer beyond their distribution of new products services of collecting the discarded and returned equipment by operating their own existing fleet of vehicles for this purpose, especially for large retailers. Joining a regional network may support retailers in developing their own core business by increasing sales through returns and optimizing the

[797] See Kaluza (1999), p. 17; Cf. also Korhonen/Malmborg/Strachan/Ehrenfeld (2004), p. 297
[798] See Posch (2010), p. 243-244
[799] See Sydow (1996), p. 45
[800] See Waltemath (2001), p. 199
[801] See Waltemath (2001), p. 204
[802] See Sander et al. (2007), p. 5; Cf. also Tojo/Fischer (2011), p. 13-14

utilization of the existing fleet. By collaborating with retailers and allocating the collection orders to them, network members, especially producers, regional collectors, or recyclers can handle reverse logistics with little additional efforts of logistics and the access routes to customers are improved, which directly affect the costs of RL operations. The cooperation between members in a regional network through business initiatives, partner evaluation, and trust can avoid the transaction costs, reduce logistics costs, and increase the value of the entire process of reverse logistics.[803]

6.2.3. Operative network

In an operative network, network members can quickly get access to other partners' resources, especially free production or logistics capabilities by a short notice.[804] Pfohl and Buse (2000) indicate that the transactions in an operative network are relatively standardized and concern single value adding activities rather than complex processes. The use of pooled resources is the main objective of this network type. An operative network is often organized by a central coordination unit with market mechanism, high formalization, and an inter-organizational information system supporting coordination.[805] An operative network in reverse logistics is often regarded as a coalition of small and independent enterprises that combine, coordinate, and manage their collective resources for the tasks of the whole network for take-back, recovery, and recycling operations. For example, the existence of operative networks of small and medium-sized companies offering services of collecting, dismantling and recycling is one of the salient features demonstrating the adaptability to reverse logistics at network level due to the changing requirements of external environments. The development of these networks can lead to the advantages of resource sharing, co-developing the capabilities and the knowhow, and avoiding the disadvantage of regional limitations, therefore increasing the winning possibilities in the tender of providing collection, treatment and recycling for discarded and returned products.[806]

6.2.4. Virtual network

A virtual network or organization is a new form of inter-organizational cooperation in RL operations. Virtual is interpreted as "unreal, looking real," i.e. a number of distinct functions or objects are perceived as a single integrated entity but in fact they are not.[807] Therefore, a virtual network as a temporary network of independent companies occurs when organizations are working together based on shared values and a common way of doing something to exploit a particular business opportunity by jointly manufacturing a product or providing a service.[808] The network is characterized through self-coordination with direct exchange and standardization to reduce coordination requirements, and trust is regarded as the foundation of this network type.[809] The collaboration of legally independent companies such as local retailer stores, post offices, petrol station, railway stations, schools, and logistics service providers is often accessed in terms of virtual groups in inter-organizational reverse logistics networks.[810] For example, local retailer stores and logistics service providers have found increasing customer demands of online shopping, which may lead to a growing amount of failed delivery and an increasing returns rate. Therefore, they come together to appear to the outside as a single unit to connect with customers, provide instructions for returns, arrange collection and transport services for returned products. Their collaboration can save time and costs for consumers, carriers, and retailers. The investment of specific assets in this type of network is limited because both local retailers stores and logistics service providers have a specific competency. They share the resources without pooling them in the network but by existing facilities of each partner. For instance, the rise of collection-and-delivery point, especially with service points of retailer stores, in many European countries such as Germany, the Netherlands, and the UK, has been the evidence for virtual collaboration between firms in the networks for delivering and return-

[803] See Waltemath (2001), p. 196-199

[804] See Pfohl/Buse (2000), p. 394

[805] See Pfohl/Buse (2000), p. 394

[806] See Ivisic (2002), p. 201

[807] See Verduijn (1999), p. 1-2

[808] See Arnold/Faisst/Haertling/Sieber (1995), p. 121

[809] See Pfohl/Buse (1999), p. 392

[810] See Ivisic (2002), p. 203

ing online orders.[811] Weltevreden (2008) indicates that the virtual network has provided better opportunities for customers to combine the collection of a parcel with other shopping activities, and for returning the products, which increases the retailers' sales. Moreover, the virtual network provides logistics service providers with possibilities of delivering parcels to service points because they may combine the delivery of parcels with the regular supply of the stores and collect the returned products, which reduces the costs of logistics and transportation.

For the current development of inter-organizational reverse logistics networks, network relationships are formed by working collaboratively between different partners at different levels. Figure 58 presents an overall picture of four types of inter-organizational networks, which is extracted from the works of Sydow and Windeler (1998), Pfohl and Buse (1999), Waltemath (2001), Ivisic (2002), and Weltevereden (2008). The collaboration in reverse logistics operations has expanded from a dyadic relationship between organizations to a multi-organizational network structure.[812] For the enlargement of the European Union to 27 member states, there have been new formations of inter-organizational networks in reverse logistics that are based on the international collaboration between partners all over Europe such as the network of European Recycling Platform (ERP) and European Recovery and Recycling Networks (RENE EUROPE). The adaptability of firms in an inter-organizational network is accessed through the capabilities of coordinating with network members, sharing information and knowledge, combining resources, and developing network capabilities to create competitive advantages and efficiency for the entire reverse logistics network.

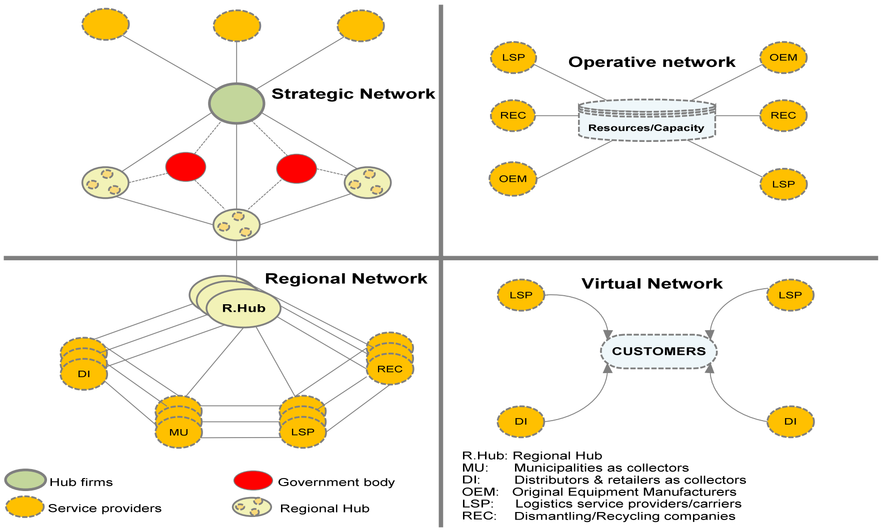

Figure 58: Visualization of four inter-organizational reverse logistics networks

Source: Own illustration

6.3. Organizational types of inter-organizational reverse logistics networks

Reverse logistics operations are implemented by the collaboration of various stakeholders and partners. The successful implementation of inter-organizational collaboration requires initially a win-win-win situation, in which all partners can gain benefits from dyad or network relationships directly or indirectly.[813] Then, the successful network relationships lead to the effectiveness and efficiency of the network as a whole. The degree of collaboration and the selection of responsibility implementation have established different organizational types of inter-organizational networks in RL system through two dimensions: individual versus collective responsibility, and competitive versus collaborative approach.[814] This part analyzes the organizational types of inter-organizational RL networks developed in the European electronics industry over the last decade (see Figure 59).

[811] See Weltevreden (2008), p. 639-641

[812] See Ivisic (2002), p. 201

[813] See Kaluza/Blecker (1996), p. 38)

[814] See Bohr (2007), p. 65

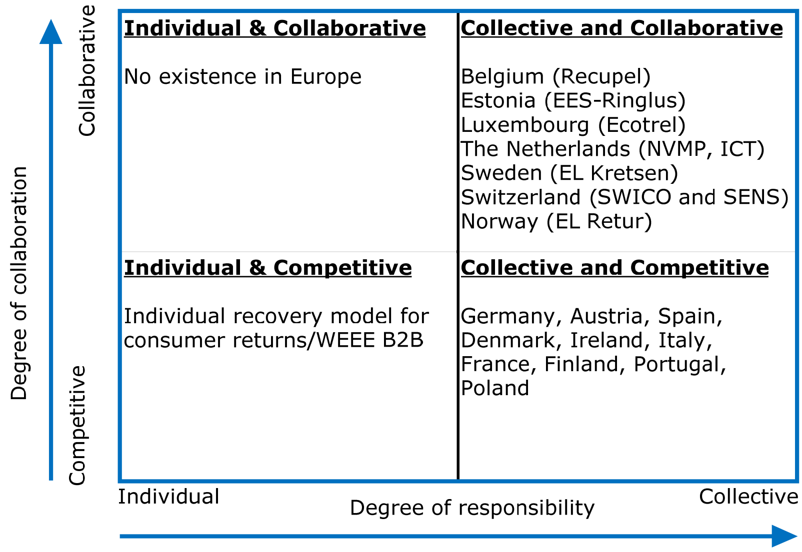

Figure 59: Organizational types of inter-organizational reverse logistics networks

Source: Bohr (2007), p. 65; Cf. also Sander et al. (2007), p. 129; Mayer (2007), p. 114-116

There are currently two main types of reverse logistics systems in the European electronics industry. The first ones is a reverse logistics system for mandated product take-back established in response to the WEEE Directive. In this system, most firms in the European electronics industry have joined different inter-organizational reverse logistics networks through industry-wide cooperation to collectively implement their responsibility. Recycling is the typical form of recovery in these networks. The second system is designed for recapturing value from used and returned products that are collected from B2B and B2C customers. In this system, firms in the European electronics industry have followed various product recovery strategies to obtain economic benefits, reduce the costs, and satisfy their customers. Reuse/resale and product recovery through refurbishing and remanufacturing are the main activities of this system. Firms have been involved themselves in establishing inter-organizational reverse logistics networks to manage their returned products. For example, a managed closed-loop supply chain is formed based on manufacturers' individual responsibility to collect and recover returned products from different sources and with different motivations.[815] For differentiating inter-organizational networks in reverse logistics systems, the first dimension of collective or individual responsibility is addressed for determining the organizational types of RL networks.

Individual responsibility means that producers are responsible for managing their own returned and discarded products, as they incur the full costs of collecting and recovering. An identification and allocation of their own EoL products is the feature of individual responsibility. In case of reverse logistics implementation for EoL products, producers are financially and physically responsible for the individual collection, transport, and sound treatment of their own products discarded by their customers. The individual take-back system has advantages of avoiding free riders in a collective system and improving product design by direct feedback loop of manufacturing and remanufacturing, therefore reducing the related treatment costs. By individual responsibility, OEMs can take back and implement product recovery by themselves, e.g. Electrolux, Fujitsu-Siemens, HP Europe, and Rank-Xerox. Otherwise, OEMs have also increased network relationships with different partners in their reverse logistics systems while conducting their individual responsibility. They normally sign contracts with service providers to collect, recycle and possibly recover components from returned product. For example, the take-back regulations in Germany has motivated the competition in WEEE management by allowing producer maximum freedom to decide how to comply with their EPR, indicating the trend of individual responsibility. OEMs in Germany can require the municipalities to collect separately and sort out their EoL products discarded and OEMs have to pay the municipalities for additional efforts going beyond their obligations. OEMs also establish their own collection points where the municipalities and consumers can bring their EoL product EoL products. OEMs in Germany may establish an individu-

[815] See Flesichmann (2001), p. 9

al brand-selective or non-selective take-back system by contracting with one or more take-back system providers on behalf of them to collect, sort out, and recover their EoL products.

Individual responsibilities through a band-selective take-back system may lead to the higher implementation costs of reverse logistics, especially in case of collecting discarded appliances from households. The individual reverse logistics system for EoL management is extremely criticized for its inconvenience for the households because they have to dispose different brands at different locations or at different times. For collectors and retailers, it would also incur unnecessary efforts to separately collect and store appliances according to different brands.[816] In fact, individual take-back systems are not a suitable solution for managing the large volumes of WEEE disposed from households, and thus have not motivated the efficiency and effectiveness for the whole network. Individual responsibility through a brand-selective take-back system is mostly applied in the case of managing consumer returns because of defects and unexpected problems in warranty time; recovering returned products from business customers with leasing or rental contracts; and conducting voluntary take-back programs with computers, printers, mobile phones, and camera where replacement is purchased (buy-back options and trade-in rebates). For WEEE management, OEMs in Germany have preferred individual non-selective take-back systems. It is another form of collective responsibility; however, they can select freely and individually take-back system providers and treatment operators. Therefore, they are motivated to improve product design for EoL treatment, control costs, and minimize the abuse of financial resources. However, it requires them to establish administrative and monitoring capacity for EoL management, which put disadvantages on many SMEs.[817]

Collective responsibility does not differentiate between different brands of product types, indicating that there is no identification and allocation of individual EoL products. This occurs in the case of the take-back laws in many European countries that motivate manufacturers to collectively take back waste appliances and provide for “environmentally sound end-of-life” product disposal. Following take-back regulations, the obliged companies may set up collective take-back systems to jointly organize and finance their EoL products. Most of these take-back systems are non-profit legal entities (e.g. producer consortia and PROs) with the obliged companies as network members.[818] Obliged companies may be competitors in the market for distributing EEE but all of them have objectives of implementing their extended producer responsibility to comply with the laws, to minimize the costs of logistics and treatment, to increase the volumes of WEEE collected and recycled products, therefore saving raw materials and material costs. Collaboration networks enable firms in the European electronics industry to pursue operational strategies that are most cost effective with respect to their circumstances. Many OEMs have jointly established producer consortia or PROs to manage product take-back and recovery for entire product sectors by designating one company in each country or in each region. Manufacturers working together can benefit from collective take-back systems by reducing collection costs and gaining the collective nature of economies of scale in recycling operations.[819] Collective take-back systems are also more consumer-oriented and suitable for collecting products discarded from households because consumers can bring their products to many collection points or call to pick-up services. Moreover, the systems require intensive cooperation between manufacturers, local authorities, disposal contractors, and system partners with a multitude of different logistics routes.

In fact, product recovery and especially, material recycling are often not within the core competency of OEMs, thus they frequently outsource to third-party service providers such as LSPs, recyclers, or waste management companies. However, most service providers of product recovery and recycling are small and medium-sized companies, especially with disassembly firms. Meanwhile, there have been substantial changes in organizational forms resulting from complying with the laws such as the centralized outsourcing contracts of reverse logistics services by OEMs, or the increasing administrative requirements for monitoring

[816] See Khetriwal (2007), p. 8

[817]See Deubzer (2011), p. 63

[818] See Arcradis and Eunomia (2008), p.75

[819] See Toffel (2003), p. 120

the collection and recycling targets from the authorities.[820] Given these reasons, service providers of reverse logistics are trying to cooperate in inter-organizational networks to provide their services. Therefore, the second dimension of organizational types of inter-organizational reverse logistics networks is characterized by the degree of collaboration or degree of competition between the partners providing in reverse logistics services.

Following collaborative approach for establishing a reverse logistics system for EoL products from households, only one PRO manages take-back and recycling on behalf of the competing industry,[821] which can be categorized as a single national or sector-based collective take-back system.[822] The single national collective take-back system has been the standard organizational form of inter-organizational reverse logistics for WEEE management in Europe since the mid-1990s. It has been established in countries with legislation prior to the implementation of the WEEE Directive including Belgium, the Netherlands, Sweden, Switzerland and Norway.[823] They have put in place and continued to develop single national take-back systems, initiated by producers or their trade associations collectively, to practically arrange the collection, transport, and recycling operations. Although there may be competitive tendering for services such as transportation, pre-treatment and recycling, the national single collective take-back system is still organized as a national-wide collection system with a relatively monopolistic mechanism (see Figure 60).[824] National-wide collection systems have established themselves in collaboration with municipal collection sites and retailer stores for improving the collection volume. They have also formed contracts with some main service providers to operate pick-up, transportation, and recovering. Even when there is more than one take-back scheme operated in the country (ICT Milieu and NVMP in the Netherlands), there is usually no competition between product categories for the management of WEEE.[825]

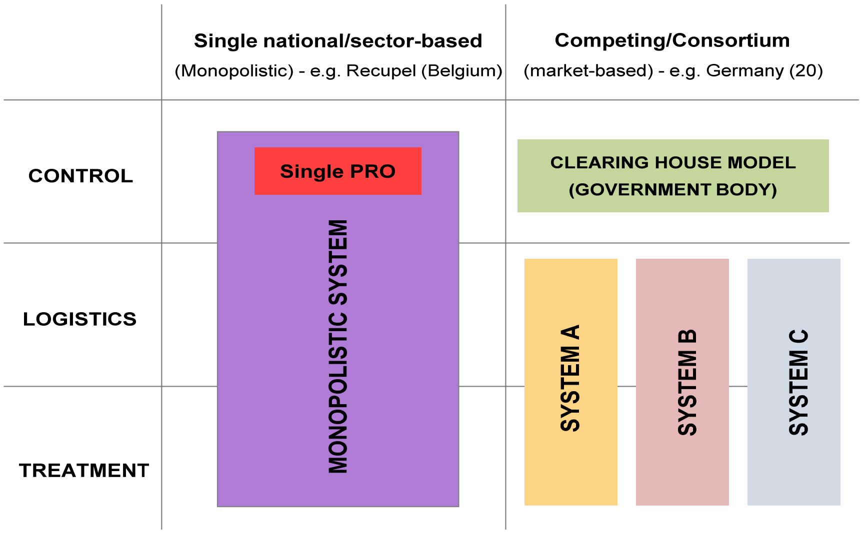

Figure 60: Mechanism in single national and competing collective take-back system

Source: ERP (2009), p. 8 with modification

Based on the degree of competition between service providers in an open market for reverse logistics operations, there has been an increasing trend towards the establishment of multiple collective systems in competition mechanism for EoL management since the mid-2000s. It is against the monopolistic arrangement of the single national collective take-back system. Take-back system providers may consist of logistics service providers, waste management companies, recycling companies, and producer consortia or PROs.

[820] See Walther/Spengler (2004), p. 334

[821] See Bohr (2007), p. 66

[822] See Mayer (2007), p. 116

[823] See Savage (2006), p. 8

[824] See ERP (2009), p. 8

[825] See Sander et al. (2007), p. 97-98

They have operated to provide services of take-back and product recovery as collective competing take-back system providers. The competitive approach is based on the viewpoints of integrated supply chain management to develop the inter-organizational reverse logistics system. It advocates that integrated supply chain management is managed on the basis of inter-firm collaboration with competitive tender and WEEE management is simply regarded as part of supply chain activities that can benefit from this management strategy.[826] Numerous partners and stakeholders involved in reverse logistics operations have approved that market-based systems are designed to meet the minimum levels of collection and recycling in the most cost-efficient manner.[827] However, in order to facilitate competition between schemes, the involvement of a governmental body or a clearing house model like EAR is very necessary to allocate the responsibilities of manufacturers in the market, e.g. setting up waste containers, emptying the containers, and coordinating with municipalities and collection points. The existence of a governmental body ensures that the competitive mechanism in implementing take-back responsibility and providing reverse logistics services is fair for all producers or their take-back system providers.[828]

Competing collective take-back systems and their mechanisms have motivated extensive inter-organizational collaboration in reverse logistics networks of many countries in Europe, especially for take-back system providers because they have diversified the degrees of coordination to get access to EoL products. For example, the four competing collective schemes in Austria are free to contract directly with municipalities to collect WEEE from their municipal collection sites. In the UK, there is also a similar set-up where competing collective schemes or waste collection companies operating on manufacturers' behalf negotiate directly with municipalities or retailers to become their designated collection facilities. In Portugal and Spain, two competing systems established their own collection networks on both retailers and municipal collection points.[829] The development of competing collective take-back schemes has been seen as more advanced in the decade of 2000s, supporting the adaptability to reverse logistics at network level with much greater collaboration among stakeholders.

Strategic networks of reverse logistics with the roles of hub firms can clearly present the network relationships among organizations, the strength of inter-organizational cooperation, the forms of governance, and the influences of network interactions on RL performance, which together indicate the adaptability to reverse logistics at network level.

6.4. Adaptability to reverse logistics in strategic networks

The findings of adaptability to reverse logistics at network level are extracted mainly through analyzing strategic networks led by different hub firms. The theoretical foundations analyzed and the third conceptual model proposed in chapter 3.4 are referred in this chapter to look at different stakeholders and their network relations to investigate their adaptability behaviors in inter-organizational reverse logistics networks. The analysis attempts to answer some questions related to the types of collaboration accessed by hub firms and their partners, the forms of governance conducted by hub firms, the ways to combine resources and develop capabilities, and the achievement of network outcome and competitive advantages.

This study uses content analysis of published case studies to explore the adaptability to reverse logistics at network level. Content analysis provides us with in-depth data from multiple sources, allowing detailed insights while extending the perspective beyond the single case. In this paper, we provide a content analysis of fifteen published case studies portraying the adaptability to reverse logistics at network level. The hub-firms in fifteen case studies vary from manufacturers (BSH, HP Europe, IBM Europe, Océ), PROs (ERP, RECUPEL, SWICO, SENS, NVMP), 3PLPs (CCR Logistics, Geodis, DHL, Wincanton), and large recycling companies (Remondis), and recycling networks (LOGEX System). They act as hub firms in inter-

[826] See Sander et al. (2007), p. 98

[827] See Savage (2006), p. 9

[828] See Sander et al. (2007), p. 99: one way of further classifying competing collective schemes is by the mechanism used for the allocation of waste to individual producers or their competing collective organizations managing their responsibilities. This mechanism use an algorithm to determine when and where a producer/ or its competing collective is required to pick up and process WEEE from collection sites.

[829] See Sander et al. (2007), p. 100

organizational networks with different strategic roles of coordinating and governing network relationships as well as implementing various reverse logistics operations to get the effectiveness and competitive advantages of the network.

6.4.1. OEMs as lead network organizations

This study explores some published case studies of OEMs including BSH,[830] IBM Europe,[831] HP Europe,[832] and Océ.[833] OEMs frequently operate as hub firms in their inter-organizational reverse logistics networks for:

- newly manufactured products failures covered by warranty and technical engineer cannot be repaired onsite,
- products damaged from transport,
- used products from leasing or rental contracts, and
- used products from voluntary take-back programs.

There has been a high spirit of collaboration between OEMs, their main customers, and their partners in adapting to reverse logistics operations for these types of returns. For example, in case of Océ, cooperation with co-developers and suppliers has thus strengthened the technology base, which enables high-level recovery of products and components to get objectives of manufacturing advanced products of excellent quality, reliability, durability, and environment friendliness. Océ also maintains collaborative agreements with local operating company in distributing, collecting, and recovering the returned products to achieve the efficiency of their entire reverse logistics system and to recapture more values from their returned and discarded products. Local operating companies are allowed to refurbish the machine returned by customers due to ending of lease contract or active buyback and put in back in the market. If operating companies themselves are not interested in refurbishing, they can return the machine to a recovery location of Océ, for which they receive a fee.[834]

BSH has established intensive collaboration networks in handling different kinds of returns. Product returns that only need repackaging are stored by its logistics service provider in a separate part of the warehouse and its LSPs take care of the repackaging and the delivery for redistribution following BSH's orders. Retailers of BSH are taking care of almost all type of consumer returns; damaged products are resold in "B-stores" with discounts; and malfunctioning products are dealt by local authorized service companies of BSH. EoL products are being collected by retailers and municipalities through BSH's member contracts with collective take-back system, e.g. NVMP in the Netherlands, Eco-Systèmes scheme in France, ECOLEC in Spain, and REPIC in the UK.[835]

HP Europe have managed three main voluntary take-back programs through HP Trade in Program from end-customers, Return for Cash from business customers, and HP Planet Partners Recycling Program for EoL products. In partnership with local authorities, regional service providers, and industry associations, HP Europe has operated and controlled its reverse flows at each European country or pan-Europe level to ensure the effectiveness and efficiency for its entire reverse logistics system. For EoL products from households, HP participates in a single national PRO in Belgium (RECUPEL), IT sector PRO in The Netherlands and Switzerland (ICT Mileu and SWICO, respectively), and competing schemes in countries that have competitive market for take-back services. HP Europe also joins a producer consortium through strategic alliances with Electrolux, Braun, and Sony to develop European Recycling Platform as a pan-European take-back system provider for WEEE.[836]

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[830] See Verweij et al. (2008), p. 65

[831] See Fleischmann et al. (2004), p. 4; Cf. also Verweij et al. (2008), p. 65; Gobbi (2008), p. 124; Monnet (2008), p. 11

[832] See Mayers (2001), 205; Verweij et al. (2008), p. 65; Mayers et al. (2005), p. 172

[833] See Krikke et al. (1999), p. 389

[834] See Krikke et al. (1999), p. 387

[835] See Verweij et al. (2008), p. 65; Cf. also BSH (2009), p. 22

[836] See HP (2006), p. 1; Mayers (2001), p. 202

For returns from business customers, for example in HP England,[837] the three main streams of spare part returns were operated in the intensified inter-organizational collaboration between HP and its partners. Redundant IT equipment returned from major HP offices was operated via the internal logistics network for disposal at HP Winnersh Triangle warehouse. HP England also outsourced transporting, processing, and redistribution to two third party service providers (Frazier and Intex). Irreparable faulty parts were returned to Test and Measurement repair center at the HP warehouse for disposal as scrap by its partner's subcontractors. Faulty spare parts from customers' returned product to HP were collected by field repair engineer to Unipart part distribution hub, and then were tested, reprocessed or disposed by the subcontractors of Frazier and Intext (see Figure 59). HP England maintained its direct and strong ties with main service providers, and let them perform some coordination and governance tasks with other network members. The long-term and direct individual contracts with main partners and indirect control of its partners' subcontractors through audit processes have supported HP England in recapturing value, reducing costs of RL, and improving corporate image, and therefore obtaining competitive advantages in comparison with other OEMs in the European electronics industry.

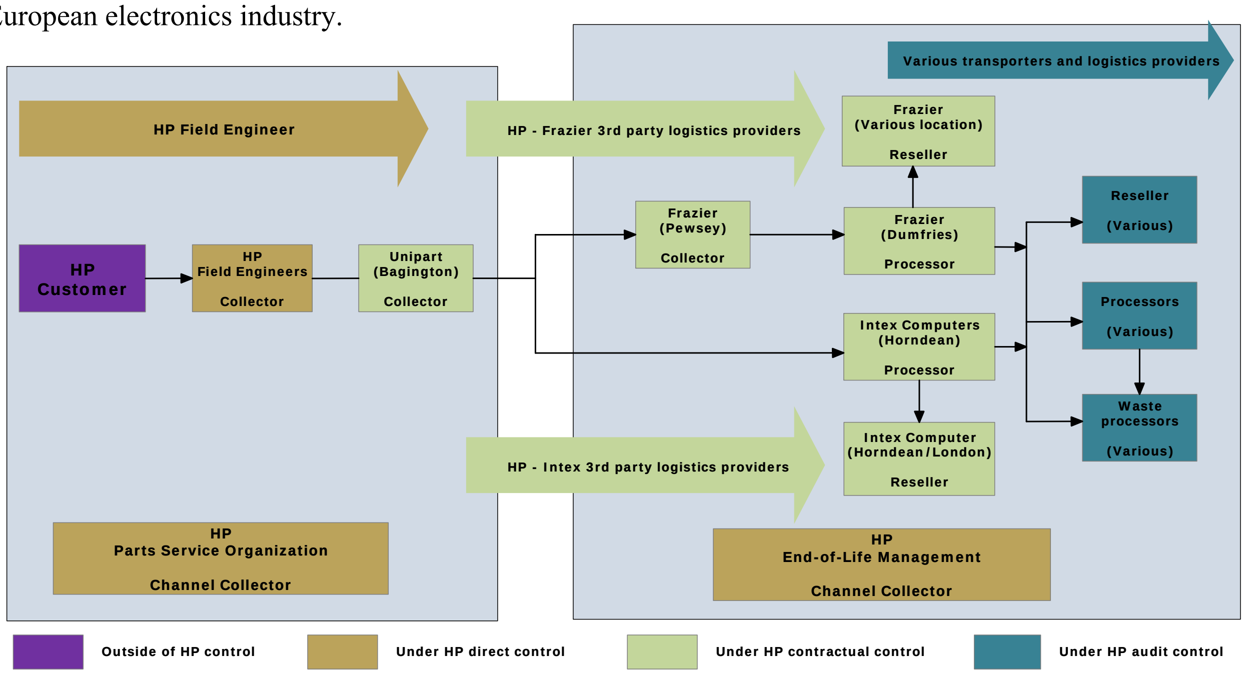

Figure 61: Strategic network of HP spare part returns management

Source: Mayers/France/Cowell (2005), p. 174; Cf also K. Mayers (2001), p. 204

The content analysis of these case studies shows that the major network-level activities and key decisions in strategic networks for returns from customers, leasing contracts, and voluntary take-back programs are frequently coordinated and operated mainly by OEMs and their supply chain partners. Many OEMs, as lead organizations in these cases, have established closed-loop supply chains, operated some reverse logistics tasks by themselves (e.g. gatekeeping and authorization, central warehouse consolidation, sorting and inspection, and some recovery processes), and outsourced other external logistics, recovery, and disposal processes to service providers (e.g. 3LSPs, remanufacturers, and recyclers).[838] For example, IBM Europe and BSH have developed long-term partnership with Geodis and DHL, respectively, for the services of forward logistics, customs formalities, and reverse logistics. OEMs have provided and shared information with their strategic partners, and facilitated the activities of their partners to create benefits for all firms joining their RL network. They often have more detailed control of the overall RL processes from collection to order closed and assign specialized in-house personnel that follow up on contractual agreements with service providers. Regular meetings may be held with main service providers to discuss the initiatives of improving

[837] See Mayers (2001), p. 203

[838] See Pfohl/Bode/Nguyen (2012), p. 12

the current process to reduce lead time and enforce quality standards of recovered products.[839] In turn, service providers can have a consistent stream of business with fewer working capital requirements and risks, as well as obtain assistance from OEMs in terms of replacement parts, design and testing specifications, improved technology, and even tooling.[840]

In case of networks led by OEMs, we can observe that there have been medium level of asset investments, e.g. physical and human resources. For example, many OEMs have increased investments for eco-design to develop measures and technologies to support product recovery. OEMs have invested in human resources and information systems for controlling and managing contracts, standards, procedures, and lead time with distributors and service providers. The integrated tracking and tracing system and other IT applications to product data collection and planning have supported OEMs in the European electronics industry and their partners in following the entire processes from collection to recovery in many places. Service providers frequently invest higher asset specificity with special equipment for collecting, inspecting, dismantling, refurbishing, and remanufacturing. Therefore, they may obtain the knowhow, the specialization, and the efficient cost structure of reverse logistics and product recovery superior than OEMs. The strategic partnership between IBM Europe and Geodis is a typical case of inter-organizational collaboration of high relational capabilities (e.g. information and knowledge sharing related to product recovery) and high physical capabilities. For example, IBM Europe and Geodis have invested in own their recovery facilities with different processes, and one of two major IBM's recovery units is located near the Geodis recovery assets center. Site-specific investments can substantially reduce warehouse and transportation costs, and therefore lower the costs of coordinating activities. Geodis focuses on manufacturing and refurbishing of PC equipment for IBM Europe with high asset specificity of site, human resources, and technology because 99% orders of Geodis come from IBM Europe and they have long-term strategic partnership.[841] The frequency of transactions between OEMs and main partners is high in these cases with intermediate level of uncertainty and rather high asset specificity, suggesting a hybrid form of governance with long-term contracts and strategic partnerships. OEMs as lead organizations in these case studies can utilize their existing capabilities, combine resources and develop new capabilities with their partners to take the competitive advantages from the network relationships, indicating the adaptability at network level.

Moreover, almost OEMs in these cases have developed the collaborative relationships in win-win situation with their distributors by developing customer service initiatives with returns management, e.g. joint rethinking of warranty processes and shared knowledge, information, and services on reverse logistics.[842] The value network of partners joining after-sales and returns process, e.g. retailers, carriers, distribution centers, and service centers, have been established virtually by these OEMs because the networks of reverse supply chain management is becoming more complex and dynamic. The close connectedness in inter-firm network led by OEMs has made them and their distributors have the end-to-end control and visibility to manage effectively the discrete activities of returns management processes, thus improving customer satisfaction, avoiding unexpected returns, and minimizing costs of returns management

OEMs have adapted to RL management as lead organizations in individual recovery model for returns from forward supply chain and market-driven stream mainly by improving their organizational, physical, and relational capabilities with their partners. The network of strategic partnerships ensures the continuity of relationships and, at the same time, the adaptability to changing circumstances.[843] The strategic alliances appear to be very specific to individual companies in inter-organizational strategic networks. The strategic and long-term collaboration helps firms in the network access to information, learn something of product take-back and recovery from partners, and develop capabilities of RL. Therefore, it has potentially differen-

[839] See Mayer (2001), p. 203-204; Cf. also Gobbi (2008), p. 128

[840] See Sundin et al. (2008), p. 539

[841] See Gobbi (2008), p. 123

[842] See Janse et al. (2009), p. 8

[843] See Gobbi (2008), p. 197

tiated themselves from competitors in returns management and product recovery. In our view, the additional linkage to further research on adaptability at network level can be tested following the proposition:

Proposition 1: The more increased share of information and knowledge as well as the greater investments of resources from OEMs and their supply chain partners, the higher level of effectiveness and efficiency of reverse logistics performance created.

Some adaptability behaviors of firms in strategic networks led by OEMs and other hub firms that are investigated from the content analysis of published case studies are provided in Table 26.

Network Adaptability	OEMs as lead organizations	PROs as NAOs	Recycling companies as lead organizations	LSPs as lead organizations
Coordinating network members	• Middle - and long term contract with service providers • Strategic partnership • Collaborative agreements	• Member contract • Medium to long-term contracts with general service providers • Collaborative agreements	• Short to long-term contract • Strategic alliance • Collaborative agreements	• Short to long-term contract • Strategic partnership • Collaborative agreements
Governing network relationships	• Lead organization • Organizational and operational works	• Network administrative organizations • Organizational and coordinative works • Non-profit organization	• Lead organizations • Organizational and operational works	• Lead organizations • Organizational and operational works
Combining resources	• Utilize existing resources • Strategic partnership with service providers and motivate them to invest and develop new capabilities	• Consolidating contracts of EoL management • Combining resources for RL by collaboration with many LSPs, recycling companies and municipalities	• Consolidating contracts of EoL management • Combining resources and capabilities through collaborative agreements, strategic alliances and joint venture	• High specific assets • Using existing capabilities • Consolidate RL orders • Synthesize resources and capacity of logistics suppliers
Developing capabilities	• OC: Managing, negotiating, contracting, monitoring, • RC: High information sharing • PC: Medium specific assets, more investments in IT and management resources	• OC: managing, negotiating, contracting, assigning, auditing, reporting • RC: High information sharing and communication • PC: High investments in IT and management resources	• OC: managing, planning, negotiating, contracting, controlling • RC: High information and knowledge sharing • PC: High investments in facilities and capabilities of collection and recycling	• OC: planning, negotiating, contracting, controlling, auditing • RC: Supply chain integrator • PC: High investments in facilities and capabilities of coordinating and logistics
Network outcome	• Cost reduction • Customer satisfaction • Profitability	• Economies of scale • Decreased member fee • Cost reduction • Competitive advantages of the whole network	• Economies of scale • Cost reduction • Profitability • Competitive advantages of the whole network	• Economies of scale • Cost reduction • Profitability • Competitive advantages of the whole network

Table 26: Adaptability behaviors of firms in strategic networks

6.4.2. Producer consortia or PROs as network administrative organizations

Normally, most producers, especially for small to medium size, have bought services directly and individually from service providers of logistics and recycling at higher prices than lager producers that have been able to secure individual contracts with service providers.[844] Therefore, producers in the European electronics industry has adapted by cooperating in networks by strategic collaborative agreements. For example, in Germany, there has a trend of bundling their demand together in order to obtain efficient performance by economies of scale in collection and recovery for EoL products due to the increased enforcement of laws since the beginning of 2000s.[845] According to Perchants (2007), five producer consortia placing around 80% of all EEE on the market are established in Germany on the basis of strategic alliances between OEMs operating business (see Table 27). They are networks of producers' cooperation acting as non-profit organizations, in which organizations in the network collectively make strategic decisions about how the network operates to implement take-back responsibilities. They are on behalf of manufacturers contracting, handling, and collaborating with services providers to implement their take-back and product recovery. These consortia aim to provide full package of take-back and recovery services for their members to satisfy current demands for reverse logistics and treatment services. It is a new management model of reverse logistics operations developed based on law requirements and fast-changing environments in the European electronics industry since the mid-1990s.[846]

Large Household Appliances	Small Household Appliances	Information Technology Communication	Consumer Electronics	Tools and Gardening Equipments
Miele, Bauknecht, Stiebel, Whirlpool, Eltron, Liebherr, Merloni, Candy, Fagor, Kueppersbusch, Gorenje	Bosch, Siemens, Miele, Philips, SEB, Vorwerk, ProBusiness	ProReturn, Philips, Sharp, Siemens	ProReturn, Loewe, Philips, Sharp, Siemens	Recycling consortium (IVG, ZWEI)
ERP Electrolux, Samsung, Elica	ERP Electrolux, Varta, Remington, Saeco	ERP Sony, HP, Samsung, Toshiba, Lucent, Logitech	ERP Sony, Braun	Robert Bosh (Willerhausen)
Quelle		ENE Panasonic, Thornson, JVC	ENE Panasonic, Thornson, JVC	

Table 27: List of producer consortia for WEEE management in Germany

Source: Perchard (2007)

The values created by producer consortia are shared among its participators including OEMs, distributors, and service providers according to the strategic collaborative agreements and outsourcing contracts. Strategic alliances between producer consortia and their service providers have increased the economies of scale for the volume of product collected and recycled, as well as motivated the share of investments on reverse logistics facilities and reduced the operation costs. Effective participation in producer consortia has created possibilities to enhance competitive advantage,[847] achieve bargaining power vis-a-vis logistics providers and recyclers, therefore reduce the cost of handling EoL products for each network member. Producer consortia as network brokers can potentially offer for the whole network a pooled source of service providers and for each member a more efficient communication and information sharing with lower transaction cost to deal with reverse logistics operations. When producer consortia successfully manage multi-tasks of reverse logistics from different companies by controlling information, consolidating scattered service requirements, and assigning operational tasks to appropriate third-party service providers, producer consortia can optimize reverse logistics operations on a large scale better than any individual participants can. The optimization is from the network-level approach, which its objective is not to maximize the profits of any individual participants but the whole network of firms.

[844] See Sander et al. (2007), p.161

[845] See Perchards (2007), WEEE Information Service. Country Report: Germany

[846] See Savage (2006), p. 19

[847] See Huber/Sweeney/Smyth (2004), p. 2

The content analysis shows that producer consortia for WEEE management have popularly been established and developed in many countries in Europe such as Austria (4), Denmark (5), France (7), Finland (5), Germany (20), Italy (6), Romania (6), Slovenia (4), Sweden (1), and The Netherlands (2), the UK (37) over the last decade.[848] The development of producer consortia in Europe is diversified and can be observed commonly through the increase in the number of PROs as collective take-back systems, e.g. competing collective systems and single national/sector-based systems. Until now, more than 260 PROs handling and recovering EoL batteries (17), packaging waste (114), and WEEE (129) have been established and developed across the European Union. They are evaluated as one of the most cost-effective solutions for increasing the recovery, reuse, and recycling of EoL products, indicating the adaptability to reverse logistics at network level. These collective take-back systems coordinate all stages before treatment, handle the administrative tasks, and manage the relations with the national stakeholders (e.g. governmental agencies, NGOs, and industry associations), producers, distributors, municipalities, and service providers. Most of collective systems do not own any collection or treatment infrastructures and subcontract all RL operations.[849] Collective take-back systems in these cases operate as network administration organizations. In case of Germany and the UK, competing take-back system are established and developed with the involvement of producer consortia, LSPs, and waste management/recycling companies. LSPs and waste management/recycling companies have managed RL networks as lead organizations or take-back system providers regarding both coordinating and operating works. Therefore, the analyses of strategic networks led by LSPs and waste management/recycling companies are separately conducted in chapter 6.4.3 and chapter 6.4.4.

PROs negotiate member contracts with OEMs and/or distributors to implement their take-back responsibilities for EoL products from households and/or business customers. OEMs are embedded in the inter-organizational networks of take-back systems led by PROs to interact indirectly and weakly with other network members. The effectiveness and efficiency of the whole network helps OEMs reduce the cost of EoL management, comply with the regulation requirements, and improve company image. The uncertainty of the transaction between producers and PROs is very low. No specific investments carried out in relation to the transaction are registered on the supplier side. Collective schemes can provide the same services to a large variety of producers and do not require the investments on buyer side, except the investments in human resources for training personnel to follow contract process with collective schemes. The PROs have mainly invested in management resources and IT to improve their relational and organizational capabilities of coordinating with network members and governing network relationships. The governance mode of the transaction between producers and collective take-back systems is market with the feature of spot contracts and outsourcing (e.g. member contracts) (See Table 26).

However, PROs often have medium to long-term contracts, or strategic partnership with some general contractors, e.g. LSPs and waste management/recycling companies, on the basis year of 2-5 years competitively tendered contracts, to support them in implementing RL activities and coordinating subcontractors for reverse logistics operations.[850] Otherwise, PROs have also strengthened the collaborative agreements with municipalities, retailers, secondhand shops, education sectors, and society clubs and associations for arranging collection points to increase the collection volume of discarded products. The network relationships led by PROs is fully supported with advanced information system, which enables to control and visualize material, information and monetary flow specifically to coordinate network members, and thus reduce administration costs substantially. Networks governed by PROs as NAOs can obtain the benefits of direct and indirect ties in inter-organizational networks for take-back and recovery services. A qualified partner network by careful auditing and benchmarking, and a mechanism of full reporting from subcontractors and general contractors have motivated resource sharing, capability extension, and information access to achieve compliance toward authorities.

[848] See DIT (2003), p. 5; Cf. also Savage (2006), p. 88, 97, 100; Lehtinen/Poikela (2006), p. 2; Sander et al. (2007), p. 101; Arcradis and Eunomia (2008), p. 311; Gobbi (2008), p. 139; ERP (2009), p. 8; NVMP (2010), p. 30; Ciocoiou et al. (2011), p. 180

[849] See Gobbi (2008), p. 106

[850] See DIT (2003), p. 65; Cf. also Gobbi (2008), p. 106

PROs as network administration organizations have played an important role in coordinating between manufacturers, local authorities, logistics partners, and disposal contractors with a multitude of different logistics routes, thus increasing the adaptability to reverse logistics at network level and obtaining the effectiveness and efficiency for the whole network. Concerning the roles of PROs as an important coordinator in inter-organizational reverse logistics networks, the further research can conduct empirical studies to investigate the influences of PROs on RL performance at network level following the proposition:

Proposition 2: The stronger the coordinating roles of PROs in inter-organizational reverse logistics networks, the better the integration of network resources and capabilities for RL operations, thus improving RL performance.

The roles of PROs in competing take-back schemes and single national/sector-based take-back schemes, as well as the network effectiveness led by PROs are specifically analyzed in published case studies of European Recycling Platform (EPR) and some single national collective systems.

6.4.2.1. Competing collective take-back system - European Recycling Platform

In countries with collective competing take-back systems (e.g. Austria, Denmark, Germany, Spain, and the UK), the responsibilities including setting up collection points, emptying containers, contracting with the municipalities and collectors should be more clearly clarified. In order to facilitate competition between take-back systems, a coordination center with the involvement of government body, e.g. Ministry of Environment, Environment Protection Agency, and WEEE Register Agency (e.g. EAR Foundation in Germany, DPA-System in Denmark) has been set up and developed in these countries as a primary network administration organization with some main responsibilities:

- organizing the different distribution of collection facilities among take-back systems
- managing logistics and informative flows between take-back systems involved in WEEE treatment
- supervising take-back systems to guarantee their efficiency
- providing updated information to control the amount of WEEE collected, reused, and treated by take-back systems.

For example, EAR Foundation in Germany operating as a clearinghouse center now has more than 7000 members registered, coordinates EEE manufacturers or their take-back systems, and allocates pickup obligations to producers based on an algorithmic calculation method and certain criteria. Producers are responsible for pick-up and treatment of the collected devices and for the provision of a new container.[851] These tasks are delegated to many take-back system providers in Germany because producers in the electronics industry frequently outsource these operations of EoL management.

EAR tracks the amount of WEEE collected at municipal drop-off points and/or consolidation site to ensure that producers' service providers (e.g. logistics providers and recycling/waste management companies) take responsibility of collecting and recovering WEEE according to their market share.[852] EAR informs a producer of its obligation of a pickup order which must be met within a certain time frame. This requires producers to develop a network of take-back systems nationwide that are available on short notice to be able to meet the demand from EAR in a timely fashion.[853] The overall network is therefore centrally coordinated with strategic networks of clearinghouse center and take-back system providers. It is then complicatedly organized in regional networks with many inter-organizational relationships. Figure 62 visualizes of inter-organizational networks in collective competing take-back systems in Germany.

[851] See Walther et al. (2010), p. 465

[852] See Grunow/Gobbi (2009), p. 391

[853] See Sander et al. (2007), p. 172

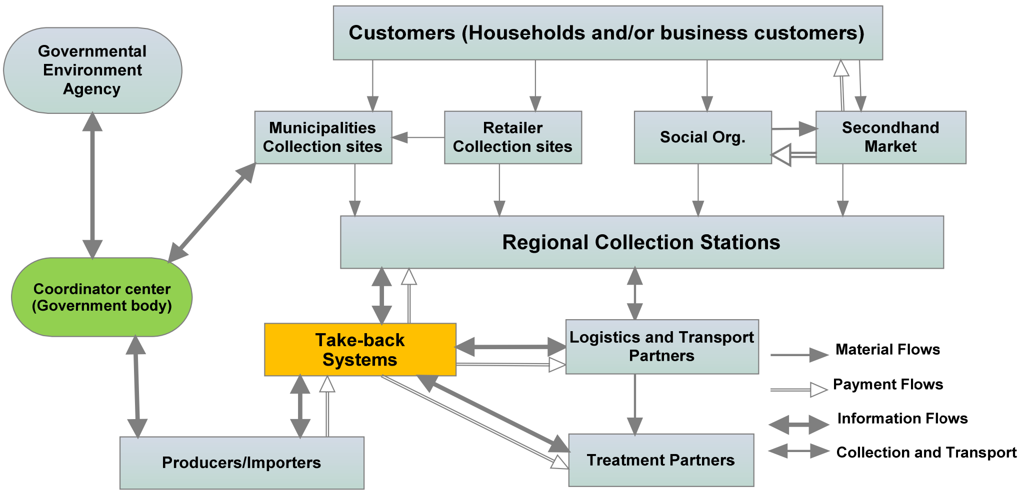

Figure 62: Visualization of network relationships in collective competing take-back systems

Among collective competing systems in Europe, the emergence of the European Recycling Platform (ERP) with "a pan-European" solution has provided significant improvements and changes for a more competitive and effective reverse logistics network in Europe during the last decade. In 2002, the ERP was established based on a strategic cooperation agreement signed between HP, Sony, Electrolux and Gillette/Braun to evaluate the alternatives and to increase the competitive pressures in reverse logistics market. ERP has operated in 12 countries across EU servicing more than 1700 customers including EEE producers, retailers, and local authorities.[854] Operating as a primary hub firm in form of a network administration organization in an inter-organizational revere logistics system, ERP follows some principal norms and rules to control and coordinate with their partners and stakeholders. They make regular invitations to tender for the logistics and recycling services as well as continuous improvement of the supply chain, conduct efficient internal order and data management through the use of a Europe-wide and customized IT system. ERP carries out audit of all recycling operations by at least an annual on-site audit by independent certified auditors. ERP also promotes cost-effective and innovative recycling strategies in Europe and carry out research and development projects. To work effectively by multi collective competing scheme, ERP establishes national schemes in several countries; develops pan-European agreements with networks of reverse logistics service providers in all ERP members' countries; creates fair competition with other schemes to achieve efficiency and cost reductions. Even in the case where single national collective scheme exists, ERP collaborates with them and negotiates to contract as service providers of reverse logistics operations.[855] ERP has increased network collaboration with other PROs in different European countries to optimize the collection process and obtain the economies of scale in product recovery.

ERP has operated as a NAO model for coordinating network members and governing the network of relationships as a whole. EPR works as the network broker playing a key role in coordinating and sustaining the network. It has maintained the number of direct ties with their members and their general contractors as well as indirect ties with subcontractors of their general contractors through auditing processes. ERP has made long-term contracts of all operational activities of collection, transport and recycling with two main "General Contractors" by competitive tendering with 15 international service providers of reverse logistics and waste management since 2004. Two of them including CCR Logistics and Geodis are selected, which provide ERP's members a full package of administrative work, pick-up, transport, treatment, recycling, disposal service and remarketing the recovered products or recycled materials on behalf of ERP.[856] General contractors under strategic partnership with ERP have provided some services by their own operations and facilities. They have invested in high asset specificity of physical and human resources to implement the contract with ERP. They, on behalf of ERP, like secondary hub firms in form of lead organizations, work together respon-

[854] See ERP (2009), p. 21

[855] See Savage (2006), p. 9

[856] See Geodis (2011), p. 2

sible for serving any collection points where necessary to reach compliance,[857] designing reverse logistics networks, establishing sub-contractual relationships with other providers in each region and nation, operating and managing all related operations on the take-back process. Consequently, ERP through their direct and indirect ties has also expanded their network relationships to increase collection volumes of EoL products by establishing receiving centers to which retailers and strategic channel partners or their logistics partners can delivery returned products free of charge. For indirect collaboration with municipalities in European countries, ERP through their general contractors has established partnership with local authority to provide tailor-made reverse logistics services for WEEE management including collecting and recycling all household WEEE, provision and installation of containers, and detailed monthly reporting of WEEE collected and recycled.[858] Figure 63 illustrates the strategic alliance and contractual relationships between partners and stakeholders in the network led by ERP.

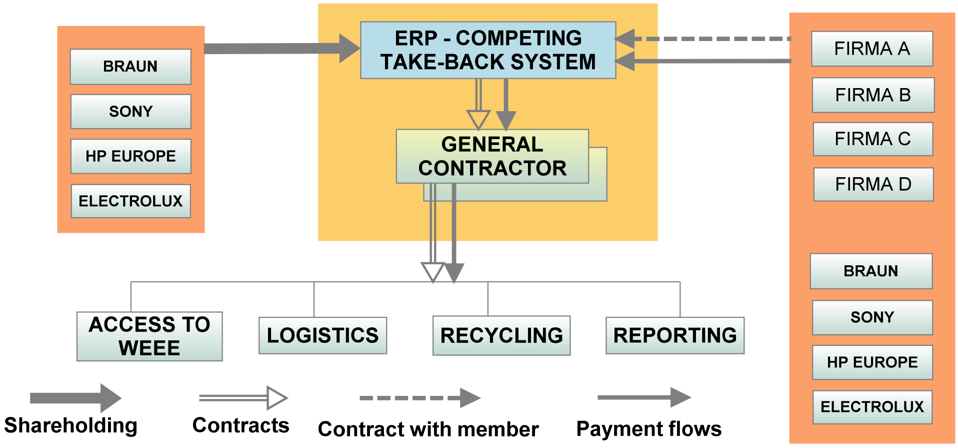

Figure 63: Inter-organizational network of ERP take-back system

Source: ERP (2009), p. 25

ERP, a pan-Europe collective competing take-back system, is little different from national collective schemes or national service providers. It may have some advantages because it can obtain significant financial synergies by pooling volumes and procuring take-back and recovering services on a European level. The process to buy the services (transport, handling, sorting, dismantling, recycling, and administration) is often the same and not specific to countries. Therefore, it should be possible to reduce the overhead costs for each member in the network and the network as a whole. A pan-Europe service provider can reach a significant "economies of scale" and buy services from the market at reduced conditions.[859] Competing take-back systems with both national and pan-Europe scope have increased the competitive pressures to other service providers, therefore motivating the whole network to obtain proactively the effectiveness and efficiency of inter-organizational reverse logistics systems, e.g. the volume of EoL product collected and recovered as well as the costs of collection and treatment. For example, the highly dynamic take-back and recycling systems with strong market competition have helped their members to enjoy lower costs of just a few Euro cents per products.[860] Table 28 compares the average price per product of some EEE paid to competing collective take-back and single national collective systems in some countries in Europe.

[857] In case of Germany, general contractors are responsible for supplying containers for municipalities following the allocation from EAR Foundation and transport the WEEE volumes collected by municipalities to treatment facilities. In case of other countries like Ireland where

[858] See ERP (2009b, 2011a, 2011b): Retailers in some European countries are required to take back discarded product on the basis 1:1, general contractors of ERP offer pickup and transportation of discarded products that is collected at retailer and municipalities collection points

[859] See ERP (2009), p. 20

[860] See HP (2006), p. 1; Cf. also Savage (2006), p. 8; Toyasaki/Boyaci/Verter (2011), p. 3

Country	Digital camera		Lap top		TV 32” LCD		TV 32” CRT		Monitor 17” LCD		DVD Player	
Belgium	1.24		1.65		8.69		8.69		4.74		4.74	
Switzerland	1.00		6.00		11.1		11.1		5.54		2.77	
Norway	0.10	0.60	1.52	2.51	4.25	11.6	4.25	11.6	1.25	3.37	0.25	2.16
Sweden	0.06		0.88		22.5		22.5		1.98		0.88	
France	0.03		0.21		4.00		8.00		1.00		0.50	
Spain	0.02		0.20		1.20		2.70		0.42		0.20	
Austria	0.02	0.02	0.39	0.23	3.30	2.40	7.42	5.09	1.48	0.84	0.36	0.32
Germany	0.01		0.15		1.10		2.25		0.49		0.22	

Table 28: Prices in €/unit paid by network members of collective take-back systems

Source: Etori (2007), p. 15. : Single national scheme : Competing scheme

Although single national/sector-based collective systems are operating in some European countries following monopolistic mechanism, the intensified network collaboration of governments, producers, retailers, municipalities, and service providers have also improved the effectiveness and efficiency of the whole reverse logistics network for EoL management in these countries.

6.4.2.2. Single national/sector-based PROs

Single national/sector-based PROs can be found popularly in countries with less-crowded population or low volume of discarded products because of the easiness in controlling the overall system. These PROs are dominantly responsible for collection, recycling of WEEE from private households and/or from business. Until now, there are 17 single national or sector-based take-back schemes in eleven countries in Europe, which are responsible for managing WEEE.[861] Some member states such as Belgium, the Netherlands, Denmark, Switzerland, Norway, and Sweden established single take-back systems and recycling schemes for WEEE before the EU Directive was put in place. Other schemes including ECOTREL (Luxembourg), Appliances Recycling S.A (Greece), and EES-RINGLUS (Estonia) have just established since 2005. Single PROs have played important roles in coordination and controlling essential logistics interfaces for organizing and operating collection, transport, dismantling, and recycling between partners in reverse logistics systems on behalf of producers. Some single PROs, e.g. RECUPEL and NVMP, have not outsourced all logistics activities, meanwhile they partly operate call center to log and dispatch their orders. They become lead organizations of inter-organizational networks in single national/sector-based take-back systems. Other single PROs such as SWICO, SENS, EL RETUR, and ECOTREL make contract with different logistics and treatment partners for collecting and recycling. They act as network administration organizations by coordinating and governing the entire network of reverse logistics. Figure 64 describes the level of connectedness and the roles of single PROs in the relationship with partners in inter-organizational reverse logistics network.

The majority of single PROs support monopolistic mechanism due to the large scale of collective system and the release of logistical difficulty of coordinating with different take-back system providers, as in competing collective take-back system. Moreover, producers who support collective models identify the additional costs of managing a national clearing house, separate collection containers, extra logistics, etc. and pointed to economies of scale of national system, especially in small countries where volume of WEEE are not sufficient to create a viable market for multiple competing take-back systems.[862] The model of single PRO in national take-back scheme is responsible for operating, overseeing, and supporting logistics operations and treatment. Each single PRO monitors the scope and logistics arrangement for take-back system, and allocates the collected WEEE to recyclers, calculate and charge the treatment and transportation costs that each member has to bear.[863]

[861] See Sander (2007), p. 133

[862] See Savage (2006), p. 8-9

[863] See Toyasaki (2011), p. 2

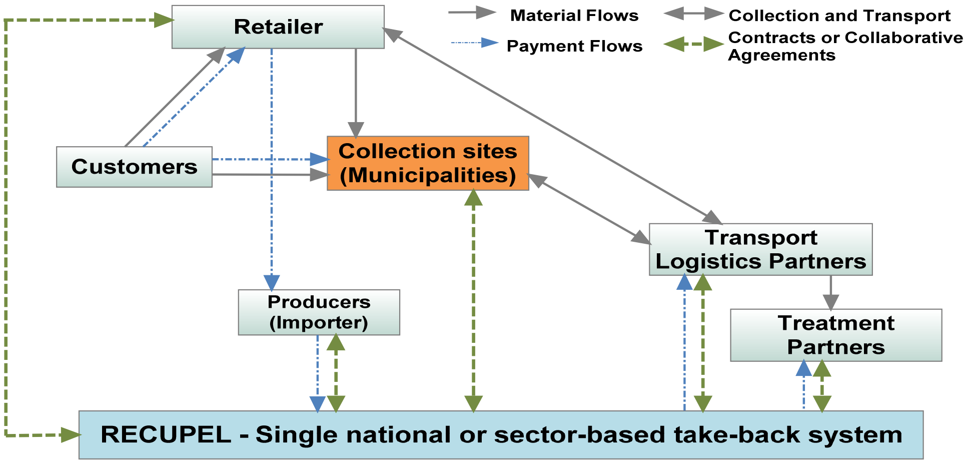

Figure 64: Network relationships in single national/sector-based PROs

Source: Own Illustration

During the last decade, single national or sector-based take-back systems have extended their inter- organizational networks by the increased outsourcing logistics and treatment activities to more service providers due to the increasing volume of WEEE, the pressures on monopolistic mechanism, the versatility of service providers, and the cost efficiency. They also have increased collaborative agreements with local municipalities, retailers, and other organizations (e.g. schools, secondhand shops, society associations) for being collection sites. Most of single PROs have used more multiple recyclers and transport firms selected based on competitive tender (e.g. quality, price and location) for controlling, reducing costs and avoiding monopolistic mechanism. Most systems have developed long-term contractual relationship with both general contractors and specialized subcontractors, suggesting the increased strategic partnerships in inter-organizational network for RL operations. Table 29 presents the current collaboration with collectors, and transporters and treatment partners of single nationwide take-back schemes.

Scheme	No. of transporters		No. of recyclers		No. of municipal points	
	2002	2010	2002	2010	2002	2010
RECUPEL	1	7	5	13	379	520
SWICO[864]	1	4	15	7 (25)	400	600
SENS[865]	-	100	18	21	450	436
NVMP	3	3	4	6	600	-

Table 29: Increased collaboration in inter-organizational networks of single take-back systems

Source: DIT (2003), RECUPEL (2010b), SWICO (2010), SENS (2010a), NVMP (2010)

For example, RECUPEL in 2002 worked in collaboration with only specialized transport firm for the whole Belgian territory, which organized collections for both municipal sites and retailers. RECUPEL also maintained some in-house transport capacity. RECUPEL had contracts with 4-5 specialized recycling and treatment providers that specialize in different waste flows at this time. Today, RECUPEL has developed its collection networks by increasing collaboration with different partners. Its network relationships includes all 520 container parks of Belgium (89 serviced directly, 444 serviced through regional transshipment stations), 29 inter-municipal regional transshipment stations, 20 used goods centers acting as regional transshipment stations, 5 re-distribution centers of retailers, approximately 3340 retailers, and collection facilities such as repair companies and waste management companies. RECUPEL has also increased its network collaboration with 7 main logistics partners and 14 treatment partners for WEEE management in Flanders and the Walloon region, with between 2 and 8 treatment partners per product flow. Partners are selected by international

[864] Collection points of SWICO in 2004 (400) and 2011 (600) beyond distributors or retailers premises for collection points (6000)

[865] See SENS (2010a, 2010b), p. 2 & p. 1. 100 logistics by SENS' treatment partners are under contract with SENs and have to be accredited by SENs; 400 collection points are official SENS including 100 municipalities in 2006, beyond 11000 retailer collection points. SENS accredited 21 treatment partners that were selected based on a rating system and the fulfilling of the SENS standard. A further 50 dismantling companies are involved in the SENS system as sub-contractor of the treatment partners.

tenders and contracts are signed for 3 years. RECUPEL has also developed a comprehensive homepage for all relevant administrative and coordination tasks with various stakeholder and partners such as submission of affiliation contracts for members, declaration of market input, registration of collection points, submission of transport orders, confirmation of amounts collected and delivered etc. The system is linked to an interactive software tool allowing information sharing, administration and other documentation tasks.[866]

In case of SWICO, beyond the increased collection points of distributors or retailers (6000 points), it has also developed its own collection points to 600 sites by making agreements with diverse partners including municipalities, railway stations, recycling/dismantling companies, and transport and waste companies. SWICO has had a long-term partnership with a logistic coordinator Cargo Domicile since 2002 by signing a general contract with a single haulage firm for the entire Swiss territory due to the high quality of reverse logistics service offered by this company. The partnership with Cargo Domicile has been extended until now with the support of three regional transport partners as sub-contractors to ensuring a 24 hours service for the take back of old equipment all over Switzerland, especially from the trade and business customers. There are 7 contracted recycling companies performing the task of recycling used WEEE equipment. These companies continuously collaborate with 25 subcontractors of dismantling companies that employ staff in social welfare institutions. SWICO have increased their inter-organizational collaboration with distributors, logistics and recycling partners to create a competitive take-back system with effectiveness and efficiency for all members in the entire network.[867]

All single PROs have been supported increasingly by the use of the Internet and other IT for all collection requests, partner communication and information sharing. PROs also pass the transport request on to its transport providers immediately through online communication. Via the website, each PRO has a permanent record of which orders are still to be performed and which are still open. Completed orders are stored in a performance data warehouse. All stakeholders have easy access to the core figures held in the data warehouse.[868] The data and practical case studies of some single take-back schemes have proved that the increased information sharing and the intensified collaboration between PROs and other stakeholders in dealing with EoL products have motivated the adaptability to reverse logistics system. Increased collaboration and strategic alliances among partners in collection and treatment EoL products via both direct and indirect ties have improved network relationships, increased information, and resource sharing, which optimize reverse logistics processes for the whole network, and achieve greater effectiveness and efficiency for each member of inter-organizational reverse logistics system.

For example, in term of total volume collected in 2010, Figure 65 and Figure 66 demonstrate that all the existing systems have increased continuously their total collection of WEEE and obtained high WEEE collected per capita. These take-back systems have collected much more than the target set out of 4 kg per capita adopted in EU WEEE Directive. Switzerland collected the largest annual volume per capita running by two PROs (SENS & SWICO) with different categories of WEEE at nearly 16.5 kg per capita, followed by RECUPEL (9.8 kg per capita) and NVMP (6.36 kg per capita). The figures show that the collection in the oldest systems (SWICO and SENS) has obtained the stable context to the amount of WEEE arising because of improving continuously process efficiencies at collection points. Switzerland continues to lead the way among European countries with over 14 kilograms of electrical and electronic appliances collected and recycled per person per annum.[869]

Almost these take-back systems have achieved these objectives of recycling rate between 70% - 100% for different kinds of waste from electrical and electronic products. The increasing collaboration through concrete agreements of recycling responsibilities and standards have recorded the growth of recycling rate in all system examined.[870] For example, 75% to almost 90% of electrical appliances, and even up to 95% of energy

[866] See RECUPEL (2010a), p. 3 - 14; Cf. also RECUPEL (2010b), p. 2

[867] See SWICO (2010), p. 5; SENS (2010a), p. 6

[868] See RECUPEL (2010a), p. 12

[869] See SWICO (2010), p. 4; RECUPEL (2010b), p. 3; NVMP (2010), p. 5, SENS (2010b), p. 1

[870] See SWICO (2010), p. 4; RECUPEL (2010b), p. 3; NVMP (2010), p. 5, SENS (2010b), p. 1

saving light bulbs, are recycled in recycling partners of NVMP in 2010. NVMP have established more local collection points by encouraging schools, clubs and associations, municipalities, shopkeepers and consumers to join the inter-partner network of collection, and then they organized special collection activities and carries out communication campaigns. These results can be achieved only by close collaborative work contributed by all partners and stakeholders involving the networks of collecting and recycling WEEE in the Netherlands.[871]

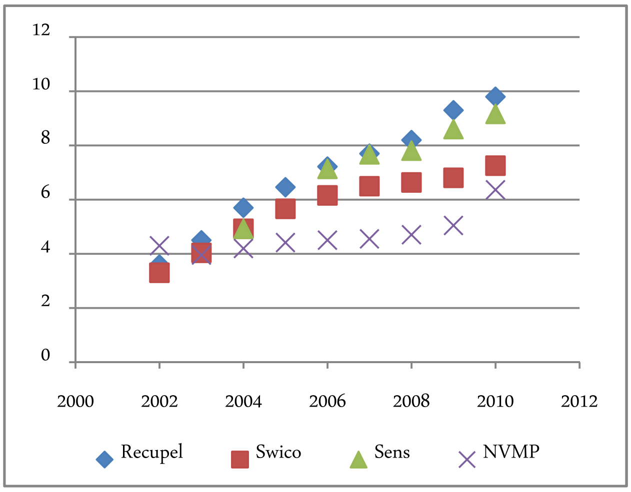

Figure 65: WEEE collected per capita (kg/capita)

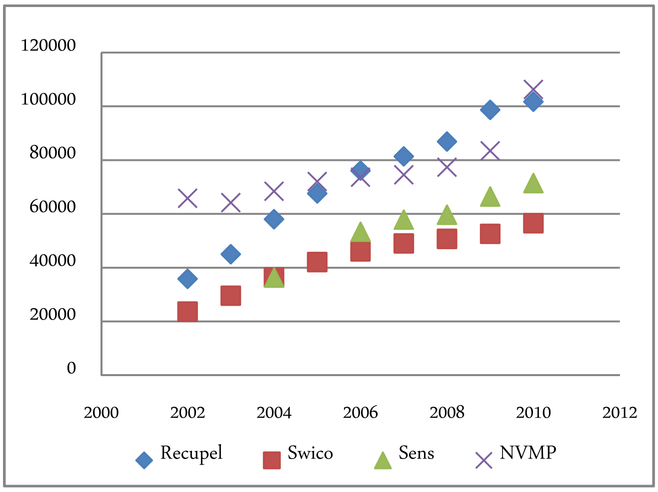

Figure 66: WEEE collected (million tons)

Source: Data collected and recalculated from DIT (2003), Savage (2006), RECUPEL (2002, 2010a), Khetriwal et al. (2007), SWICO (2010), SENS (2010a), NVMP (2010)

In 2002, the average direct cost of logistics and treatment of WEEE in these system varied from 0.35 Euro/kg to 0.64 Euro/kg.[872] In recent years, the costs of logistics and treatment have decreased steadily in almost existing systems with the variance range from 0.31 Euro/kg to 0.53 Euro/kg.[873] These variations reflect different labor costs, geographies, product areas, and recycling standards. However, generally, there has the trend of reducing costs related to reverse logistics and recycling in all schemes examined in 2010. Each scheme has looked for new optimization possibilities in their context, such as examining and collaborating the process of transporting waste to the processors between logistics partners and recyclers in case of RECUPEL as well as increasing collaboration with collection partners through varying various networks as the effective initiatives of NVMP to obtain optimal collection and recycling costs. By using tenders for collection and recycling of discarded products, the logistics and recycling costs of all schemes have been reduced in recent years. Besides, the higher raw material prices are also favorable for the processing rate over the last decade. Since 2004, the rate of logistics and recycling cost in both SWICO and SENS has reduced by more than half from 1.01 Euro/kg and 0.81 Euro/kg to 0.53 Euro/kg and 0.45 Euro/kg, respectively. Figure 67 and Figure 68 illustrates the total costs of managing WEEE and the costs of logistics and recycling in each scheme examined over the last decade.

PROs in both collective competing and single take-back systems have worked together with local operators, e.g. municipal waste management companies, logistics providers, and recycling companies, for collecting and recycling WEEE to deliver the best results. The decrease in per unit of collection and transportation cost as well as recycling cost has proved that the effectiveness and efficiency of these take-back systems to some extent. The increased collaboration between network members and the effective governance of network relationships have supported these systems to adapt to reverse logistics at network level, therefore reducing the costs of the whole network and increasing the competitive advantages. The effectiveness and efficiency of these collective take-back systems brings the economic and ecological benefits for not only network members but also the whole society in a closed-loop economy.

[871] See NVMP (2010), p. 8

[872] See DIT (2003), p. 6

[873] See NVMP (2010); Cf. also RECUPEL (2010a); SWICO (2010); SENS (2010a). Recalculate following the data from these sources.

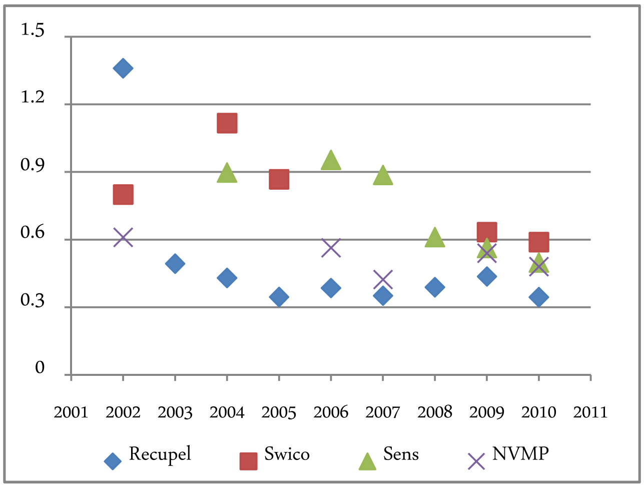

Figure 67: Total costs of EoL management (Euro/kg)

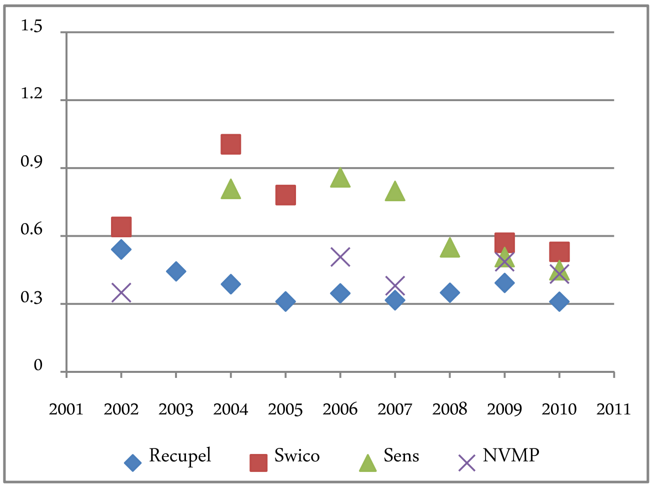

Figure 68: Costs of logistics and treatments (Euro/kg)

Source: Data collected and calculated from DIT (2003), Savage (2006), RECUPEL (2002, 2010a), Khetriwal et al. (2007), SWICO (2010a), SENS (2010a), NVMP (2010)

6.4.3. Large waste management/recycling companies as lead organizations

Due to the requirements of take-back laws (e.g. packaging waste, EoL vehicles, and WEEE), there have been organizational changes in recycling industry under the trend of centralized awarding of recycling contracts by OEMs, producer consortia, single national and competing collective take-back systems for monitoring the collection and recycling targets.[874] Service providers of dismantling and recycling have responded by increased cooperation to extend their range of services, increased investment to achieve higher levels of environmental quality, offer comprehensive waste management services, and realize synergies in sharing resources and capabilities when entering new markets.[875]

In pan-Europe scope, in 18 months from the start of 2006 there have been 16 major mergers and acquisitions in recycling/waste management industry in Europe, with a total price of over 12.5 billion Euros.[876] The forms of inter-organizational collaboration in this industry over the last decade have varied with joint venture, strategic alliances, and contracts with unaffiliated firms.[877] In 2008, there was a significant increase of deals in the recycling sector, which accounted for 66% of all deals completed in this year.[878] There has been significant concentration in the sector as a result of the transactions to increase market share, positions, and turnover in European level. The concentration can also be observed in national scope as well as with different levels. For example, the percentage market share of the three largest waste companies exceeds 40% in Spain, France, Netherlands and Belgium, and is close to it in Germany.[879] Recent takeovers have concentrated the waste management sector in Germany into four large private groups (see Figure 69). There are now no waste management and recycling companies with annual sales over €100 million left for sale in Germany. Strategic alliances between large-sized recycling companies at national level have also increased for recent years. For example, the strategic alliance between Interseroh and Alba Recycling group in 2011 has brought substantial benefits for both companies, their sub-contractors, and their customers. In cooperation with ALBA, Interseroh can offer its customers from a single source, with the full-range of package services for WEEE including waste avoidance concept; returns, logistics and recycling concepts; the operations of collection, recycling of waste and recyclable materials, trading in secondary resources, industrial supplies of raw materials and closed-loop systems.[880] Strategic alliance between SITA and Geodis is also one

[874] See Walther/Schmid/Spengler (2008), p. 334; Cf. also Spengler et al. (2010), p. 465
[875] See Lemke (2004), p. 178
[876] See Hall (2007), p. 3
[877] See Magali (1999), p. 637
[878] See GRANT THORNTON (2009), p. 1
[879] See Hall (2007), p. 7
[880] See INTERSEROH (2011), p. 7

of typical cases of collaboration in reverse logistics networks of WEEE management. SITA and Geodis decide to pool their skills and networks to create a dedicated entity, which specialize in WEEE management and product from the automotive repair and maintenance business, by setting up a 50-50 joint venture. This joint venture benefits from the combined expertise of both SITA and Geodis subsidiaries in operations management, logistics, reprocessing, and marketing for processed products to offer better services of reverse logistics at European level.[881]

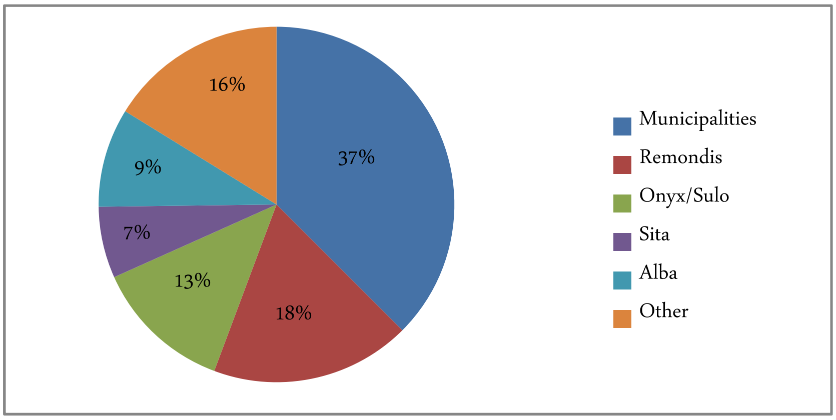

Figure 69: Market shares in German waste management

See: Lindauer (2006)

The content analysis discovers that in order to provide OEMs and distributors with take-back and product recovery services for WEEE management, large waste management/recycling companies have also adapted themselves as collective take-back systems with the roles of primary lead organizations in inter-organizational reverse logistics system. They are responsible for operating directly the works of take-back and recovery for their customers and coordinating network members to provide full package of RL services, e.g. ALBA, Remondis, and SITA. For example, twenty competing take-back system providers are today operating for WEEE management in Germany mostly managed by the involvement of waste management companies.[882] They also can operate as secondary lead organizations in the contract with producer consortia or PROs, and other take-back system providers. The take-back systems operated by large waste management/recycling companies often have advantages of offering a lower treatment price because they have been involved themselves for a long time in the investments in physical capabilities of technologies, equipment, and facilities for treatment. However, the investments are not specific to any transaction since recyclers' investments are not tied up to a particular buyer or processed product.[883] Therefore, participating in inter-organizational networks of reverse logistics as lead network organizations allows large recyclers to gain certain volume of waste for their plants, to benefit from their in-depth knowledge of waste treatment process, and to exploit the efficiency due to economies of scale. The low frequency of transaction on the annual basis, and the low uncertainty of transaction (e.g. OEMs and PROs do not have high specific investments related to the transaction, and they can contact with different recycling companies) indicate that the contractual relationships are popular in the networks led by waste management/recycling companies.[884]

However, in the roles of both operators and coordinators, large waste management/recycling companies have increased their strategic collaboration with other logistics service providers, dismantlers and recyclers on nationwide and a pan-European scale to support them in offering a full package of RL operations. For example, Remondis has operated themselves, controlled, and coordinated relationship networks handling operations of national take-back and recycling of large household appliances for a producer consortia with 30 large manufacturers including BSH, Philips, Miele, SEB Germany, Kärcher and Vorwerk, etc. Remondis is one of the cases motivating integrated concepts among individual companies as well as systems that connect

[881] See Geodis (2011), p. 1

[882] See Perchards (2007), WEEE Information Service. Country Report: Germany

[883] See Gobbi (2008), p. 203

[884] See Pfohl/Bode/Nguyen (2012a), p. 15

several companies working together to provide full package of RL services. Remondis has attached great importance to cooperating as partnership with different partners including producer/distributors, take-back schemes (e.g. ERP, Ecosystem, and Ecologic), local authorities, municipalities, disposal partners, and logistics service providers.[885] The goal of inter-organizational networks operated by large waste management/recycling companies is to offer services ranging from collection to treatment and recycling, regarded as "one stop shop" approach in operating reverse logistics services with coordinated and centralized procedures.

This company has set up a close network of branches and transfer points as well as logistics and dismantling centers, with the support of closely cooperative partners assessed by Remondis like Rhenus Logistics.[886] Remondis has established consolidation centers throughout Germany where this company and its logistics partners take over the discarded products at the municipal collection points and consolidation centers and transport them to the dismantling centers. Remondis have used IT solutions for many years to set up interfaces to the customers, to the partners, to the operators of take-back system as well as to government body. For example, as soon as a municipality reports that a container is full, Remondix must connect with local disposal partners to collect it within 48 hours. Remondis has more than 6,000 company-owned trucks to carry out the work and coordinates a wide network of independent haulage businesses. Moreover, Remondis is operating three dismantling centers in Germany and six ones in neighborhood countries including France, Poland, and Austria with a wide range of reprocessing facilities for different kinds of WEEE. A close network of relationships with partners helps Remondis ensure the effective and efficient way to collect, transport and recover the discarded products, which have brought the benefits of environmental-friendliness, greater efficiency, higher quality and cost reduction for each customer and the whole network of their inter-organizational reverse logistics system.[887]

The changing environments have led to the adaptability of large waste management and recycling companies that can benefit all stakeholders in reverse logistics networks when the economies of scale in recycling are strong. Therefore, we highlight the capabilities large waste management/recycling companies as lead organizations of centralizing operations of product take-back and recovery by combining resources and developing capabilities in recycling industry with the proposition:

Proposition 3: Reverse logistics performance can be more cost-effective with the development of inter-organizational collaboration between recycling companies.

6.4.4. Logistics service providers as lead organizations

The content analysis shows that OEMs, distributors, and take-back system providers such as producer consortia or PROs, and recycling companies have increasingly outsourced reverse logistics operations with logistics service providers (LSPs). They include both third-party logistics providers (3PLPs) and professional reverse logistics providers (RLPs). While RLPs offer only take-back and recovering services, many OEMs and distributors want to integrate their logistics operations for both forward and reverse flows[888] because the greater the consolidation of tasks provided by the 3PLPs, the lower the transaction cost is.[889] This leads to increased collaboration between manufacturers/distributors with 3PLPs in managing product returns because it can allow not only for inventory carrying cost, transportation cost, and waste disposal cost, but also for the improvement of customer loyalty and future sales.[890] The main benefits of outsourcing reverse logistics to 3PLPs is that these 3PLPs offer a reverse logistics program without interrupting forward flows; moreover, logistics cost can be reduced. 3PLPs have served a critical role for achieving effective logistics integration by which inter-and intra-firm activities are integrated to enhance customer satisfaction and provide a competitive advantage.

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[885] See Remondix (2011), p. 3

[886] Rhenus Logistics - a sister company of REMONDIS, takes care of the forward logistics for many manufacturers of electronic equipments in Europe

[887] See Remondis (2007, 2008, 2010)

[888] See Ko/Evans (2007), p. 1

[889] See Ellram (1991); Cf. also Hobbs (1996)

[890] See Ko/Evans(2007), p. 2-5

Conventional 3PLPs were hesitant in offering fully integrated logistics program in the 1990s, but this seems to be changing.[891] The increased volume and scope of reverse logistics services demanded from 3PLPs have given rise to their changing role, where today they are engaged in strategic coordination of their customers' integrated supply chain activities.[892] 3PLPs may now serve manufacturers and distributors in the European electronics industry ranging from forward logistics, returns management and recovering services, and therefore bring value-added services and reduce costs for both 3PLPs and their customers.[893] During the last decade, many 3PLPs have started offering reverse logistics as one of their core competences. We have observed some case studies in practices (see Appendix 5) and found that more 3PLPs have added reverse logistics to their full package services, and more specialized firms have developed core competency in providing RL services. For example, DHL has evolved from a provider of simple delivery services to offering complete services of inbound logistics, outbound logistics, and reverse logistics, especially with its service packages of return repair inventory and real-time control of complete reverse logistics processes.[894] Rhenus Logistics has offered the entire process chain from manufacturing through distribution to reverse logistics for waste appliances including replacement parts management, repair services, recycling services, and returns management.[895] CCR Logistics has developed as a specialist in the development and implementation of Europe-wide reverse logistics solutions for products, components, and materials with a focus on B2B solutions.

In inter-organizational reverse logistics networks, 3PLPs and RLPs have adapted and embedded themselves in relationship networks as secondary lead organization with the roles of operating and coordinating reverse logistics operations.[896] However, the functional role of 3PLPs as a RL service provider in practice is limited, most 3PLPs can only provide limited functions of transport, collection and warehousing services rather than the whole processes of reverse supply chain management. There has been also the tendency toward consolidation in number of logistics suppliers over the last decade.[897] The trend of consolidation and collaboration between LSPs has developed them as Fourth-Party Logistics Providers (4PLPs) that can fully provide comprehensive RSC management solutions in the European electronics industry, indicating the adaptability to reverse logistics at network level, e.g. CCR Logistics, Geodis, RENE AG, and Wincanton. 3PLPs and RLPs in these cases are treated as a strategic partner, rather than a tactical one and is a supply chain integrator that synthesizes and manages the resources, capabilities, and technology of its own organization with those of complementary service providers to deliver a comprehensive supply chain solution.[898] They operate as "solution integrators" that manage integrated reverse logistics processes for customers and coordinate complex networks to combines resources and capabilities with several partners.[899] They can consolidate the scattered reverse logistics tasks from different OEMs and take-back system providers to assign integrated tasks to most suitable service providers. For example, Wincanton in UK has brought together some service providers into strategic partnerships known as 'REVIVE' to provide a 'one stop' solution for all aspect of returns and EoL management, in which this company works with Remploy in reuse area, collaborates with Grundon and Simms in waste management. Wincanton has also joint venture with US software company GENCO, namely R-Log, who provides reverse logistics expertise with a sophisticated logistics interface to manage functions such as counting, tracking, auditing, storage, and quota satisfaction.[900]

LSPs have increasingly offered the integrated supply chain solutions of transporting, warehousing, order fulfillment, and especially designing and managing solutions for take-back, recycling and remarketing of

[891] See Delfmann (2007), p. 23

[892] See Zacharia/Sanders/Nix (2011), p. 1 & 4

[893] See Murphy/Poist (2000); Cf. also Knemeyer et al. (2003)

[894] See Rupnow (2007), p. 2

[895] See RHENUS (2011), p. 1

[896] See Pfohl/Bode/Nguyen (2012a), p. 16

[897] See Persson/Virum (2001), p. 53

[898]See Setaputra/Grove (2006), p. 718; Cf. also Pinna/Carrus (2006), p. 106

[899] See Pinna/Carrus (2008), p. 106

[900] See Wincanton (2004), p. 41

returned products. In order to create the competitive advantages for their RL networks, they have developed relational capabilities, e.g. information sharing of rules, knowledge, and common view and culture to create and maintain relationships with stakeholders and partners. These relationships can be short and long-term contracts with OEMs, distributors and PROs; strategic partnerships with recyclers; and political relationships with governmental agencies, NGOs, and industry associations. Logistics providers have also improved their organizational capabilities through improving skills of purchasing and negotiating with sub-contractors of treatment or transport services, structuring the network, assembling and controlling resources of different services providers.[901] Therefore, they can facilitate the involvement of the services suppliers of collecting, dismantling, and recovering, especially with the participation of small dismantling and recycling companies. 3PLPs and RLPs have also increasingly invested in physical capabilities by developing their own specific assets and motivating the integration of resources from complementary service providers. Specifically, the investments for increasing the capacities of information systems and logistics of the LSPs are necessary for the improvement of the reverse logistics processes to ensure spread information, control the suppliers, and facilitate the commitment of customers facing statutory obligations. LSPs benefit from experience feedback and get more involved with customers owing to newly acquired know-how.[902] Comprehensive investments of specific assets of treatment and recovering returned and discarded products have not been found popularly in developing physical capabilities of LSPs because they position themselves on the market of reverse logistics on a European level by offering a global service of organization of various service providers.

For example, some LSPs such as Geodis and CCR Logistics can provide pan-Europe solutions with a single point of contact providing reverse logistics services for many individual OEMs and distributors, and collective take-back systems in the European electronics industry (see Figure 70). Geodis has collaborated with ERP for the design, implementation, and coordination of recycling operations of EoL products in France, UK, Ireland, Spain and Portugal. Geodis has also cooperated with IBM Europe through a longstanding partnership to perform the remanufacturing and refurbishment of IBM's end-of-lease personal computers in its dedicated site in Mainz. Geodis has carried out different activities including collection of the returned product through Europe, moving to an Asset Recovery Center in Mainz run by Geodis, inspection and testing, refurbishment and repair, dismantling and harvesting parts of products, disposal of the computers and redistribution following IBM orders. The transportation, handling services, and pre-treatment are partly performed by Geodis and partly outsourced, depending on the infrastructure capacity deployed in each country. An integrated track and trace system allows Geodis and IBM to follow the entire inbound logistics for each picking and for 15 European countries serviced by Geodis. Following this process, 85% of the received computers in this center are resold and all the parts utilized for repair come from the dismantling of the machines that cannot be repaired and resold. Millions of machines are repaired, recovered and redistributed under this contract.[903]

It clearly appears that LSPs as supply chain integrator or 4PLPs interact with all the stakeholders of an inter-organizational reverse logistics network and that they act as intermediating actors among the suppliers on the market, the political actors, the salvagers and the operators, and, finally, the holders.[904] This solution economizes on logistics costs, but certainly complicates the network due to a range of product varieties and different types of network actors. By offering full package of reverse logistics services, they have increased their roles as lead organizations in managing and coordinating the value-creating networks of inter-organizational reverse logistics system. The trend will be continuously developed due to the increasing reliance on collaboration and synchronization of the integrated supply chain between various partners and stakeholders,[905] suggesting rather highly adaptability to reverse logistics at network level.

[901] See Pfohl/Bode/Nguyen (2012), p. 16

[902] See Monnet (2008), p. 14

[903] See Janse et al. (2009), p. 64; Cf. also Geodis (2007), p. 530 - 531; Gobbi (2008), p. 122-126; Fleischmann (2004), p. 7-8; EPR (2009), p. 27-28

[904] See Monnet (2008), p. 10

[905] See Sangam (2008), p. 4

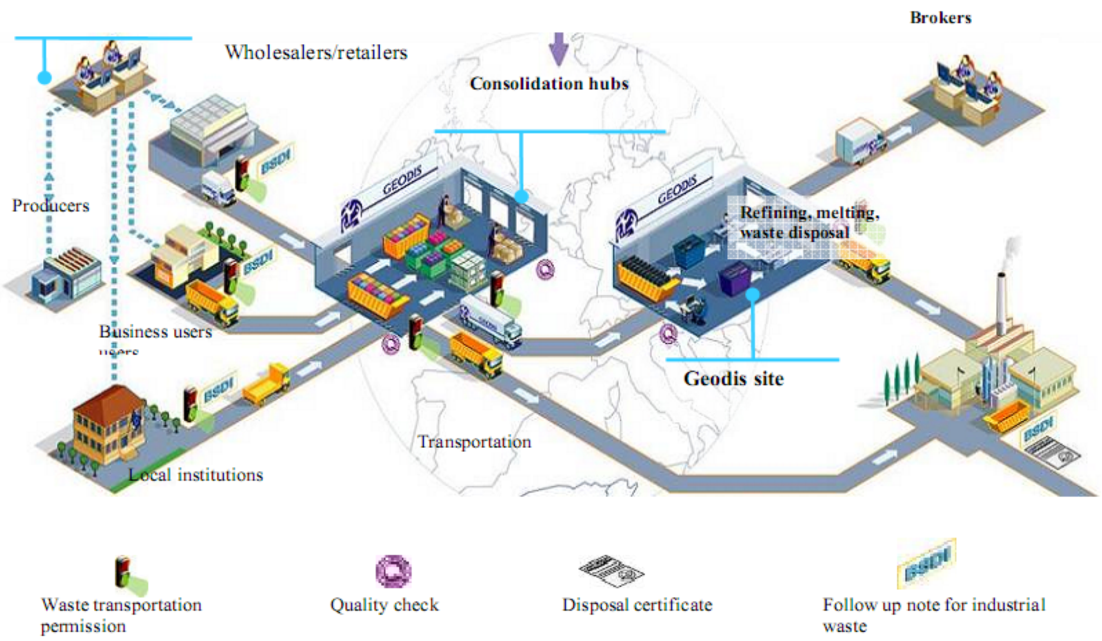

Figure 70: Network relationships coordinated and governed by Geodis

Source: Janse et al. (2009), p. 64; Cf. also Geodis (2007), p. 530 - 531; Gobbi (2008), p. 122-126; Fleischmann (2004), p. 7-8

This study highlights the adaptability to reverse logistics at network level of LSPs in reverse logistics operations through the propositions:

Proposition 4: Operations of reverse logistics can be more cost-effective with the development of LSPs as supply chain integrators or 4PLPs.

6.5. Adaptability to reverse logistics at regional network

The enforcement of European WEEE Directive has created changes of business process, logistics chains, and information flows for not only producers but also regional small and medium companies in the sector of electrical and electronic waste disposal and public waste management companies. They have reacted quickly and adapted to the changing national regulations. Currently they are under pressure to stick out the new role in the waste management system to develop a corporate strategy and to take the opportunity to act in regional cooperation to achieve potential competitive advantages.[906] The changes of strategy and increased collaboration with both regional recycling companies and public waste management companies suggest the adaptability to reverse logistics at regional networks.

Municipalities and recycling companies

Prior to the WEEE Directive, decentralized regional networks for collecting discarded EEE in Europe have been developed for a long time in Europe. Some of discarded EEE were collected by informal collectors and secondhand market. Many of them were commonly collected by municipalities and usually recycled by a contracted disassemble or recycling company, e.g. Germany, Denmark, Netherland, and Sweden. The disassembly companies are in form of social enterprises, community-based recycling organizations (CBOs), and small and medium private dismantlers/recyclers. For example, long-term supply agreements between public waste management companies with independent disassembly companies have been common in Germany before the transposition of the WEEE Directive to the Electrical and Electronic Equipment Act (ElektroG).[907] The Strasbourg Urban Community has signed a service contract with ENVIE 2E to collect household appliances from municipal waste container parks and domestic appliance retailers to repair for reuse, or to dismantle for recycle since 1995. Following the example of Strasbourg, nine other French municipalities have contracted with ENVIE 2E for managing WEEE. The collaboration between GOAB GmbH and Offen-

[906] See Luger et al. (2010), p. 122

[907] See Spengler et al. (2010), p. 465; Cf. also Walther/Spengler (2005), p. 337

bach Commune in sorting and dismantling WEEE since 1989 is another example of regional network relationships in reverse logistics operation.[908] Local municipalities in Denmark worked with approximately 30 small and medium-sized enterprises that specialize in WEEE treatment before this take-back system transferred to competing take-back schemes. Small private sectors and social enterprises in WEEE collection existing in many countries in Europe are represented mainly by external contractors to local authorities (mostly local small and/or medium-sized enterprises).[909] These partnerships result in a network for exchange of experiences and contribute to WEEE reductions, increase of recovered assets, cost savings for society, job creation for unemployed and disadvantaged groups, and friendly environment.[910] The high level of regional diversity has created opportunities for municipalities and disassembly companies with specialized knowledge of their respective regions to have advantages in regional networks of reverse logistics operations.

Since the adoption of WEEE Directive and transposition to national regulations in 2003, OEMs in the European electronics industry have to take back their EoL products nationwide and provide an appropriate recovery and recycling program. Disassembly contracts have now been no longer operated in a decentralized ways by every single public management company, but are centralized by producers, producer consortia, and their take-back system providers.[911] However, the WEEE Directive leaves broad scope for the EU Member States to determine which actors should be responsible for the physical management of collecting WEEE from households up to the collection facilities, as well as the financing of such activities. This has led to a variety of solutions by different countries in which producers, distributors, and municipalities, or a combination of two or three of these actors, are responsible for collection of WEEE from households or non-households sources (See Appendix 1). The involvement of many stakeholders in collecting discarded EEE has increased the cooperation in regional networks.

Collection channels offered for household WEEE include regular curbside pick-up and designated drop-off collection points by municipalities, retailer take-back and storage, producer take-back and storage, and other collection points offered by PROs. An observation of the level of collection achieved and the actors in charge of collecting WEEE from households in Europe reveals that the top three countries that achieve a collection rate of greater than 50% engage the municipalities in the collection activities. Except for one, the same is observed among nine countries that have achieved a collection rate of greater than 30%. Among the nine countries with the collection rate of 30% or more, six involve distributors, while two involve producers. It should be noted that the majority of these top performing countries also had well-established waste collection systems from households that were principally handled by municipalities. This could be another explanation for the extensive use of municipalities in collection activities and their important roles in regional networks of reverse logistics systems for EoL management.[912] Many municipalities in European countries have developed a company strategy for WEEE and adapted themselves as a regional collection stations where discarded products from OEMs' and retailers' collection points are sorted, and separated.[913] A number of sorting containers and/or pallets are provided for municipalities according to the product scope and logistical arrangements with regional collection sites, recyclers and transporters.[914] Many take-back system providers have increasingly used increasingly regional collection stations as regional hubs to which retailers, producers, and municipalities in regional networks can bring discarded products for consolidation. The model has simulated optimal logistics solutions for all partners involved in collecting process of WEEE,[915] especially for increasing the level of cooperation between OEMs, producer consortia, take-back system providers, dismantlers, recyclers, and municipalities

[908] See Vindigni (2012), p. 1- 3

[909] See Antonioli/Massrutto (2011), p. 6,

[910] See Vindigni (2012), p. 2

[911] See Spengler et al. (2010),p. 465

[912] See Tojo/Frischer (2011), p. 14

[913] See Lehtinen/Poikela (2006), p.

[914] See DIT (2003), p. 17

[915] See ICT Milieum (2010); Cf. also NVMP (2010); Recupel (2008)

Since reverse logistics operations for EoL management are now more centralized by disassembling contracts from OEMs, producer consortia, and take-back system providers. Most of them have outsourced tasks of pick-up, transportation, and treatment to service providers, e.g. a recycling network or a large recycling company.[916] Collaboration in regional networks between municipalities and independent disassembly companies have now adapted by the development of recycling networks. Different transportation and disassembly companies in the networks can pick up products at the municipal collection points. It may lead to some issues of implementing the tasks of collection and pick-up. For example, an equal container size for pick-up is necessary in order to allow a flexible and varying system to work. Thus, it is necessary to intensify the collaboration work with recycling networks to optimize logistics processes and ensure the quality of discarded products at the gate of disassembly companies. Companies within recycling networks are now more interested in cooperating with municipalities because they can increase the collection volume for economies of scale and obtain masses for reuse and treatment within their region.[917] By close cooperation with municipalities, disassembly and recycling companies can share information with regard to reusability and sorting criteria upon which the following processes are facilitated or additional value can be obtained.[918] Although decentralized collection and treatment networks have been no longer existed, it is renewed under the regional cooperation between recycling companies in a network and municipalities, indicating the adaptability to reverse logistics at network level.

Local retailers and their regional partners

Although the majority of take-back system providers have organized collection of WEEE primarily around the municipal collection system over the last decade, there is also the increasing trend of using retailers as collection centers in regional networks of reverse logistics system in many countries in Europe (See Appendix 1). Regarding physical responsibilities, in 16 counties in Europe, besides their actual role as vendor or provider of distribution channels for electronic products, retailers are required to involve in the collection of EoL products through their distribution channels on a one-to-one basis.[919] Therefore, local retailers have also adapted to the regulatory requirements by increasing the collaboration with their regional partners.

In the reverse logistics system of Switzerland for WEEE, the national take-back regulation has mandated all electronics retailers to take back discarded products from customers since 1994 because of several benefits they provide such as their availability of storage and transportation logistics chain in place, their wide coverage and easily accessible locations, their closer relationships with producers than municipalities. More than 10,000 retailer premises are used as collection points for two single sector-based take-back systems (SWICO and SENS) in this country.[920] On the Swedish market, single El-Retur take-back scheme has exclusively accessed to municipal collection sites since 2001. However, a new take-back network is emerging that most likely use the existing nation-wide network of large retailers on a one-to-one basis. In this case, producers are obligated to manage EoL products collected by retailers, while municipalities are responsible for managing WEEE that is discarded to municipal collection sites.[921] In other schemes such as RECUPEL (Belgium), NVMP and ICT Mileu (The Netherlands), Danish system (Denmark), AMB3E and ERP (Portugal), and WEEE Ireland and ERP (Ireland) have required intensive involvement of retailers as collection and storage facilities, again with varying levels of reciprocation.[922] Nearly 30% of WEEE volume in Europe has been collected by retailer networks,[923] indicating that retail site has become a significant stakeholder in regional networks. Therefore, distributors nowadays have expanded their regional network relationships with municipalities, regional operators, and recyclers for collection of discarded products in reverse logistics system.

[916] See Walther et al. (2010), p. 466

[917] See Luger et al. (2010), p. 123-125

[918] More detail examples of cooperation between municipalities and recycling companies can be referred by Luger et al. (2010), p. 123-129; Cf. also Spengler et al. (2010), p. 467

[919] See Sander et al. (2007), p. 60

[920] See Khetriwal et al. (2007), p. 4-5

[921] See Sander et al. (2007), p. 186

[922] See DIT (2003), p. 35; Sander et al. (2007), p. 156

[923] See DIT, (2003), p. 38; ERP (2009), p. 14

Take-back system providers coordinate with distributors by collecting the appliances to comply with the laws, in turn the distribution sector, for its part, helps take-back schemes by providing consumers with information about recovering and recycling programs. Increasing agreements and collaborations with municipal associations allow retailers in single take-back schemes to bring appliances in small quantities to their local container park or regional transshipment station free of charge.[924]

Local retailers contribute to achieving a higher collection rate of discarded products for the whole network and streamlining returns management to satisfy customer and increase profit.[925] By providing take-back services from retailer stores, they can have opportunities to improve their company image by activity of environmental protection, to increase their sales by the principle of new for old, and to build their customer relations. Retailer collection is taken place in two basic forms in which consumers can drop off old appliances at the stores, mainly used for smaller size appliances; and can give back to retailers' logistics partners when a new larger appliance is delivered to the consumer's home. However, the most important function of retailer is to act as the first filter to separate working and functional equipment from the broken and unusable. The fact that retailers and/or their logistics partners have the choice, and the competence, to decide whether the appliance can be reused in part or whole, which give the right to retailers to reuse and resell equipment before being back for disposal.[926] As a result, the rate of reuse and recovery of returned product can be increased substantially, which bring the benefits for the whole network in a closed-loop economy

6.6. Adaptability to reverse logistics at operative network

We analyze the adaptability to reverse logistics at operative network by exploring the development of recycling networks because these networks have played an important role in increasing economic and ecological benefits in closed-loop economies in European countries. The changes of law enforcement, the growing competition, and the market maturity have made difficult for small and medium-sized dismantling and recycling companies to sustain in this market. This situation has forced many small-and medium-sized firms to align and collaborate in a larger company or a more professional recycling network to enhance the capabilities and the quality of their offering in the market.[927] For example, the number of private recycling companies in Germany is more than 6000 companies, nearly 182% increase compared with the number in 2002. They have provided various services in waste management, mostly are partial services such as collecting, dismantling, shredding, and recycling. Especially, most of them are small and medium-sized firms with an annual turnover not exceeding two million Euro. However, the market share of the four largest recycling companies in Germany is greater than 40%.[928]

An operative network of recycling and dismantling companies (for short, a recycling network) refers to inter-organizational cooperation of independent, small- and medium-sized recycling companies,[929] e.g. EARN (the European Advanced Recycling Network), LOGEX system, and ZENTEK. In recycling networks for EoL products at national level, relationship networks between small-and-medium sized enterprises has motivated the most powerful cooperation of family-owned regional dismantling and recycling companies. An external representative as a network center or a central coordination unit often coordinates this network. This center preserves the existing decentralized treatment system of small and medium-sized companies in a new form with coordinated operations. However, it acquires and negotiates contracts with OEMs, producer consortia, PROs, and take-back system providers from national or European-wide scope. It coordinates their network members, allocates processing orders to companies in the networks, and ensures their general contracts being adequately fulfilled.[930] Network members are required to have agreements amongst themselves on the conditions of the internal network for further processing. They focus on fulfilling customers' orders, reduce risks

[924] See DIT (2003), p. 57

[925] See Toffel (2004), p. 5

[926] See Khetriwal et al.(2007), p. 4-5; Cf. also ERP(2009), p. 9; DIT (2003), p. 74

[927] See Frost/Sullivan (2009), p. 1

[928] See Bünder (2011), p. 21; Cf. also Lindauer (2006)

[929] See Walther/Spengler (2004), p. 363

[930] See Walther/Schmid/Spengler (2008), p. 337

in capacity planning, encourage the development of new packages of services, and allow to share and optimize resources and capabilities of partners in the network.[931]

The coordination unit of recycling networks often aims to manage the network in a way that is able to compete with other networks, to coordinate effectively with different members, and to satisfy its customers.[932] Members in the recycling networks take on diversified tasks from transaction-base and original logistics to sorting, storage, disassembly, retreatment, recycling, and disposal. The network center depends on the frame contracts with customers, the geographical features, recycling price offer, recycling rate, and capacity and innovation to allocate works with system partners to fulfill the network's orders. Network partners that are committed to service the customers always sustain the link to the network center to exchange information and ask for consulting. By bundling volumes in different orders, larger allotments can be obtained. Thus, the network can optimize the benefits for both system partners and its customers. Moreover, the use of network partners' facilities and resources for treatment make the network meet the large quantity of customers' order and optimizes facility capacity and planning of each partner.

For example, LOGEX System in Germany consists of long-term committed small and medium-sized dismantling and recycling companies that carry out all operational services using their own vehicles, equipment, and labor. The objectives of LOGEX System are to increase the competitive advantages of small and medium-sized enterprises in providing services of waste disposal and develop new markets. LOGEX System acts a network center to coordinate independent recycling companies in the system with some administrative tasks as follows:

- conducting demand and market analysis,
- contacting customers and negotiating contracts,
- allocating processing orders to network members,
- consulting for participating companies in the network,
- marketing secondary raw materials,
- providing customer services, e.g. on site, hotline, and customer training,
- billing, order processing, and claims management,
- data processing, IT solutions, paperless billing.[933]

The inter-organizational network of LOGEX System is characterized by a powerful nationwide focus, in which the partners have been in operation and integrated in their region for several generations. Many years of experiences and customer relationships, knowledge of the regional structures and authorities, and social and corporate commitment have contributed to the success of LOGEX System. The more than 40 operation partners, many with regional branches, make up the network of relationships of LOGEX System. LOGEX System can offer its clients customized solutions to fit their individual needs such as:

- operation of on-site waste collection centers, including the supply of staff and technology,
- recovery of old products, EoL product processing, and recycling completing the resource cycle,

Through the collaboration with 40 system partners and many regional disposal partners, LOGEX System is able to organize an entire range of special containers from within its system of partners (See Figure 71). It also has a whole range of available treatment, recovery and recycling facilities from the pooled resources of system partners, e.g. 100 operating locations, more than 130 recycling facilities with 5000 employees, 2500 special vehicles, and can obtain the turn over more than 600 Million Euro for the whole network.[934]

The comprehensive inter-organizational collaboration of recycling networks has resulted in win-win outcomes for customers and system partners in recycling networks. Especially, the large volume of collected and recovered, and the optimal usage of capacity and resources of network partners can obtain the economies of scale and the efficiency in RL operations. The more powerful collaboration between small and medium

[931] See Arcadis and Eunomia (2008), p. 207; Cf. also Spengeler et al. (2009), p. 720

[932] See Walther/Spengler (2005), p. 342; Cf. also Spengeler et al. (2008), p. 335

[933] See LOGEX System (2011), p. 1

[934] See LOGEX System (2011), p. 5

recycling companies can also be observed through some networks in Europe such as ZENTEK,[935] RENE Europe,[936] and EARN.[937]

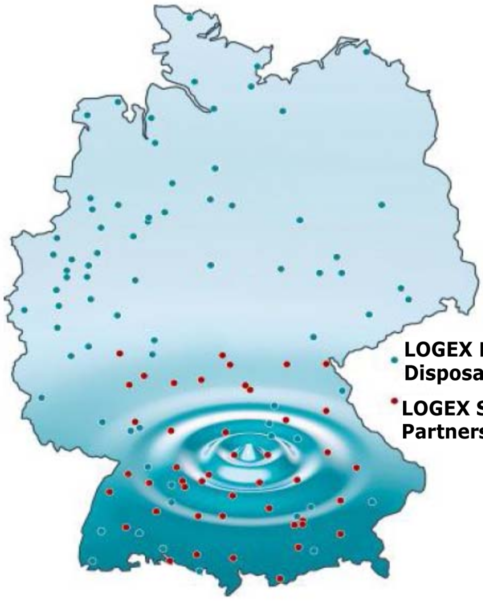

Figure 71: Network relationships of 40 system partners in LOGEX System

Source: LOGEX System (2011), p. 3

[935] See ZENTEK (2011), p. 1

[935] See EARN (2011), p. 2

[936]See RENE (2011), p. 3

7. Contextual Differences - Opportunties and Challenges for Transferability of Reverse Logistics

The adaptability to reverse logistics at both firm and network level in the European electronics industry has partly demonstrated the dynamic development of reverse logistics in Europe over the last decade. Meanwhile reverse logistics has still been in its embryonic stage in Vietnam, increasingly popular for the electronics industry that exists more opportunities for implementing reverse logistics. In Vietnam, reverse logistics is featured on the one hand through an informal private collecting and recycling system of discarded products, e.g. packaging waste, waste paper, and used electrical and electronic equipment. Furthermore, reverse logistics is also increasingly applied at firm level related to returns management that takes care of customer returns in warranty time. This chapter analyzes the current context, the opportunities, and the challenges for the implementation of reverse logistics in Vietnam at macro level or at network-level. In chapter 7.1, we present the framework of transferability with concepts, typologies, and analysis methodology. Factors influencing the transferability of reverse logistics to Vietnam and the model of identifying contextual differences are also determined. Data collection and methodology for seeking similarities and identifying differences are provided in Chapter 7.2. Chapter 7.3 investigates the opportunities and challenges in the implementation of reverse logistics at network level through the analysis of current context related to economic, legal, socio-cultural aspects. Chapter 7.4 analyzes the contextual similarities between Vietnam and a selected European country to identify the relevance and the potentials of transferring reverse logistics management models.

7.1. Framework of transferability of reverse logistics

7.1.1. Concepts, typologies and analysis methodology of transferability

7.1.1.1. Concepts and typologies of transferability

In academic research, transferability is a process performed by researchers or readers of research. They note the specificity of the research situation and compare them to the specificity of an environment or situation with which they are familiar. If there are enough similarities between the two situations, they may be able to infer that the results of the research would be the same or similar in their own situation. In other words, they "transfer" the results of a study to another context. To do this effectively, researchers need to know as much as possible about the original research situation in order to determine whether it is similar to their own. Therefore, researchers must supply a highly detailed description of their research situation and methods.[938]

Results of any type of research method can be applied to other situations, but transferability is most relevant to qualitative research methods such as ethnography and case studies. From a qualitative perspective, transferability is primarily the responsibility of the one doing the generalizing. The qualitative researcher can enhance transferability by doing a thorough job of describing the research context and the assumptions that are central to the research. The person who wishes to "transfer" the results to a different context is then responsible for making the judgment of how sensible the transfer is.[939]

Transferability takes into account the fact that there are no absolute answers to given situations; rather, every individual must determine their own best practices. Transferring the results of research performed by others can develop and modify these practices of implementation. However, it is important for readers of research to be aware that results cannot be completely transferred; a result that occurs in one situation will not necessarily occur in a similar situation. Therefore, it is critical to take into account differences between situations and modify the research process accordingly.[940]

Transferability is also seen as a subset of generalizability, which applies to specific occasions where we may be attempting to generalize research results to a context in which they are not studied. This aspect is most commonly found in the desire to generalize results from one location to another (e.g. between cities and countries), but it can potentially apply to any critical dimension that limits the meaning of research findings.

[938] See CSU (2010), p. 2

[939] See Trochim (2006), p. 3

[940] See CSU (2010), p. 2; Cf. also Curacao (2007), p. 2

The main point is that transferability analysis focuses on identifying contextual differences and dealing with their impacts.[941]

The practices of transfer have been applied in many fields such as policy transfer, transfer of learning, transfer of technology, transfer of management (e.g. management models, programs, methods and skills), and transfer of transport and logistics initiatives.[942] There has been an increasing amount attention of applying management theories, techniques, and practices originally developed in one cultural context to another.[943] The practices of transfer, e.g. model of business management system, model of governmental management through political policy and legislation framework, and model of urban logistics, have received considerable attention in the international business and remained a pressing issue in many sections in economy.[944] The concept of transferability is developed in this study based on the definitions of horizontal transfer and transplanting of institutions.

In the transfer of technology, Teece (1977) defines horizontal transfer as the transfer of (similar) technical knowhow from one project to another. The scope of horizontal transfer can range from intra-organization transfer (such as from one corporate division to another) to inter-sectoral (such as from the public sector to the private sector or vice versa), and to the process of international horizontal technology transfer, especially between technically advanced countries and those less developed. Transfer of learning describes the horizontal transfer regarding the activation and mapping of new information on to an existing knowledge structure.[945] In the transfer of urban transport and logistics initiatives, horizontal transfer is defined as territorial transfer that covers the full range of situations where experience may be transferred between different locations.[946] For example, the experiences of managing EoL products and adapting to reverse logistics at both firm and network level in the European electronics industry can be transferred to Vietnam to some extent.

Transplantation of institutions and related competence instruments covers situations where changes of institutional structures may be required (Institutional transplantation). Institutions are generally seen as stable patterns in social interactions and are the rules of the game that structure the action and signal of rational behaviors.[947] The transplantation was used earlier to describe the borrowings of one model country to other countries in need of that model (mostly with legal frameworks and political norms from developed countries to less developed countries or developing countries). Legal transplantation implies the transfer of constitutional, organic, or other legal frameworks or pieces of legislation one constituency to another, mostly usually from country to country. The imitation and emulation of legal frameworks and practices of leading nations by those consider themselves to economic, political, and legal laggards. International benchmarks encourage countries to engage in legal transplantation, e.g. the transposition and transplantation of legal framework of WEEE and RoHS Directive in the European electronics industry.

The institutional transplantation today has been replaced by multilateral operations in which countries borrow policies or models from each other in a more ad hoc manner and within in multilateral learning setting. It explores the borrowings of political institutions, business fashion, management practices, and policies from one country to other.[948] Globalization, e.g. the intensification of international and transnational exchanges seems to stimulate institutional transplantation between different countries because there are more opportunities to look for performing institutions and promising policy solutions in other countries with the support of information and communication technologies as well as exchange of staff and expertise.[949] In

941 See Curacao (2007), p. 104 ; Cf. also Martin/Lalenis (2002), p. 1

942 See Curacao (2007), p. 103; Cf. also Kirkbride/Tang (1989), p. 7; Chiang/Birtch (2007), p. 1293; Elsler/Eeckelaert (2010), p. 325; TURBLOG (2011), p. 80; Liker/Fruin/ Paul (1999), p. 1

943 See Kirkbride/Tang (1989), p. 8

944 See Curacao (2007), p. 103; Cf. also Kirkbride/Tang (1989), p. 7; Chiang/Birtch (2007), p. 1293; Elsler/Eeckelaert (2010), p. 325; TURBLOG (2011), p. 80; Liker/Fruin/ Paul (1999), p. 1

945 See Teece (1977), p. 242

946 See Curacao (2007), p. 104

947 See North (1990), p. 3

948 See Martin/Latenis (2002), p. 1

949 See Martin/Lalenis (2002), p. 3

addition, globalization also boots the need to improve local conditions to compete in global markets. Nowadays, institutional transplantations occur at increasing speed over greater distances and are often hastier than in previous. Institutional transplantations are today conducted long before they have proved themselves. Especially, instead of borrowing readymade, but probably unfit, institutions from the origin country, the transplantation is today more likely to pool out their experiences and their expertise to identify and develop the best practices.[950] Institutional transplantation, as a result, may bring improvements to the host country and speeds up development or achieve it at lower costs.[951] Borrowing institutions from a successful country is seen as a means to share in that success because pooling from best practices is seen as strategy to lower the cost of innovation and speed up it diffusion.[952]

This study uses horizontal transfer and institutional transplantation as the reference concepts for analyzing the transferability of RL to Vietnam because the transfer of reverse logistics management models can be conducted between different locations and requires the borrowings of management practices and policies from other countries. The legal framework of WEEE Directive and the practices of reverse logistics management models in the European electronics industry have been transferred and carried out in other countries such as Australia, China, Korean, Japan, Taiwan, Thailand, and the USA. Moreover, the development of producer responsibility organization model (PRO model) in Europe and Asia has proved its impacts worldwide on the implementation of reverse logistics. It is now continuously expanded to the different regions and is classified as a pattern of institutional transplantation in reverse logistics initiatives. For example, in the case of China, the related regulations in "China WEEE" reflect key aspects of the European Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE Directive). Transferring the laws and learning some models from EU support Chinese companies' entry to the European market. Moreover, referring to "advanced" foreign laws has improved the institutional, legislative, and technological level of Chinese industry.[953]

7.1.1.2. Methodology of transferability analysis

As transferability is a learning process, we use prospective assessments[954] to study transferability of RL, which attempts to anticipate under what circumstances, and to what extent, a RL management model that works in European countries can also be operated in Vietnam. A generalized transferability analysis that looks at a range of good practical examples cannot be objective as each practitioner has assessed merely their individual situation and provides a subjective perspective. In practice, there are many variables determining the context for how an individual implementation process takes place. Certain key elements for transferability can be extracted from existing case studies and expert input. These elements give valuable hints for others who want to implement similar schemes, but will also require amendments to fit the individual context. An abstract analysis of case studies regarding context conditions, success factors, and barriers in the implementation process is necessary to provide a basis for guidance for uptake.[955] A good transferability analysis should be combined between the practices of case studies with the support of expert who have already experiences with the implementation of similar concepts. These two elements are combined to provide the guides and evaluation of transferability in actual individual cases so that transferring can avoid reinventing the wheel and problems that have already been experienced elsewhere.[956]

Moreover, one of the important points in analyzing transferability is the need to take care of the compatibility of the transplantation with the new host (e.g. country, region, city, organization) because of the contextual differences. Most institutional transplantations hardly involve the physical removal of persons and organizations, but they are more often a story of imitation and emulation with much more malleability than organs.

[950] See Mamadouh/Martin/Lalenis (2003), p. 281

[951] See Martin/Lalenis (2002), p. 4; Cf. also Watson (1993)

[952] See Martin/Latenis (2002), p. 4

[953] See Savage (2006), p. 32

[954] See Cucacao (2007), p. 105

[955] See Bührmann et al.(2010), p. 8-9

[956] See Bührmann et al. (2010), p. 9

Therefore, good practical examples can be transformed to fit the local circumstances with a careful analysis of the relation between the goals of transfer and the expected performance of institution transplanted, and the contextual differences and similarities between the case transplanted and the actual context of the host. Without the careful analysis, conflicts can be occurred during implementation, which leads to the resistance, rejection, and unexpected effects. Therefore, the prospective assessment of transferring reverse logistics management models to Vietnam requires the delicate analysis of current situations of the country, and the identification of contextual differences and similarities with the original selected case.

Based on the approach of prospective assessments of transferability and the practices of transferability analysis in logistics and transport initiatives,[957] this study develops a general approach with twelve steps (see Figure 72) to identify the transferability of reverse logistics to Vietnam and suggests potential solutions for implementing reverse logistics management models. Chapter 7 directs mainly at analyzing the content of step 1 to step 5 to investigate the opportunities and challenges for the implementation of reverse logistics at network level. The measures with potentials and relevance for transferring are also identified in this chapter by looking for similar contexts and making comparison. Chapter 8 proceeds step 6 to step 9 to analyze the likelihood of adopting RL implementation formally at firm level, select models to transfer, and suggest some solutions for RL implementation. Learning some experiences of transferring best European practices of RL management models in some Asian countries is also carried out in chapter 8. Evaluating models and solutions as well as the need for adjustments (step 10 to step 12) will be studied in the future research after some solutions are practically carried out in Vietnam.

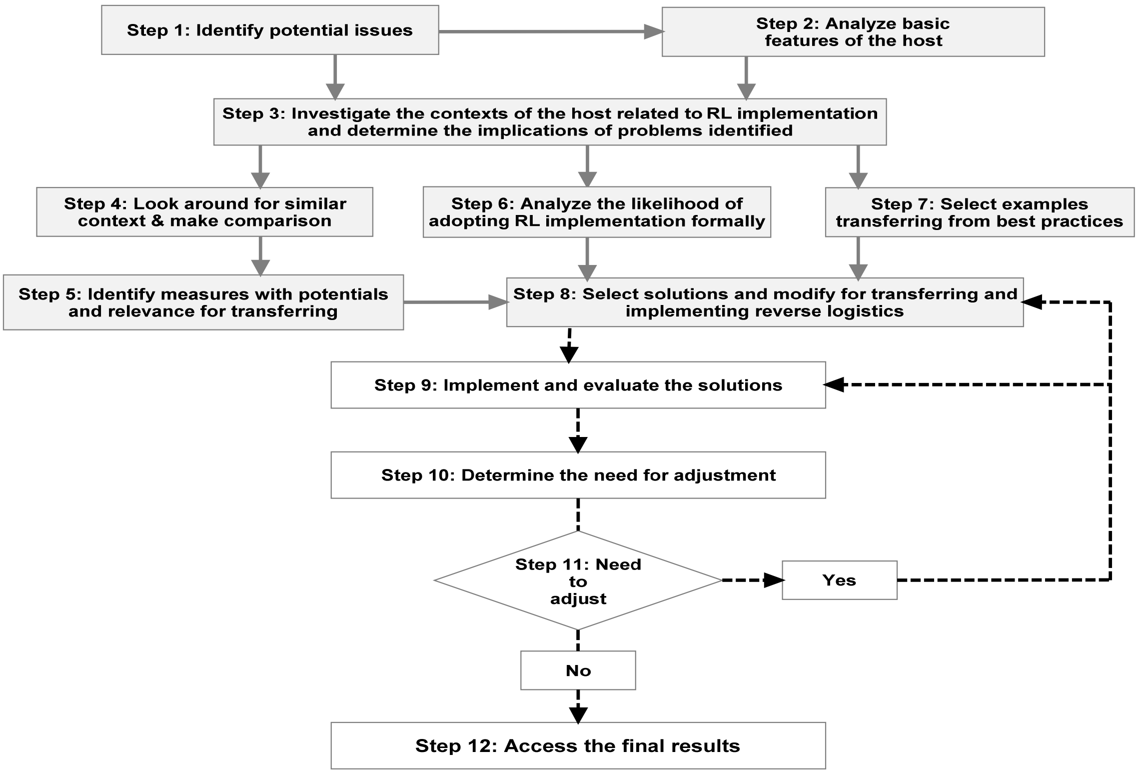

Figure 72: Methodology of analyzing the transferability of reverse logistics

Source: Adapted from Martin/Latenis (2002), p. 1-4; Bührmann et al. (2010), p. 8-9; Macario/Marques (2008), p. 146; Curacao (2007), p. 106; Dadzie (1990) with modification

- Step 1: Identify potential issues of reverse flows from different sources
- Step 2: Analyze the basic characteristics of the host country (e.g. demographic and geographic features, politics, legislations, economic development) to identify the chances and difficulties

[957] See Dadzie (1990); Cf. also Curacao (2007), p. 106; Macario/Marques (2008), p. 146; Buhrmann/Rupprecht/Beecroft/Jeffery/Cre (2010), p. 8-9

- Step 3: Analyze the current context of host country related to reverse logistics implementation at network level and determine the implications for the opportunities and challenges
- Step 4: Look around for similar context and make comparison
- Step 5: Identify the measures with potentials and relevance for transferring
- Step 6: Analyze the acceptability of implementing a formal RL program at firm level
- Step 7: Analyze examples transferred from best practices of reverse logistics in Europe
- Step 8: Select models and modify for transfer and implementation
- Step 9: Suggest solutions for the implementation of reverse logistics
- Step 10: Implement and evaluate models as well as solutions proposed in step 8 and step 9
- Step 11: Identify the need for adjustments after trial implementation
- Step 12: Access final results

7.1.2. Factors influencing the transferability of reverse logistics

In order to be able to transfer a specific model or measure within or to another country, it is necessary to identify basic conditions of the model and adapt these factors to the current context of the organization or the host country. It means that transferability is learning process with copy and adaptation. A wide range of factors may affect the transfer of reverse logistics management models from one country to another. Successful transplantation requires being congruent with the legal, economic and social context of host country and the involvement of different stakeholders.[958] The success of transferability also depends on realizing the important features of different context. For example, cross-cultural differences play a certain role in the transferability of economic incentive schemes for occupational safety and health, reward preference management, and urban logistics management.[959] Culture may greatly affect micro-level behavior processes than macro-level structural relationships, e.g. pro-environment attitudes of consumers, producers, and distributors. For example, Lu (2004) denotes that the differences of awareness and acceptability from society, producers, and consumers between countries are also important factors influencing the transfer of environmental oriented reverse logistics models, especially for implementing EPR as a policy approach.[960] At macro level, contextual factors influencing the transferability may include:

- political view (e.g. sustainable development, environmental protection, pollution prevention),
- geographic and demographic characteristics (population, area, density),
- legislation (enforcements, obligations, and rights),
- economic development (income, demands, industrialization, and urbanization),
- infrastructure (logistics, facilities, equipment, and IT system),
- resources (people, finance and technology),
- culture values (customs and behaviors),
- and social values (awareness, attitudes, and relationships)

They are necessary conditions for considering the transferability and implementation of reverse logistics management models.[961] Figure 73 presents factors likely influencing the transferability of reverse logistics to Vietnam.

At firm level, the diffusion of a new management approach, e.g. reverse supply chain management, is similar to the transformation of political, legal, social and technical innovations at macro-level, in which the speed and extent of the diffusion depends on institutional environments, size and resources of the adopters. For example, business system with larger firms is easier to keep abreast of and implement the latest technological and management innovations due to the larger investments of human and financial resources. Their changing awareness of economic benefits obtained from satisfying customer and recapturing value of returned prod-

[958] See Martin/Stoter (2009), p. 316

[959] See Kirkbride/Tang (1989), p. 8; Cf. also Chiang/Birtch (2007), p. 1299; Elsler/Eeckelaert (2010), p. 329; Curacao (2007), p. 103

[960] See Lu (2004), p. 39

[961] See Ciocoiu/Tiu/Burce (2010); Cf. also Savage (2006); Fredholm (2008), p. 3

ucts motivates them to more easily accept the requirement of laws and increasingly invest resources, and therefore creating changes for their eco-design of products, EoL management strategy, existing returns policy, and extant logistics system. Institutional environments cover everything outside the corporate system including consumer awareness and demand, the regulatory factors, the infrastructure and technology base, the educational system, the socio-culture base,[962] which have affected the adoption of firms for new management approach of reverse supply chain management.

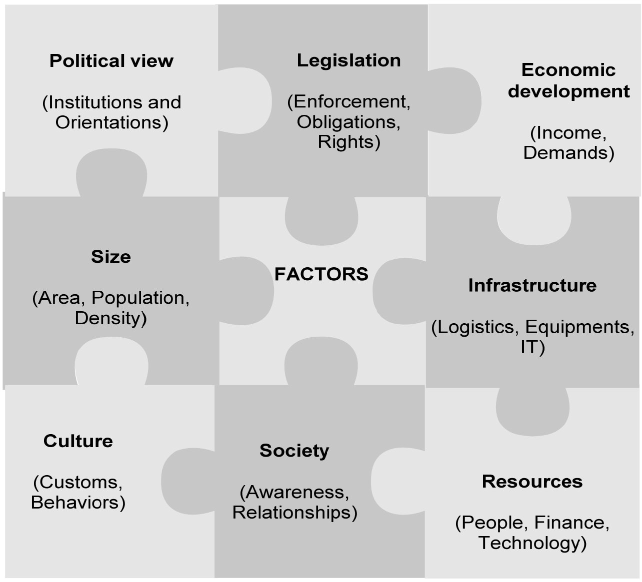

Figure 73: Factors influencing the transferability o reverse logistics

Source: Own Illustration

Specifically, the loose enforcement of environmental laws is a barrier for transferring a formal reverse logistics system for EoL management because EPR-based policy requires the transformation of waste management responsibilities from government to manufacturing industry. In practices, firms are passive and reluctant to change to implement this task because financial and physical responsibilities of take-back and recovery become a significant burden on producers. Unspecific regulations without instructions hinder firms from active carrying out their EoL collection.[963] The success of legal transplantation to make fundamentals for reverse logistics implementation of EoL management needs the clear understanding of ERP-based policy, the sound awareness of closed-loop economy, and the collaboration between stakeholders. If the legal framework is transplanted without these understandings and practice experiences, the borrowings of legislations and regulations cannot be implemented effectively. However, the compatibility of legal framework for extended producer responsibility normally just refers to the legal side of the phenomenon. For successful transplantation of a reverse logistics management model, it is necessary to consider economic and socio-cultural context.[964]

For socio-cultural issues, concerns for the environment and green issues from society have become almost a cultural constant or norm in western society, and has been proved as the main facilitation for the development of closed-loop economy in Europe. Beyond the differences in population, the geographic and demographic dimensions, and the level of economic development, the low public awareness from consumers and firms has been an important factor influencing the transfer and implementation of product take-back and recovery system in many developing countries like Vietnam.[965] Public awareness is an important factor because their attitudes and knowledge of negative effects of improper waste disposal motivate their proactive

[962] See Liker/Fruin/ Paul (1999), p. 5 & 12

[963] See Kojima (2009), p.263-264

[964] See Martin/Stoter (2009), p. 316

[965] See Carisma (2009), p. 56 ; Cf. also Ciocoiu et al. (2010), p. 14; Department of Trade and Industry (UK) (2005), p. 16

actions of discarding EoL products.[966] For example, if citizens and firms do not realize the importance of recovering and recycling UEEE, it is more difficult to transfer and implement management models of collective take-back and recovery due to the collaboration requirements of different stakeholders in implementing reverse logistics for EoL management.[967] The lack of economic motivation (e.g. monetary and non-monetary incentives) is also mentioned as a substantially barrier to transfer and implement RL models of collective collection for discarded products in developing countries.[968] The poor infrastructure of logistics, e.g. transport system, collection infrastructure, and information system has also limited the transfer and implementation of a formal RL management model.[969]

In case of transferring a reverse logistics management model to developing countries like China, Vietnam, Thailand, and Philippine, the factors affecting the transferability may be the same. Several factors, varying from location to location, are most likely evaluated to limit the transferability. It is very necessary to identify the socio-cultural base with which the conditions of the model transferred will be interacted, e.g. public awareness, attitudes, and behaviors. It is also important to determine the influences of legal compatibility to the host country that affect the interaction of stakeholders involving in implementing reverse logistics and thereby influence their behaviors in a manner frequently unfamiliar to the origin, e.g. enforcement of laws, the reaction and adoption of firms and consumers with take-back laws. It is very essential to assess resources, infrastructure, and technology of the current context, with which the model transferred can be operated. Therefore, decision-makers can realize the feasibility of transferring and the compatibility of the models. The study develops an analytical framework to identify contextual differences and similarities for evaluating the transferability of reverse logistics by looking at three major "stable factors" that influence directly the transfer of a reverse logistics management model at both firm-level and network-level (see Figure 74).

Many stakeholders have been involved in developing the legal framework and implementing reverse logistics, e.g. governmental agencies, industry associations, NGOs, OEMs, distributors, service providers, and consumers. The different practices of reverse logistics management models in Europe countries analyzed in Part 2 indicate that the intensified collaboration between stakeholders have increased the greater adaptability to RL as well as the efficiency and effectiveness of RL operations. Therefore, the relationships among stakeholders are also considered in an analytical framework regarding interactions within current legislative, economic, social, and cultural environments. The compatibility of the models transferred is explored by identifying drivers and barriers arising from the relationships among the related interactional partners in contextual differences and the results of the tasks fulfilled by stakeholders.

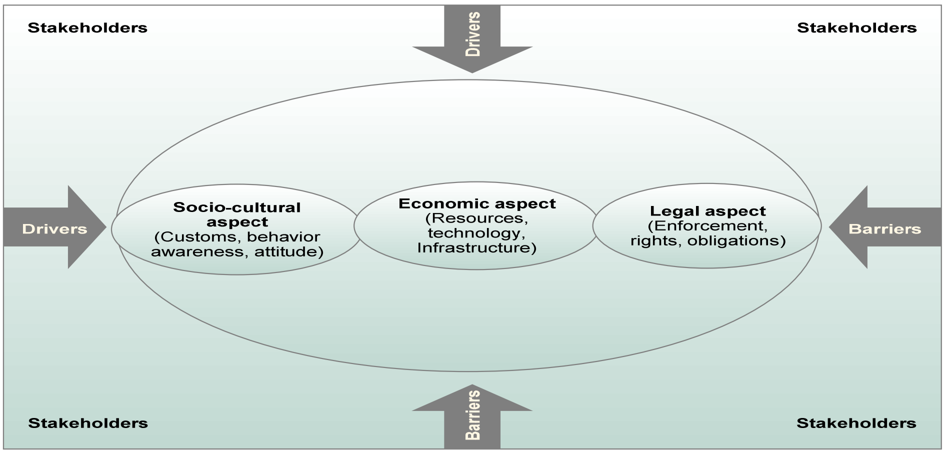

Figure 74: Analytic framework for analyzing of contextual differences

Source: Own Illustration

[966] See Erol et al. (2010), 43

[967] See Ciocoiu et al. (2010), p. 4

[968] See Budak/Oguz (2008), p. 926; Cf. also Derksen/Gartrell (1993)

[969] See Lau/Wang (2009), p. 457; Ciocoiu et al. (2010), p. 13

7.2. Data collection and methodology

In order to analyze the transferability of reverse logistics to Vietnam, the study uses an exploratory research approach by collecting primary and secondary information such as reviewing available literature, conducting semi-structured questionnaire, implementing informant interviews, direct observations and site visit. The generation of data comes from a number of sources to ensure the validity of analysis. Content analysis is used for secondary literature and primary data is collected through case study, survey, and observations. An argument by analogy is used in this chapter to make a comparison between Vietnam with selected countries for exploring contextual similarities and differences to evaluate the transferability of reverse logistics

Firstly, the study investigates some characteristics of Vietnam and analyzes contextual similarities and differences by reviewing its current legal status, economic aspects, and socio-cultural conditions, in comparison with selected countries in Europe. The related data is collected from different sources of official report, articles, and statistic database.

- Official reports from general statistics office related to geographic and demographic characteristics of Vietnam
- Reports from academic, government (official), intergovernmental, and nongovernmental organizations about economic development, the development of electronics industry, and the volume of EEE consumption and the discarded products
- Legal administrative framework for managing discarded products and managing products returns from customers after sales
- Published reports and surveys relate to disposal and processing EEE discarded in Vietnam

Secondly, for more detail analysis of socio-cultural aspect such as consumer awareness, attitudes, and behaviors of returning and discarding electronic and electrical products, we conducted a cross-sectional survey at the beginning of 2011 in Vietnam. A cross-sectional survey collects data to make inferences about a population of interest at one point in time.[970] This study carried out the survey with 181 households by semi-structured interviews in three cities and provinces including Hanoi city, Bac Ninh city and Hoa Binh province, which are in the northern part of the country. Among the investigation areas, Hanoi is the most developed area, followed by Bac Ninh and then Hoa Binh. The survey was conducted during the field trip in the North of Vietnam within two months. Given the difficulties of getting households to agree to be interviewed, the sample was an opportunistic one, with the ones drawn from among people who already know us and are willing to join. Because of the limited size of the sample population, the result might have limited representativeness for the general situation. However, semi-structured interviews implemented with open circumstances allowed for a focused, conversational, and two-way communication, which made the households express openly their opinions of environment issues, disposal behavior of discarded products, and their satisfaction of firms' returns policy.[971] Descriptive statistical analyses are conducted with structured questions by using SPSS® version 17. Differences in propositions of demographics, data of electronics products used, related attitudes and behaviors of using, disposing, and returning are compared using Chi-square tests. The significant level is set at p-value ≤ 0.05.

There are certainly differences between countries in Europe and in Asia, especially in the case of Vietnam because the country is developing based on substantial differences of politics, economic development, and socio-culture base with many European countries. It is difficult to analyze the transferability of a reverse logistics management model to Vietnam based on many contextual differences. Therefore, it is necessary to look around for similar context and make comparison to determine the implications of the relevance and the potentials for transferring RL management models.

The facts that not all new technologies and modern collecting models accepted and implemented in developed countries can be applied successfully in developing countries because they requires the changes of a

[970] See Abramson/Abramson (2000), p. 34

[971] See Pfohl/Ha (2011), p. 3

legal framework, the investments in infrastructure and technology, the improvement of public awareness, and the intensified collaboration among stakeholders and partners.[972] These changes need time to adapt, and particular resources to develop. In practice, the development of reverse logistics in Europe has also passed different phases depending on its influential factors and actual conditions in each period. Given these arguments and based on the framework and analysis methodology of transferability, the study explores the contextual similarities and differences in comparison with two main countries: Germany and Romania. These two countries have some similar features with Vietnam, e.g. geographic and demographic characteristics (Germany), the degree of economic development (Romania); the status of legal framework (Romania); the degree of public awareness (Romania). Some basic similarities and differences between Vietnam and these countries provided in Table 30 make the fundamentals for more comparison.

Country	Population[973] (Million)	Area (km^2)	Density[974] ($/km^2$)	Income (USD)	Legal framework	Public awareness	Infra-structure	Model applied
Germany[975]	*81,471*	*357,022*	*229*	*43,900*	*Complete*	*High*	*High*	*Competition (20 systems)*
Romania[976]	21,436	238,391	90	8,500	Partially Complete	Moderate	Moderate	Competition (6 PROs)
Vietnam[977]	90,549	331,210	259	1,400	Incomplete	Below moderate	Below moderate	Not officially performed

Table 30: Similar and different contexts between Vietnam, Germany, and Romania

Germany is selected as a comparative reference because it is the typical case of a collective competing take-back model with effectiveness and efficiency as analyzed in chapter 6. Moreover, Germany is also a successful example for reverse logistics management over the last decade in Europe, with many effective reverse logistics management models at both firm and network level.[978] This study selects Romania to look for similar contexts because this country also faced the difficulties in the transplantation of EPR-based policy and WEEE Directive as well as in the implementation of reverse logistics for EoL management. The following section analyzes the current context of Vietnam related to economic, legal, and socio-cultural aspects to identify the opportunities and challenges for the transfer and implementation of reverse logistics management models.

7.3. Contextual differences - Opportunities and challenges for RL implementation

7.3.1. Vietnam geography and demography

Vietnam is located on the eastern part of the Indochinese peninsula, which has border with China to the north, Laos and Cambodia to the west, the East Sea to the east, and the Pacific Ocean to the east and south. Vietnam has population of 90,549 million living on a landmass of 331,210 km^2 whereas Germany has a population of 81,471 million on a landmass of 357,022 km^2. Vietnam and Germany also have the similar population density of 259 and 229 residents per km^2. However, Germany has a flat plain that stretches to the North Sea, and Vietnam is shaped like a long “S” with more mountainous and longer coastline.[979]According to the Deutscher Städtetag, some 51 million people – the equivalent of 63 percent of Germany’s total population - live in the country’s 5,700 towns and cities. The population of Germany’s 300 largest cities amounts to almost 37 million or 45 per cent of all people living in the urban areas.[980] Although the highly dense popula-

[972] See Furedy (1994), p. 3

[973] Data of population, area, GDP nominal per capita are updated from the source of Central Intelligence Agency (CIA) in 2011.

[974] Data of density is adapted from the source of United Nation World Population Prospects updated in 2011

[975] Information of Germany adapted from Sander et al. (2007), Eurostat, (2010), Perchards (2007), Walther and Spengler (2005)

[976] Information of Romania adapted from Ciocoiu et al. (2010), Ciocoiu et al. (2009)

[977] Information of Vietnam adapted from General Statistic Organization (GSO) and updated data from survey and case study

[978] See Fleichschmann et al. (2004); Cf. Also Lebreton (2007); Miele (2010)

[979] See Wikipedia (2010a; 2010b)

[980] See GATC (2010)

tion in the cities is common characteristics of both countries, Vietnam with more mountainous landscape has the higher densely populated in some main cities than Germany,[981] especially in two main cities in North and South of Vietnam. Nowadays, approximately 33% of the country's residents are currently living in the cities, resulting in more than 30 million urban dwellers, especially when the expansion of Hanoi capital was implemented in 2008.[982]

Some similarities of geographic and demographic characteristics between Vietnam and Germany may suggest for the transferability of a competing take-back systems in providing reverse logistics services for EoL management in Vietnam because countries with large population and high density may be advantage for using the municipalities and competitive-based market.[983] Both Germany and Vietnam often have the mechanism of the local authority waste management service in each city or province. Therefore, it may be advantageous to Vietnam for implementing a formal reverse logistic system by using public waste management companies in each city as main collectors for EoL products. Using municipalities can reduce the cost of take-back[984] due the available human resources and facilities for drop-off and curbside collections, and the smooth accessibility to the origin sources of discarded products (e.g. households and business customers).

However, Germany is a high-end and mature consumer market with high demand for electronic and electrical products. At present, German electrical and electronics firms, with an annual turnover of 183 billion Euros, manufacture more than 100,000 different electrical and electronic products and systems ranging. Germany has more than 40 million households with the largest purchasing power - a potential market for all kind of electronic goods, suggesting a large volume of discarded and returned products. The amounts of WEEE collected and recovered in Germany in 2008 are 693.775 tons and 684.986 tons, respectively and with the rates of collection, recovery, and recycling that exceed so far the minimum requirements of the WEEE Directive. Reverse logistics systems for EoL management in Germany are supported by the intensive collaboration among stakeholders as well as rapid evolution of recovery and disposal technologies and infrastructure– a large and modern green market in Europe.[985] The differences in economic development (e.g. GDP, GDP per capita), infrastructures, and consumption pattern between Vietnam and Germany may be the main barriers for Vietnam to transfer successfully reverse logistics management models of Germany. However, some experiences can be transferred related to the development of municipal collection, capacity building, education, training, and awareness raising at city and province level by the intensified collaboration between local authority, community level, private sectors and non-governmental organizations. For example, in Germany, trade unions and private sector businesses have played an active role in shaping integration ecological and business concern in management of EoL products.[986]

7.3.2. Economic mechanism and development

In 1986, the government of Vietnam embarked on a reformed "doi moi" (renovation process) to guide the country from a centrally planned toward a market economy. While Vietnam's economy remains dominated by state-owned enterprises, which still produce about 40% of GDP, Vietnamese authorities have reaffirmed their commitments to economic liberalization and international integration.[987] They have moved to implement the structural reforms needed to modernize the economy and to produce more competitively export-driven industries. Vietnam joined World Trade Organization in January 2007 following more than a decade-long negotiation process, which was regarded as an anchor for Vietnam to global market and reinforced the domestic economic reform process. Vietnam, with a population of nearly 90 million, reached the GDP growth rate around 7% over the last decade, which surpasses that of many countries in the region. Vietnam has moved from the group of poor country to the one of average income with GDP per capital nearly $1,400.

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[981] See WB (2010)
[982] See CIA Factbook (2011a)
[983] See Savage (2006), p. 59
[984] See Sander et al. (2007), p. 61
[985] See BWI (2008), p. 6; Cf. also BMU (2010), p. 1; ZWEI (2010), p. 3
[986] See BMU (2010), p. 1
[987] See CIA Factbook (2011a), p. 1

However, the economic recession has hurt Vietnam's export-oriented economy, with GDP growth rate in 2009-10 growing less than the 7% per annum average achieved during the last decade. In 2010, exports increased by more than 25%, year-on-year, but the trade deficit remained high, prompting the government to consider administrative measures to limit the trade deficit.[988]

The economic metamorphosis brought about by these policies has profoundly altered the country, particularly the urbanization and industrialization process in its large cities. Indeed, it is argued that Vietnam is beginning one of the most intensive urban transitions in the world.[989] Vietnam has increased urbanization with over 30% of the population living in cities and 3% annual rate change of urbanization.[990] A substantial agrarian population exists in Vietnam's rural areas, which has the potential to transition into higher-value, non-farm activity production. The country has been rapidly evolving toward a more industrialized economy. The agricultural sector has steadily decreased as a share of GDP since 1999, when it represented 25% of total GDP. However, it still comprises 20.6% of Vietnam's economy. Evidence of an exodus to urban areas is occurring as the country's agriculture sector, which hired 58% of the workforce in 2004, currently accounts for 48% of total employment.[991]

Vietnam is also ranked as among the world's most promising retail markets because of growing disposable income, consumer spending, and the increasing number of young people.[992] These changes have created greater exposure to new lifestyle trends and have resulted in growing retail demand, which topped almost $65 billion in 2009 and nearly tripled to that in 2004. Vietnam's retail market has grown steadily at a 12% annual rate, which includes more than 400,000 traditional retail stores, 400 supermarkets, 60 commercial centers, and 2000 convenience stores. By 2010, the number of supermarket increased by 62% and the building boom is creating shopping centers that expand the current base by 150%.[993]

Over the last 10 years, Vietnam's domestic consumption has expanded 88% after adjusting for inflation – almost three times faster than developed countries. Between 2004 and 2009, private consumption increased from $12 billion to more than $20 billion in real terms. As economic development progressed, private consumption to GDP share expanded to 63% in 2009, increasingly contributing to GDP growth. Consequently, domestic consumption in Vietnam, dominated by private consumption, has become one of the most important engines of the country's continuing GDP growth. The contribution of private consumption alone to the country's GDP growth increased from 38.4% in 1999 to 98.3% in 2008.[994]

The trend of expanding urbanization, combined with industrial growth and the modernization leads to a significant increase in discarded products and hazardous waste generation. The country is producing more than 15 million tons of waste each year, and this volume is expected to grow rapidly over the next decade. Urban areas produce more than 50% of the country's municipal waste.[995] The threats to the country's environment with the increasing amount of waste, environmental pollution, and scarcity of resources have also required a harmonization strategy between socio-economic growth and sustainable development. It is also the key objective of Vietnamese government's socio-economic development plan (2010–2020), which requires more concerns and investments in proper waste management, increased recycling, and recovery of discarded and returned products instead of incineration and landfill.[996]

[988] See GSO (2011), p. 5

[989] See Douglass (2002), p.23

[990] See CIA Factbook (2011a), p. 2

[991] See Dang et al. (2010), p. 16

[992] See Dang et al. (2010), p. 8; Cf. also PRLog (2011), p. 1

[993] See Dang et al. (2010), p. 16; Cf. also Consumer Electronics Assoication (2008), p. 3; GSO (2009)

[994] See Dang et al. (2010), p. 12-18; Cf. also GSO (2009)

[995] See Thanh/Matsui (2011), p. 285

[996] See Pfohl/Ha (2011), p. 2

7.3.3. Vietnam electronics industry

7.3.3.1. Growth of electronics industry in Vietnam

Vietnam has changed the economic situation after the process of successful renovation "doi moi" since the mid-1990s. It can be partly observed through the growth of the electronic industry over the last decade. During the period of 1970s – 1980s, the country had only limited number of radios, a slow increase of black-white TVs or radio-cassettes. There were a sharply increase in production of color TVs in the 1990s. The usage of refrigerators, washing machines, air conditioners, and other home electronic appliances has been popular since the 2000s all over the country.[997] From 2000 to 2004, electronics production grew 25% per year. In 2006, the total electronics market in Vietnam was about $2.4 billion, which accounted for just 2.2 percent of the Asian electronics market and 0.06 percent of the global electronics market.[998]

The Vietnam government tried and made Vietnam an attractive destination for electronics manufacturing by high protection policies in the period of 1995-2005. The Vietnam electronics industry has drawn large sums of foreign investment because of potential domestic market, the low-cost labor, and the favorable government policies toward foreign investors during this period. Many Japanese consumer electronics firms such as Sony Corporation, Matsushita Electric, JVC, and Toshiba have formed joint ventures with Vietnamese state enterprise since the mid-1990s to enter the domestic market and are now assembling different kinds of products. Korean firms such Samsung Electronics and LG Electronics arrived somewhat later, and followed by growing Chinese firms in the 2000s. The healthy development of the Vietnam electronics industry over the last decade has been supported by a sufficient agglomeration of foreign direct investments (FDI) from Japan, Korea, and other countries.[999] Foreign companies, especially from Japan and Korea, countries where specific domestic laws of take-back based on the principle of EPR were established, have dominated Vietnam electronics market presently. According to Quang (2008), Japanese companies supplied 59.3% of TVs in use while Korea companies supplied 32.9%. In case of refrigerator, washing machine, and air conditioner market, companies from Japan held 57.3%, 52.4% and 49.8% market share while Korea obtained 33%, 34.3%, and 39.5% respectively.

In 2010, Vietnam has approximately more than 39 acting enterprises in manufacturing of office accounting and computing machinery, 282 manufacturers of radio, television and communication equipment and about 470 firms producing engines and other electrical equipment.[1000] Among them, more than 30% are FDI companies. Overall production of electronics goods continues to increase. Figure 75 presents the increasing total production of four main types of large home appliances in Vietnam in the period of 2005-2010.

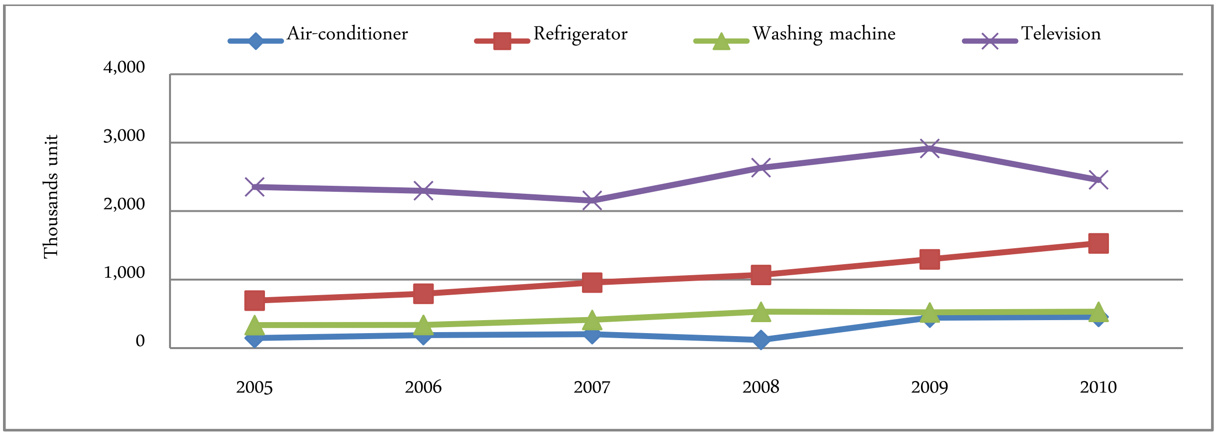

Figure 75: Production of large household appliances in Vietnam

Source: GSO (2010), p. 2

[997] See Quang (2008), p. 12

[998] See VentureOutsource (2006), p. 2; Cf. also Quang (2008), p. 14

[999] See Mitarai (2005), p. 31-32

[1000] See GSO (2010), p. 1

In 2008, production of the Vietnam electronics industry reached $3.2 billion with a stable growth rate of 21% percent year on year, in which 33% of total production was accounted for by consumer equipment, 34% by computer products and parts, 18% by components, and 8% by communication products.[1001] From simply assembling imported components, Vietnamese firms can design products bearing Vietnamese trademarks and manufacture for export. However, the number of domestic enterprises with capacity to compete has been tiny due to the lack of long-term strategies and resource investments. The amount of local production increased mostly through domestic assembly.

In 2008, export turnover were over $3.0 billion, 35% higher than a year earlier, dominated mainly by foreign giants, accounting for over 80%. Meanwhile, Vietnam's import for electronics and components is continuously increasing from nearly $1.5 billion in 2004 to $5.1 billion in 2010 because of rapidly growing consumption, opening the retail market, and along with tax reduction roadmap under the agreements of joining WTO and the Trade Partnership Agreements with Japan, China and Asian countries. When Vietnam joins the WTO, tariff barriers are gradually reduced from 50% to 25% within 5 years for electronics consumers including TVs, refrigerators, air-conditioners, washing machines, different kinds of audio equipment and fans. Especially, some information technology equipment, e.g. computers, mobile phones, and cameras, following the Information Technology Agreement of WTO has tax rate of 0% after 5 years integrating WTO. Moreover, the tax rates, in agreement with free trade such as ASEAN free trade area, ASEAN-China, and ASEAN-Korea, have also decrease sharply from around 40% to 10%, 5%, and 0% until 2015.[1002] The competition pressures from imported products have resulted in the negative effects on the Vietnam electronics industry. There has currently been a loophole in strategizing the development of the electronics industry,[1003] which has led to the decrease in domestic production and the increasing import of electronic and electrical products to meet the increasing domestic customer demands. As shown in Figure 76, the total import and export value has increased during the last decade, denoting the growth in this industry to some extent and the increasing demand of electronic and electrical products from Vietnamese consumers.

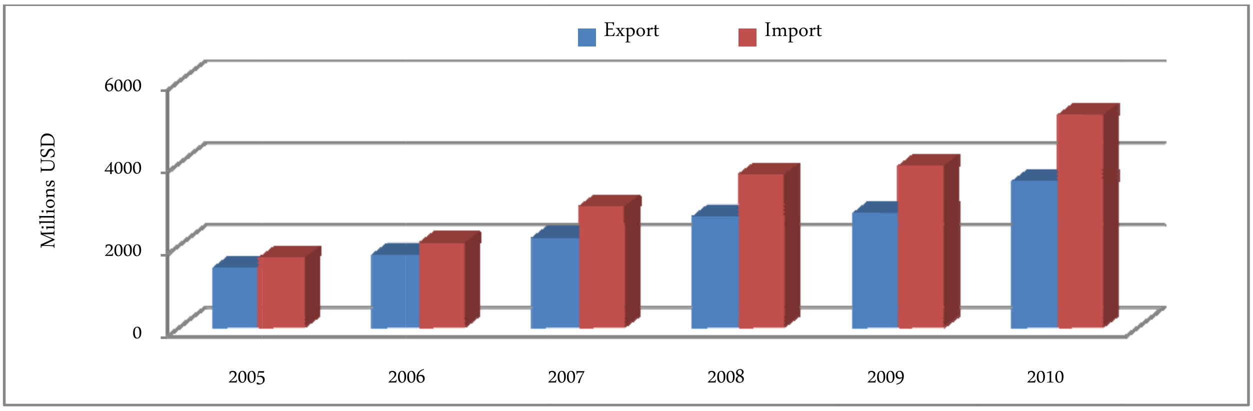

Figure 76: Import and export value for electronic and electrical products

Source: GSO (2010), p.3

The abolishment of tax barriers and protection policies has stimulated the more transparent competition between OEMs and distributors in the Vietnam electronics industry, which have resulted in the increased import of EEE and the growth of electronic and electrical supermarkets. Since 2008, there has been a rapid increase in the number of local distributors establishing EEE supermarkets with large scale, especially in Hanoi and HCM city,[1004] indicating the development of a modern distribution network in electronics market in Vietnam. This trend has also contributed to increasing consumer demands and consumptions of EEE in Vietnam for recent years.

[1001] See PRLog (2011), p. 1

[1002] See trungtamwto.vn (2008), p. 1-4; Cf. also GSO (2010), p. 5

[1003] See VCCI (2010), p.2

[1004] See Duc (2010), p. 1

7.3.3.2. Consumer demands and disposal of electronic and electrical equipment in Vietnam

Since the 2000s, the increasing economic growth and population in Vietnam has led to the growing amount of goods and services to meet customer demands. The increasing disposable income and higher living standards, especially in urban areas where account for more than 30% of the total population, have stimulated the increased consumption of electronic and electrical products. According to the market survey by GfK Vietnam, a Vietnamese person spent $36.2 on electronic and IT products on average in 2007, over 27% compared to the number of $28.4 in 2006, especially in telecom fields with mobile phones and laptops.[1005] Additionally, more than half of Vietnam's population is age 30 or younger and ready to spend on high tech products, indicating that the demand for products of high value and advanced technology is continuously rising next years. A separate study conducted by GfK research group also showed that the market share of plasma TV sets climbed by 15% in the first half of 2008, and the demand for high-end audio products also is rising.[1006] Demands for consumer electronics and IT equipment have been increasing in Vietnam, particularly in urban areas. The white-goods and consumer-electronics sectors in Vietnam comprise a number of foreign-invested joint ventures that manufacture their brands locally, have attracted the majority of Vietnamese consumers.[1007] GfK predicted that Vietnam's electronic and mechanical appliance market in 2009 increased 19 percent, reaching roughly $4.7 billion. The mobile phone sector surged 16% while high tech and digital products were expected to increase 24 and 29 percent, respectively.

Moreover, manufacturing and trading companies in the electronics industry have been in dramatic competition for years due to shorter lifecycle products and more advanced technologies. These trends have resulted in rapid price erosion in worldwide electronics markets. Reduction in sales prices have made many people in Vietnam affordable to buy EEE even low-income people. Furthermore, the development of modern distribution networks has increased the accessibility of consumers to products with new technology, competitive prices, and green functions.[1008] Therefore, it is today cheaper and more convenient to buy a new electronic product than to repair and upgrade an old one, especially in urban areas in Vietnam. In 2002 and 2004, GSO-Vietnam conducted a living standard survey, in which the share of households having durable electronics goods was included. The relatively increasing changes of percent ownership between 2002 and 2004 in Vietnamese households presented the growing consumption of electronic and electrical equipment (see Figure 77).

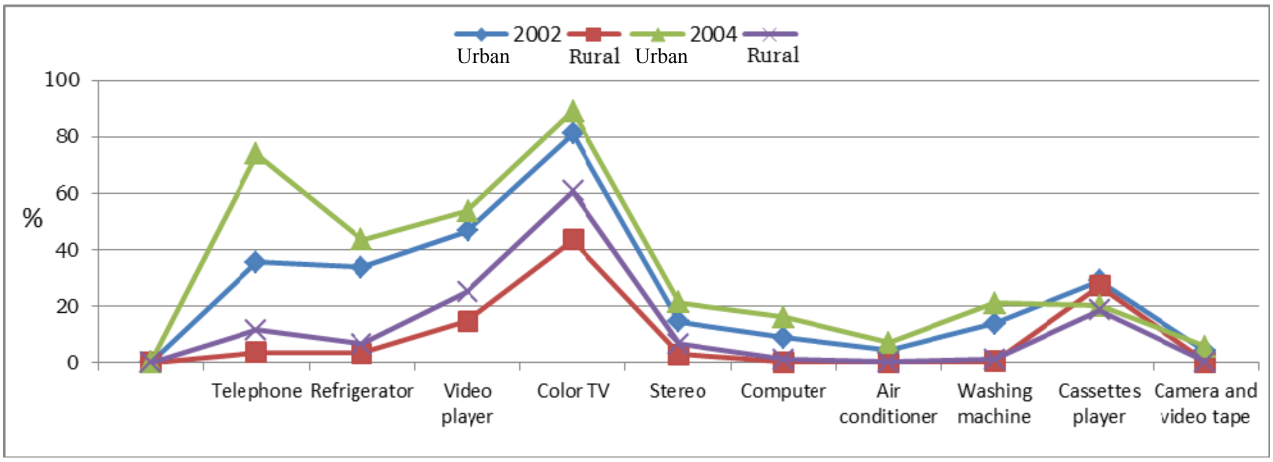

Figure 77: Share of households having main EEE by types of goods and area

Source: Data adapted from GSO (2004)

In our 2011 survey with 181 households in Northern of Vietnam, 89% of households asked are using the product with foreign brand name and among them 63.5% purchase the products produced or assembled in Vietnam and 89% purchase the 100% new products. People have bought less secondhand products than

[1005] See Consumer Electronics Assoication (2008), p. 2

[1006] See GfK group (2008), p. 1

[1007] See EIU (2008), p. 1

[1008] See Duc (2010), p. 2

before because of price reduction and the availability of new products. The cross-sectional survey also shows that Vietnamese households possess more EEE in house, especially in urban areas. Mobile phones and TVs are in the highest ranking of possession, followed by computers, refrigerators, washing machines, and air conditioners (see Table 31).[1009]

Area	*Refrigerator*	*Washing machine*	*Television*	*Radio*	*Computer*	*Mobile phone*	*Air conditioner*
Urban area	1.064	0.917	1.752	0.991	1.422	2.706	1.193
Rural area	0.722	0.181	1.181	0.764	0.556	1.722	0.097

Table 31: Average number of electronic products possessed per household in 2011

Given these arguments and data, there might have been an increase in generation of used electronic and electrical equipment (UEEE) discarded in Vietnam for recent years and in future, particularly in urban areas, due to EoL cycle, unfashionable designs, and outdated technologies. However, there was the time in Vietnam for the boom of secondhand market for UEEE due to the increased demands. Meanwhile, the capacity of assembly lines was not fit with actual demand and the importation was still restricted due to the tariff barriers throughout 1995-2005.[1010] Therefore, the secondhand market for UEEE has developed in Vietnam since the mid-1990s. Most electronic products in Vietnam are frequently used in households for a long time, then are given to other users, or are collected by informal collectors and private services shops. Repair and second-hand shops buy discarded appliances from end users or informal collectors, repair, reassemble, or refurbish, and sell them back to other users. UEEE were also imported from overseas to Vietnam until 2006 when Vietnam promulgated the Implementation Rules for the Law on Trade (No.12/2006/ND CP) and banned the importation of waste materials, toxic chemical substances and second-hand commodities, including electronic, cooling and home appliances (following Basel Convention procedures).[1011]

However, the growth of the electronics industry and market over the last decade has made the new products to become available, cheaper, and easier access. Thus, the second-hand market has less developed and mainly served for rural areas and people with low income. Discarded UEEE in Vietnam are now increasingly used for spare part businesses, refurbishing and recycling objectives. Trading market for secondhand appliances has not been under official control of legislation, which makes it difficult to collect data and estimate the number of UEEE reused, recovered, and recycled in Vietnam. Moreover, the official data on the amount of UEEE discarded, collected, and recovered is also limited in Vietnam.

In fact, the number of discarded UEEE is dramatically growing year after year, especially for personal computers, mobile phones, and TVs because TV is a most common appliance and has been widely used for long time. Figure 78 shows the estimate of discarded UEEE in Vietnam over the last decade.

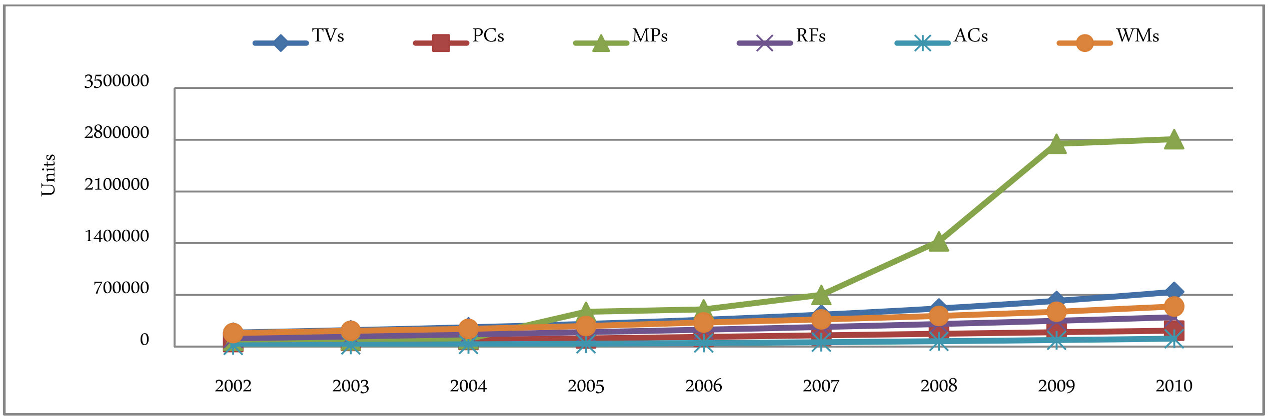

Figure 78: Estimated generation of discarded UEEE in Vietnam

Source: Duc/Tuan (2008), p. 7-12; Cf. also URENCO (2007), p. 149 – 154

[1009] See Pfohl/Ha (2011), p. 6

[1010] See Urenco (2007), p. 141; Cf. also Quang (2008), p. 17

[1011] See URENCO (2007), p. 142

Meanwhile, personal computers and mobile phone has shorter lifecycle than other IT equipment due to the technology advances. Urban area has the higher discarded rate for the home appliances, especially in big cities like Hanoi and HCM. The total discarded amount of the main types of home electronic appliances (is currently estimated about 113 thousand tons per year in 2010.[1012] According to Quang (2008), the average discarded ratio for TV is 8.8%, while the ratio are only 5.6% for refrigerator, 2.6% for washing machine, 8.5% for PC, and 1.1% for air conditioners.

7.3.4. Legislative framework

In Vietnam, the laws on quality of products (2007) and consumer protection (2010) that have been passed since the late 2000s prohibit disseminating and advertising the false information, fraudulent acts on the quality of products and the origin of goods, information concealment about potentially unsafe of products for people and environmental surroundings. The manufacturers are obliged to stop producing timely, notify the relevant parties, and take measures to solve the consequences because of unsafe products, to collect and treat the product properly. Vendors including OEMs, wholesalers, and retailers are mandatory to refund or ex-change new products, and to take back the defective goods returned by their customers. These laws require manufacturing and trading companies to pay more attention to their responsibilities in warranty time, after-sales services, and returns management. Firms in the electronics industry are no beyond the influences of these laws. Using logistics in handling returns as well as improving after-sales services and repair services has become necessary to reduce costs and increase customer satisfaction.

In addition to regulations related to customer protection, the issues of discarded UEEE at the end of useful life have just been paid attention since 2005. In Vietnam, no official information is available to distinguish UEEE from brand new EEE. There have currently been neither an official national definition of WEEE nor any specific regulations and guidelines on management and disposal of UEEE.[1013] Law on environmental protection amended in 2005 defines that wastes are substances in form of solid, liquid, gas, which are dis-charged production, service, living, or other activities. Vietnam government adopted Decision No. 23/2006/QD-BTNMT of Ministry of Natural Resources and Environment (MONRE) on issuance of list of hazardous waste, in which WEEE is considered as hazardous waste.[1014] Therefore, Vietnam laws related to controlling discarded UEEE and WEEE directs to the regulations of hazardous waste management.

However, the changes in legislation framework of environmental and waste management in recent years in Vietnam have also established the fundamentals for the legal transplantation of EPR-based policies and take-back regulations. Article 67 in the Law on environmental protection (2005) regulates the responsibilities of producers for their products put on market at EoL cycle including: (1) battery, accumulator; (2) electrical and electronic equipment for household and professional usage; (3) means of transport; (4) tire and wheel; and (5) other products following the President's decision. Additionally, the Decree No. 80/2006/ND-CP with Article 21 also determines the classification and labelling hazardous mark for discarded products to define responsibility and method of separating at source and collecting. With the imported products, the Decree also requires importers to register the quantity and necessary technical information with the central environmental management authority to identify solutions of collecting and treatment after consumer's disposal.

Moreover, according to the Decree No. 59/2007/ND-CP, solid waste including hazardous waste muss be controlled, classified at source, and kept in bags or containers separately. It is the first decree regulating the responsibility for waste classification. The Decree also states that waste containers for solid waste should be arranged in main streets, trading centres, zoos, and parks; the areas with high density of population, traffic nodes, and other public areas. The Government also offers many incentives for all kinds of investment in solid waste management such as lower renting cost, tax advantages, and other conditions. The Decree is regarded as a dynamic response of Vietnam government to develop market and networks for waste manage-ment. This Decree has a positive impact on promoting private sectors investing and participating officially in

[1012] See Quang (2008), p. 127

[1013] See Li et al. (2010), p. 13& 17

[1014] See Anh (2007), p. 6

collecting and recycling EoL products, an essential condition for developing a formal reverse logistics system in Vietnam.

Regulations on prohibition of importing e-waste to reduce the amount of illegal imported products from discarded EEE from the other countries as well as regulations on instruction of importing old appliances for reuse have reduced the possibilities of feeding the informal recycling

The legislative conditions in Vietnam have become more restrictive with more regulations on waste management, and responsibilities of producers/distributors. However, waste management operators, industries and other line agencies, and authorities have suffered some gaps in enforcement and insufficient supervision of waste management practices. Although the Article regulating of extended producer responsibility have based on fundamental principle of EPR-based policy, no specific regulations of take-back responsibility have been promulgated until now.[1015] This Article has not been fully enforced. Regulations are not specifically implemented large due to the economic conditions in Vietnam, the limitation of infrastructures and facilities, the fragmented and overlapping roles of various government agencies, and the limited interagency coordination.[1016] There are several ministries directly involved in hazardous waste management in Vietnam. The main ministry responsible for hazardous waste management in Vietnam is the MONRE - for environment management, monitoring, and assessment. Additionally, five other ministries are also directly involved in waste management activities (see Figure 79). The provincial and municipal governments play key roles in providing services of solid waste management, consisting Peoples' Committee (PC), Department of Natural Resource and Environment (DONRE), and Urban Environment Company (URENCO). DONRE is an important agency of MONRE, it also operates under the influences of both parties: PC in terms of administrative and political relations, and MONRE in terms of collaboration, support, and technical guidance.[1017]

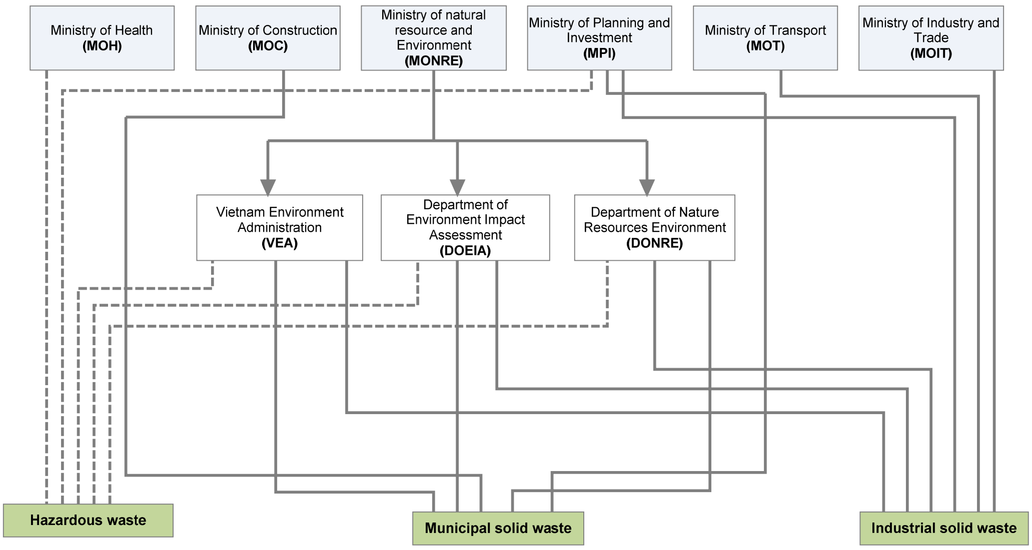

Figure 79: Governance structure of waste management in Vietnam

Source: Thanh/Matsui/ (2011), p. 286

The structural holes of legal framework have required more efforts and collaboration of governmental agencies in learning and borrowing management policy from other countries to modify and implement in Vietnam. Since 2008, Vietnam Environment Administration (VEA) conducted a research to build the concrete regulations and instructions for the responsibility of product take-back and recovery based on EPR-based policy in Europe. At the end of 2010, VEA submitted a draft regulation on collection and treatment of EoL products to Prime Minister after getting the comments of other ministries and related stakeholders.[1018] Suc-

[1015] See Hai (2010), p. 127

[1016] See Duc/Tuan (2008), p. 20

[1017] See Thanh/Matsui (2011), p. 286

[1018] See MONRE (2008b), p. 62

cessful legal transplantation of EPR-based policy is one of the most important factors for the feasibility of transferring a formal reverse logistics management model to Vietnam.

Very soon issuing and implementing the specific regulations on extended responsibilities of manufacturers on collection and treatment of their EoL products are expected to be performed at the end of 2011. However, it takes time and efforts more than expected to issue regulations, instruct, and support the implementation because of the compatibility of legal transplantation and the acceptability of the involved partners. Implementing EPR-based policies in developing countries has still been a major challenge to policy makers due to the unwillingness of consumers, the reluctance of producers in implementing their take-back responsibility,[1019] and the lack of comprehensive infrastructures and technologies. For instance, if smuggled goods, imitated products and no brand products dominate market, it may be difficult to put responsibilities to all of producers and importers, which reduces their acceptability.[1020] Lack of concrete regulations and instructions and the loose enforcement of existing laws are still making conditions for the operation of informal system of collecting, recovering, and recycling EoL products in Vietnam.

7.3.5. Resources, infrastructures, and technologies

This part focuses on analyzing the current situation of resources, infrastructures, and technologies for collecting, reuse, recovering, and recycling of discarded UEEE from households in Vietnam. The analysis partly reflects the opportunities and challenges for implementing reverse logistics at network level.

7.3.5.1. Collecting system

Urban Environment Company system (URENCO)

In the late 1990s, collecting and treatment system for discarded products was still plagued by a number of problems including inadequate management, lack of technology and human resources, a shortage of transportation vehicles and insufficient investments. In 2000, there were only 95 organizations - only two of which were privately-owned companies operating in the waste management industry and together serving 82 cities and/or towns in Vietnam.[1021] In the late 2000s, there have been nearly 2000 enterprises working in environmental and waste management area including state-owned companies, privately-owned enterprises, and joint-venture firms.[1022] The network of urban environmental companies is representative of public urban environmental service providers (municipalities) focusing on municipal waste management. There is at least one representative of URENCO in each city in Vietnam responsible for waste handling. They implement different activities of collection, transport, treatment and disposal of all types of municipal waste (e.g. package waste, paper waste, hazardous waste) from residential areas, streets, commercial areas, offices, markets, industrial parks, hospitals, etc.[1023] URENCO cooperate with private businesses in areas that they are unable to reach to implement their responsibilities of waste handling. This outsourcing focuses solely on collection and transportation processes. These private businesses collect wastes and transport them to landfills. The system of URENCO is officially the single entity responsible for solid waste treatment: composting, incineration, and landfill.[1024]

Waste handling by URENCO is mainly collected at urban central areas and apart of sub-urban areas. The systems with early work in the field of public services to collect and transport waste and urban sanitation have developed in most provinces/cities with an annual turnover of up to several thousand billion.[1025] Normally, households can place their discarded products in the open waste bins on the street or in front of their dwelling for URENCO employees to pick up. Handcarts that the URENCO collectors push on foot door-to-door transport the waste to designated transfer stations. Waste generation including hazardous and non-

[1019] See Herat (2010), p. 8
[1020] See Kojima (2009), p. 19
[1021] See Thuy (2005), p. 103
[1022] See Huong (2010), 2
[1023] See MONRE (2005), p. 21
[1024] See Bucher (2005), p. 28
[1025] See Thanh/Matsui (2011), p. 286

hazardous waste from various sources in municipal areas is temporarily stored at conventional locations, and then collected, transferred and transported to intermediate treatment facilities and final disposal site. Figure 80 visualizes a formal reverse logistics system for EoL products in Vietnam including waste storage, collection system, transfer station, transportation, and final disposal.

Most URENCO are using on-site collection for various kinds of EoL products including plastic/paper bags, plastic/metal bin, waste basket, hazardous waste, e.g. batteries and small UEEE discarded. The on-site collection has not separated EoL products discarded specifically and still mixed with other solid wastes. URENCO have been involved themselves in and in collaboration with other private service providers to supply waste bins/containers in public areas and to fulfill the transportation to the final treatment and disposal facilities. The processes of sorting and testing for reuse and recovering have not been implemented officially due to the small volume of valuable used products discarded to municipalities. Furthermore, the local URENCO collectors frequently select the good ones to sell to informal collectors or secondhand market before moving to the transfer points. URENCO have not invested in designing and building the network of staffed drop-off sites where consumers can bring their discarded product like UEEE for final disposal with the support of URENCO workers. URENCO in big cities such as Hanoi, Ho Chi Minh, and Da Nang have built the network of unmanned drop-off sites with two separated waste bins: one for organic waste and another for other waste including EoL products such as package waste, paper waste, used batteries, and small UEEE. However, the size of waste bin is small and not specialized for collecting discarded UEEE.

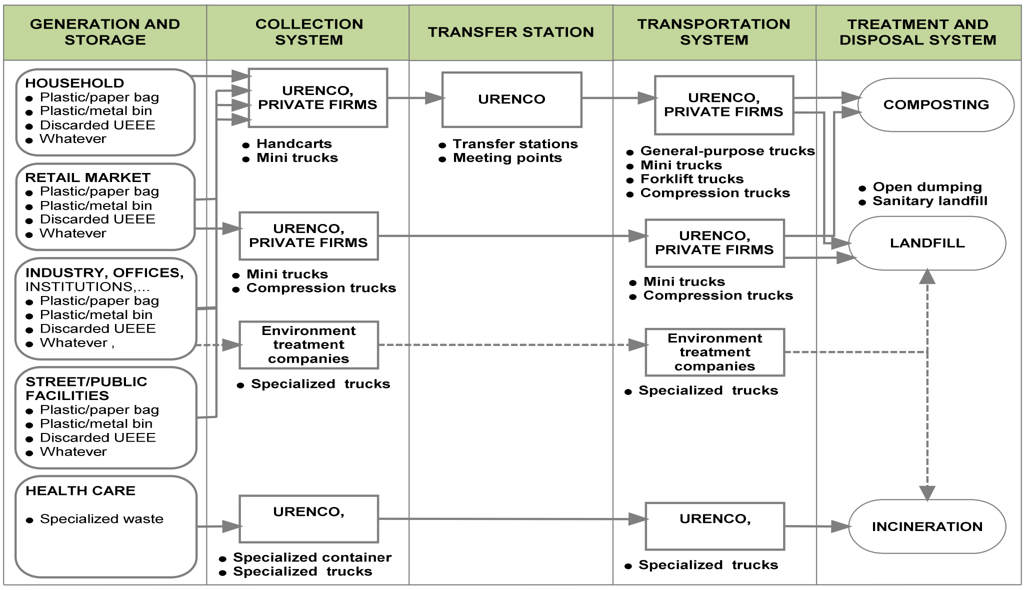

Figure 80: A formal reverse logistics system for collecting EoL products in Vietnam

Source: Adapted from Thanh/Matsui (2011), p. 287; Cf. also Quang (2008), p. 20 with modification

Although there have been significant improvements by URENCO in handling EoL products, proper handling of hazardous waste has remained severely limited, especially for discarded UEEE. URENCO handle practically only a minor fraction of UEEE discarded by industries, shops, institutions, and households.[1026] Actually, there has not been a specialized system developed in the country that focuses on collecting used products discarded such as package waste, battery and WEEE. It is due to the variety of reasons as the shortage of specialized equipment and facilities for collection, storage, transfer, transportation, recycling and disposal; the economic benefits extracted from discarded products; and the lack of public awareness of waste handling system and environmentally unfriendly materials. Moreover, the coverage collection area and frequency of collection have been limited by the effective use of vehicles and schedule transport system. Hazardous waste handling remains weak and industrial hazardous waste treatment systems are largely inadequate.[1027]

[1026] See Furedy (1994); Cf. also Quang et al. (2006)

[1027] See Anh (2011), p. 2; Cf. also Thanh/Matsui (2011), p. 294

Collecting system by private firms

The collection of EoL products today has also been supported by the participation of private companies in many cities, but the expansion has been still limited to collection and transportation in the collaboration relationship with URENCO. For example, collection of discarded UEEE can be implemented through the participation of private sector in hazardous waste management in the form of private companies and "socialized model." An example of private sector participates in collection of solid waste is privatization of the City of Lang Son, in which the private Huy Hoang company is allowed to collect products discarded from households and enterprises. In order to recover its operation costs, Huy Hoang Company collects solid waste fees from households and businesses. The collected fees currently account for 30% of the total revenues of the company while remaining 70% of the revenues are provided from Government budget as a subsidy. Huy Hoang Company has been running its business of solid waste management for Lang Son City very well.[1028] In addition to the participation of private companies, a "socialized model" in the form of "community-based organizations" (CBO) for collection and transportation of solid waste was firstly carried out in Hanoi in 2002 in three precincts of Nhan Chinh, Minh Khai and Thanh Cong. The objectives of these models are to motivate the participation of community and residents in disposing properly the solid waste including WEEE, increasing the awareness of environment problems, and reducing the burdens on URENCO.[1029]Three organizations operated in form community-based solid waste management organizational structure with the participation of different community association such as Women Union, People's Committee, Farmer Union, and in collaboration with the local URENCO. Although the model of privatization and community-based organizations have got some successful achievements, the collection volume of UEEE through this channel is also limited due to the little concerns in improving collection method of special waste, the existence of informal groups associated with valuable waste, and the shortage of infrastructure.[1030]

Informal collecting system

In fact, discarded products such as package waste, scrap paper, and UEEE in Vietnam are often collected by informal collecting system because of the economic benefits obtained from these products. Informal collecting system for these valuable discarded products in Vietnam is operated by waste pickers, junk buyers, repair/secondhand shops, private collecting agents or dealers, craft villages, and private recycling companies (see Figure 81).

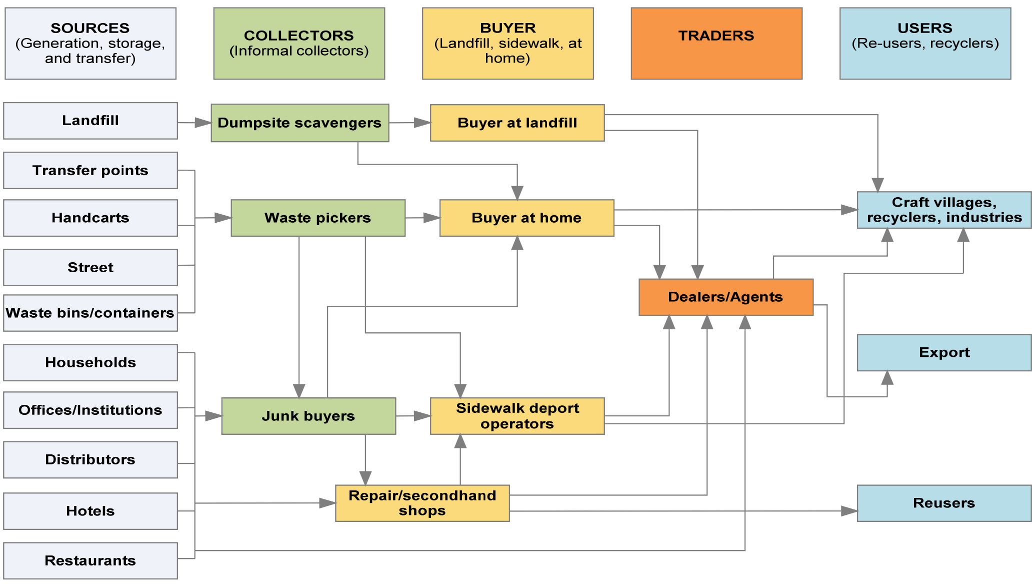

Figure 81: Informal collecting system for discarded UEEE

Source: Adapted from Quang (2008), p. 20; Cf. Also Thai (2010), p. 5; Thanh/Matshui (2011), p. 287 with modification

[1028] See Minh (2005), p. 6

[1029] See Richardson (2003), p. 36

[1030] See Minh (2005), p. 10; Cf. also Richardson (2003), p. 38

Since the renovation process in the late 1980s, migration to urban areas has become a major form of spatial mobility in Vietnam.[1031] The rural commuters and migrants within urban areas engaged primarily in informal activities.[1032] Collecting valuable used products discarded from households and business customers is one of the most popular occupations of many migrants. Informal waste-recovery industries operating under economic pressures "motivated by demands for secondhand products, recovered materials, and the income needs of the low-skilled labor force."[1033] In Hanoi, the system of informal collectors consists a complex hierarchy, which includes a three-tiered network of waste collectors (city-based waste pickers, dumpsite pickers, and junk buyers), intermediaries (receivers, dumpsite depot operators, and sidewalk depot operator), and dealers. Waste pickers scavenge for waste at transfer sites in the city, refuse bins, and waste carts, and on the street. They do not purchase waste; rather, their income is derived from the sale of 'found' objects.[1034] For this study, we refers junk buyers, repair/secondhand shops and private collecting agents/dealers as "informal collectors" who buy discarded products typically from households, restaurants, small hotels/guest houses, and institutions (office building, both private- and government-owned) with three main groups including small collectors, medium, and large sized collectors (see Figure 82). Households in Vietnam often sell their discarded UEEE to junk buyers (small collectors) when they want to dispose the products. The small collectors collect UEEE from many generators then resell to the medium and big collectors (e.g. repair/secondhand shops, dealers) for repair, refurbishment, and recycling. To collect of UEEE from offices are always medium and large collectors (repair/secondhand shops, cooperatives or collecting agents, and dealers). Differences between collectors for households and offices are legal status and budget. Most small collectors have not registered for their operations and have been not under any control. About the collectors for offices, they are often small and medium-sized private cooperatives and companies. Contracts of collection are often established after offices' call and select the best collectors for UEEE that they discard. Repairing for reuse, dismantling for spare part businesses, and recycling are there common activities for the treatment processes of discarded UEEE in Vietnam.[1035]

Figure 82: Photos of informal collectors in Vietnam

Reuse of UEEE and reselling to informal collectors has already been common practices in many households in Vietnam. They have been largely accustomed to an informal collecting system rather ran a municipal collecting system because of economic benefits, low awareness, and without information about environmental issues caused by discarded UEEE. The informal collectors pay consumers a positive price for their discard of these products. Informal collectors, in turn, also separate reusable and recyclable wastes; then sell their collections to repair and secondhand shops who repair, dismantle, and refurbish; or dealers who aggregate and sort different kinds of waste and then sell them to recyclers, who recover the metals. Many informal

[1031] See ODI (2006), p. 2

[1032] See Douglass et al. (2002), p. 23

[1033] See DiGregorio (1994), p. 2

[1034] See Mitchell (2008), p. 2020

[1035] See URENCO (2007), p. 43

collectors and repair/secondhand shops of discarded UEEE said that it is today easier to buy these products from households and organizations in urban area because they are more often updating their old appliances and electronics with newer models, and the profit from reselling is higher (see Table 32).[1036]

Types of waste material	Price for repurchasing (USD/kg)	Price for reselling (USD/kg)
Scrap Steel	0.30	0.40-0.5
Scrap Iron	0.20-0.28	0.30-0.48
Plastic	0.05-0.03	0.075-0.35
Paper	0.08-0.15	0.10-0.18
Electric cable	1.30-1.50	1.50-1.75
Spare part of machinery	0.50-2.50	1.00-4.00
Fans, TVs, RFs, and WMs	2.50-10.00	5.00-15.00

Table 32: Price for repurchasing and reselling of valuable waste materials in Vietnam

Source: Thai (2010), p.6; Cf. also Mitchell (2008), p. 2023; and interview with informal collector in the field trip

The informal system including more than 1000 establishments with thousands of collectors[1037] has been regarded as a temporary but an effective solution for collecting and recycling discarded UEEE in Vietnam when the formal collection system does not provide a proper collection and incentive mechanism to the households. In the case of Hanoi, the total population of waste collectors in all nine districts is estimated at approximately 22,500,[1038] among them the 'upper tiers' of the waste recovery hierarchy, including approximately 1700 waste intermediaries (city-based sidewalk depot operators and fixed-location waste receivers) and an unknown number of waste dealers. Many researchers argue that informal waste collectors can contribute to ''cleaner urban neighborhoods, financial viability (of waste management organizations), reduced volumes of disposed waste through recycling, re-use, and composting, and employment creation for predominately poor people,[1039] especially in developing countries like Vietnam where infrastructures and technologies for logistics and recycling have been still far from adequate.

Vietnam actually has a very active and successful informal collecting system, where almost of discarded UEEE and valuable parts are collected directly from end-users, the industry, and the landfills.[1040] Informal sector activities contribute to some positive environmental effects in waste management. For instance, the collecting activities of the informal sector allow the conservation of resources and the recovery of secondary materials. However, the informal collecting system have resulted in many issues related to environmental pollutions, public health and the vulnerable groups including waste pickers, poor women and children. The integration of informal sector into a formal collecting system in new model of reverse logistics for EoL management might be the opportunity for developing a formal reverse logistics system in Vietnam

OEMs/distributors' collecting system

In Vietnam, only a few manufacturers and distributors have been involved themselves in collecting discarded UEEE because they want to stimulate customer demands and increase sales in the period of gloomy economy. Their collecting systems are conducted through "old for new" programs. Collecting discarded UEEE in the form of "old for new" exchange has begun for recent years mainly by foreign manufacturers, and large distributors and retailers (see Table 33). For example, Saonam photocopy - a distributor for Brother, Sanyo, and Konica Minolta - has carried out the campaign of "analogue for digital" in the form of repurchasing the old ones since 2008 if the customers buy a new photocopy in its store chain. They carry out this policy to stimulate business customers to purchase new products for replacement. The programs of "old for new" are mostly carried out in big cities with the main objectives of stimulating demands and increasing sales because the majority of Vietnamese people are acquainted with using their products until it cannot be used and the

1036 See Pfohl/Ha (2011), p. 4; Cf. also Thai (2010); Mitchell (2008), p. 2023-2025

1037 See Tuan (2010), p. 2

1038 See See Mitchell (2008), p. 2024

1039 See Baud/Grafakos/Hordijk/Post (2001), p. 3

1040 See Quang (2008), p. 19

issues of consumption savings in the period of economic crisis.[1041] However, the problems of identifying the value of used products and the discounts for new product by exchanging the old one have made customers little bit dissatisfied. Furthermore, these "old for new" programs mostly focused on IT equipment and small household appliances. The arrangement of logistics and delivery of used large household appliances discarded from end-users have not been smoothly operated, which might hinder consumers from joining the program.[1042]

Operators	Types of firms	Types of used products exchanged	Time
Panasonic	Manufacturer	TV Plasma, TV LCD, Digital camera	2011
Panasonic	Manufacturer	Washing machines, Refrigerators	2009-2011
Duremart	Distributor	Air conditioner	2011
Pico Plaza	Distributor	IT equipment	2010
Westcom IT	Distributor	MPs, USB, Keyboard, Headphone	2010
Topcare	Distributor	TV LCD, Washing machines, Refrigerators	2009
TranAnh	Distributor	IT equipment, CEs	2008
Saonam	Distributor	Photocopy machines	2008
Mobileworld	Distributor	Mobile phone	2008
FPT Mobile	Distributor	Mobile phone (Samsung)	2005

Table 33: "Old for new" programs in Hanoi

National collection day

The final collection channel for UEEE discarded from households is through the "Recycling day" conducted by governmental waste management agencies in big cities such as Hanoi, Ho Chi Minh and Da Nang. For example, HCM Department of Natural Resources Investment carries out annually its formal collection of discarded UEEE on 18th April. These campaigns stimulated the participation of the households through the exchange of old electronic products that have been no longer used to take gifts as supermarket coupon and small family products. Although the results of these programs were reported with lower collection rate, it has partly contributed to enriching the people's awareness of a formal collection for discarded UEEE in Vietnam.[1043]

7.3.5.2. Reuse, repair and refurbishing

In Vietnam, secondhand market for UEEE has been relatively popular since the mid-1990s and has still developed, especially in rural and low-income areas for mobile phones, TVs, refrigerators, washing machines, and air conditioners. It is due to a large discrepancy between rural and urban areas in terms of income, living standard, and household penetration of EEE. The increasing demands for UEEE in rural areas, together with the shortened lifecycle of these products in urban areas have stimulated the collection and movement of secondhand electronic appliances from urban to rural and low-income areas. According to Duc (2008), the secondhand market for TV is reducing in Vietnam due to the lower price of new brand, while the secondhand market for the other appliances such as refrigerators, washing machines, and air conditioners is still growing.

The electronic appliances discarded in Vietnam are firstly prioritized for reuse, repair and refurbishing for reuse, and dismantling for spare part businesses because economically speaking the remaining functional value of these products is usually higher than the inherent recoverable material value. Repair businesses are also very popular in developing countries like Vietnam because labor costs are low, and the secondhand market, where repaired items are resold, has been still potential.[1044] In repair and refurbishing processes, the discarded appliances are remade into new ones by replacing the failed parts. For example, in secondhand TV sets and computer monitors, repair shops usually reuse the CRT tube with a new casing, and imitation brand

[1041] See Azzone/Noci (1998), p. 94

[1042] Interview with the households in survey

[1043] See HCM DONRE (2011), p. 1

[1044] See Kojima/Yoshida/Sasaki (2011), p. 267

logos are put on new casings. The repair shops also offer services such as computer and mobile phone software upgrade, addition and personalized accessories such as changing LCD screen, altering original lights with new colors, additional ring tones, etc.[1045]

In 2007, URENCO conducted a survey with 210 collectors, repair and secondhand shops, and recyclers in Hanoi, Ho Chi Minh, and some big provinces to investigate current recovery processes and management models of discarded UEEE. They found that in repair and secondhand shops, the quantity of UEEE collected was equivalent to those sold out (see Figure 83). Repair and secondhand shops collect UEEE and then try to repair them as much as possible, from 80 to 90%. Refurbishment activities occupied from 5% to 15% in total of collected quantity.[1046] Mobile phones are rarely refurbished because they are fashion products. This explains why the growth rate of mobile phone sales is always high and the rate of mobile phone discarded is continuously increasing.

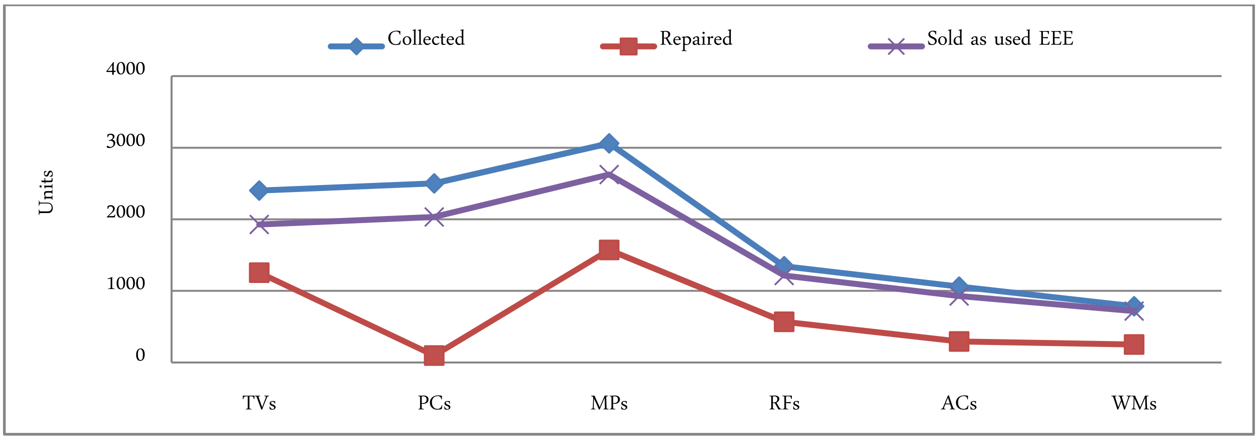

Figure 83: Rate of repair, refurbish, and sold as UEEE in repair/secondhand shops

Most repair and secondhand shops were previously small private-owned shops that had poor treatment facilities and lack of modern technology. However, repair and secondhand shops for large household appliances and consumer electronics are now operating with the larger scale with the increased number of workers, as well as more supporting equipment, which has resulted in the development of small and medium-sized centers and enterprises providing professional repair and refurbishing services in recent years (see Figure 84).[1047] The changes may improve facilities and technologies of product recovery in reverse logistics management model of EoL products.

Figure 84: Photos taken at Anh Duc and Bach Khoa EEE repair centers

[1045] See Nguyen (2011), field study results

[1046] See URENCO (2007), p. 91

[1047] See URENCO (2007), p. 45

7.3.5.3. Recycling

The reuse and repair of discarded UEEE in Vietnam has currently been in a good condition, but the recycling is uncontrolled. The potentials for recycling in Vietnam are high, especially with the high valuable discarded products such as package waste, paper waste, and UEEE. Moreover, informal collecting and recycling system for these discarded products is very active and successful with nearly 100% collected and 80% of total electronic waste are repaired, refurbished, and recycled.[1048] In the case of electronic waste handling from households, a great number of residues from repair and refurbishment activities are collected and recycled at recycling units, e.g. craft villages and small recycling companies. For an industrial waste, it is classified at source under treatment method: reuse, recycle or discharge. Reusable and recycled wastes are sold to recycling units, non-recycled parts are collected, transported and treated by signing contract with URENCO or environmental treatment companies for incineration or landfill.[1049] Table 34 presents the ratio of collecting, dismantling, recovering and recycling of some main UEEE discarded in Vietnam in current years.

Description	TV (%)	PC (%)	Mobile (%)	Refrigerator (%)	Air conditioner (%)	Washing Machine (%)
Collection	100	100	100	100	100	100
Dismantling	<20	<20	>30	<20	<20	<10
Repair/Refurbishment	>80	>80	<70	>80	>80	>90
Processing of recyclables	>8.5	>10	<10	>15	>15	<10
Incineration/Energy						
Disposal/Landfilling	<5.5	<10	<20	<10	<3	<5

Table 34: Ratio of collecting, dismantling, refurbishing, and recycling for discarded UEEE

Source: Duct/Tuan (2008), p. 7-12

However, there have currently been no large-scale systematic waste recycling facilities in Vietnam for WEEE in Vietnam. Recycling industry is almost established informally in forms of craft villages, small family business, and private enterprises (see Figure 85).[1050] Up to date, Vietnam has had a chain of 4600 craft villages creating 11 million jobs for labour force and has attracted approximately 30% employments in rural areas.[1051] Among them, 81 waste recycling villages related to metal scrap and aluminium waste are allocated mainly in some main cities and provinces in Northern of Vietnam such as Hanoi (Trieu Khuc, Thanh Tri), Vinh Phuc (Yen Lac), Nam Dinh (Van Chang, Yen Xa), Hung Yen (Dong Mai), and Bac Ninh (Chau Khe, Nam Truc). According to MONRE statistics, it is approximately 95.2% of WEEE recycled in recycling villages in Vietnam, which produced the huge volume of 700,000 tons of products and materials annually to meet the market demand.[1052]

HCM City has more than 300 recycling enterprises that collect various scrap materials including paper, glass, metal, aluminium, copper, plastic, and rubber. However, most these enterprises are small-scale and use outdated technology, which focuses on only two types of incineration or grinding waste materials, and adding chemicals waste to produce new products. More complex electronics scrap like TV sets, washing machines, and fridges are not recycled properly.[1053] These recycling villages and enterprises contribute significantly to reduce waste, recapture value from discarded products and recycle materials. However, many recycling villages and enterprises have still used backward technology and rudimentary equipment for their operations of dismantling and recycling that cause not only low economic benefits but also serious environmental pollution.[1054]

[1048] See Duc/Tuan (2008), p. 7-12

[1049] See Hai (2010), p. 110

[1050] See Hai (2010), p. 111

[1051] See Vietnamnet (2007), p. 3

[1052] See Thai (2010), p. 7; Cf. also MONRE (2008a), p. 43

[1053] See Vietnamnet (2009), p. 2

[1054] See Pfohl/Ha (2011), p. 5

Figure 85: Photos at craft villages of metal and lead recycling in Vietnam

Since the mid-2000s, the Vietnam government has currently paid more attention to creating incentives for the participation and investments of both public and private sector in collecting and recycling EoL products. There has been an increasing investment in recycling facilities and technology in the network of URENCO, craft villages, and recycling companies.[1055] URENCO have increased their investments in waste collection, transport vehicles, transfer and treatment facilities for hazardous waste. URENCO also intend to collect and treat WEEE by setting up long-term strategic plan of investing collection and recycling facilities.[1056] Private sector including both local and foreign companies has also invested in some projects of waste recycling in Vietnam. Around 60 facilities including public and private sectors are licensed by MONRE for officially treatment, collection and transportation of hazardous waste in 2010.[1057] VEA in collaboration with Ministry of Construct has outlined a response to the solid waste problem with a proposal to construct waste treatment facilities in the period of 2010-2020 that would process hazardous waste disposals through chemical or physical treatment, stabilization and solidification.[1058] Moreover, there have been significant shift in recycling operations in craft villages, in which they increasingly set up the cooperatives of craft villages in each region and established formally private enterprises specializing in collecting and recycling with larger scale. More investments are put on technology upgrade but the changes are not so much due to the limited capital. For example, Dai Bai metal recycling village in Bac Ninh province now has 680 households, 2 cooperatives, and 11 limited companies collecting and recycling metal scrap from different kinds of discarded UEEE. Most recycling companies asked in Dai Bai are planning to expand their business to recycling and treatment of discarded products but they are not so confident of a specific project due to the lack of finance resources.[1059]

The recycling sector in Vietnam is very active and providing a good basis for developing a formal reverse logistics system for EoL management, especially for with plastic, metal scrap, and paper. The positive changes of awareness, investments, and collaborations are good signals for the feasibility of implementing a new management model.

Beyond the current context of economic development, laws and regulations, and infrastructures and technologies, cultural and social aspects shown through consumer awareness, attitudes, and behavior have also an important impact on the implementation of a formal reverse logistics management model in Vietnam. The following part focuses on studying these issues.

[1055] See Hai (2010), p. 111; MONRE (2008b), p. 54

[1056] See MONRE (2008b), p. 54

[1057] See VEA (2011), p. 11

[1058] See Umali (2010), p. 2

[1059] See Interview with the households in Dai Bai in field trip

7.3.6. Cultural and social aspects

7.3.6.1. Changes of based-culture value of Vietnamese people

Before the late 1970s, nearly all Vietnamese people lived in villages, and the cultivation of wet rice was the principal economic activity. The basic component of rural society was the nuclear family. Since 1986, the Vietnamese government has adopted an economic reform program that based on free market principles, and encouraged foreign investment and tourism development. As a result, the Vietnamese people have been gradually influenced by the lifestyles from developed countries of South East Asia and the West. They have a stronger sense of individual freedom and personal autonomy. However, some traditional culture values and social ethnics remain strong in Vietnam society. Its core values, which embrace the principles of Confucianism, are harmony, duty, honor, respect, education and allegiance to the family, and saving culture.[1060]

During the years of centralized planning, most people in the country suffered from the lack of access to necessities, as well as an unstable economy. Therefore, even when the country opened up and people started having higher income, they have maintained (or were used to) a low standard of living, i.e. using durable goods for long time, consuming the same foods, wearing the same clothes and avoiding entertainments as much as possible.[1061] Reuse, recycling and lateral cycling are therefore common practices and economically necessary in many Vietnamese households. The custom of saving and the concept of product reuse have been part of the Vietnamese culture for a long time, especially for the old generation who used to live in poverty and war. Ordinary Vietnamese people who cannot easily afford to buy expensive items such as electronics may find it hard to dispose valued possession right away. Therefore, it has led to the traditional custom of using for long time until it is broken, repairing and reusing, giving them to other people, and finally selling them to informal collectors, repair and secondhand shops for years. The custom of savings and the habit of classification may support positively a formal collecting system for discarded UEEE if a formal incentive system is initiated; and collection infrastructures are well invested and easily accessed by end-users.[1062]

However, economic restructuring and development have partly led to a departure from many of the values, attitudes, and behaviors associated with traditional Vietnamese culture. Product, brand, advertising, and retail outlet proliferation, rudimentary class stratification, institutional as well as personal changes in sacred versus profane possessions, entrepreneurship, conspicuous and aspirational consumption are all very much a part of Vietnam now.[1063] These shifts have altered consumer behavior, spending pattern of Vietnam people, and increased consumer demands, especially for urban areas and high-income regions. Private consumption has steadily increased for recent years.[1064] The result of nationwide social changes after years of limited choices within a planned economy has created Vietnamese consumer enthusiasm and optimism in spending, consumption, and disposal. Therefore, more products are discarded to replace by new ones with updated technology and functions, especially for young people.

7.3.6.2. Consumer awareness, attitudes, and behaviors for discarding used products

Although there are some positive changes in consumer behavior and spending pattern, Vietnamese people have been facing many difficulties of lower income than many other countries, inadequate infrastructure, and information accessibility. Differences in economic conditions and social-cultural value lead to the gaps in consumer awareness and attitudes toward environmental issues in comparison with Western countries and developed countries.[1065]

While Vietnamese people have been in an environmental way of thinking bias to Asian traditional values of honoring parents and family security for a long time, Western people believe that such thinking opposes against their altruistic values.[1066] Altruistic values support for high individualism, unity with nature, respect-

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[1060] See Marsha (2004), p. 1

[1061] See Anthony/Clifford/Schultz (1993), p. 234

[1062] See Pfohl/Ha (2011), p. 6

[1063] See Anthony/Clifford/Shultz (1993), p. 236

[1064] See Dang et al. (2010), p. 10 & 16

[1065] See Inglehart (1971); Cf. also Inglehart (1977), p. 991

[1066] See Aoyagi-usui (2003), p. 23

ing the earth, protecting the environment, and a world at peace, equality, and social justice. Traditional values in contrast focus on honoring parents and elders, family security, and self-discipline.[1067] However, Factors encouraging environmental behaviors are different among countries, and vary according to the types of environmental behavior, social and economic situation.[1068] For example, new phenomena in Vietnam economy in recent years including views on economy of knowledge, society of information, globalization, human development, environmental and sustainable development, have been borrowed and learned for application in Vietnam. These things have changed the thinking of environmental value by linking with both traditional values and altruistic values. Although Vietnamese consumers have increasingly understood about the role of nature, the issues of environment pollutions, and the importance of environmental protection, they have largely been unaware of the impacts of individual behaviors on the environment.[1069] Most of them follow the cultural model toward environment in which they view nature as limited resources and human must rely on for their survival without interdependence relationships.[1070] For example, not so many people draw a clear boundary between humans and nature, and discuss nature in the context of its balanced and interdependent relationship to humans. The lack of a clear boundary between humans and nature causes destruction of nature and makes people in many developing countries in Asian like Vietnam take a long time not to care environmental problems individually and their roles in socio-economic activities towards environment protection.

However, environmental awareness in Vietnam has steadily been raised since the 2000s, when activities for environment were popularly organized to mobilize public attention in protecting the environment.[1071] In the study of Tuong and Rambo (2003), many consumers interviewed believe that Vietnamese people generally begun to have more concerns about environmental issues.[1072] The reasons for their increasing concerns in the environment are the revision of environmental law with regulations that are more specific, the increasing number of environmental risks (water pollution, heavy floods, etc.), the negative effects of pollution on people health and existence, and the available information of environmental problems in the mass media. People asked, especially with high-income and well-education, have the common viewpoints that people's activities have impacts on nature, and nature reactively affects the welfare of human beings. However, many ordinary people have still lacked appropriate knowledge about the human-nature relationship. The overwhelming majority of Vietnamese people are only concerned about whichever environmental problems directly affect their life and health. They do not care about other environmental problems which impact in the long term, because they have too many other things relating to their daily lives to worry.[1073] Socio-demographic factors and income have affected Vietnamese people's awareness and decisions of individual responsibility towards environment protections.

In order to understand consumer awareness and attitudes towards discarded UEEE, and their current behaviors of discarding UEEE, the study conducts a cross-sectional survey in 2011 and makes some comparison with the results of a previous survey conducted in 2007 by MONRE (2008). The comparison may partly show the changes over time and identify the opportunities for the implementation of a formal reverse logistics management model.

In 2007, many users in Vietnam did not have enough information and knowledge of characteristics of the expired products like UEEE as well as their negative impacts on environment during and after their usage. The majority of Vietnamese people frequently separated their used products into the product with useful functions and the products without usage functions. They were interested in only usage functions of used products with the main objectives of repairing for reuse, reselling to informal collectors, giving to other people or charity. The main reasons for their classifications were due to earning some money (51%), reuse

[1067] See Stern/Dietz (1994), p. 65; Cf. also Stern et al. (1995), p. 723

[1068] See Aoyagi-usui (2003), p. 30

[1069] See Nguyen (2011), field study results

[1070] See Hang (2005), p. 18

[1071] See MONRE (2008a), p. 93

[1072] See Tuong/Rambo (2003), p. 81

[1073] See Tuong/Rambo (2003), p. 80

and repair (45%), and cleaning the city (4%). Most of the households, especially in rural areas, interviewed said that used products were firstly repaired, reused in their house, or given to other people with the rate 90% and 70% in rural and urban area, respectively.[1074]

In comparison with the cross-sectional survey conducted in 2011 with 181 households, the knowledge of negative impacts of used product at expiry period has increased steadily, especially in urban areas and people with high education level. Approximately 37.6% of the households interviewed have not paid attention to the information related to use period of EEE purchased. The rest households asked (62.4%) have different levels of concern in usage functions and expiry time, in which the respondent rate of households in urban areas (69.7%) and higher income (66.9%) is higher than the rate in rural area (52.6%) and lower income (51.4%). Chi-square tests are conducted to find the significant relationships between economic conditions with two variables of income and living area, and the awareness towards concerns in use period of EEE. The empirical results indicate the statistically significant relationship between economic conditions ($\chi^2_{urban/rural}$= 8.299, df=3, p=0.04, V=0.214; $\chi^2_{higher/lower}$= 13.409, df=3, p=0.004, V = 0.272) and the awareness of people related to use period of EEE. Figure 86 presents the different levels of concerns in expiry date of used products in 181 households interviewed in the 2011 cross-sectional survey.

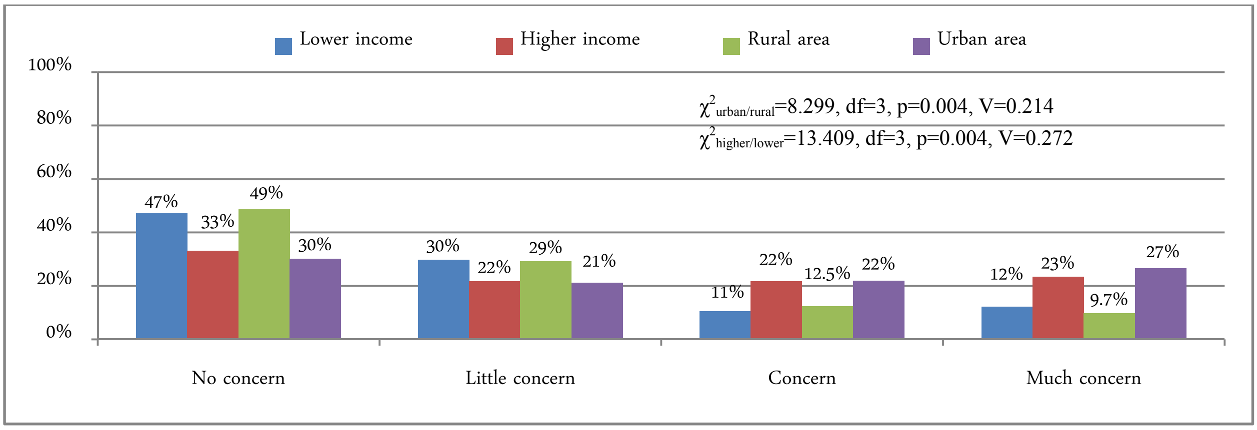

Figure 86: Different levels of concerns in functions and expiry date of UEEE

In the 2011 survey, the households are asked about their reasons for classification of their UEEE. The response rates are 40.9% for more income, 50% for repair and reuse, and 9.1% for cleaning the environment, indicating that many Vietnamese people are still interest in separating for repairing and reusing due to their saving culture and social values (see Figure 87).

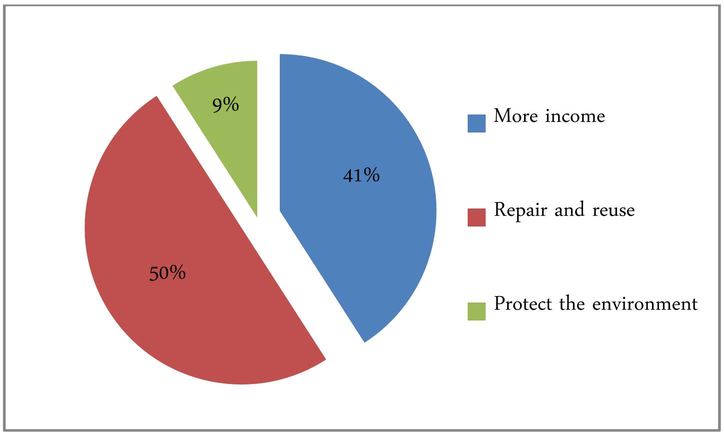

Figure 87: Different level of classification reasons of UEEE

The habit of classifying the used appliances is rather positive for developing a formal collecting system in the future. However, economic benefits are also continuously an effective incentive for them to classify used products and sell to informal collectors. In semi-structural interviews during cross-sectional survey with

[1074] See MONRE (2008a), p. 97

different households, the reuse and repair rate for large household appliances is estimated about 1.5 to 2 times for total lifecycle of products and this rate in rural area is higher. Many households, especially with lower income and in rural area, still use the electronics products they own until they would be broken and cannot be repaired anymore. This situation happens more often with large households appliances. Although Vietnamese people are increasing their awareness about general issues of environments, they have not enough information about the negative impacts of EoL products on environments. The reason of cleaning the environment through classification is increasingly concerned but with lower rate (9.1%).

In order to analyze current behaviors of discarding, the household respondents are asked to select their response to UEEE broken or discarded, including repair and reuse, sell to informal collectors, sell to repair/secondhand shops, give to others, and storage and disposal to municipalities. Selling UEEE to informal collectors (28.2%), and repair/secondhand shops (26.1%) is the most preferred option chosen by Vietnamese households for disposal of UEEE. Thus, 54.3% of the generated WEEE are passed into informal collecting and recycling sector (see Figure 88). Recently, the selection of repairing and reusing (30.8%) is decreasing due to the shorter lifecycle products and the price erosion. Giving to other people, normally to relatives in rural area or for charity accounted only for 10.9%. Keeping in house UEEE and finally disposing through municipal collection made up only 4%, indicating that the formal collecting system operated by URENCO in Vietnam have not fulfilled their responsibilities of collecting valuable discarded products. It can be observed that it is necessary to find the solutions for integrating informal collecting system to the current system for the successful transfer and implementation of a formal reverse logistics model for EoL management.

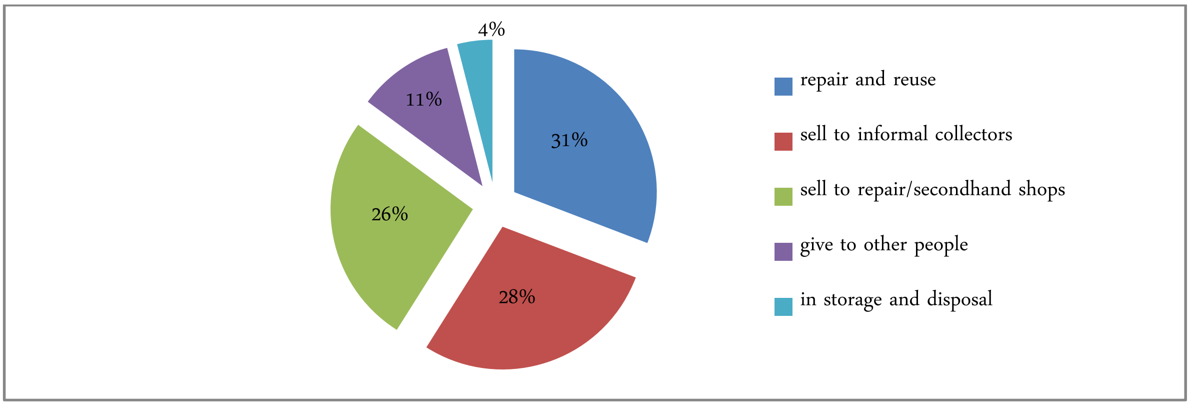

Figure 88: Disposal behaviors of Vietnamese households for UEEE

Buy-back campaigns or "Old for New" programs for discarded UEEE have not been conducted formally and popularly in Vietnam because Vietnam has not issued the specific regulations related to extended producer responsibility and take-back obligations of WEEE. There are only a few electronics firms, mainly with foreign manufacturers or large electronics distributors voluntarily conduct "old for new" programs through annual marketing events in order to motivate consumer demands and increase sales in the period of economic recession, but not for environmental concerns. For analysis of the feasibility of implementing a formal reverse logistics model for EoL management, the household respondents are asked to evaluate three choices of a formal collecting system. Drop-off collection point (bring system) where the households can hand in discarded UEEE is evaluated with the lowest rate of suitability due to the inconvenience of bringing discarded UEEE to collection points (49.7%), especially with traffic conditions and transport distance in Vietnam. Meanwhile, curbside or door-to-door collection (collection system through URENCO) is more preferred (81.2%) due to its convenience to the households (see Figure 89). However, the household respondents commented that they would be more willing to discard to URENCO with small financial incentives (e.g. small gifts, supermarket coupon).[1075] It is due to the competition of informal sectors in collecting the discarded products. Collection system at retailer stores with "old for new" exchange is most preferred with the highest rate (88.4%). The household respondents also indicate that they can bring to retailer store the old ones by themselves only with small equipment for exchanging the new ones. In case of large household

[1075] Interview with the households in the survey appliances, the delivery services "door-to-door" for new products of distributors are very useful to take back their return.

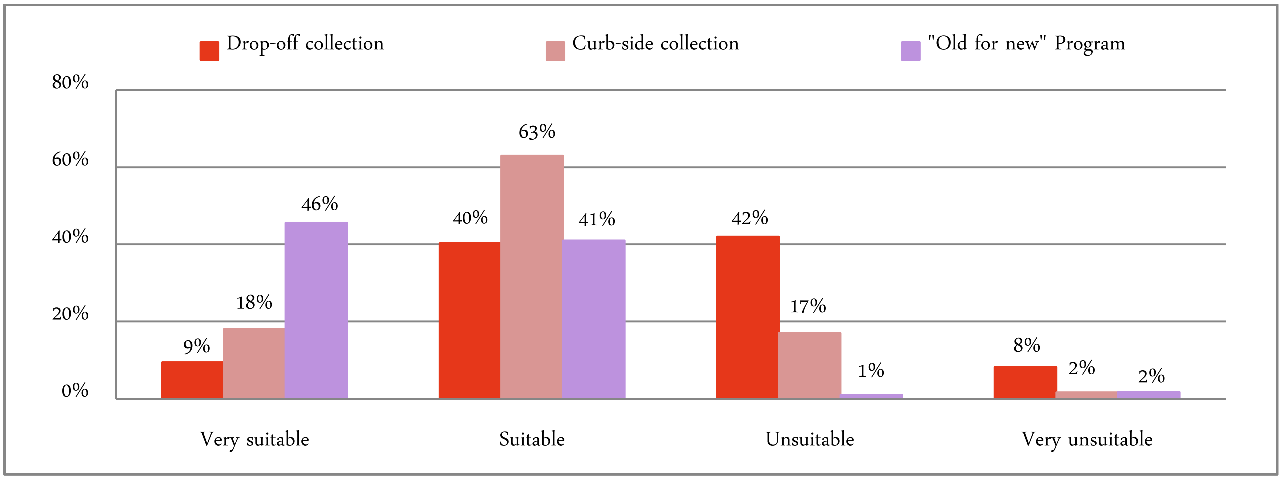

Figure 89: Households' acceptability of collecting channels

7.3.6.3. Consumer attitudes and behaviors for returning products

There have been currently any data and empirical studies in Vietnam concerning current consumer attitudes and behaviors for returning products after sales. It may be due to traditional thinking of sellers' market environment in centralized planning economy. However, the transformation to a market oriented economy with the international integration and the participation of different sectors of both from private and foreign investments have steadily changed the Vietnam electronics market to customer orientation. Consumers in Vietnam have currently increased their awareness and demands regarding product quality, after-sale services, and consumer rights.

According to the 2011 survey, most of the household respondents have buying habit through indirect channels (75.1%) with the diversified chain of retailer stores and small markets. Although there have been increasing people in Vietnam to use Internet (27.1% of the total population),[1076] a very small percentage of Vietnamese households can have access to Internet for buying product (5%) due to the limitation of payment system and security. For electronics market, the new established electronics supermarket and centers have increased consumers' accessibility to many kinds of products with new technologies and functions as well as different brand name worldwide. The consumers nowadays have increased their concerns in return and exchange polices offered from manufacturers and distributors (81%). However, behaviors of exchanging and returning products have not become popular in Vietnam because the consumers have not acknowledged their full rights in purchasing and dealing with the problems occurring (quality, techniques, damage, and unexpected issues). More importantly, the procedures for exchanging and returning products are very complicated and difficult for them to return the products. Only 2.8% of the households asked comment that members in their family deal with exchange of products frequently. The response rate with frequent returning is only 0.6%. The number of consumers sometimes exchanging and returning the product after sales is increasing with the rate of 35.4% and 7.7%, respectively. They return products because of different reasons, but mainly due to product quality (73.5%) and not meet customer expectations (22.1%). Many members of the households asked complain about the willingness attitude of OEMs/distributors in solving the issues related to exchanging products and returning with refund. They said that many electronics supermarkets and centers have unclear exchange and returns policies, e.g. responsibilities of return shipping, strict conditions of exchange and return, and the ambiguity of repair and exchange operations. Only 22.7% of household respondents evaluate exchange procedures of firms relatively comfortable and this rate with return procedures is only 12.2% (see Figure 90).

[1076] See Internet World Statistics (2010)

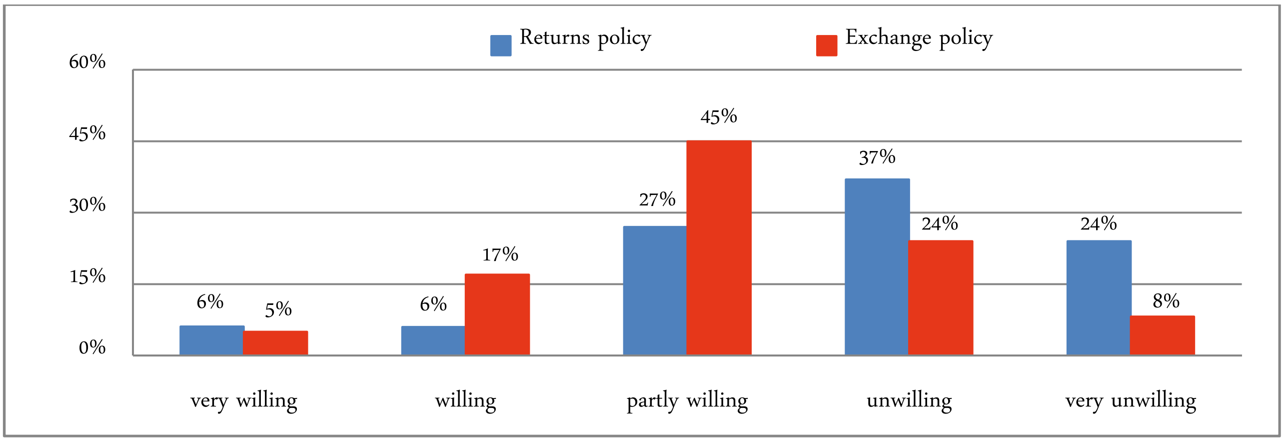

Figure 90: Evaluation of exchange and returns policy

By analyzing the main culture-based value, the awareness, attitudes, and behaviors of Vietnamese consumers related to disposing and returning products, this study can conclude that the public awareness in Vietnam has been generally low, but now positively increased due to the changes of external environments. The economic and socio-demographic factors have strong impacts on the social movements, attitudes, and behaviors towards environmental issues, discarding UEEE, and returning products. The custom of selling UEEE to informal collectors can be gradually changed by setting up a formal collecting system as in the case of Romania[1077] and Ireland[1078] via buy-back program and incentive mechanism.

7.4. Contextual similarities – The transferability of reverse logistics

The brief data extracted from different sources shown in Table 28 signifies that there are many differences between Germany and Vietnam in the legal framework related to environmental management and take-back regulations, the level of economic development, the level of infrastructure and technologies, and the level of public awareness. Therefore, it is impossible to look for a similar context in term of these aspects between Vietnam and Germany to make fundamentals for the analysis of transferability of a formal reverse logistics management model to Vietnam, although two countries have some similarities in geographic and demographic characteristics. For profound analysis of feasibility of transferring reverse logistics to Vietnam, Romania is selected because of narrower gaps in aspects of economic development, legal framework, infrastructure, and public awareness. Vietnam and Romania were in the transition process from a centrally planned to a market economy since the late 1980s. Both countries have the relatively similar rate of economic development in the period of 2000 - 2010 with the GDP growth rate from 5% and 7%, respectively.[1079] Romania is also the country in Europe implementing the transplantation of legal framework and reverse logistics management models later than other countries due to its constrained conditions. Their success to some extent in institutional transplantation of legal framework and management practices of reverse logistics may strengthen the feasibility of transferring a formal reverse logistics management model from Europe countries to Vietnam.

7.4.1. Economic development, electronics industry, and consumer demands

Romania is the seventh largest nation among the 27 EU nations with 21.4 million habitants. Romania has continued its macroeconomic stability and growth with necessary economic reforms over the last decade.[1080] The fact that Romania is one of the least developed European countries and characterized by a significantly lower level of disposable income than the European Union average, but in the process of growing.[1081] Viet-

[1077] See Ciociou et al. (2010), p. 20

[1078] See Sander et al. (2007), p.

[1079] See CIA Factbook (2011a, 2011b)

[1080] See Stoenescu (2010), p. 2

[1081] See Euromonitor (2010)

nam and Romania have the similar growth rate of GDP in the period of 2000 - 2010 (see Figure 91), and GDP per capita is in narrower gap.

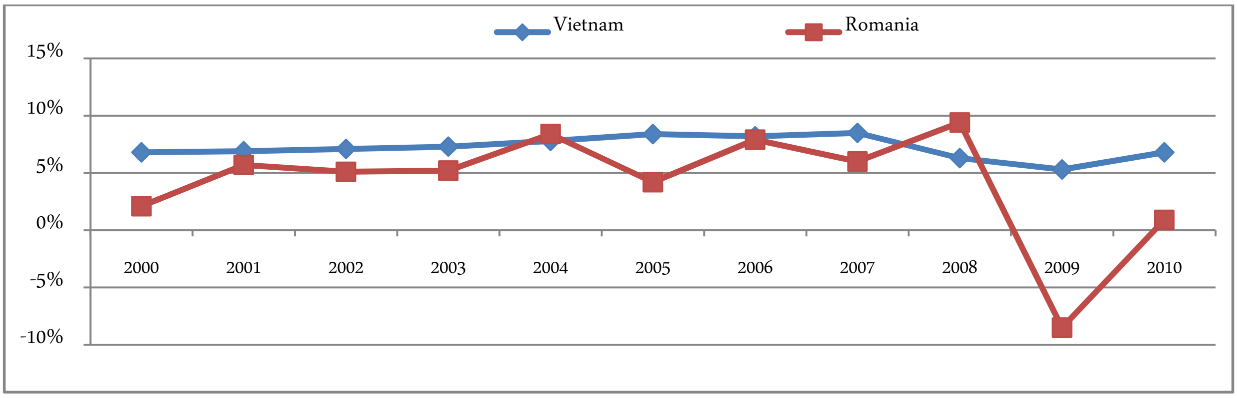

Figure 91: GDP growth rate of Romania and Vietnam

Source: CIA Factbook (2011a, 2011b)

More than half of Romanian population (55%) living in urban areas spend less on basic needs (e.g. food), and more on luxury products and services (e.g. durable goods, restaurants and hotels, recreation). Like Vietnam, the Romanian retail market has enjoyed tremendous growth in recent years with the expansion of modern retail forms such as hypermarkets, supermarkets, cash and carry, discount stores, and online selling, which contributes to changing consumers' behaviors in Romania, especially in the large urban areas.[1082] In the 2000s, more Romanians (70%) have preferred imported products including electronic and electrical home appliances, cosmetics, perfumes, and cigarettes. However, in comparison with Vietnamese consumers, Romanian consumers prefer shopping at larger stores (e.g., hypermarkets, supermarkets) where they find all products that they are looking for at a better price than in smaller shops. Online selling and shopping has also been more popular with Romanian consumers and has become the most dynamic segment in retail market with an 11.4% increase in 2010 and 16.1% in 2011.[1083] In addition, consumers in Romania generally have the right to return goods without any required explanation within 14 days, and retain the right to compensate for faulty goods thereafter. The right to return and replace the products within the cooling-off period without giving a reason is highly appreciated as one of the best ways to protect consumers in Romania.[1084] The Romanian consumer behaviors of exchanging and returning products have thus been more popular and have easily been accepted in Romania rather than in Vietnam. These changes have led to the increased attention from both OEMs and distributors for returns management.

In comparison with Romania in case of the growth of electronics market, it can be observed that the electronics industry in this country is still developing and going through a hard time adapting to the new reality in Romania as the market becomes ever more open and competition driven under the trend of globalization.[1085] Romania like Vietnam has attracted many contract manufacturers due to low competition, low corporate taxation policies, and low-cost labor force, which has made it become one of the fastest-growing electronics manufacturing services (EMS) markets in Eastern Europe.[1086] Romanian Electronics Manufacturing Markets finds that the markets earned revenues of over $1.6 billion in 2008 and estimates this to reach $3.38 billion in 2014. Foreign companies through joint venture business with local firms dominate electronics markets in both Romania and Vietnam. The largest market share in Romania belongs to multinationals, such as Nokia, Samsung, and Sony.[1087] In particular, the technology saturation may cause the boosted increase in the electronics industry through foreign investment in both countries, making the home appliance demand easily

[1082] See Price Waterhouse Coopers (2005), p. 1

[1083] See Stoenescu (2010), p. 6; Cf. also Nicolae (2007), p. 20; Price Waterhouse Coopers (2005), p. 161

[1084] See Stefanescu/Baltatsescu (2010), p. 308; Cf. also US Commercial Service (2011), p. 13

[1085] See APREL (2005), p. 1

[1086] See Frost & Sullivan(2009), p. 1

[1087] See Euromonitor (2010), p. 1

satisfied. Overall, the Romanian electronics and electrical engineering industry market is estimated at around US$ 3.3 billion, approximately 0.15% of the world market while the population share is of 0.35%.[1088]

Romanian electronics market is still immature and has substantial potential to grow. The last years have shown that Romania is more and more a society with changing needs and this is reflected in different consumer trends and behaviors. The economic growth has been one of the main drivers encouraging consumption growth during 2005-2008. Consumption rise in Romania can be seen in the increase in the number of long- term goods purchased by the population.[1089] Moreover, a desire to adopt living standards more in line with those in developed EU countries along with rising annual disposable incomes has gradually translated into positive trends in consumer electronics sales.[1090] Especially, an increasing living standard correlated with the access to credits for consumer goods has generated an increase in the acquisition of EEE in Romania over the last twenty year. The amount of EEE sold in Romania has increased progressively in recent years, growth rates being slowed after 2008 only by the worldwide economic crisis.[1091] In addition, there is evidence of the influence of up-to-date technology and improving existing products with new features. Consumers increasingly desire modern digital TVs, netbooks, bluray players, smart phones, and home cinemas. This includes inter alia computers, HDTV, in-car navigation, portable digital camcorders, cameras, and portable media players. Electronics and appliance specialist retailers constitute the preferred distribution channel among Romanian consumers. A typical feature of this channel like Vietnam is that local distributors and retailers maintain a lead over multinationals. Multinational companies have yet to announce their intentions to expand in this segment in Romania as well as in Vietnam. Local retailers in both countries have increasingly opened lager-sized stores in top locations, such as shopping centers, hypermarkets, and supermarkets to meet higher standards and benefits from a larger number of customers.[1092]

The survey conducted by the association Daedalus Millward Brown for EcoTic, on the number of EEE held by households in Romania shows that in the period September 2008 – June 2009, the number of Romanians who have a telephone in the house dropped by 7.5%, while the percentage of those who have MP3 players rose by 7.4%.[1093] Compared with similar studies conducted in September 2008, the percentage of people owning a device to play MP3 audio files has increased from 30.5% to 37.9%, while the percentage of Romanians who have a telephone fell from 86.2% to 78.7%. Significant increases in 2009 compared to 2008 were recorded also on radio segment (51.3% - 58.9%), DVD (63.5% - 67.3%) and mobile phones (93% - 99 %). For this segment of personal computers (laptop/desktop), the penetration rate increased from 84.8% to 86.9%.[1094] Figure 92 presents the amount of EEE put on markets of Romania in 2007 and 2006.

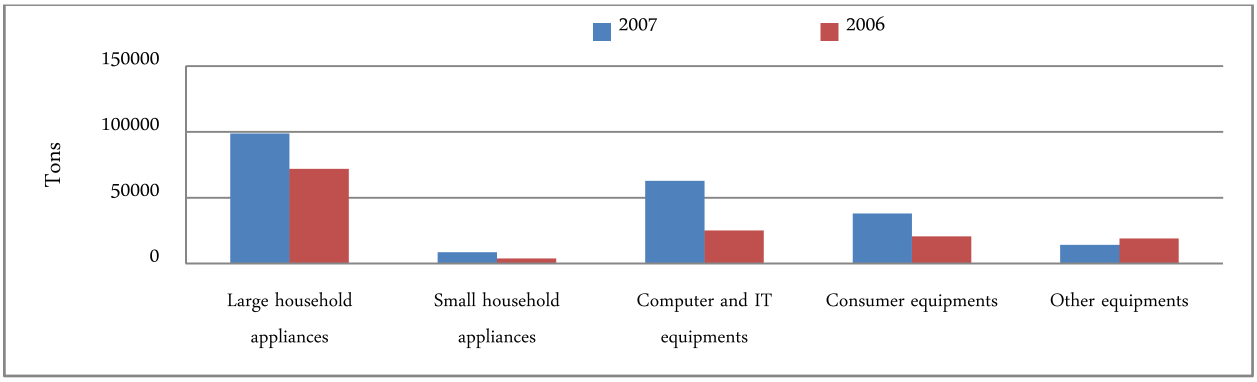

Figure 92: The volume of EEE sold in Romanian market

[1088] See APREL (2005), p. 1

[1089] See Euromonitor (2010b), p. 2

[1090] See Euromonitor (2010), p. 2; Cf. also Price Waterhouse Coopers (2005), p. 164

[1091] See Ciocoiu et al.(2009), p. 211. Cf. also Ciocoiu et al. (2010), p. 11

[1092] See Euromonitor (2010), p. 2

[1093] See Daedalus (2009), p.

[1094] See Ciocoiu et al. (2010), p. 14

Based on some analysis of economic development and the growth of the electronics industry in Romania and Vietnam, it can be observed that electronics market in these countries still developing and has more potential to develop and increase the sales due to the increasing income, growing consumer spending, and easier accessibility to distribution channels of electronic and electric equipment. According to the Huisman et al. (2007) report, the quantity of WEEE generated by the Romanian households is going to increase within the period 2010-2020. The computers and the fixed phones are examples of household equipment with high rate of moral depreciation. Another example is represented by the current TV sets, which will become obsolete when the UHF analogical television services are replaced by the digital television services.[1095] Figure 93 presents the estimated generation of discarded UEEE in Vietnam in Romania in the period of 2010 - 2020. The similarity in economic development, consumer demands and consumption pattern between two countries have led to the increasing trend of waste generation in the future. The volume of WEEE generation in Vietnam is higher due to the difference in population.

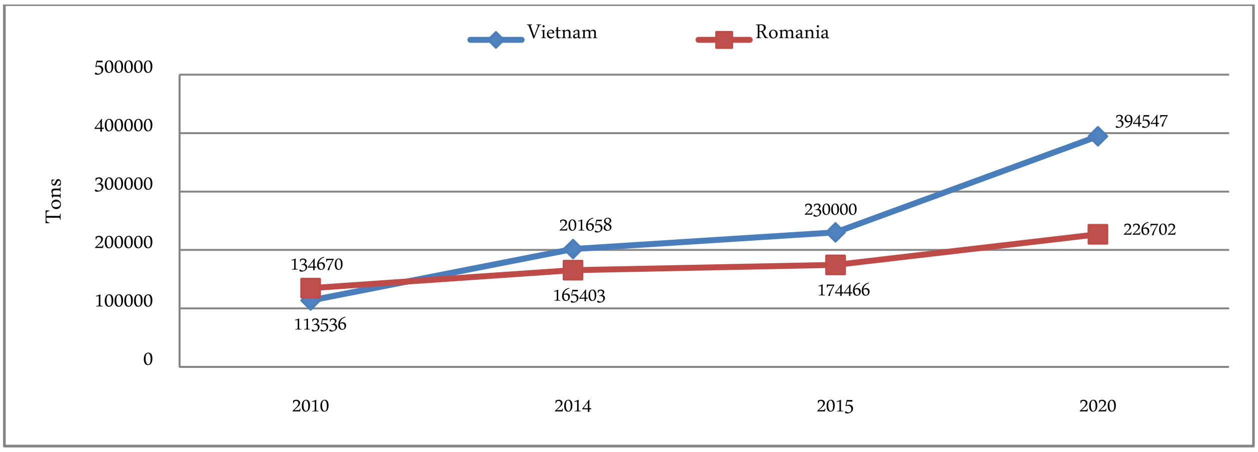

Figure 93: Estimate of UEEE discarded in Vietnam and Romania

Source: Ciocoiu et al. (2010), p. 14; Cf. also URENCO (2007), p. 142; Quang (2008), p. 127; United Nations University (2007), p. 67

7.4.2. Legislative framework, infrastructure and technology

Romania is very different with other European countries that have a WEEE culture (Sweden, Denmark, and Netherlands) and have available and modern collecting and recycling infrastructures but no legislation present (Germany, France, Spain and Portugal). Directive 2002/96/EC has been transposed in Romania by HG 448/2005 regarding electric and electronic equipment waste and by series of orders of the related authorities. This is especially true that there were no pre-existing legislation or comprehensive collection and treatment infrastructures in Romania before the transposition of the WEEE Directive. Romania has faced significantly greater problems in developing required legal and operational infrastructures for a formal reverse logistics management model of EoL products. Difficulties of the implementation arose because of complexity of involving many stakeholders in operating EoL management and the responsibility interfaces between stakeholders. The interaction and overlap with other areas of legislation (e.g., hazardous waste regulations, trans-frontier shipment regulations) have also delayed the transposition and implementation of take-back laws based on EPR-based policy in Romania. The implementation in practice, especially for achieving the collection target of 4 kg/person/year, has not been surpassed at the deadline of 31st December 2008 due to its lack of recycling and collecting infrastructure as well as lower public awareness in Romania.[1096]

Like Vietnamese consumers, public awareness in Romania regarding the negative effects of improper WEEE management can have on the environment is relatively low. The same situation is occurring with the knowledge of the obligations imposed by the law. Many Romanian consumers contend that selective waste collection activities are important, but still they do not operate in this direction. They are willing to adopt an eco-

[1095] See Huisman et al. (2007); Cf. also Ciocoiu et al. (2012), p. 32

[1096] See Ciocoiu et al.(2009), p. 214

logical environmental behavior regarding electronic equipment only to the extent that this does not require great efforts on their part. It means that the convenience of the system to them. Most consumers in Romania say that they plan to use electronics product they own until they would break down. The percentages vary between 40% and 58% depending on product mix. For example, 45% of respondents who own a laptop say that they are not going to change it until it is no longer functional, while only 7% think at an upgrade in less than a year. Daedalus study also revealed that over 60% of the Romanian people have in their houses non-functional equipment, most of them say they do not know what to do with it, 26% intend to fix it, and only 6% keep it until the collecting period.[1097] The European average of usage for large household appliances is 8-10 years, while in Romania the duration is 13-17 years. In some rural areas, household electric appliances are still used above the average recommended by the manufacturer (even decades). This situation is similar as Vietnam due to the low income, the socio-cultural value, and the consumer awareness.

The successful transposition of take-back laws, the efforts, and the collaboration of many stakeholders and partners in Romania have motivated this country to set up a formal reverse logistics management model for WEEE. Many positive solutions have been carried out over the last decade, e.g. the issuance of specific national take-back regulation based on EPR-based policy and the WEEE Directive, the increased investment in municipal collection system, the motivation and support policies for the participation of private sectors, and the improvement of public awareness. After 5 years of setting up facilities for collecting and treatment, this country has currently organized three formal collection channels for WEEE. Users are required to separate WEEE at source sites and leave organized collection systems to carry forward to the points of treatment.[1098] Figure 94 describes the overview of a formal RL system for WEEE management in Romania.

- ***Distributor collection points*** – "Buy-back" system – Distributors are obliged to take old equipment from private households, in a one-on-one system, when new equipment is sold. Distributors in Romania, in order to increase their sales, can also offer a 10%-15% or even 20% discount when consumers buy new equipment from the same product line as the old ones.
- ***Municipal collection points*** **–** Consumers can discard their WEEE, free of charge, by giving them to municipal collection points. Municipalities must organize the collection of WEEE from private households to consolidation points, from where they must be transported for treatment by producers, in a manner not adversely affecting the environment, as required by law.
- ***"One day collection" actions*** – these actions are organized at fixed dates, previously announced. The main purpose is to collect UEEE discarded from households and the secondary purpose is to inform and educate the citizens regarding proper disposal (organized by Romanian Ministry of Environment).

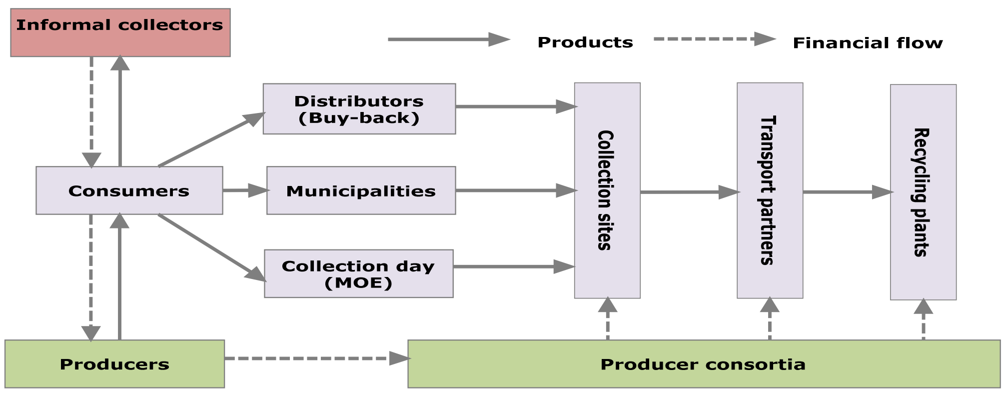

Figure 94: Reverse logistics system for WEEE management in Romania

Source: Adapted from Ciociou et al. (2011), p. 180; Cf. also Ciociou et al. (2012), p. 31; Ciociou et al. (2009), p. 216-217

The most well-known action of "one-day collection" type is "The Big Get Rid of Waste" initiated by the Ministry of Environment in 2007 and carried out at national level. Quantities of WEEE were also collected

[1097] See Daedalus (2009), p. 2

[1098] See Ciocoiu et al. (2012), p. 31

through one-day actions such as "Your house is not a museum – Recycle!" and "Throw it in the street!"[1099] Many consumers in Romania have been involved themselves in buy-back systems for non-functional home electronics and appliances organized by distributors/retailers. Over 50% of the respondents in one survey conducted in Romania agree to give up the malfunctioned equipment if they receive a price reduction at a new product purchase or if the equipment is collected by specialized organizations directly from the households. In addition, the WEEE collection volume by municipalities in Romania is increasing steadily due to more investments in collection facilities and information propagation of a formal collecting system for WEEE. The infrastructure of WEEE collection through the municipal collection points is in an ongoing development process, especially in the communities with more than 50,000 inhabitants. Nowadays, the number of the municipal collection points specialized for WEEE is now 240 service points. In Bucharest, there are 67 collection locations which are collecting electrical and electronic equipment, light bulbs and fluorescent tubes, batteries, for a total of 27,8% from the ones existing at the national level. In general, large WEEE coming from private households are now placed on streets to be collected by representatives of the local municipalities.[1100] These efforts have partly supported Romania in building a formal reverse logistics system of WEEE management.

The economic development, the increased living standards, and the globalization have contributed to the changes in the consumption trend and consumer behaviors, the increase in the number of EEE purchased by the population, and the increasing investment in collecting and treatment of discarded UEEE in Romania. Until 2010, six collective producer consortia are authorized in Romania to take over the responsibilities of producers of discarded UEEE namely: EcoTic, Environmental, Recolamp, Rorec, CCR Logistics Systems RO SRL and Recycling Ecosys. Joining them are numerous manufacturing and commercial organizations making business in the Romanian electronics industry and NGOs that regularly organize national information and education campaigns, fundraising galas for environmental projects and waste collection campaigns.[1101] For purpose of organizing the collection and recycling of WEEE, various tasks like collection, transportation, sorting and disassembly of products and storage and selling of material fractions as well as reusable products and parts are conducted. The producer consortia are sourcing the reverse logistics from regional operators; usually from a social economy enterprises or public institutions. The producer consortia, municipal waste management companies, distributors, and local operators in Romania are trying to increase the collaboration for optimizing collection processes.

Disseminating information to Romanian consumers has been increasingly implemented with the support of information technology and visible fee system. The Romanian citizens have free access to an online map that includes all the national WEEE collection and recycling centers to identify the most suitable place for their disposal. This map is set up to ensure comfort and easy usage of the collection service for this type of municipal waste.[1102] The "green stamp" system of visible fee first introduced in Romania in 2007 is a clear way to inform consumers about recycling costs because it is shown separately on labels and invoices, when selling new products. The "Green Stamp" has initially not achieved the success in implementation because of the poor collection infrastructure and low level of public awareness and acceptability.[1103] However, this system is continuously improved to increase the awareness of producers, distributors, and consumers in minimizing waste and increasing waste recovery.

In addition to the actions of local administrations, nongovernmental and collective organizations, private initiatives have rapidly developed in Romania by motivation policy and supports from the government. More than 320 selective operators for collecting WEEE have been licensed nationally until 2010. Regarding the recycling, approximately 40 companies are authorized for WEEE processing in Romania, four of them can be found as the biggest integrated WEEE treatment facility in Eastern Europe (having an annual capacity of

[1099] See Ciocoiu et al. (2011), p. 180

[1100] See Ciociou et al (2010), p. 16

[1101] See Ciocoiu et al. (2010), p. 16

[1102] See Ciociou et al. (2012), p. 31

[1103] See Ciociou et al (2011), p. 17

50.000 tons WEEE), and one of them is the most modern in Europe.[1104] Currently, the largest investment in WEEE recycling sites, worth 10 million Euros, is made by the group of investors consisting of S.C. Romcarbon S.A. Buzau (72%), two Swiss investment funds (18%) and a private investor (10%), in the South East region of Romania. Factory Green WEEE International is currently regarded as the biggest recycling plant of waste electrical and electronic equipment in Romania and Southeastern Europe.[1105]

The total recycling capacity at national level just covers the recycling targets (80,000 tons/year, approximately 4 kg/inhabitant). The collection remains a major issue with high logistics costs and unnecessary handling processes. Consequently, less than one third of the target is collected each year and the existing companies specialized in WEEE recycling are currently struggling with profitability issues because of having not enough WEEE for their recycling capacity.[1106] Like in Vietnam, many discarded UEEE from Romanian households have been collected and treated through informal collectors and recyclers. Romanian households have kept their UEEE in house and many of them are more attracted by economic incentives from informal collectors and feel convenient to sell their old ones to them directly. Informal collecting and recovery process is steadily integrated and replaced by formal and professional collecting and recycling system of WEEE management in Romania. However, the shift has been still low because in Romania there is currently no official database of informal sector. With national plans and strategies for WEEE management in the coming time, Romania intends to open channels of communications with informal stakeholders and partners into the planning process to implement a formal reverse logistics system for WEEE more effectively and efficiently.

Although there are more similarities between Vietnam and Romania in some aspects, we cannot give out the absolute comparison because differences still exist between two countries related to demographic and geographic characteristics, the development background, and the initial infrastructure base. Generally, the situation of Vietnam may be relatively similar to Romania in transferring and implementing ERP-based policy, take-back laws, and a formal reverse logistics management model to some extent. The difficulties of no existing legislation, low public awareness, and no comprehensive collection and treatment system are challenges for both Romania and Vietnam to transfer and implement a formal reverse logistics management model. Beyond these barriers, some opportunities and strengths of economic development, increased awareness, and improved collecting and recycling systems above-mentioned can support positively for developing a formal reverse logistics system in Vietnam. Table 35 summarizes the barriers that Romania has faced in transferring and implementing a formal reverse logistics system for EoL management, the specific measures that Romania has conducted, the evaluation of relevance and potentials to transfer to Vietnam, and the reasons.

Although there are difficulties and challenges in transferring and implementing a formal reverse logistics management model in Vietnam, the opportunities and strengthens of current collecting and recycling system may have supported for developing a formal reverse logistics system. There are also positive changes in the legislation framework for extended producers responsibility, the improvements in infrastructure and technology, the consumer awareness and behaviors concerning environment issues, especially in the urban areas. The increasing consumption followed by the increasing volumes of returns may be the certain chain of causes-effects in the process of developing economy and urbanization in the developing countries like Vietnam, with large population and high density. The increasing enforcement of laws may require producers to implement formally their extended responsibility for EoL management and their obligations in taking back the goods returned by customers. The increasing public awareness of environment issues and consumer rights may have forced manufacturers and distributors to concern more in their corporate image through different activities of eco-design, design for recycling, and returns management. It may lead to the acceptability of the implementation of a formal reverse logistics program at firm level. Chapter 8 investigates this topic and gives out the solutions for transferring reverse logistics management models from European practices to Vietnam.

[1104] See Ciociou et al. (2012), p. 33; Cf. also Larive Romania IBD SRL (2011), p. 17

[1105] See Ciociou et al. (2010), p. 17

[1106] See Larive Romania IBD SRL (2011), p. 20

Barriers	Relevance to Vietnam	Measures	Potentials to transfer	Reasons
No pre-existing legislations and specific take-back regulations	+++	• Transposing EPR-based policy • Issuing specific regulations of producer extended responsibilities	+++ +++	• Vietnam's development strategy and plan • Current changes of legal framework for waste management • ERP-based policy is compatible with the current legal framework
Low public awareness	+++	• "One-day collection" actions • Green stamp system • Online map for collection points and recycling centers	+++ + ++	• Some trial one-day collections were organized in Vietnam • Lower acceptability (lower income, awareness, and information accessibility) • Take time to implement (Collectors and recyclers should be formalized)
No formal collecting system	++	• Formal collectors are obliged and formalized by take-back laws + Distributors (buy-back systems, old for new programs) + Municipal collection points + "One-day collection" actions	++	• This model can be well transferred to Vietnam, but needs some modification based on contextual differences
Informal sector	+++	• Communication with informal stakeholders and integration into planning process of a formal reverse logistics system	+++	• Understand the importance and active roles of informal sectors • Increasing collaboration between URENCO and private firms
No comprehensive collection and treatment infrastructures	++	• Setting up producer consortia to increase collaboration, combine resources, develop capabilities, and optimize processes • More investments in municipal collection points • Motivating private initiatives and investments for the implementation of reverse logistics (e.g. local and foreign investments)	+++ ++ ++	• 90% companies are SMEs, shortage of experiences and investments in EoL management • Strategic plans of URENCO system • More support policies and incentives from Vietnam government for the involvement of private and foreign sectors

Note: *+: Low, ++: medium, +++: high*

Table 35: Relevance and potentials of the transferability of reverse logistics in context of Romania and Vietnam

8. Acceptability and Transferability of Reverse Logistics to Vietnam

Chapter 7 analyzed the contextual differences in Vietnam and identified the opportunities and challenges for the implementation of a formal reverse logistics management model for EoL products at network level. This chapter focuses on assessing the acceptability of firms in the Vietnam electronics industry of implementing a formal reverse logistics program for managing different kinds of returned products and suggesting solutions for the implementation of reverse logistics in Vietnam. To this end, chapter 8.1 investigates the practices of current returns management through an in-depth comparative case study analysis of four companies making business in the electronics industry in Vietnam. Some practices of formal reverse logistics management models transferred from European countries and applied in other Asian countries are examined in chapter 8.2 to learn experiences of transfer and implementation from the forerunning country in the region. Based on the analysis in chapter 7, the findings from case study, and the assessments of reverse logistics models transferred and implemented in some Asian countries, we select and modify a formal reverse logistics management model for EoL returns with potentials for implementing in Vietnam in chapter 8.3. We also recommend some solutions to implement this formal reverse logistics model in chapter 8.4. Solutions of conducting a formal reverse logistics program at firm level are also proposed in chapter 8.5.

8.1. Acceptability of implementing a formal reverse logistics program at firm level

The facts analyzed in chapter 7 indicate that there are many difficulties and challenges to transfer a formal reverse logistics system for EoL management to Vietnam at network level. According to the principles of EPR, producers become the most important actor in a formal reverse logistics management model because there is the movement of waste management responsibilities from government to manufacturing industry. The acceptability of implementing a formal reverse logistics program at firm level through both strategic and operational level for different types of returned products might increase the transferability and the successful implementation of reverse logistics in Vietnam. This part firstly identifies the acceptability of implementing a formal reverse logistics program through the content analysis of the empirical results from a cross-sectional survey with manufacturers and importers of battery and accumulator conducted in 2007 by MONRE (2008a). Then we ourselves conduct in-depth interview with four companies in the Vietnam European electronics industry and implement a comparative case study analysis. We investigate the practices of RL management, the drivers, barriers, and the acceptability of implementing a formal program of managing EoL and customer returns at firm level in the Vietnam electronics industry.

Due to the exploratory purpose of this study for understanding the unknown phenomenon of RL management at firms in the Vietnam electronics industry, the in-depth case analysis with detailed interviews and cross comparison constitutes an appropriate methodology. A number of propositions are formulated and evaluated after the analysis of cross cases. In order to ensure the validity and reliability of data collection and analysis, we employ some sets of criteria appropriate for qualitative methodology (see Table 36). Construct validity examines whether the study measures what it is proposed. For assuring construct validity of case study research, data were triangulated by using several sources of information (e.g. direct observation, in-depth interview, and secondary data). Secondary data were obtained from company documents, company websites, and public information in specialized press. We use in-depth interview because it is flexible and allows new questions addressed during the interviews based on the response of the interviewees. The in-depth interview contains closed- and open-ended questions relating to different aspects of RL management (see Appendix 8). Internal validity is only concerned with factors within the research designs and looks at the extent that conclusions can be drawn for causal relationships. We build the explanations based on logic framework proposed and cross case analysis. External validity tests whether the research results can be applied to the populations and the settings of interests. Thus, the results of the study can establish a domain in which the findings can be generalized. For ensuring the external validity, we adopt cross-case comparison among four companies interviewed. Reliability refers to whether a study can be replicated by other researchers, which depends on the context and the researchers. This study ensures the reliability by consistent approaches of summarizing or transforming raw data into a transcript. We use case study protocol for analyzing each unit of analysis.

Test	Definition	Methods used in this study
Construct validity	Examines whether the study measures what it is proposed	Using several sources of information
Internal validity	Looks at the extent that conclusions can be drawn for causal relationships	Explanation building Conceptual framework
External validity	Tests whether the research results can be applied to the population	Cross case analysis
Reliability	Refers to whether a study can be replicated by other researchers	Consistent approach of summarizing and transforming Use case study protocol

Table 36: Reliability and validity of data collection and analysis

8.1.1. Content analysis of empirical survey results

In 2007, MONRE conducted a cross-sectional survey to investigate the awareness of battery and accumulator manufacturers/importers about their responsibility for EoL batteries/accumulators. Although the survey did not include other manufacturers/importers of electronic and electric equipment, it partly demonstrated the challenges and the possibilities of adopting and implementing EoL management at firm level in the Vietnam electronics industry. The survey was carried out with 25 companies, seven of which are battery and accumulator manufacturers and the rest ones are importers for their production of other products, e.g. motorcycle, automobile, and electrical and electronic equipment.

Most of the company respondents (85%) said that they have known about the Article in the Law on Environment Protection regulating the responsibility of producers/importers for their products put on market at end-of-life cycle, indicating that the Law has affected their awareness and attention. The list of discarded products that should be collected can be acknowledged by 88% of the companies asked, suggesting that many companies have been concerned in information related to their responsibility for their products after post-stage consumption.[1107] However, the necessity for collecting used batteries was not as highly evaluated as other products regulated in the Article such as accumulators, electronic and electrical equipment for household and professional usage, means of transport, and types and wheel because of their low value at EoL cycle and the existence of eco battery. Figure 95 demonstrates the manufacturers/importers' evaluation related to the necessity of collecting discarded batteries and accumulators in Vietnam in 2007.

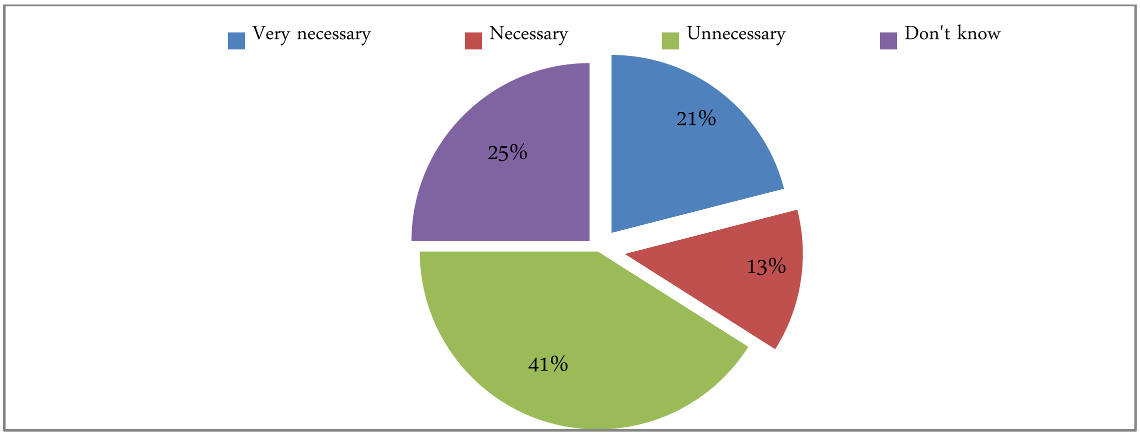

Figure 95: Necessity of collecting used batteries/accumulators

Source: MONRE (2008a), p. 121

The majority of battery/accumulator manufacturers stated that collecting the used battery/accumulator is essential. Only one manufacturing companies commented that collecting battery is not necessary and difficult to implement because small size of battery, wide dispersion, and low value. They said that the important

[1107] See MONRE (2008a), p. 121

solutions are to increase public awareness to separate battery, and dispose them to municipalities or distributors, or to produce environmental-friendly products. Meanwhile most importers did not agree to have responsibility to collect used batteries/accumulators because they are only parts of their complete products/services. Many importers of battery/accumulator for manufacturing EEE showed their agreement with the responsibility for collecting discarded UEEE in complete.

Most company respondents have not formally organized collection of used batteries/accumulators discarded from household and business customers, especially for the importers, because the collection of used batteries/accumulators is very difficult to carry out. Their networks of distributing new products can be used to collect the discarded product. However, they are not widespread and convenient, and especially uncompetitive with networks of informal collectors. They have currently organized the collection of products returned by customers due to quality problems in warranty time. These products are collected and then resold or exchanged for lead recycled from recycling units in craft villages, or with small recycling companies. Only a few companies conducted voluntary take-back systems through the campaign "old for new," especially for accumulators. Nonetheless, they could not last the program due to the low volume of collection and the competition of informal collectors.[1108]

MONRE (2008a) also presented a projected reverse logistics management model for collecting and recycling batteries/accumulators at their EoL cycle, and enclosed it with the questionnaire in order to investigate the firms' assessments and acceptability. This reverse logistics model is based on the system of Producer Deposit Refund (PDR) to allocate responsibilities of information, collection, and recycling that depends on three main actors: Department of Nature and Resource in each region (DONRE), Environment Protection Fund (EPF), and manufacturers/importers. DONRE requires manufacturers/importers to pay advance deposit fee to cover recycling costs. The amount of deposit fee is calculated from the number of products put on market in the next year. The amount is refunded based on the report of the volume of battery and accumulator properly collected and recycled by producers. Manufacturers/importers are obliged to have economic and physical responsibilities for collecting and recycling their products discarded by using their distribution channels supporting for collection system with deposit refund mechanism and contracting with commercial recycling companies to conduct product recovery.[1109]

Almost of company respondents said that the responsibilities of stakeholders in the model are relatively clear (63%). They also commented that Vietnam have large potentials of reuse and recycling due to saving customs and the habit of reselling used products to informal collectors. They intend to contract with commercial recycling companies of battery/accumulator to implement their obligations (100%). However, many companies said that the lack of infrastructures, technologies, and supporting industry for collecting and recycling system has currently been the main barriers for their responsibility implementation. They added that the lack of municipality participation, the popularity of informal collectors, and the low public awareness also hinder them from collecting used batteries and accumulators (60%).[1110] Therefore, nearly 48% of manufacturers/importers said that the model might not be applicable to the case of battery/accumulator, especially with deposit refund mechanism because of the low value and wide dispersion of battery/accumulator. Approximately 52% of manufacturers/importers indicated that the model should be modified to effectively apply with battery/accumulator and other valuable discarded UEEE. Figure 95 shows the responsibility of different actors in the projected reverse logistics management model of collecting and recycling used batteries/accumulators suggested by MONRE in 2007.

We analyze more comprehensively the likelihood of adopting a formal reverse logistics program for EoL products and customer returns at firm level in the Vietnam electronics industry through case study methodology. Their practices of RL management, their discussion of drivers and barriers in the implementation of reverse logistics, and their comments on the MONRE's projected collecting and recycling model for EoL products contribute to evaluating the transferability of reverse logistics to Vietnam.

[1108] See MONRE (2008b), p. 49

[1109] See MONRE (2008a), p. 122

[1110] See MONRE (2008a), p. 126

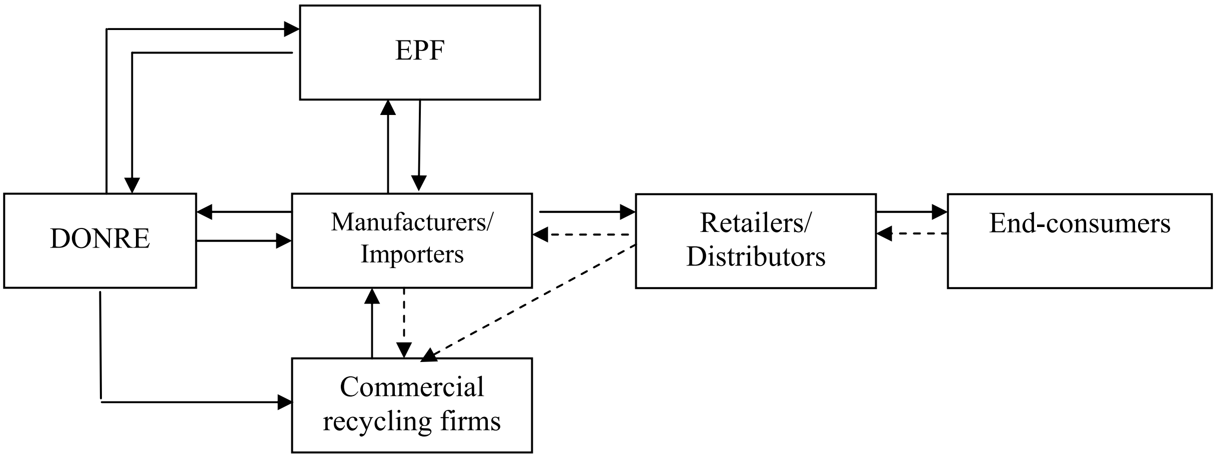

Figure 96: A projected RL management model of collecting used batteries/accumulators

Source: MONRE (2008a), p. 108

8.1.2. Case study results

The profile of four company respondents is presented in Table 37 with the overview of business directions and operation in Vietnam. Due to commercial confidentiality reasons, four companies in cross case analysis are referred to as company A, B, C and D for short. Two of them are foreign manufacturers, the other is local distributor with a retail chain of electronic products, and the rest one is a big local manufacturer. This study uses different criteria of returns management and EoL management with the application of reverse supply chain management to evaluate the acceptability of a formal program of reverse logistics

Company name	Description
Company A	**Company A** is one of the worldwide leaders in developing and manufacturing electronic and electrical equipment. Over the last decade, its operation has rapidly expanded with six companies, 7000 employees with revenue of approximately $1000 million. Company is continuously expanding their business in Vietnam and commits to maintain their business direction with high responsibility for the progress and development of society and the well-being of people through their business. With the slogan "Friendly to the environment," company A complies with the Vietnamese laws concerning environmental protection. This company has many activities in order to reduce waste, save resources, and raise public awareness for green products and environment protection. Company A assesses the impacts of all its business operations on environment and promotes activities to formulate its key business strategy of "Sustainable Development."
Company B	**Company B** is one of the Korean manufacturers of electronics products. This company focuses its strategy on sustainable direction and customer orientation. In Vietnam, company B has 1500 employees manufacturing and importing home appliances and consumer electronics to sell through its own stores and distributors with the sales of nearly $200 million. Company B focuses its strategy on satisfying customers and improving company image by fast innovation and fast growth. Company B has actively participated in giving comments and suggestions for drafting take-back regulations in Vietnam. It supports the implementation of extended producer responsibility in Vietnam and hopes that infrastructure and technology conditions for EoL management will become available in the near future.
Company C	**Company C** is a one of the biggest local manufacturers in Vietnam that has started its business since the mid-1980s. This company manufactures, imports, and distributes their products with 3000 employees and the revenue of nearly $300 million USD. This company develops in manufacturing and trading sector of electronic products with business direction of customer orientation and profit maximization. Under the fierce competition and economic crises, this company restructures the fields of business operation, strengthens the structural organization of the company, and obtains market share in both the domestic and international market. The company controls the life cycle analysis for all its electric and electronic products under the environment management system of ISO 14000.

Company D	**Company D** is one of the largest distributors of electronic consumers, home appliances, information technology, and communication equipment for the leading brands in the world. The company distributes through its own retail chain of supermarket and shopping centers in big cities and operates online shop. The company operates with 2000 employees and has the revenue of approximately $100 million. Company D has been increasing concerned in satisfying customers' demand to increase sales and improve profitability.

Table 37: Company profile

8.1.2.1. Practices of customer returns management

All four companies asked said that they have engaged in activities of customer returns management with different levels following their marketing strategy and resource investments. Firstly, they have identified some types of returns occurring in their business process and have paid more attention to customer returns in warranty time. For example, company C and company B recognize that their returns occur mainly because of quality problems and damaged delivery. Meanwhile, company D has returns from customers with different reasons defective products, technical issues, and buyer's "remorse" returns during warranty period. Company A is more proactive in identifying different kinds of returns from production, distribution, and consumption, even including EoL products. Actually, returns rates from customers of four companies are rather low in comparison with the total sales volume in Vietnam market. Company A had returns rate nearly 1.7% of total sales, company B and C estimated the returns rate in 2010 only nearly 0.8%, meanwhile D predicted the rate with nearly 1%. Table 38 describes the level of occurrence of returns of four companies interviewed.

Types and rate of returns	Company A	Company B	Company C	Company D
Production returns	2	1	1	0
Marketing returns	2	2	1	1
Remorse returns (unexpected)	1	1	1	2
Warranty returns (poor quality, damage, technical issues)	2	2	3	3
Product recalls	1	1	1	1
"Old for new" returns	2	1	1	1
End-of-lease returns	2	1	1	0

Note: *(1) low, (2) moderate, (3) high*

Table 38: Types and rates of returns

Secondly, all four companies have paid more attention to formalizing a returns policy with products returned from customer in warranty time (see Table 39). However, all of them are conducting a restrictive returns policy. Returns policies of four companies emphasize the rules of exchanging products instead of returning products with full refund. They provide customers with information related to conditions to accept the exchange, the days to returns, the reimbursement for returns shipping and handling fee, and the processes of returning products. For example, customers buying products from company C and D can only exchange the product purchased with the new ones having the similar model if the products returned can meet some requirements such as technical errors occurred by producers' problems, remaining the stamp and seal of manufacturers/distributors, retaining full accessories and packages. Especially, when customers want to change product by their desire without any reasons (e.g. remorse returns), they are not frequently refunded the full amount of money paid and have to buy new ones with similar models. In addition, they have to pay some fees related to returning the products, e.g. installation, dismantling, and transportation.

The minimum number of valid days to exchange and return products has not been regulated specifically in the Vietnam Law on Consumer Protection. Therefore, days to exchange product mentioned in exchange policies of four company respondents is limited and short. For example, company C and company D permit their customers to return and change their product in 10-day maximum after delivery and upon the different kinds of products (e.g. not exceeding 10 days for large household appliances, within 3 days for electronics consumers, within 2 days for ICT equipment, and only one day for digital and IT accessories). Since 2010, company D has offered less restrictive returns policy for customers by adding a trial-use policy within 5 days with full refund if customers meet their conditions. Company A and company B also standardize their returns policy with less restrictive requirements of 14-day returns policy. However, they have applied stricter returns authorization process with their distributors and retailer stores because they sell their products mostly through these indirect distribution channels. Returns from customers in company A and company B are initially released by their distributors and retailer stores.

Formalizing returns policy	Company A	Company B	Company C	Company D
Exchange policy	3	2	2	2
Returns with full credit refund	1	1	1	2
Days to return	2	2	1	1
RMA process	3	3	2	2
Returns handling through Email	1	2	2	2
Returns handling through hotline	1	1	2	2
Returns handling through online services	1	1	1	2
Returns handling through onsite services	2	2	1	1
Warranty center	2	2	1	1

Note: *(1) low, (2) moderate, (3) high*

Table 39: Returns policies and practices of customer returns management

Thirdly, company C and company D are solving the issues regarding returned products in terms of after-sales customer services with the focus on marketing strategy. They have not formulated strategy for customer returns management separately and perceived that customer returns occurring increase their business costs. Two foreigner companies have been concerned more in avoiding the returns occurring in the production and distribution through quality control and careful instructions. They believe that customer satisfaction and competitiveness can be improved through their after-sales service with the supports from effective returns management because the consumer rights can be ensured and the quality of customer service can be improved. Company A and company B said that they are implementing customer returns management because of not only increasing customer satisfaction but also enhancing their company image through a strategy of sustainable development. Two foreign manufacturers frequently have different campaigns to increase customers' awareness of green products, guide the usage of products for customers, and implement special care programs. Since the mid-2000s, company A has organized programs of "special care" to maintenance and repair its customers' used refrigerator and washing machine free of charge and with 50% discount of substituted spare parts. Company B organizes the program of "Green product +..." to introduce and motivate customers with green actions in purchasing and using their products. Both foreign manufacturers not only produce and sell electronics and home appliances, but also focus on developing eco-products to protect environments and bring a green lifestyle to each house and building in Vietnam. Company C has also invested in avoiding the returns in production through life cycle analysis and quality control of ISO standard. However, the investment in eco-design and customer returns management has been limited with this company.

Company A and company B sell their products to end-consumers through electronics retailer stores, supermarkets, and shopping center. Meanwhile company C distributes their products through its own stores and some main distributors. Company A and company B own some service centers themselves in main cities, and mostly outsource nationwide to more than 100 local authorized warranty centers (WC) for repair and technical services. Warranty centers in the case of company A and company B include retailer stores and service providers for repair and maintenance services. Company C has organized its own technical and warranty service centers in big cities of Vietnam. Company C has a special program "Saturday Free" that offers services of maintenance and installation at its main customer service centers free of charge for their customers. Company D has its own technical assistant group in each supermarket responsible for dealing with customers' complaint related to product quality, technical issues, and defects.[1111] Company C and

[1111] See Pfohl/Ha (2011), p. 9 & 10

company D have also outsourced partly repair services to local repair centers. All four companies handle returned products through the process of return avoidance, gate-keeping, and returns merchandise authorization with the supports of on-site services (field engineer), email, hotline, and online supports (see Table 39).

Fourth, developing reverse logistics networks has not been formally established and paid attention in RL management for customer returns at four companies. It may be due to the small volume of returns and the lack awareness of strategic importance of reverse logistics. No four companies have operated returns centers and all of them have partly outsourced returns delivery to some carriers and logistics providers. Company D outsources partly logistics operations including transporting and handling the returned goods from customers in regions where company does not have distribution centers or warranty centers. Company C has not invested in reverse logistics networks. This company has used its own stores, warranty centers, and field engineers for collecting returned products from customers. Two foreign companies have not focused on developing reverse logistics networks because their retailer stores and distributors are primarily responsible for handling consumer returns and selecting disposition options. Their own/authorized warranty centers and field engineers are also used to collect products returned from customers in these companies. Company A and company B have combined the networks of distributing products to take back returned products from their distributors/retailer stores because distribution schedules are usually fixed, and there is more freedom in specifying the moment the returned products are taken back.

Fifth, developing disposition for returned products have not been formally conducted in company D. Most of returned products in this company are due to quality issues, damage in delivery, and technical problems in warranty period. Many returned products are not carefully inspected and then returned to manufacturers if they are domestic sourced products. For products imported from other countries, any returns that cannot be repaired are sold to refurbishment companies or dealers to recapture some value of returns. Company D has been not involved themselves in refurbishing and only 15% of the returns in this company are refurbished in repair centers or refurbishing companies. With the experiences in manufacturing industry, three manufacturing companies have initially established disposition options to recapture the recovery value from returned products. Workers at the manufacturing facilities inspect returned appliances and decide on their dispositions that include direct storage in the warehouse for repacking and redistributing, repairing, refurbishing, remanufacturing, recycling, and disposal. However, they have not identified a predetermined set of criteria that define specifically where the product will go after it has been returned. Due to the small volume of returns, the most popular disposition options of these companies are returning to stock, repairing and refurbishing, and then reselling to the market. Only company A has invested in the operations of remanufacturing and recycling but with the limited scale. Electronic manufacturers in developing countries like Vietnam have not invested in recapturing value and recovering assets from returned products probably due to low volume of returns, limited investment in remanufacturing technology, and the popularity of repair and secondhand business. Most of the company respondents have not paid attention to dealing with secondary market for their returned products because of the dynamics of informal collecting system and secondhand market in Vietnam.

Finally, no four companies have formally developed a metrics framework for RL performance with the comprehensive measurements of returns rate, types of returns, the value of returns, the impacts of returns on short- and long-term sales, the costs of returns management, and the value recovered from returned products.[1112] All four company interviewed are much focused on returns avoidance and cost reductions by developing restrictive returns policies.

Table 40 presents the current situation of adopting a formal reverse logistics program for customer returns in four company respondents.

[1112]I could not get any specific information about the value of returns recovered through repair work, refurbishment, remanufacturing, and recycling from company respondents. They have not recorded formally the data of returns and value recovered.

A formal reverse logistics program	Company A	Company B	Company C	Company D
Developing strategy of RL	2	2	1	1
Developing RL network	2	1	1	1
Developing disposition options	2	1	1	1
Outsourcing RL services	2	2	2	2
Remarketability of returned products	2	2	1	1
Metrics of RL performance	1	1	2	2

Note: *(1) low, (2) moderate, (3) high*

Table 40: Current situation of adopting a formal reverse logistics program

Linking the evidences analyzed through case study comparison in Table 38, Table 39, and Table 40, we found the causal relationships between the criteria of developing returns management, formalizing returns policy and the acceptability of implementing a formal reverse logistics. The results supported this study to formulate research propositions to explore the situations having no clear outcomes in customer returns management and evaluate the acceptability of implementing a formal reverse logistics program.

- **Proposition 1 (S1):** *The more increasing the customer returns management at firm level is, the higher acceptability of a formal reverse logistics program is.*

Reverse logistics is being implemented for customer returns management at firms in the Vietnam electronics industry. All four company interviewed have applied reverse logistics to returns management in their daily business, especially for customer returns in warranty time. They have paid more attention to identifying types of returns, formalizing returns policies, and developing disposition options. Although they have not developed a separate comprehensive strategy for customer returns management, they have still worked with returns through their strategies of marketing and sustainability. Developing reverse logistics network for returned and discarded products has not been formally established in all four companies. Measurement metrics of RL performance have been also developed specifically. The results suggest the moderate acceptability of a formal reverse logistics program for customer returns management.

- **Proposition 2 (S2)**: *The more increasing the formalization of returns policy is, the higher acceptability a formal reverse logistics is*. In addition, we develop one sub-proposition of proposition 1 and proposition 2 that specifies the relationship between customer returns management and formalizing returns policies. The more increasing the customer returns management at firm level is, the more increasing the formalization of returns policy is (S12).

8.1.2.2. Reverse logistics for EoL management in electronic firms in Vietnam

Firms in the Vietnam electronics industry have paid attention to formalizing specific returns policies. All four companies have paid more attention to formalizing returns policies, e.g. RMA procedures, gate-keeping guidelines, and rules of days to return and credit refund. Their returns policies have been more strategically focused on restrictive customer returns policy for returns avoidance and cost reductions. The comparative analysis indicates that the high likelihood of adopting a formal reverse logistics program through formalizing restrictive returns policies. Although restrictive returns policy has supported these companies in avoiding returns, it has made customers reluctant and dissatisfied when they want to exchange and return products. Empirical results extracted in chapter 7.3 also demonstrated the current issues of exchanging and returning products from customer view. Restrictive returns policies can avoid the returns, likely reduce costs of reverse logistics, but does not bring in the friendly image for companies in offering after-sales services, which may not motivate customers to increase their repetitive purchase, especially in the currently economic recession with the strategy of expenditure savings from Vietnamese consumers.

Although the Article regulating the extended responsibility of producers for taking back their EoL products has not been enforced, Vietnam is preparing for the application of EPR principle in practice. All three manufacturers have known profoundly about legislative framework with the Article of producer responsibilities. Nevertheless, they complained about the lack of specific regulations and instructions. Company D has not concerned in take-back responsibilities of discarded products because they think that it belongs to producers or local municipalities. Through case study analysis, we find that all four companies have been involved themselves in management of their discarded products by customers to some extent. However, they are conducting EoL management with small scale and spontaneous programs, especially through “old for new” programs. Foreign companies have more awareness of EoL management because they have implemented their extended producer responsibilities in their own countries and joined different collective take-back schemes in European countries. Meanwhile the local companies have not fully understood the significance of EoL management and have not invested company resources for this activity.[1113]

Company A has organized some “special care” programs since the late 2000s that support customers in repairing used digital camera, Plasma and LCD TV, washing machine, and refrigerators. This company has offered, the discount to 50% for their spare part replacements, and conducted “old for new” programs with some models of these products. For the special programs, company A can offer the discount value up to 50% for customers to change the old model for a new one, with support for transportation and installation in urban areas. This program has attracted many customers in many big cities and provinces in Vietnam. Company A has increased sales by selling new products and replacing spare parts, recapturing value from the returned products, and partly saving cost of materials and energy by refurbishing and remanufacturing operations. Company A intends to have different and profound plans for EoL management because their purpose in the recovery of these products is to create credibility and trust for customers, as well as to implement their social corporate responsibilities for the entire lifecycle of the products they put on market. These “old for new” programs have also helped this company to stimulate customer demands with durable electronic products, especially in the period of economic recessions. Company A also collects UEEE for leasing and rental contracts with some professional business customers. This company has invested more resources in reverse logistics management by minimizing residual during the production and promoting recycling activities. Since 2008, 100% waste in production has been recycled in manufacturing plants of company A. This company has adopted eco-design strategy and conducted lifecycle analysis for all its products to promote energy conservation, reduced waste generated by its operations, and increase recycling of EoL products. Company A follows sustainability strategy in dealing with EoL management from its corporate strategy. Figure 97 describes the overall reverse logistics system of company A.

In Vietnam, the investment of company B for EoL management has just limited with the amount, which is along with forward logistics such as waste avoidance in production and distribution, warehouse, means of transport or information technology. Although company B has not invested its own resources in EoL management, this company has also collaborated with big electronics supermarkets and centers such as Topcare, MeLinh Plaza, and Pico in their “old for new” programs to stimulate customer demands. Company C has rationalized its collection with small incentive money to users for returning of UEEE through its repair and maintenance centers. However, this company stopped this program due to ineffective operations and fierce competition with informal collectors. Company D often organizes “old for new” campaign when there are large stocks of inventory in their supermarket, mainly to increase its sales volume and refresh their products. Company D has incorporated with its manufacturers and vendors for exchanging the new ones or established the agreements with local repair/service shops for refurbishing contracts.

All four company respondents were asked about a formal collecting and recycling model suggested by MONRE (2008a) following the regulations of extended producer responsibility. All four companies said that establishing a formal collecting and recycling system for discarded UEEEis necessary for Vietnam, and they are willing to involve and implement their responsibility following the regulations. However, all four companies think that the responsibilities of stakeholders involving in the projected model with Deposit Refund System is not clear and are not suitable with UEEE because these products have higher value than batteries and accumulators, especially with durability of home appliances and consumer electronics products. Manufacturers and distributor are very difficult to apply the mechanism of deposit refund with end-consumers for these kinds of products. Deposit refund system can be applicable to a wide of products, such as container, packaging, plastic and glass bottle. However, it has not been used for household electronic appliances and IT

[1113] See Pfohl/Ha (2011), p. 9

equipment.[1114] Company D commented that the responsibility of distributors should be specifically regulated in taking back free of charge UEEE discarded from end-consumers via "old for new" purchase. Information, economic, and physical responsibility should be allocated definitely in a formal collecting and recycling model in the relationships between manufacturers, municipalities, distributors, and consumers.

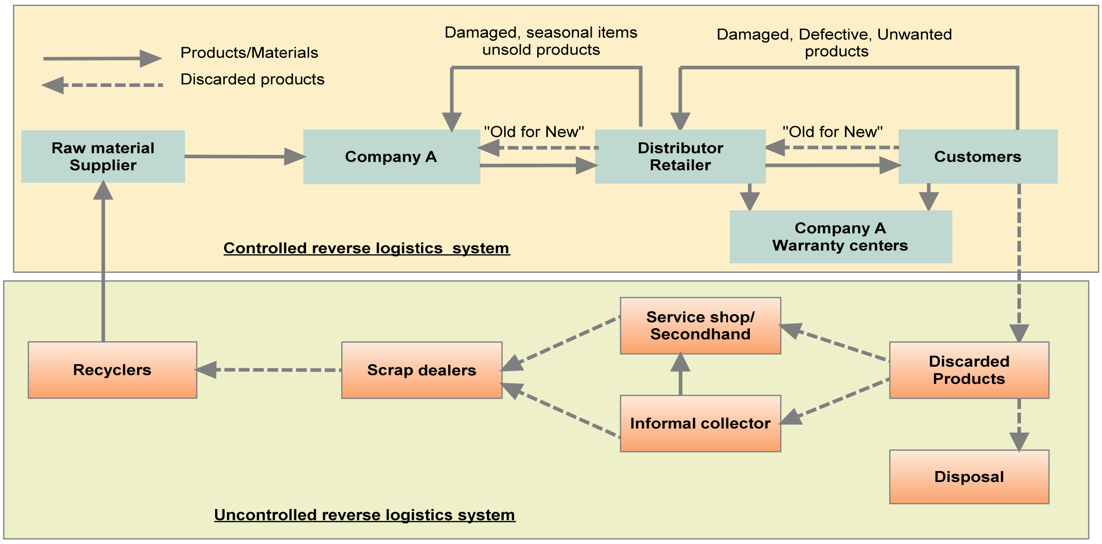

Figure 97: Overall reverse logistics system of company A

All three manufacturers said that under fierce competition, it is not easy to maintain the competitive advantages if manufacturers are forced to set up their own collecting and recycling system of discarded UEEE from end users, especially for local companies. They are unable to set up themselves their own collecting system because of their limited resources and experiences. In fact, two foreign manufacturers stated that the volume of discarded UEEEin Vietnam is still low in comparison with other countries and Vietnamese consumers have not been acquainted with discarding their UEEE to a formal collecting system. Company A commented that using the program of "old for new" purchase carried out by collaborating with its retailers and distributors may be a suitable model in the first stage of implementing their extended producer responsibility for EoL management. The program may increase end-consumers' awareness of properly discarding products, and removing their customs of selling UEEE to informal collectors, and bringing economic benefits to both customers and OEMs/distributors.[1115] However, setting up a formal reverse logistics network for collecting, storage, sorting, inspection, and recovery is necessary to optimize collection and transformation processes, and thus reducing costs of logistics. Company A added that managing EoL returns requires the collaboration with many stakeholders and needs the involvement of third party service providers, e.g. carriers, waste management companies, and recycling plants.

Three manufacturers said that setting up an effective product recovery system in Vietnam takes more costs and time because of lacking infrastructures, facilities, and coordination mechanism. If producers have to implement physical responsibility for collecting, it will be unrealistic because financial investments of collection infrastructure become significant burdens on producers. Therefore, all four companies interviewed thought that cost reduction and economic benefits are not drivers for them to implement voluntarily EoL returns management. All four companies judged the increased costs as the major barrier hindering them from implementing a formal reverse logistics program for EoL products. It is necessary to invest financial and managerial resources for controlling and operating reverse logistics processes due to the complexity and uncertainty of reverse flows. The enterprises have to invest in additional technologies and facilities such as return centers and warehouses to receive and handle returned products so that they can balance their needs of

[1114] See Panayotou (1998), p. 1
[1115] See Pfohl/Ha (2011), p. 9

material and product planning. Table 41 figures out the viewpoints of company respondents related to the concerns and barriers for operating a formal reverse logistics system for EoL management.

Concerns and Barriers in EoL management	Company A	Company B	Company C	Company D
Concerns in take-back laws	3	3	2	1
Activities of EoL Management	3	2	2	1
Unspecific Regulations	1	1	1	1
High Costs	2	2	2	1
Insufficient infrastructure	2	2	2	2
Low recycling technology	2	2	2	2
Informal collecting system	1	1	1	1
Weak supporting mechanism	2	2	1	1
Weak collaboration network	1	1	1	1
Low public awareness	2	2	2	2
Shortages of experiences	2	2	2	2

Note: *(1) low, (2) moderate, (3) high*

Table 41: Barriers in the implementation EoL management

They also complained about insufficient infrastructures and unprofessional logistics systems in Vietnam as the reasons for the difficult implementation of EoL management. The shortage of a formal recycling system with standardized facilities and technology is mentioned as obstacles for executing an efficient reprocessing in reverse logistics system. Although there are many craft villages and small commercial recycling companies allocated in different provinces, most of them are limited in scale, technology, and experiences.[1116] All three manufacturers asked intend to outsource collecting and reprocessing to other parities, but they are not sure about the quality of recycled materials as their input requirements. Company A and company B intend to establish producer consortia for implementing their take-back responsibilities by coordinating manufacturing companies in Vietnam because they have experiences of joining producer consortia in their countries for implementing collection and recycling of WEEE.

For EoL management, all four companies interviewed commented that the government should give out the concrete regulations with detail instructions for different stakeholders involving in a formal take-back and recovery system. It is necessary to develop a formal collecting and recycling channel and stimulate the collaboration in networks. They are afraid of the ambiguity of the regulations as the obstacle for ineffective implementation of EoL management. It may lead to the free riders issues, the inequality among the companies in the industry, which make firms lose their competitive advantages. All four companies interviewed have expressed their desire that the Vietnamese government should clarify producer responsibilities by specific regulations of take-back and provide greater consistent supports to motivate enterprises in the electronic industry to operate a formal collecting and recycling system for EoL products, e.g. producer consortia, coordination body, and recycling fund. They are also anxious about low public awareness, the existence of informal collecting and recycling system, and the lack of collaboration among stakeholders and partners. Information dissemination of specific regulations to companies is necessary to enhance their awareness of legislation. Supporting mechanism from the authority is an important instrument to help the companies to deal with EoL management.

The cross case analysis of reverse logistics for EoL management in four companies supports us in formulating some related propositions that investigate the acceptability of a formal reverse logistics program for EoL management.

- **Proposition 3 (S3)**: *The more concerns in regulations of take-back are, the higher acceptability of a formal reverse logistics program.*

Firms in Vietnam electronics industry have been concerned in information regarding extended producer responsibilities for EoL management regulated in the Law on Environment Protection. All three manufactur-

[1116] See Pfohl/Ha (2011), p. 10

ing companies have been highly concerned in information related to the law regulated the extended producer responsibilities. Due to unspecific regulations, distributor has not paid attention to the related regulations. The results suggest a moderate likelihood of adopting formal reverse logistics program.

- **Proposition 4 (S4):** *The more formal activities for EoL management are, the higher acceptability of a formal reverse logistics program*. We also develop another sub-position of proposition 3 and proposition 4 which determines the relationship between concerns in laws and the implementation of EoL management. The more concerns in regulations of take-back are, the more formal activities for EoL management are (S34).

Firms in the Vietnam electronics industry have initially carried out reverse logistics operations for their EoL products. Although legislation framework for producer responsibility has not been used as an impetus for establishing a formal reverse logistics system for EoL management, some manufacturers and distributors is voluntarily taking back EoL products from customers due to economic benefits obtained from increasing sales of new products. However, reverse logistics system at firm level for EoL management was conducted limitedly and spontaneously following the marketing campaign with "old for new" program. The cross case analysis indicates the moderate acceptability of a formal reverse logistics program for EoL management at firm level, especially for foreign companies. All four companies commented and discussed many barriers affecting their implementation of EoL management.

- **Proposition 5 (S5)**: The higher acceptability of a formal reverse logistics program is, the higher transferability of reverse logistics to Vietnam is.

The in-depth comparative case study with four companies in Vietnam electronics industry indicates that there is the moderate likelihood of adopting a formal reverse logistics program for both customer returns and EoL products, suggesting the transferability of reverse logistics to Vietnam. It led us to conclude that reverse logistics management models are ***likely being transferred to Vietnam to some extent***. Economic development, globalization and information technology supports have made the transplantation of these management models is being borrowed and learned more quickly before they are acknowledged. The future research may use the propositions formulated from the comparative case study analysis as a conceptual model to guide the research process and test with lager sample size (see Figure 98).

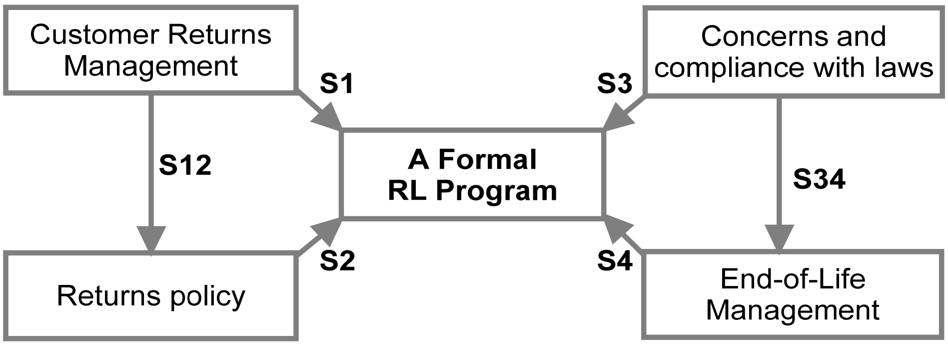

Figure 98: Research framework of the acceptability of a formal RL program

8.2. Assessments of reverse logistics models in Asia

In addition to support for the feasibility of models transferred, this study also examines some case studies of Asian countries that have transferred some reverse logistics management models for EoL management from Europe and modified them to implement in their countries. The lessons learned of success or failure from these countries may support the appropriate selection of a reverse logistics management model transferred and implemented in Vietnam.

Reverse logistics has been used since the EPR principle entered the spotlight as a potential policy alternative for waste management in the beginning 1990s in Europe. EPR-based policies and regulations of WEEE take-back have been implemented and transferred at an international level since 1990s. Learning from practices of RL management models for WEEE in Europe countries (e.g. Germany, Norway, Sweden, the Netherlands, and Belgium) can be observed in the cases of Australia, Canada, the United States, and some Asian countries. This part focuses on assessing reverse logistics models for EoL management transferred to Asian countries, making a qualitative cross-comparison of the main results, and identifying the measures modified for adapting to different contexts in Asia countries. Japan, South Korea, and Taiwan are countries successful in transferring and implementing EPR-based policy and reverse logistics models for WEEE management. Thailand and China are also mentioned because they are currently as the same situation in Vietnam in the process of transplanting the legal framework and transferring formal reverse logistics management models for WEEE.

8.2.1. Case study of Japan

Japan has dealt with WEEE management by institutional transplantation of EPR-based policy and closed-loop economy from Europe since 1998 by the basic law for recycling-based society using the "3Rs" framework of "reduce, reuse, and recycle." In 2001, two laws following this orientation were established. One is the Law for Promotion of Effective Utilization of Resources (LPUR), which focuses on enhancing measures for recycling goods and reducing waste generations of personal computers and small-sized secondary batteries designated as recylable products.[1117] The other is the Japanese law for household appliance recycling (LRHA) fully enforceable in 2001, which covers four home appliances including air conditioners, refrigerators, CRT televisions, and washing machines. While LPUR is more broadly based and encourages manufacturers' voluntary efforts, the latter impose compulsory obligations on manufacturers. LRHA is a major step toward producer responsibility in Japan, which extends the manufacturers' responsibility from the production stage to the whole cycle of the product, including the post-use and disposal stages and requires manufacturing industry to establish a collecting, recovery and recycling system for used products. LRHA is the most concise and universally applied in Japan because it currently covers Japan's four major home appliances.[1118]

Japanese legislation framework followed the EU Directive and organized a nationwide take-back system with two competing schemes.[1119] By close cooperation, the major producers set up joint venture companies for developing recycling facilities, thereby limiting their exposure to financial risks, and reducing their capital expenditure. Moreover, the vertical integration with the parent manufacturing organizations also made recycling easier, cheaper, and quicker.[1120] Manufacturers in Japanese split themselves into two main consortia that then set about building the recycling plants based on shareholdings. These plants are fed by a national collection system operating through 380 designated collection points that act as bulking and transfer facilities. The plants only take back product brands related to their group companies.[1121] Manufacturers in each consortium have the obligation to establish regional consolidation centers and to ensure the transport of collected products from these centers to recycling facilities. The first group comprises four main manufacturers: Electrolux, GE, Matsushita, Panasonic, and Toshiba; the rest one is composed of Daewoo, Sony, Sanyo Hitachi, and Sharp. The first group uses the maximum capacity of existing waste management companies including industrial waste treatment companies, existing local scrappers, and companies belonging to a national organization of industrial waste treatment companies (25 recycling plants). They utilize the facilities of existing recyclers as collection sites in their reverse logistics system. The second group built themselves 16 recycling plants and attempts to reduce total cost by adopting efficient logistics system. This group uses transport company warehouses as collection sites.

Like take-back requirements for electronics in Norway, Sweden, the Netherlands, and Belgium, the HARL imposes an "old for new" requirement on Japanese retailers.[1122] Collection is carried out primarily through retailer stores who are required to take back used products from end-consumers either when they purchase a new product or if consumers deliver the old product back to where it was bought from with proof of purchase. In Japan, it is estimated that 80 percent of recycled appliances are currently being collected through

[1117] See Chung/Rie (2008), p. 128

[1118] See INFORM (2003), p. 1; Cf. also Chung/Rie (2008), p. 130

[1119] See INFORM (2003), p. 2; Toyasaki/Boyaci/Verter (2011), p.2

[1120] See Department of Trade and Industry UK (2005), p. 16

[1121] See Lee/Na (2010); Cf. also Chung/Rie (2008); Department of Trade and Industry (UK) (2005)

[1122] See INFORM (2003), p. 1

retail channel. However, municipalities still collect and treat used home appliances in their area of jurisdiction, which includes appliances that are illegally dumped.[1123] In rural areas, without major appliance retailers, the local municipality or the Association of Electric Home Appliances (AEHA) collects discarded products.[1124] When discarding used home appliances, Japanese consumers are responsible for the cost of transportation as well as national recycling fee. Following collection, retailers, local municipalities, or AEHA is obligated to transport the collected materials to consolidation centers operated separately by two manufacturer consortia. Because they may not choose their nearest collection sites, the transportation costs cannot be optimized. Figure 99 shows the flows of used home appliances and the roles of associated actors in the reverse logistics system in Japan.

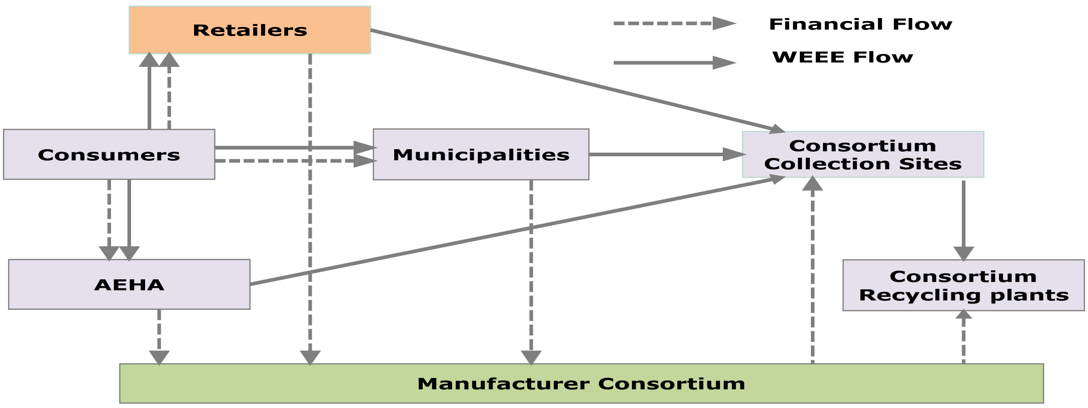

Figure 99: A formal reverse logistics system for WEEE management in Japan

Source: Chung/Rie (2008), p. 129; Cf. also Savage (2006), p. 20

The collecting and recycling rate is impressive with year-on-year in Japan, but it is achieved at relatively high cost compared to other European countries as well as Asian countries.[1125] Japanese society and legislation are environmental friendly. However, it is so costly driven due to high costs of transport, dismantling and recovery.[1126] Legal transplantation and model modification have provided the manufacturers in Japan with a clear basis to involve in the implementation of WEEE management and to develop advanced knowledge of how to run WEEE management model with legal system, infrastructures, logistics, and plants. The knowledge and the learning curves of reverse logistics management models for EoL products may support Japan companies in other countries to set up their plans for their own companies. It is also an opportunity for the transferability of a formal reverse logistics model to Vietnam because many Japanese companies are making business in Vietnam.

8.2.2. Case study of Korea

The first law of Korea to regulate WEEE, the Act on Promotion of Conservation and Recycling Resources (also called the Waste Recycling Act), took effect in 1992 with some main home appliance categories such as televisions and washing machine, and then covered air conditioners and refrigerators in 1993 and 1997, respectively. In this period, the Korea Ministry of Environment used the Waste Deposit Refund System to control producers' EoL management. However, it was not successful in encouraging collecting and recycling of EoL products due to lack of economic incentives for producers. After joining of the OCED in 1996, environmental policy of South Korea was directly affected by the direction of policy in Western countries, especially in the field of EoL management.[1127] In 2003, Korea modified the Waste Recycling Act to promote effective collection and recycling of waste material, leading to the adoption of the EPR principles. However, this scheme also failed to distinguish WEEE from other types of waste. In 2008, new legislation, the Act on

[1123] See Chung/Rie (2008), p. 130

[1124] See Savage (2006), p. 34

[1125] See Lee/Na (2010), p. 1642; Cf. also Department of Trade and Industry UK (2005), p. 28

[1126] See Department of Trade and Industry UK (2005), p. 7 & 53; Cf. also Aoyagi-usui (2003), p. 23

[1127] See Chung/Rie (2008), p. 133

the Resource Recycling of WEEE and EoL vehicles, was enacted separately by adopting ERP policy and regarded as the counterpart of EU directives such as WEEE Directive, ELV Directive and RoHS Directive.[1128] The legal transplantation in Korea has been implemented by the growing concerns about EoL management of special waste stream, and the more proactive involvement of stakeholders and partners in collection, treatment, and recovery of EoL products.

In Korea, reverse logistics system for WEEE management is often called in short "Producer Recycling" (PR) system, which requires electronic producers to take more responsibility for managing the environmental impacts of their products throughout their life cycle. The initial program of PR system focused on main home appliances (televisions, refrigerators, washing machine, air conditioners), then followed by other products such as personal computers, mobile phones, audio equipment, fax machines, printers and copiers. In PR system, manufacturers must collect and recycle an assigned quantity based on certain percentage of the number appliances they put on market. Like take-back rules in most European countries, both the collection costs and recycling costs are generally born by the producer. They can fulfill their legal obligations by constructing their own recycling plant and do their own recycling, outsourcing the job to commercial recycling companies, or joining PRO. Both individual responsibility and collective responsibility are possible under the PR system.[1129] Korea has two separate reverse logistics systems for managing WEEE: one is operated by producers, and the other is run by private operators. Either the Association of Electronics Environment (AEE) or major manufacturers manage producer recycling centers, which operates as producer consortia in Germany or competing collective take-back schemes in other countries in Europe. AEE in form of PRO also manage producer responsibility by contracting in proxy with the chains of commercial recycling companies in Korea. Many of them, approximately 28 companies, focus on dealing with the valuable discarded products such as television sets, monitors, computers, and mobile phones.[1130] The private recycling facilities around the country recycle smaller amounts of WEEE than the producer do, often deal with televisions, mobile phones, computers and other consumer electronic equipment, and are not well established and lower technology.[1131]

In a formal reverse logistics system for WEEE management in South Korea, there are three main ways to collect products discarded by end-consumers (see Figure 100). Like Sweden and Norway, OEMs and distributors in Korea are obliged to take back used products discarded from end-consumers free of charge when they purchase a new product, and then transport them to manufacturers' returns centers for recovery and recycling. There are more than 60 returns centers around the country that are established by producers and importers of consumer electronics in Korea.[1132] It is still highly probable that consumers can also discard their used EE products to public collectors (e.g. municipalities or special collection campaigns for those not subject to replacement purchase) at designated areas or curbside with municipal solid waste collection near residential complex. However, in this case households must pay fee for their discarded products via buying a sticker and placing them to the curbside or temporal storage area. The discarded electronics are picked up weekly by local transporters contracted by municipalities and delivered to private WEEE recycling facilities, either producer recycling centers, off-site treatment facilities or local reuse centers.[1133]

Approximately 70% of discarded UEEE in Korea have been collected by producers via the channel of retailers and distributors in recent years.[1134] The volume of discarded products collected by public collectors is also limited in the case of Korea due to consumer's unwillingness to pay for disposal fee, the lack of the establishment of an effective WEEE collection network by municipalities, and the low cooperation between manufacturers and municipalities.[1135] Only about 40% (98 out of 232) of the municipalities actively coope-

[1128] See Lee/Na (2010), p. 1636; Cf. also Jang (2010), p. 288

[1129] See Chung/Rie (2008), p. 133

[1130] See Chung/Rie (2008), p. 134

[1131] See Jang (2010), p. 291

[1132] See Jang (2010), p. 289

[1133] See Jang (2010), p. 289

[1134] See Jang (2010), p. 290; Cf. also Yoon/Jang (2006), p. 328

[1135] See Chung/Rie (2008), p. 134

rate with manufacturers because the municipalities have to pay the costs of transportation to the manufacturers' recycling facilities. In Korea, private collectors play a minor role in collection system of WEEE.

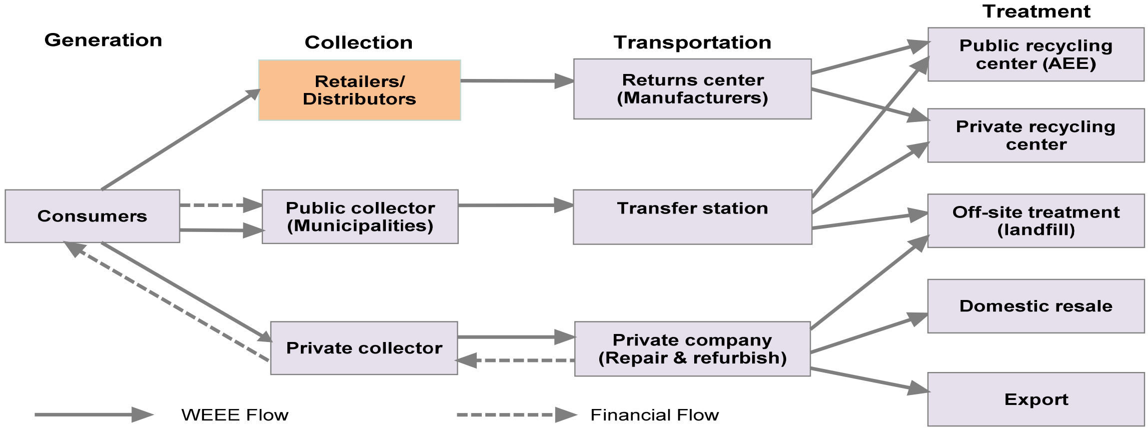

Figure 100: Reverse logistics system of WEEE management in Korea

Source: Jang (2010), p. 290; Cf. also Yoon/Jang (2006), p. 328

8.2.3. Case study of Taiwan

Taiwan is one of the typical cases adopting the orientation of ERP earlier than other countries in Asia. Prior to 1988, the collecting and recycling system of discarded UEEE was not defined by laws and carried out by informal collectors and recyclers. The recycling system had already existed in Taiwan at that time but it was based on self-profit and such behavior was not associated with public benefits. In 1988, the Waste Disposal Act (WDA) required the manufacturers/importers/sellers collect, recover and treat properly some certain discarded items PET bottles, tires, containers, batteries, vehicles, electrical and electronic equipment, and IT products. The ERP principle was not declared concretely in the legal framework, but the direction of ERP was incorporated since the responsibility of waste management is shifted from government to manufacturers. In the period of 1988-1997, although the producers could select one of three approaches to fulfill their physical and financial responsibility (individual, contracting, and collective take-back), most of them joined collective take-back scheme by private PROs to meet the requirements of collecting and recycling target.[1136] Reverse logistics for EoL management in Taiwan in the period of 1988-1997 was not successful to implement collection and recycling works because the overlapped authority and competition between private PROs. The infrastructure and facilities for collection (e.g. few collection points, inconvenient access for disposal) were not adequate to ensure the operation and profitability of recycling. The economic incentive was provided but small rewarding money could not motivate many people to bring back their discarded products. The reverse logistics system designated for EoL management at that time did not take into consideration the demand of secondary market and the market of informal collectors and recyclers.[1137]

From 1998, the mechanism of collecting, recycling, and financing for WEEE management in Taiwan was changed in which producers are obliged to pay recycling fee to the fund of recycling management (RMF) under the control of Environment Protection Administration (EPA). RMF operated as the single PRO in Taiwan that has been organized and controlled by the (EPA) since 1998. In RMF system, producers are financially responsible for the end-of-life disposal of their products by paying the fees to the RMF and do not need to fulfill the physical responsibility of take-back and recycling because the industry of electronic and electrical manufacturing in Taiwan is made up numerous small and medium-sized manufacturers.[1138] RMF become the coordinator in the Four-in-One Recycling network that works together with local municipalities, collection firms, households, and recyclers. RMF system organizes an incentive mechanism in form of

[1136] See Lu (2004), p. 16

[1137] See Lu (2004), p. 16

[1138] See Lee/Na (2010), p. 1639; Cf. also Chung/Rie (2008), p. 137

subsidies for consumers, retailers, collection firms, and commercial recycling companies to operate the tasks of collecting and recycling of discarded UEEE.[1139]

ike other take-back systems in Europe countries, consumers do not have mandatory take-back requirements and they can freely choose their preferred route for disposal of EoL products such as retailers, local municipalities, and private collectors. In order to change the low awareness of consumers and call for their attention, RMF provided economic incentive (€2.35 per piece in average) at the beginning of carrying out RMF system in combination with information propagation and education to encourage consumers to bring back discarded UEEE to designated collection points. Collection points in Taiwan reverse logistics system for WEEE management include retailers, municipalities, and private collectors. However, collection in Taiwan is largely dependent on collection contractors rather than producers or local governments. They buy products from different collection points and obtain revenue by reselling products collected to secondhand market, export, and recycling plants.[1140] The critical factor in determining collection volumes in Taiwan is therefore the amount of subsidy because the higher the subsidies these contractors receive from the RMF, the greater the incentive to boost their WEEE collection volumes. RMF in collaboration with collecting companies established three large-sized storage yards to store the collected discarded products. These collecting companies are also responsible for transporting the collected products from collection points to the storage yards. These three storage yards are located in the northern, central, and southern part of Taiwan, respectively, to minimize transportation costs. The expansion of take-back system with different stakeholders has made conditions for consumers in Taiwan to easily access the collection points in the disposal stage, therefore supporting the recycling system to reach higher collecting rate. At the beginning, Taiwan government also encouraged retailers, service station, and recycling plants registered as collection points by proving economic incentive (€1.17 - €2.12 per piece in average). In 2002, the government has cancelled the rewarding money to consumers and subsidies to collectors. However, most collectors have still provided economic incentive to collect discarded UEEE from customers.[1141] Figure 101 describes the networks of reverse logistics system for WEEE management in Taiwan.

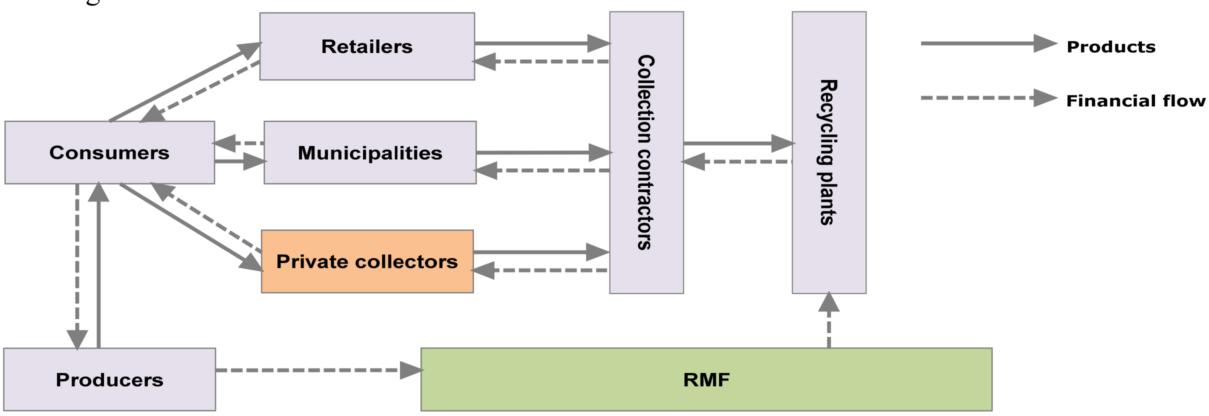

Figure 101: Reverse logistics system for WEEE management in Taiwan

See: Chung/Rie (2008), p. 137; Cf. also Lu (2004), p. 18-19

Recyclers in Taiwan are not compelled to perform all recycling with RMF scheme, and they are free to choose whether to participate in RMF system. Recycling plants in RMF system buy WEEE from collection sites that are managed by collection contractors and recycle them to obtain subsidies from RMF in accordance with the amount of various items. The work and results of recycling plant are monitored by the auditing and verifying organization entrusted by Taiwan EPA. There are some challenges for reverse logistics system of WEEE management in Taiwan related to determining economic incentives and subsidies to motivate private collectors (collection contractors) and recyclers to join RMF. Because the decision of joining the system can be made at the discretion of the commercial recycling companies, the reasonable subsidy plays an

[1139] See Chung/Rie (2008), p. 136; Cf. also Lu (2004), p. 17

[1140] See Lee/Na (2010), p. 1641

[1141] See Chung/Rie (2008), p. 137; Cf. also Lu (2004), p. 18-19 important role to make the implementation of EoL management formally operate and be controlled. However, the amount of fee paid independently by manufacturers for the cost of EoL management has not stimulated manufacturers in Taiwan to proactively deal with the issues of reverse logistics for EoL management.

8.2.4. Assessments and implications

By reviewing some practices of reverse logistics management models for WEEE transferred to Asia countries, it can be observed that three countries have constructed their respective reverse logistics systems for WEEE management based on EPR-based policy. However, the concrete models transferred and implemented of each country were modified accordingly and significantly due to the contextual difference in each country. For example, both Taiwan and South Korea impose economic responsibility on manufacturers; Japan meanwhile is the only one country to put this economic responsibility on consumers due to high public awareness and individual ways thinking of relationships between nature and people. The range of responsibilities for physical facilities also differs between countries. In Japan, the burden on municipalities to collect WEEE was sharply reduced due to the popularity of retailer chains for collection responsibility. Meanwhile, in South Korea, municipalities are still obliged to collect the discarded EEE, but the collection through retailer chain is more dominant. In Taiwan, collection is largely dependent on the operation of collection contractors rather than producers or local governments. Japan and South Korea have the common feature that physical responsibilities of recycling are fulfilled by manufacturers, which resulted in a similar phenomenon of setting up new recycling plants by manufacturers or collaborating with recycling companies to comply with the laws, to increase recycling capacity and to reduce the cost. Taiwan is the unique case, in which manufacturers are not considered as the sole actors in the collecting and recycling process. They are only required to pay fees for sales of the previous year, which are converted into economic incentives for customers' disposal and subsidies for collection contractors and commercial recycling companies in the system. In Japan and South Korea, the consumer's responsibility lies in cooperating with the other stakeholders (e.g. retailers, local governments) during collection whereas in Taiwan, the consumers' responsibility is not clearly stipulated but rather left to the market's discretion. Table 42 summarizes the main characteristics of reverse logistics system for WEEE management in three countries.

Characteristics	Retailers	Municipality	Other collectors	Financing system	Collective/ Individual	Competing/ Collaborative
Japan	80%	Muni & AEHA	Private collectors	End-of-life visible fee	Individual	Collaborative
South Korea	70%	Muni & AEE	Private collectors	Front-end Invisible fee	Collective Individual	Competing
Taiwan	11%	Muni	Private contractors	Front-end Invisible fee	Collective	Collaborative

Table 42: Comparisons of RL management models in three countries

Some lessons learned from transferring reverse logistics management models for EoL products can be observed through the analysis of practices in these countries. The high costs of logistics and recovery for EoL management in the case of Japan have led to the lessons of optimizing the reverse logistics network in collecting, consolidating, and transferring to final treatment facilities. The implementation of reverse logistics management model based on Deposit Fund system transferred to Korea at the beginning failed because it appears not to be a good system for motivating producers/importers to pay more attention to EoL management (e.g. discrepancy between deposit fund and recycling costs). Due to the shortage of collaboration between municipalities and manufacturers as well as the lack of consumer incentives for collection, the volume of WEEE being recovered and recycled in Korea have been still low.[1142] Taiwan failed when this country operated many private competing PROs at the first stage of the implementation of reverse logistics management model due to its low public awareness, and insufficient infrastructures and facilities. Recycling

[1142] See Jang (2010), p. 292

fund operated as single PRO in the collaboration with many stakeholders and partners have helped Taiwan succeed in transferring and implementing a formal RL system for EoL management. Setting up an appropriate incentive mechanism may be also a good measure to adapt to the actual situation in Taiwan at the first stage of implementation when public awareness has been still low, and consumers are accustomed to selling products to informal collectors for economic benefits. However, the increase subsidies for collection contractors and recyclers may force the producers to bear more costs, resulting in the lower competiveness of Taiwan electronics firms. It may be innovative to require the participation of producers in improving physical responsibility for recycling while maintaining the mechanism of RMF. Moreover, the municipalities have not made substantial contribution to increasing the collection volume of EoL products in three reverse logistics management models of three countries as in the cases of Germany, Sweden, Netherlands, Denmark, and Spain. Municipalities can play more significant role in WEEE collection by raising public awareness, improving collection networks, and enhancing their collaboration with consumers and manufacturers. Municipalities can become a regional transfer point where transporters contracted by OEMs, producer consortia, PROs can hand in consumer electronics to the recycling centers as the case of reverse logistics system in Germany.

The process of transferring and developing of a formal reverse logistics system for EoL management in developing countries including China, Thailand, and Vietnam is being implemented. These developing countries are moving forward to transplant legislation as well as extract the practices and experiences from EU countries and other forerunning Asian countries to operate their reverse logistics management models for EoL products. Developing Asian countries have made efforts to establish formal collecting and recycling systems based on EPR-based policy for recent years. Both China and Thailand have drafted legislation for WEEE collecting and recycling and released it for public review. For example, the Chinese government has developed a variety of policies since 2000, which reflect the key aspects of ERP-based policies and the European WEEE Directive. On 1 January 2011, the Regulations for the Administration of the Recovery and Disposal of Waste Electrical and Electronic Products, often referred to as the China WEEE Directive, was finally enacted.[1143] The growing purchasing power of the EU has contributed to China's increased focus on the transplantation of laws and reverse logistics management models that draw from European best practices. China is operating a RL system for EoL management with open collection network with different stakeholders. China has successfully carried out a new collection channel through "old for new" program in large scale with 44 provinces/cities, under the collaboration between manufacturers/distributors and a subsidy budget from recycling fund. Consumers, OEMs, and qualified recyclers welcomed the "old for new" program because it has provided higher incentives, created remarkable strength in retail sales of home appliances, and significantly reduced the gaps between the actual amounts of treated WEEE and the treatment capacity.[1144] However, setting up a formal collection network has still been a core challenge for the implementation of EoL management in China because the establishment and maintenance of a multi-channel collection network is based on many related stakeholders' participation as well as legal administration and the construction of network is very costly. Thus, a formal reverse logistics system in this country has not been well organized.[1145]

In Thailand, the Thai government and industries reacted by accelerating efforts toward establishing Thai WEEE Bill in 2005, following the issuing of directives on WEEE and RoHS (Restriction of Hazardous Substances) in the European Union because Europe isThailand's second largest export market after the United States. Thailand with the support of Japan have proposed a formal reverse logistics management model for WEEE with recycling fund collected from producers' payment of recycling tax. Thailand also intends to apply an incentive mechanism for consumer discarding their EoL products to certified collection

[1143] See Zhang (2011), p. 23; Cf. also Kojima/Yoshida/Sasaki (2009), p. 265

[1144] See Zhang (2011), p. 17

[1145] See Lee/Na (2010), p. 1639

centers. Collection centers in turn also receive a subsidy from the recycling fund based on the amount collected. Collection centers then sell e-waste to recycling factories or ask them to treat the WEEE.[1146]

The common bottlenecks of developing a formal reverse logistics system for EoL management in developing countries are mainly due to the lack of a comprehensive collection network, the shortage of infrastructure and technology for recycling system, the low public awareness, and the popularity of informal operators, repair businesses and small assemblers, and secondhand shops. Moreover, the principle of EPR placed on producers has been mentioned as quite general and merely an informative rule in some policies. It is not explicitly articulated within a concrete EPR scheme like take-back models in European countries. There are also no specific collection mechanisms with compensations and incentives for consumers and no consumer responsibilities specified take-back regulations proposed. There is no overall platform to coordinate the whole administration supporting work engaged by governmental bodies and partners involving in collecting and recycling system. More importantly, solutions for controlling and integrating informal collectors have not been widely discussed for setting up formal reverse logistics models for EoL management in developing countries.

The analysis of contextual differences in Vietnam in chapter 7.3 has partly showed both challenges in transferring and implementing a formal reverse logistics management model for EoL products. However, the analysis of contextual similarities in comparison with Romania partly showed the relevance and potentials for Vietnam to transfer a formal reverse logistics management models. Moreover, the empirical results of survey conducted by MONRE (2008a) and in-depth comparative case study carried out by this study in 2011 also demonstrated the moderate likelihood of adopting a formal reverse logistics program at firm level. Based on the analyses it can be said that a formal reverse logistics management model for both customer and EoL returns can be transferred to Vietnam. However, some modifications and solutions should be given out to adapt to the actual situation of Vietnam. The following sections focus on selecting and modifying a model of reverse logistics management to transfer and apply in Vietnam with some suggested solutions. This study selects the model of reverse logistics to transfer and implement in Vietnam by two main levels:

- first, at network-level for a formal reverse logistics system dealing with EoL management;
- and second, at firm level for developing a formal reverse logistics program to manage different kinds of reverse flows.

8.3. Selecting and modifying a reverse logistics model for EoL management

In order to transfer and implement a formal reverse logistics management model, it is necessary to answer the questions to clarify who will play the leading role within a reverse logistics system and how to collaborate stakeholders and partners in a multi-level collecting and recycling system. According to the actual practices in EU countries and Asian countries, the model can be transferred with a choice between a manufacturer-centered role system via manufacturer consortia, single or competing collective take-back system, and a government-centered role system via recycling management fund.

The process of developing a formal reverse logistics system for EoL management as in the cases of Romania and Germany has been proved as a mutual coherence process between enterprises (e.g. OEMs, importers, distributors, and service providers), market (e.g. consumers), and government (e.g. legal and institutional framework, tax means, and support mechanism). A formal RL management model needs at first the active participation of enterprises to operate collecting, recovering and recycling, and these operations of reverse logistics business should bring benefits (e.g. monetary or non-monetary values) to all enterprises in the whole network. The necessary condition for running a successfully formal RL system is the active participation of consumers because reverse logistics starts from collecting the products discarded or returned by customers to repairing, refurbishing and recycling. If customers returns or discards their product improperly, it means that the supply side for a formal RL system is broken and there is no meaning to operate it. The role of government is extremely important in developing a formal RL system because it is the body to clarify, supervise, and coordinate the responsibilities of different stakeholders in collecting and recycling system (so-

[1146] See Kojima/Yoshida/Sasaki (2009), p. 263

called as coordinator center). Moreover, the governmental bodies can set up some funds to subsidize for formal collectors and recyclers, and to create incentives for the enthusiastic participation of consumers and enterprises.

Analyzing contextual differences in Vietnam and exploring the empirical results have shown that one of the most external barriers for successful transferability and implementation of a formal RL system for EoL products is the shortage of collaboration at network-level between the government, the enterprises, and the market for the investments of facilities, infrastructure, and technologies of reverse logistics. The shortage of coordinating role from the government and the supporting mechanism may be the main reasons for the loose enforcement of laws, the decentralization, and scatter of recycling facilities, and the less development of infrastructure and logistics for collection network.

While selecting and modifying RL management model for Vietnam, this study takes into account carefully the roles of enterprises, market, and government in mechanism of intensified collaboration to motivate the implementation of a formal RL system. A model of cooperative operation and governance by enterprises, government, and market is proposed, which bases on collective responsibility and collaborative mechanism. Reverse logistics may bring economic, social and ecological benefits for the whole society in long term, but in the short term, enterprises may be reluctant and passive in the implementation as in the first period of RL development in Europe because RL operations are complicated and resource intensiveness. Government in Vietnam is moving forward to promote sustainable development with a closed-loop economy. However, the local government has not been effective to deal with the issues of reverse flows, e.g. loose enforcement of laws, unspecific regulations, the lack of unified planning of reverse logistics for EoL management, and no investment for collection network and recycling facilities of special waste streams.

Therefore, a model of cooperative operation and governance extracted from the practices of collective take-back systems in Germany, Romania, and Taiwan maybe a potential solution when single regulator of the government and the market have not worked well in a collaborative network. This model is developed based on legal transplantation of EPR-based policies with specific regulations of take-back responsibility for WEEE and the borrowing of producer responsibility organization model, namely a PRO-based model. A PRO-based model of reverse logistics system is transferred to Vietnam with the reference to the models of Romania and Germany because there are some similarities between Vietnam and these countries in demographic, economic, and social factors. However, this model of a formal reverse logistics system for WEEE management has some separate features that should be taken into consideration in modifying the model to be suitable for Vietnam. **Firstly**, the market for reuse in Vietnam is continuously, the roles of intermediate trader, repair, and secondhand shops therefore should be paid more attention in modifying the model as collection sites or storage facilities. The objectives of this modification are to reduce the total distance of transportation, increase the number of used appliances collected from consumers, reduce the amount of used appliances carried to recycling plants inefficiently, and connect reverse logistics to forward logistics in an efficient way. **Secondly**, informal sectors are quite complex and composed of many unspecified factors such as informal collectors and recyclers. Most of discarded UEEE in Vietnam are now collected and recycled by this informal system, this sector should be included as one of key actors in a PRO-based model proposed for developing a formal RL system. **Thirdly**, infrastructures for collection network and recycling of special EoL products have not been constructed, requiring the collaboration between government, firms in the industry, and private operators to raise capital for more comprehensive investments. **Finally**, public awareness in disposing UEEE properly is lower than other countries due to economic benefits. Therefore, incentive mechanism is also added as the important tool to increase public awareness and attention at the beginning time of model implementation. Figure 102 presents a PRO-based model for developing a formal reverse logistics system for WEEE management in Vietnam. The sub-parts identify clearly stakeholders and their responsibilities in a formal RL system.

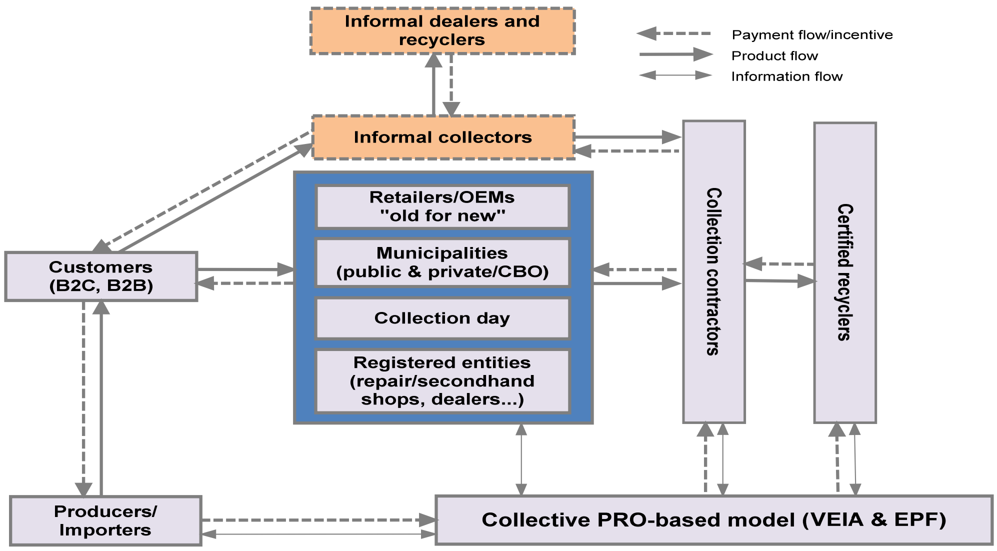

Figure 102: A formal reverse logistics system for WEEE management in Vietnam

8.3.1. Organization type

Due to complex informal and recycling system, the low volume of discarded UEEE, the limited investments in remanufacturing and recycling technology, most of electronic manufacturers in Vietnam have not been involved themselves in collecting their EoL products to recapture value and recover assets, especially for local and SMEs companies. In fact, it can be said that economic benefits derived from reverse logistics for EoL management are very limited at this stage in Vietnam and it costs a lot of money. In order to support manufacturers to start their reverse logistics programs for EoL management, it is necessary to improve infrastructures for collection networks and recycling facilities.

This study proposes a producer responsibility organization (PRO) model as a non-profit organization that combines the cooperation efforts of government bodies and manufacturing industry in structuring a formal collecting and recycling system. The model proposed aims at cooperatively managing and governing the obligations of take-back and recycling of producers, and stimulating the integration of informal sectors. In this model, all active producers are members in a PRO and all collection and this PRO coordinates recycling partners.

The majority of PRO in other countries is mostly run by only cooperative industry effort and the recycling fund is only controlled by government bodies.[1147] Two main bodies, including Vietnam Electronic Industry Association (VEIA) and Vietnam Environmental Protection Fund (EPF), are suggested to participate in organizing and managing the operation of this PRO. The reason for this authority collaboration is that a cooperative policy is seen as a prerequisite for effective policy into existing environmental protection practices.[1148]Furthermore, shared-governance networks with inter-agency cooperation can strengthen collaboration between stakeholders in environmental management in a broader policy environment, rather than focusing on a specific organization.[1149] VEIA established since 2000 is only one non-profit and non-governmental organization that is now representative for nearly 150 producers and traders in the field of electronics, information technology, and telecommunications in Vietnam. VEIA is responsible for protecting the legitimate interests of their members and promoting the cooperation among its members for the development of Vietnam electronics industry.[1150] VEIA acts in PRO model as a representative for producers in PRO to ensure their responsibilities and benefits. EPF is authorized by the competent governmental authority, e.g. MONRE at the level of sovereign power and DONRE in regional level. PRO-based model is established to control

[1147] See DIT (2003), p. 5

[1148] See Kaluza/Blecker/Bischof (1999), p. 5; Chen/Chen (2010), p. 389

[1149] See Watson (2004), p. 43

[1150] See VEIA (2010), p. 1

mandatory producer registration, coordinate collecting and recycling partners for EoL take-back and recovery, and support the establishment and development of a formal collecting and recycling system for discarded products.[1151]

In the first stage of developing a formal reverse logistics system, a single PRO-based model is proposed by this study due to the low volume of UEEE discarded and the necessity of collaboration to formalize informal sectors and improve infrastructures for collection networks and recycling facilities. In the second stage, this model can be developed as collective competing take-back systems based on the collaboration between DONRE and producers in each region as well as on the economies of scale for collecting and recycling. With the industry efforts by VEIA and the support of governmental authority, the required fee paid by producers/importers is controlled and distributed for developing collection networks, subsidizing recycling plants, administration monitoring, and improving public awareness. This single PRO also calls for the participation of NGOs and the associations of consumer to increase consumers' awareness and to integrate informal sectors into a formal collecting system.

Producers in this model including manufacturers and importers of electronic and electric equipment are obliged to register with the PRO, declare their sales or import volume of EEE and their plan of their voluntary take-back and recovery programs (if they want to individually implement collection responsibility). Producers have to pay required deposit fund in case they implement collection and recovery responsibility individually. Otherwise, producers are required to pay the fee and let the PRO do take-back and recovery responsibilities on behalf of them. In this case, producers carry only financial responsibilities and are not directly involved themselves in collecting and recycling programs. However, manufacturers are encouraged to implement voluntary take-back programs by themselves or through their distributors. In this model, individual producer collection efforts (own-brand) are accounted toward its general obligations under the PRO to motivate producers to develop voluntary collection networks and recovery facilities. In addition, through VEIA roles in PRO model, producers are motivated to be more proactive involvement in EoL management by designing eco-products and increasingly collaborating with other members to set up recycling plants. Therefore, producers can contribute to reducing the required fee. Customers, both households and business clients, have to pay the advance disposal fees at the time of purchasing electronic and electrical equipment. The amount of advance disposal fee is invisible and incorporated in the selling price at the first stage of implementing the model. Consumer can return EoL products free of charge in Vietnam by four ways: disposing to municipal collection sites, exchanging with the new one at retailer stores, giving them to registered collectors, and participating in "Collection day." Until now, Vietnam households are disposing their used products through informal collectors and repair/secondhand shops because they can obtain economic benefits from their discarded products. In fact, the saving custom, the low public awareness, and the inconvenience to access the collection points have affected Vietnamese consumers' willingness to dispose their UEEE to municipalities. In order to change the consumers' awareness, the PRO should conduct a rewarding mechanism at the first stage of implementation a formal collecting network. A rewarding mechanism should be applied to encourage consumers to bring back discarded UEEE to formal collection points, e.g. "old for new" programs at retailers stores, small incentive money or gift at registered collection sites and municipal collection points. Romania and China has been rather successful in implementing "old for new" programs with the discount at retailer stores to collect discarded products. Taiwan is the successful case study in improving consumers' awareness at the first stage of implementing take-back models by applying an incentive money system. Thailand also intends to use a refund system to support consumers when they bring their discarded UEEE to certified collection points.

8.3.2. Collectors

In the model proposed to transfer and apply in Vietnam, instead of setting restrictions on collection, the multi-channel collection network is proposed in this study (see Figure 103).

[1151] See MONRE (2008), p. 127

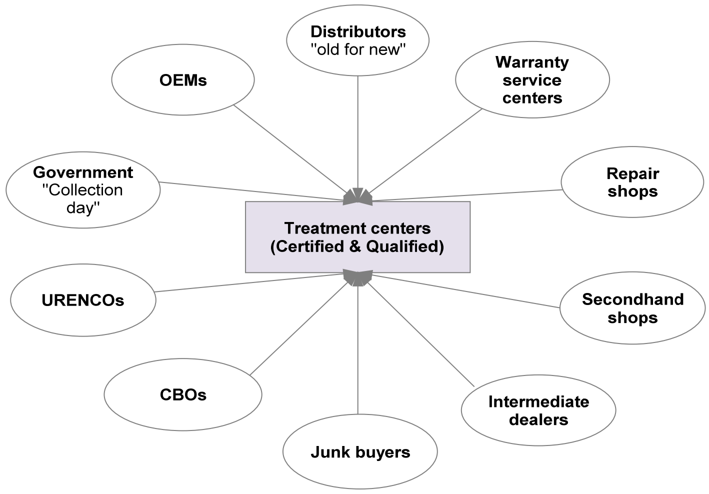

Figure 103: A multi-channel collection network

Source: Own illustration

The reasons for adopting multi-channel collection network is to take full advantage of current operators in the existing collection system because Vietnam has not formally established and fixed collection channels for special waste stream like discarded UEEE, packaging waste, and waste paper. Meanwhile, the model of "informal collectors pay and consumers sell" has been dominant in Vietnam for many years.[1152] Therefore, it is necessary to organize, group, and establish gradually a formal collecting system based and support of the informal sector. EPR-based policies can promote the development of a formal collecting and recycling sector by bringing the informal sector into the open.[1153] Measures to control and integrate informal collectors should be discussed in this model. Representatives of the PRO in each city and province (DONRE) should be responsible for collecting information about different kinds of informal collectors, increasing education, and certifying business entities such as repair/secondhand shops, recycling plants, community-based organizations, and intermediate dealers as registered collection points.

Distributors (e.g. OEMs, retailer sores, electronics supermarket, and centers) are expected to be the second actor in a formal collecting system by applying take-back free of charge on the basis of 1:1 old for new purchase with some discount bonus because many consumers are now in favor with the "old for new" programs carried out by manufacturers/distributors. This collection is either performed by the retailer themselves at the retailer stores when they distribute the similar products; or by their logistics partners, who deliver new appliances to consumers (large appliances). OEMs/distributors nowadays are also more accustomed to "old for new" programs for both increasing the sales volumes and recovering the value from the returned products. "Old for new" collection method is also evaluated as the most suitable one in empirical survey with 181 households. Distributors are also obliged to bear a part of the physical and informational responsibility of taking back the product in categories they have on sale such as information provision, storage, and separation of discarded products. They can have the right to decide the disposition options for the discarded products by refurbishing themselves or selling to secondhand market and collection contractors.

Households in Vietnam pay a small amount of nearly €0.71/household/month for a local municipal waste tax to fund general waste collection and operation of municipal sites. Although households may dispose UEEEfree of charge to municipal collection sites, this collection channel have actually not been successful with the valuable discarded products, especially for UEEE. However, the highly dense networks of URENCO developed in most cities/provinces may play important roles in collecting efficiently discarded products from Vietnamese households like Germany and Romania when the infrastructures and services for collection networks are improved. In order to encourage the households in Vietnam to get acquaintance with returning

[1152] See Mitchell (2008), p. 2025

[1153] See Kojima et al. (2009), p. 265

the discarded products through municipal collection points, the PRO with the collaboration of industry and government should also use a rewarding mechanism for municipal collection sites to refund consumers small incentives or gifts when they discard UEEE to municipalities. Municipality is the unique formal collector that can provide the households with convenient services of collecting at door (curbside collection) due to its special functions. For constructing an efficient and effective WEEE collection system in long term, the solutions suggested for municipalities should be paid more attention.

In PRO-based model, distributors, registered collectors, and local municipalities are designed to become a formal collecting system for EoL management. Among them, municipalities and large registered collectors (e.g. repair/secondhand shops, and intermediate dealers) are proposed to be storage facilities and main collection sites to reduce additional transportation. With sorting and testing functions inside these storage facilities, the reusable products can be sent directly to secondhand market or be resold to recycling plants. Especially, large registered collectors should be developed as specialized collection contractors that are not only primary collectors for reuse in the secondhand market but also as collection contractors by storing and consolidating the volume of discarded products/materials that can be recycled. This, therefore, allows the smooth flow of reusable products from secondhand shops to customers. However, the PRO should also encourage repair/secondhand shops, intermediate dealers, and recycling plants to register as collection contractors by providing subsidy based on the volume of UEEE collected.

8.3.3. Recyclers

Recyclers in the PRO model should be developed from current recycling plants and craft villages because Vietnam has not had any recycling plants specializing in recycling discarded UEEE. Normally, they are often in form of dismantlers, remanufacturers, and recyclers collecting and recycling EoL products.The required fees paid by manufacturers/importers are mostly used for subsidizing certified recyclers. Since discarded UEEE is frequently traded at a positive value in the market of developing countries like Vietnam, certified recyclers also must buy UEEE discarded from the market. Therefore, they need the subsidy from the PRO to compete with informal recyclers. Small recycling companies asked in Dai Bai village are interested in a subsidizing mechanism for developing qualified and certified recycling networks proposed in the model because they are motivated to invest in updated technology to become the specialized recyclers of the system.

It is also necessary to have collaborative investments between the PRO, OEMs, and recyclers (villages and small plants) to establish and develop joint venture recycling plants for recovering discarded products because the economies of scale in recycling can lead to the efficiency and effectiveness of reverse logistics system. The projects of collaborative investments for recycling facilities and technology should be carefully selected and examined related to geography and economic development of each region. The PRO in collaboration with OEMs should subsidize these certified recyclers for both financial and technological issues as well as the experiences to improve recycling capabilities for the whole system at the beginning stage. The output of recycling plants should be sold to material market, with the priority to the producers belonging to VEIA.

Table 43 describes in brief the roles and responsibilities of stakeholders and partners in collective PRO-based model proposed by this study for the case of Vietnam.

Actors	Roles and Responsibilities
EPF(MONRE, DONRE)	Instructing specific take-back regulations, controlling and monitoring the registration of producers, managing the fee and subsidy mechanism, licensing authority for registered collectors and recyclers; improving public awareness
VEIA	Participating in PRO on behalf of manufacturers/importers to ensure their responsibilities and benefits; controlling and managing the daily operations of collective take-back and recovery systems; Supporting for the development of a formal collecting and recycling system; Improving

	collaboration between producers
Manufacturers/Importers	Registering with the PRO, declaring the sales volume of EEE and their expected individual implementation, paying deposit fee (individual implementation), paying required fee for financial responsibility, cooperating with VEIA to support for a formal collecting and recycling system.
Consumers	Responsible for returning their discarded products to retailers, municipalities, and registered collection points
Registered collectors (Collection contractors)	Receiving discarded products from end-users, testing, storing and reselling them to secondhand markets or registered recyclers
Distributors	Offering take-back free of charge on the basis 1:1 "old for new" purchase with discount bonus; providing information related to collective take-back scheme to customers when they buy products
Municipalities	Offering take-back free of charge for discarded UEEE by curbside collection or at municipal collection points
Registered recyclers	Paying for discarded products from collection contractors; offering recycling operations for discarded products; ensuring the standard requirements to operate recycling as requirements of PRO

Table 43: Actors and responsibilities in a PRO-based model for EoL management

8.4. Solutions for a formal reverse logistics management model at network level

According to result findings in chapter 4, it is clearly found that both internal and external factors have influenced the development of reverse logistics in Europe. However, based on the analysis of contextual differences of Vietnam in chapter 7 as well as the findings from case study, the most barriers to reverse logistics implementation in Vietnam are from external factors with macro perspective. In case of Vietnam, the external factors, e.g. the shortage of specific regulations, the lack of infrastructure and technology, the lower income, and the low public awareness have partly hindered firms from clarifying the status and role of reverse logistics and developing a formal reverse logistics program. There are closed links between external barriers influencing the transferability and implementation of reverse logistics. For example, the lack of specific legislations decreases the pressures to implement a formal management model of reverse logistics at both network level and firm level. Consequently, these in turn minimize the investments in RL infrastructures, facilities, and technology; and limit the collaboration between supply chain partners in the whole system for common objectives of economic efficiency, environmental protections, and sustainable development. The lack of public awareness has limited the development of a formal reverse logistics system that can bring the benefits for both firms and society.

Therefore, it is necessary to propose some solutions, which can combine the efforts, the strengths, and the potentials of all stakeholders in a reverse logistics system, especially from the governments, the firms, and the consumers. Solutions are given on the basis of cooperative operation and governance between governments, enterprises and markets in reverse logistics operations, which focus on promoting sufficient framework of legislation and specific regulations, improving public awareness, conducting supportive policies, increasing investments for infrastructures, facilities, and technologies of RL operations, strengthening the collaboration between supply chain partners in reverse logistics networks. The suggested solutions act together with organizational-related factors inside a firm may affect the strategic considerations of developing a formal reverse logistics program at firm level to some extent (see Figure 104).

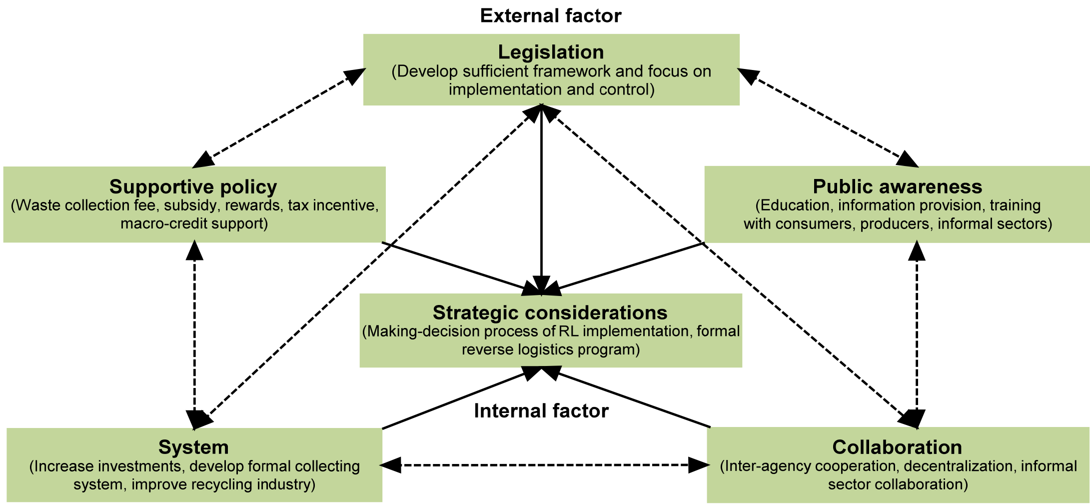

Figure 104: Solutions for developing a formal reverse logistics management model

8.4.1. Developing a sufficient framework of legislation

Vietnam has not issued specific regulations and instructions on management of special waste streams, especially for discarded UEEE. Moreover, the gaps in loose enforcement and the ambiguity of the existing regulations, which may be related to the current situation of political and economic development, are the main barriers to transfer and implement a formal reverse logistics in Vietnam. As Vietnam was rapidly growing over the last decade, the government might not want to impose the very strict rules on performance of the firms, especially with regulations on extended producer responsibility that put the economic burdens on manufacturers/distributors. They are afraid of overly responsibility limiting the growth rate of economy due to the increase of related costs, especially when 90% of the firms in Vietnam are small and medium-sized companies. However, for a long-term orientation of sustainable development and a closed-loop economy, Vietnam government should issue the concrete regulations to stimulate, control, and standardize the extended responsibilities of producers for managing their EoL products. As the development practices of reverse logistics in the European electronics industry, the principle of EPR and the take-back regulations have been used as an impetus for establishing a formal reverse logistics system to collect used products from the waste stream, extend their useful life, and recapture value. These operations can reduce the prices of raw materials, save resources, protect environment, and minimize landfill disposal and incineration. Some solutions are suggested as follow based on the actual situations in Vietnam and the PRO model proposed for developing a formal reverse logistics system.

The government should strengthen to implement the Circular 12/2006 on registration and licensing system for specialized service providers of reverse logistics operations, e.g. collectors, transporters, and recyclers. The Decree 59/2007 on solid waste management with the stakeholder responsibility in separating, disposing, and collecting properly the solid waste should be paid more attention and taken it into practice by increasing public awareness, and investing in collection facilities such as waste bins, collection points, and transport modes. The government should increasingly introduce to the industry the corresponding laws and regulations for WEEE and RoHS like those implemented in the EU countries. It may be the time to issue the draft regulations for public review because Vietnam governmental agencies and industry associations have made the basic preparations for issuing and implementing the legislation for recent years.

In 2007, URENCO implemented the project of the development of e-waste inventory in Vietnam, with the support of MOE Japan, MONRE Vietnam, and Ex Corporation. The project launched a multi-stakeholder partnership in order to prepare strategies aimed at achieving the environmentally sound management of discarded UEEE in Vietnam. It complemented for the limited data on the amount of WEEE, increased the public awareness, and shared experiences and information for decision-makers. The project also emphasized the necessity of a sustainable system for the environmentally sound management of electrical and electronic waste in Vietnam with reference to experiences of other countries in the world.[1154]

APRO-based model suggested by this study is based on reviewing actual situations of Vietnam, experiences from other countries with similar context, and the draft model proposed by MONRE (2008a). It emphasizes the collaborative governance and operations of the government, the industry, and the market by the establishment of a single PRO with the closed collaboration between VEIA and EPF. However, the implementation of legislative framework and the development of model related to extended producer responsibility of EoL management should be implemented in accordance with the economic development, the improvement of infrastructure and technologies for collecting and recycling system, and the increase in public awareness. There should be a roadmap for manufacturers and importers to collaborate for implementing their responsibilities of collection and treatment of discarded products. Furthermore, in relation to establishing a formal collecting and recycling system, new legislation objectives and standards must be matched to economic conditions and the available resources of stakeholders. Therefore, it should be introduced with a realistic time schedule. For example, municipalities and distributors should be aware of legal requirements of their roles in a formal collecting system, intermediate traders and repair/secondhand shops should be encouraged to join formal collecting networks by the registration procedures. Municipalities' capacity for collecting, sorting, and recovering discarded products should be steadily improved. Unless a culture of non-compliance with environmental directives can develop, as well as creating resentment and frustration of stakeholders at the network level. Therefore, this study propose a two-stage scenario of issuing related regulations in accordance with the development of a PRO-based ERP model for EoL management in Vietnam (see Table 44). The interval time should be relatively considered because it depends on the actual development of Vietnam politics, economy, and society in the next coming years.

Stage	Regulations	Producers	Consumers	Collectors	Recyclers
1st stage (2015-2020)	WEEE[1155] Regulation	VEIA & EPF (single PRO)	ADF (invisible) Incentive	Registered collectors Distributors, Municipalities, Informal collectors	Recycling plants Craft villages
2nd stage (2020s)	WEEE[1156] Regulation	PROs Collective Competing	ADF (Invisible) No Incentive	Municipalities Retailers Registered collectors	Waste management companies Recycling plants

Table 44: A two-stage scenario of developing a PRO-based model

For management of discarded UEEE, the application of EPR is certainly appropriate. However, the government should pay attention to analyzing the impacts of costs on setting up different take-back scheme, perceiving the socio-cultural differences, and especially understanding the role of different partners in the system. A suitable model of take-back scheme with optimal handling of logistics supports producers to reduce costs and makes consumers easily access to collection points. The government should not be only policy maker with top-down enforcements. Instead of that, they should play the main role as coordinator and supporter by giving definite instructions on mechanism of responsibilities and benefits among manufacturers, distributors, collectors, recyclers, and end-users.[1157]

[1154] See URENCO (2007), p. 13

[1155] The regulation should be imposed at the first period on some main EEE with the high volume of discarded products such as batteries/accumulators, TV sets, personal computers, and mobile phones. Single collective PRO model should be advised to implement in this case for improving awareness and infrastructure of collecting and recycling in the whole system.

[1156] The regulation of WEEE will cover all kinds of used electronic and electrical equipment and products. With the development of supporting facilities, infrastructures, and technology; especially of waste management industry, it is expected to have a competing collective PROs model of reverse logistics system in the second stage. Municipal collection points and retailers stores are developed as two main actors in collecting system in the 2nd stage

[1157] See Pfohl/Ha (2011), p. 10

8.4.2. Improving public awareness

Public awareness in this study includes the awareness of end-consumers related to environmental issues and consumer rights, the awareness of producers/distributors concerning their responsibility for environmental protection, and the awareness of collectors and recyclers.

8.4.2.1. Improving end-consumer awareness

First, in order to be successful in implementing a PRO-based model for EoL management, the public must be aware of the negative consequences of reusing expired EEE or improper disposal and their accountability in paying municipal waste tax for better waste management services. Many academic researchers state that waste collection, and especially separated waste collection will be successful if the consumers are aware of environmental consequences.[1158] Therefore, it is necessary to make end-consumers conscious of a proper way of discarding and recycling UEEE. Vietnam government should continuously incorporate with many NGOs in different public education programs to educate citizens to enhance awareness of environmental protection and the need for waste reduction and recycling such as 3Rs-HN project, Recycling Day, and Eco-product campaign.[1159] These programs have obtained the participation of many Vietnamese people. The public awareness of environmental issues, solid waste collection and separation has steadily been raised. Moreover, the partnerships between different stakeholders such as households, municipalities, community-based organizations, and governmental authorities should be built to act together the activities of reuse, reduction, and recycling of waste.

Second, the increasing awareness of consumers plays an important role in implementing the model of collecting and recycling discarded UEEE because this waste stream has characteristics of hazardous waste, higher recovery value, and are competitively collected by many informal collectors. Factors influencing the collection results in a PRO-based model include a rewarding mechanism, level of convenience of collection points, and level of information access. For consumers in the PRO model, there is often no specific mandatory of returning by law; therefore, there should be additional approaches to stimulate consumers' willingness to return their discarded products to formal collectors instead of selling to informal collectors. The PRO with the collaboration of VEIA and EPF should provide end-consumers with related information via multiple channels (brochures, posters, TV program, and website information)to introduce the formal networks of collection and stakeholders' responsibility. Monetary incentives by rewarding end-consumers small money, gifts or discount bonus should be used as a strategy to call for consumers' attention, improve their awareness, and motivate their proper disposal to formal collecting networks at the first phase of implementing take-back regulation and a PRO-based model.

Finally, training and education programs of 3Rs at schools are highly recommended by this study because they enhance public awareness at the root, especially for young generation in Vietnam. More importantly, the PRO can incorporate with school systems, Youth Union, and Women Union to motivate them to register as formal collection points as well as to increase their awareness. For example, the model of collecting discarded products through school system has been successful in many countries such as the Netherland (NVMP), Belgium (RECUPEL), and Philippines (Marikina).[1160] Systems of primary and secondary schools can become the collection points for small electrical appliances and IT equipment, e.g. battery, mobile phone. Each pupil can receive one savings point for every appliance collected and they can choose rewards from the representative shops of the PRO at school with their saving points, for example sport and play equipment, books, software, chocolate, drink, or supporting a charity. The PRO should frequently organize national awareness raising campaigns to cultivate consumers to purchase environment-friendly products and participate in WEEE collection day. In any case, higher public awareness and growing participation in product recovery may increase the volume of products discarded to formal collecting and recycling systems, thus

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1158 See Breen (2006); Cf. also Budak/Oguz (2008); Valle/Rebelo/Reis/Menezes (2005)

1159 See URENCO (2008a), p.129; Cf. also Cf. also Huong (2005), p. 9

1160 See NVMP (2010); Cf. also RECUPEL (2010a); EDP (2011), p. 48

leading to economies of scale in reverse logistics operations, reducing logistics and treatment costs, and motivating manufacturing industry to proactively join EoL management.

8.4.2.2. Improving awareness of manufacturers and distributors

As analyzed in the in-depth comparative case study with four companies, they have known about the law and article related to the extended responsibility of producers/importers with products put on the market. However, a formal reverse logistics program for EoL management to comply with the law and for customer returns management has been a relatively new management model for manufacturers/distributors in the Vietnam electronics industry, especially for local companies and SMEs. In Europe, reverse logistics is today perceived as an important part of logistics system and more complicated than forward logistics. The development of reverse logistics in Europe under strategic considerations has also indicated that firms have adjusted their existing supply chain to adapt to reverse logistics management from reactive, proactive to value-seeking level. Developing a formal reverse logistics program at firm level requires a specific strategy with different kinds of reverse flows, cross-functional integration, and intensified collaboration with different partners. Manufacturers and distributors in Vietnam should enhance the awareness of reverse logistics by paying attention to clarifying the role and status of reverse flows in business performance, reengineering their current logistics processes, developing a specific strategy and policies for EoL and customer returns management, adequately allocating resources for RL management, and training logistics personnel to implement reverse logistics. If firms have comprehensive awareness of reverse logistics, they may very well respond to external pressures and fast-changing environments by making only small changes to its existing system. The detail solutions of conducting a formal logistics program at firm level should be suggested in Section 8.5.

At network-level, if specific take-back regulations with EPR principle is issued and taken into effect without the understanding and awareness of OEMs and distributors, the enforcement of implementing producer responsibility for collecting and recycling EoL products may be unsuccessful and get the resentments towards the governmental authority. Therefore, enhancing producers' awareness and knowledge of EPR-based regulations and reverse logistics will make them more willingness to comply with the laws and accept their responsibility in a PRO-based model. Some approaches are proposed for the case of Vietnam as follows:

First, the PRO with collaboration between VEIA and EPF should incorporate with different governmental agencies and NGOs to organize seminars and training workshops to introduce EPR-based policy and related laws implemented in other countries such as WEEE Directive, RoHs, package waste Directive, and EoL vehicle Directive, as well as other countries' experiences in compliance with the requirements. The project between VEIA and UNIDO in 2011 related to enhance corporate society responsibility (CSR) by improving the producers' awareness of RoHs should be expanded to other related take-back laws. It is the chance for Vietnam companies to improve their awareness of EPR and their responsibility in making business to compete with other firms in the global market.

Second, the PRO with the governmental agencies should make manufacturers, especially for local firms and SMEs, aware of benefits from investing in eco-design with products and package. Eco-design management with environmental-friendly products and package can bring a lot of environmental and economic efficiency gains, especially in recapturing the value from the discarded products, waste minimization, and improving corporate image. In fact, OEMs in many collective take-back schemes often pay required fee to a PRO, manufacturer consortia or recycling fund, and do not take so much care of collecting and recycling their products because the fee can be compensated rather well by end-consumers through the selling price without reducing competition. Therefore, improving the awareness of producers should be in accordance with supports in technology consultancy, and even micro-credit program for SMEs to implement the strategy of Design for Environment (DfE) or Design for Recycling (DfR). Normally, firms are always voluntary to comply with the laws and implement their responsibility when they find the real value and benefits from these operations. It is important to let them now that the investments in reverse logistics management through DfE or DfR actually bring the benefits both forward and reverse logistics in their integrated supply chain.

Finally, there should be closer network collaboration between foreign manufacturers and local firms (producers and distributors) to share information and experiences related to the implementation of take-back responsibilities, product design development, technology development for production and recovery. For nearly 15 years operating business in Vietnam, many foreign manufacturers have only collaborated with local firms through assembly contract and sub-contractors with component production. The comprehensive collaboration to develop product design and the management skills of take-back and recovery has not been established. In fact, local firms in electronics industry have still been lack of a long-term strategy, source technologies and skills, insufficient resources, and management experiences to develop a robust electronics industry themselves.

8.4.2.3. Improving awareness of informal collectors and recyclers

Informal collecting and recycling sectors in Vietnam has a significant financial impact on local economies. The informal sector collects the majority of the recyclable and reusable waste in urban areas, especially with discarded UEEE from households.[1161] In order to integrate informal sector into a formal collecting and recycling system, it is necessary to improve their awareness and need active supports from the government and industry associations.

First, the programs conducted by the PRO, governmental agencies, and NGOs to improve the awareness on health and safety and environmental aspects through public relation campaigns and social action activities should include meetings and discussions with scavengers, junk buyers, intermediate traders and unlicensed recyclers. It is essential to organize formal training and education sessions for informal collectors and recyclers. If the distribution of information through leaflet, through mass media and direct contact is performed effectively, it is sure that informal collectors and recyclers may be willing to go for more training and education.

Second, grouping and disseminating information to informal sectors, especially for the collectors, should be implemented through the community-based organizations such as waste cooperatives, waste collection groups, Youth Union or Woman Union because they can contact directly with informal collectors in their local places. The society should expand supports for informal collectors by official recognition of the roles of informal sectors, and provide them microcredit supports to develop their works, gathering them in collector groups, and collecting them in private collecting companies.

Finally, it is more appropriate for recycling villages to increase their awareness through commune level authorities that are regarded as the skeleton in environmental management system and recycling technology. The awareness of informal recyclers in recycling villages can be also improved by developing preferential policies to motivate environmental protection activities through village regulations. Recycling villages can improve their technology as well as production organization and planning with the supports from technical institutes and management agencies at all level.

8.4.3. Motivating collaboration and investments for a formal RL system

As analyzed in chapter 7.3, inadequacy system (e.g. infrastructure, logistics and technology) is one of the main barriers for developing a formal reverse logistics system in Vietnam. The functional and specialized separated waste system has not been invested sufficiently in the country, which targets package waste, paper waste, and discarded UEEE as special waste stream.[1162] The unavailable collection points without pick-up services free of charge and no rewarding money have partly minimized the willingness of Vietnamese households to discard UEEE to municipalities. Moreover, the way to dispose UEEE as municipal waste is not usual due to economic benefits and the popularity of informal collectors. If the small UEEE is discarded as municipal waste, informal collectors also gather them at municipal collection points or landfill site. The inadequate infrastructure, logistics, and technology have also hindered firms from recapturing the value from their discarded products, and developing a formal reverse logistics program due to the increasing cost of RL operations.

[1161] See MONRE (2005), p. 28

[1162] See MONRE (2008a), p. 93; Thanh/Matsui (2011), p. 293

Like developing countries in Europe and Asia such as Turkey,[1163] Romania,[1164] China,[1165] and Thailand,[1166] the government should collaborate with different partners and call for their investments to remove the barriers of system inadequacy including insufficient infrastructure, undeveloped logistics system, and outdated recycling facilities. It is very essential to construct a comprehensive collection networks, renovate local recycling facilities to have capabilities of recovering the discarded product with suitable quality as input requirements for production. The participation and investment of private sectors in collection, transport, and recovering facilities should be supported and motivated by different incentives of financial subsidies, loan financing with low interest rate, and lower income tax. Formalization process of informal collectors and recyclers can also be removed by motivating the participation of informal sectors in setting up facilities and infrastructure for reverse logistics. For example, encouraging repair/secondhand shops, intermediate traders, and informal recyclers to participate in formal collecting and recycling system can be carried out by official registration with the local government (DONRE), through which they can obtain monetary incentives, subsidy, and supports to invest for their storage, testing and recovering facilities. The public platforms of collection points, vehicle transport, storage facilities, recycling centers can also be improved through public-private partnership as in the case of municipalities in Germany. For this, it is necessary to develop appropriate institutional arrangement so that there can be assured commercial viability for private sector as well as fulfilling the social responsibility by the public sector.[1167]

First, the solution suggested by this study for building capacity and increasing public-private partnerships is to increase inter-agency cooperation[1168] when working on EoL management issues. Inter-agency cooperation is a key component for implementing the strategy of MONRE in solid waste management sector, which may eliminate the constraints of financial resources and administrative capacity.[1169] According to Watson (2004), the level of interaction between agencies involved in waste management may not be sufficient to allow for the effective implementation of waste management, especially with recyclable waste. Improving the role of municipalities in reverse logistics system for EoL management explicitly calls for the collaboration of a number of government agencies to achieve a diverse range of waste management objectives. Municipal organizations in Vietnam can obtain the capacity improvements in collecting, separating, and properly disposing the discarded products by the supports and guides in the collaboration of pertinent governmental agencies involving in the provision of waste management services such as MONRE, DONRE, VEA, PC, and MOC. For example, the projects of building of waste treatment plans in the country's urban hot spots in the period of 2010-2020 should have the close collaboration between URENCO and the national agencies, as well as with MOC, MOT and research institutions in different cities/provinces. The collaboration with NGOs and foreign partners should be also strengthened to obtain the financial, experience and technique supports for developing a formal RL system of WEEE management.[1170]

Second, the national and sub-national government agencies should increase the potential for decentralization of waste management authority identified in the strategy of developing Vietnam environmental industry for recent years by the increasing involvement of community-based organizations, the waste collector groups, and private waste collection and recycling companies, which leads to the socialization of waste management. In the Vietnamese context, socialization is often understood to mean increasing the involvement of individuals or groups of citizens in service delivery, but can also refer to the transfer of waste management service delivery to private, profit-oriented companies.[1171] Solid waste management is a complex task, especially with discarded UEEE, which depends as much upon organization and cooperation between manufactur-

[1163] See Erol et al. (2010), p. 48

[1164] See Ciociou et al. (2009, 2010, 2011), p. 211, 5, 178

[1165] See Lau/Wang (2009), p. 447

[1166] See Kojima/Yoshida/Sasaki (2009), p. 267

[1167] See Thanh/Matsui (2011), p. 294

[1168] See Watson (2004), p.50

[1169] See MONRE (2008b), p. 48

[1170] Interview with government official of MONRE (2011)

[1171] See Watson (2004), p. 58

ers/distributors, households, municipalities, communities, private enterprises and government as it does upon reuse, recycling and disposal. The PRO and URENCO should collaborate and support the community-based organizations to utilize the sources and experiences of informal sectors (collectors and recyclers) to increase the possibilities of reuse and recycling of discarded UEEE, and reduce the collection burden on the municipal waste management sector for special waste stream. For example, URENCO can group informal collectors in each region (e.g. district and city) through community-based organization or private companies, offer training and environmental education to them, and recruit them as part-time labor. These solutions can reduce the negative influences of informal collectors on the establishment of formal collecting system of discarded products because they often collect most of the valuable recyclables needed for formal recycling system to be profitable. **Finally**, in related to the municipal solid waste collection fee, calculating and charging following volume of products discarded should be also considerate and taken into effect, especially in big cities. The current waste collection fee for waste management cover the majority of waste management operating costs, but there has not been full cost recovery achieved by the URENCO in major cities of Hanoi, HCM city, and Danang.[1172] In addition, capital costs for equipment purchases and upgrades cannot be met through this fee, which mostly receives from governmental additional waste management funds and ODA investments. Some government officials of MONRE and managers in URENCO indicated that overcoming the shortage of capacity building in urban waste management, requires the increase in the fees charged to urban residents and businesses. The fee should be calculated in volume and increased to cover the costs of existing waste management services. According to them, the fees should be at least doubled in order to meet present operating costs and allow for adequate funding for future waste service improvements.[1173] Especially, with the increasing income and consumption in urban areas, the increase of collection fee is a feasible option because most households can afford to pay if the collection points are more convenient and pick-up services free-of-charge with small incentive money are carried out by municipalities for valuable discarded UEEE. Practices of municipal waste tax applied in European countries have proved that providing services that users want to pay for is a strong prerequisite for the financial sustainability of waste management.

8.4.4. Developing a formal collecting system

The major challenge of reverse logistics system for EoL management in Vietnam is the need to establish a formal collecting system for a stable supply chain of discarded UEEE. A formal collecting system is constructed by collection infrastructure and collaboration network between stakeholders. Collection infrastructure relates to the points at which generators handover the used products to the network.[1174]Vietnam can develop collection infrastructure for not only discarded UEEEbut also other EoL products with the three prominent types as follows:

- On-site collection: Used products are collected on the premises of the generators. This type of collection is often applied to commercial firms or for the curbside collection of refuse and recyclables from households. This type can be carried out in Vietnam with discarded UEEE from households through municipalities with small EEE such as battery, fryers, and hair dryers. However, on-site collection with large household appliances and valuable UEEE should be added with incentive mechanism because the reselling habit of Vietnamese people and the existence of informal collectors. Therefore, municipalities can offer on-site collection of such specific items following time schedule by announcing the date and the household can place their discarded UEEE on the street for pickup.
- Unmanned drop-off sites: The generators bring the discarded products to large storage containers at a designated location in the neighborhood. This is often used as an alternative to curbside collection for refuse or separated recyclables such as glass bottles, paper, or textiles. Vietnam should invest for this type of collection infrastructure, especially in urban areas due to the densely populated, increasing awareness and income. URENCO should be the main actor in coordinating the investments for unmanned drop-off sites.

[1172] See MONRE (2005), p. 45
[1173] Interview with government officials of MONRE and managers of URENCO
[1174] See Beullens (2005), p. 300; Beullens/Oudheusden (2002), p. 4-

- Staffed drop-off sites: Staff supervision allows for a more selective acquisition and careful separation. Municipal collection depots, retailer stores, OEMs warranty or returns centers, local reuse centers, and registered collectors can all fulfill this function. Staffed drop-sites are now popular in collecting system in Vietnam, especially for repair/secondhand shops and intermediary dealers. For example, there are in Hanoi around 1700 waste intermediary traders and repair/secondhand shops under small and medium-sized centers/enterprises.[1175] Therefore, developing a formal collection system requires the formalization and registration of these collectors by supporting policy and incentive mechanism from the government at the first stage of implementation.
- Ad hoc and mobile drop-off sites: The collection might be organized infrequently. For example, generators can be invited through the local media to bring the products in a specific “collection week” or “collection day” to the municipal depot. In the mobile case, vehicles can make short stops near convenient locations such as schools and offices. This collection program has been carried out in Vietnam in recent years. However, it should be supported by active media campaign to attract more people to participate because low collection volume can make these programs fail.

URENCO is currently a unique formal public utility in Vietnam for collecting EoL products free of charge from households. However, it has not been involved effectively in any above-mentioned types of collection for discarded UEEE although they have the advantages of services in covered geographical areas and the availability of collecting workers, equipment, and facilities of collection and transport. Therefore, rewarding mechanism should be offered for households from URENCO to increase the households’ disposal through this channel. The four main channels of collecting UEEE suggested by this study require more investments of URENCO network in collaboration with other stakeholders (e.g. governmental agencies, OEMs, PRO, and registered collectors). Municipalities should provide a place (municipal transfer points) within the municipality where transporters contracted by the government or recycling companies can hand in consumer electronics to the recycling centers. Producers/importers should have responsibility of taking discarded UEEE that are collected by retailers and local governments, and transfer those products to recycling facilities for environmentally sound management. The number of collection points and transfer facilities is crucial for an acceptable level of convenience for the consumers and the density features of a collection network can have an important impact on the efficiency and cost of a reverse supply chain. Developing separated collection points, waste collection hubs, recycling facilities, and incineration facilities require more collaboration between URENCO and private service providers to establish a formal reverse logistics system for EoL products.[1176]

In order to develop a formal collecting system for discarded UEEE, the clear allocation of economic and physical responsibility between URENCO, registered collectors, transport partners, and licensed recyclers in the reverse logistics model suggested by the study should be identified. Producers/importers should have common agreements with their retailers/distributors related to the discount amount for the customers with “old for new” programs, and support them with information related to take-back policy (responsibilities, costs) and collecting system. The close collaboration between OEMs/importers with their distribution channel increases the possibilities of recovering the value from discarded/returned products, which bring economic benefits to both producers and distributors, and help them to comply with the laws. Collection from retailers stores or OEMs warranty/customer service centers can be consolidated at OEM returns deports (CRCs) for their own refurbishing and remanufacturing or reselling directly to registered recyclers.

Registered collectors can be operated as collection contractors because their function of storage and testing in reverse logistics system for reuse and recycling. Municipalities can use their municipal depot as transfer points to registered recyclers or landfill. The PRO subsidizes licensed recyclers through the required fee paid by manufacturers and importers. Licensed recyclers have responsibility to buy discarded products collected by registered collectors following market price. The close cooperation between OEMs, distributors, municipalities, registered collectors, and recyclers may enhance the volume of discarded products collected and

[1175] See Mitchell (2008), p. 2024

[1176] See MONRE (2005), p. 49

recycled in a formal collecting system. Figure 105 describes the collaboration network of the formal collecting system proposed for UEEE in Vietnam.

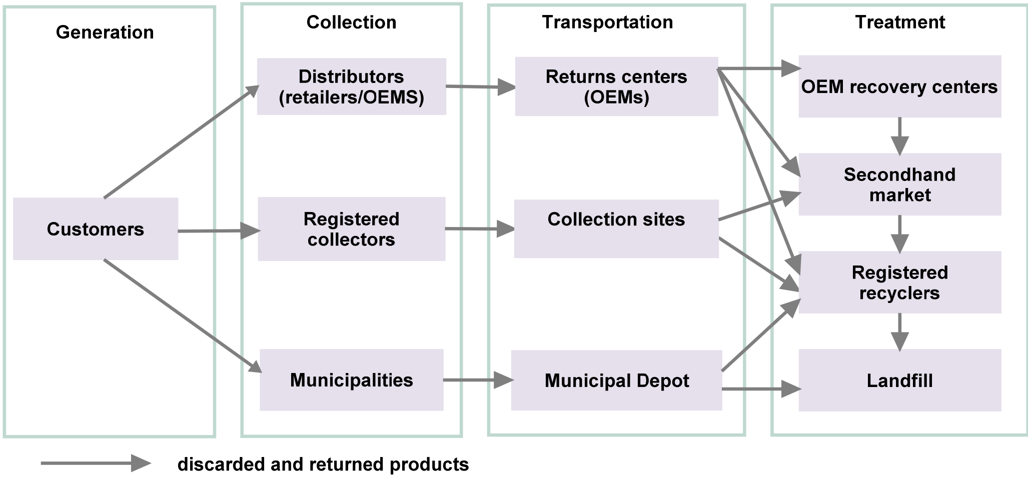

Figure 105: A formal collection system for discarded UEEE

8.4.5. Developing a formal recycling sector

Informal recycling sector with craft villages and small private recycling plants has operated dynamically and effectively with the higher rate of recycling and the large amount of products and materials supplied in the market.[1177] Based on the current situation of informal recycling system in Vietnam, some solutions are suggested to establish and develop a formal recycling system with basic standards of environment and technology from the current system.

First, recycling units should be registered officially with the support of the local government where each recycler is operating their business. Heavy obligations should not be imposed to encourage them to participate in at the beginning. After registration, the next stage should involve tightening of the regulations. However, the standards should be reasonable and enforceable. It is also better to set a time limit for adoption of the standards to become certified and qualified recyclers of PRO and a notification system should be formalized to improve information sharing.

Second, pollution control should be imposed on recycling plants and craft villages by the local government. This requires recyclers to increase their investments in upgrading technology and facilities and to improve their collaboration for larger economics of scales in production. Due to the individual and spontaneous production of businesses in craft villages, the centralized production planning system and logistics for collecting and recycling cannot be operated efficiently and effectively, which resulted negative influences on the environments and business performance in overall. Environmental monitoring system for recycling villages should be firmly established and frequently examined with environment impact assessments to improve the awareness of people in recycling villages.

Third, recyclers should establish recycling associations or groups based on the types of product recycled to share information and improve compliance with the regulations. Members in these recycling networks can support together in raising funds for updating technology and expansion of recycling operations, sharing free capacity and resources for recycling, and improving the business performance. For example, after the DONRE carries out different solutions to improve the awareness, and enforce the households to comply with regulations, many households at Dong Mai lead recycling village integrate their collection and recycling of discarded batteries/accumulators into two main recycling firms (Ngoc Thien and Minh Quang). With the support of DONRE, two firms are now completing their projects of environmental impact assessments and having a specific project for reallocating their production place for two main recycling plants of lead battery in Northern of Vietnam in the area that are remote from residents. Practically, many household businesses in recycling villages have acknowledged the negative impacts of backward recycling technology and facilities.

[1177] See MONRE (2008b), p. 51

However, the shortage of finance resources and the lack of collaboration mechanism between individual businesses have limited the development of a formal recycling system in Vietnam.[1178].

Fourth, Improving recycling technologies and facilities by providing financial subsidies and/or technical supports from the government, the PRO, and OEMs is regarded as the most important way to establish and develop a formal recycling system in Vietnam. Tax reduction and low-interest loan for recycling companies should be provided. The Vietnamese government is keenly interested in environmental infrastructure investment, but there are often few mechanisms to mobilize capital resources for investment, which has led to significant underinvestment in recycling facilities. The Vietnamese government made efforts to develop solutions to diversify investments into environment and established the Vietnam Environmental Protection Fund (EPF) in 2002 for helping localities and enterprises to invest in environmental infrastructures. However, the investment has not been well organized and the investment rate is still lower than in other countries in Asia. Waste Recycling Fund of HCM (WRF) city established in 2008 with the objective of meeting the capital demand of private recycling plants in the South of Vietnam have not received enough supports from the Government.[1179] The member fee paid by producers to PRO properly governed and operated by VEIA and EPF for collective collecting and recycling EoL products may increase the state investments in promoting and formalizing a formal reverse logistics system.

Fifth, the PRO in the proposed model in the first stage should have a suitable subsidy mechanism for companies involving in the processes of recycling to motivate them to participate in a formal reverse logistics system for EoL management. However, the PRO also should carry out a strict monitoring and auditing process for their operations in providing the related services. VEIA should stimulate OEMs, especially with foreign companies, to support recycling plants/villages in technical information for more easily treatment and reducing the costs and negative impacts on environments. Foreign companies, mainly from Japan and South Korea, that have more sound awareness of recycling technology and experiences with EoL management in their home countries and Europe should be motivated to develop the collaboration with specialized recycling plants and become the leading groups in establishing recycling joint venture firms. It is the opportunity for Vietnam in developing a formal RL system because 90% of market share of electronic and electrical equipment belong to foreign companies.[1180]

Finally, because recycling villages/plants are mainly allocated in some main cities and provinces in the Northern and South of Vietnam, the final solution suggests creating the network of collaboration between recycling centers or industrial recycling parks and collection hubs to support for collecting, handling and storing the discarded products. Recycling centers in this study is understood as the groups of individual businesses doing recycling business like recycling villages or the groups of small recycling plants. Industrial recycling parks are group of medium and large-sized company specializing in recovering and recycling the discarded products. Recycling parks is often located in a suburban area of large cities like Hanoi and HCM with the support of collection points. Collecting hubs include main collection hubs in big cities and provinces, e.g. Hanoi, Ho Chi Minh, HaiPhong, and regional collection hubs in each region. Collecting hubs encompass private collecting companies with medium and large-sized companies in big cities or regional recycling units. They should establish in cities and regions the main hubs for collecting, separating, and sorting discarded products from different sources including distributors, producers, municipalities, and informal collectors. In PRO-based model, recyclers repurchase discarded products collected by these collecting companies depending on market price and demand. If the collaboration between recycling centers with collecting hubs is implemented effectively, logistic costs for collecting, sorting and transporting can be reduced, which led to the effectiveness and efficiency of the whole reverse logistics system. In order to do so, the government and the PRO should motivate the greater participation and investments of private sectors in providing collecting services as well as the closer collaboration between recycling and collecting networks. The solution is drafted through the example of mapping network for main and regional hubs of collecting and recycling in Hanoi, Nam Dinh, BacNinh, VinhPhuc and Hung Yen (see Figure 106). The new formal collecting and

[1178] Interview with recycling households in Dong Mai battery craft village in the fieldtrip of 2011

[1179] Interview with government officials of MONRE

[1180] See Pfohl/Ha (2011), p. 9

recycling network will need further research on the location planning, the coordination between individual businesses in recycling villages, the collaboration between recycling centers and collecting hubs, and the recycling technology of each center to ensure the efficiency and optimize the capacity of recycling, as well as environmental protection.

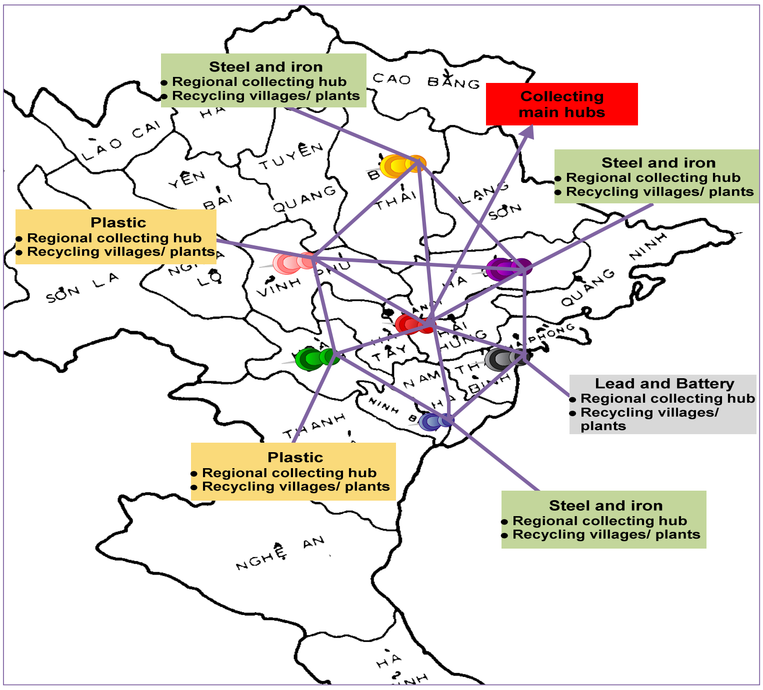

Figure 106: Mapping collaboration networks between recycling centers and collecting hubs

8.5. Solutions for a formal reverse logistics program at firm level

The development of reverse logistics in Europe indicates that both external and internal factors have affected the adaptability to reverse logistics. The external environments in Vietnam have partly hindered firms in the electronics industry from clarifying the status and role of reverse logistics in business performance and developing a formal reverse logistics program. Some solutions are proposed for the transferability and implementation of a formal reverse logistics system at network level. These solutions implemented may affect strategic decisions of firms in developing a formal reverse logistics program at firm level in the future. In-depth interviews conducted with four firms in the electronics industry indicate how electronics firms in Vietnam manage the reverse flows and the extent to which they concern and invest in reverse logistics management. Based on the analysis of case studies, it is also found that the degree of a formal reverse logistics program they are implementing, their achievements and weaknesses. This part focuses on seeking solutions of conducting a formal reverse logistics program for electronics firms in developing countries like Vietnam. The solutions focus on developing a model of decision-making process for RL implementation as well as a reference model of a formal reverse logistics program at firm level in developing countries like Vietnam.

8.5.1. Model of making-decision process

Although four companies interviewed are mostly the large manufacturers and distributors in the electronics industry, the analysis of RL management in practice demonstrates that firms in the Vietnam electronics industry have not formulated a comprehensive strategy of RL management. For example, all of them are conducting a restrictive returns policy with only exchange rules and without full credit refund. In addition, they have not concerned so much in behaviors and attitudes of customers when they want to exchange and return products. They have increased their interests in reverse logistics partly due to the increased competition and the increased amount of warranty claims. Moreover, some of them deal with collecting discarded products from customers by “old for new” programs for increasing sales, not due to their compliance with the legal requirements or recapturing the value. The high product returns from their customers are mostly due to the promotional campaigns in which consumers' used products is changed with a new one and customers may have small benefits from the discounts. It may be expected that companies' main objectives for collecting used products in this industry is to increase their market share and stimulate the consumer demands in the period of gloomy economy and the saturation of electronics market, instead of using the returned products for product recovery.

However, with the increasing enforcement of legal requirements, the increasing customer demands, and the increased economic benefits from product recovery, it is estimated that firms in developing countries like Vietnam have to make decision of investing strategically in reverse logistics operations in order to minimize the costs, increase their competitiveness, and profitability. Therefore, this study develops a model of decision-making process to identify the main external drivers and internal supports of implementing reverse logistics, as shown in Figure 107.

Based on the analysis of contextual differences in Vietnam and reverse logistics management in four companies, the main motivations for firms in Vietnam to enhance their awareness of RL and concern in RL management are sales increase by motivating customer demands (economic benefits), customer satisfaction (customer demands), competition improvement (company image), and law enforcements. In fact, almost companies in the Vietnam electronics industry are now not under high pressures to implement a formal RL program because customer demands and awareness is still low, economic benefits obtained is not high, the returns rate is low, and the law is weakly enforced them to implement their EoL management officially.

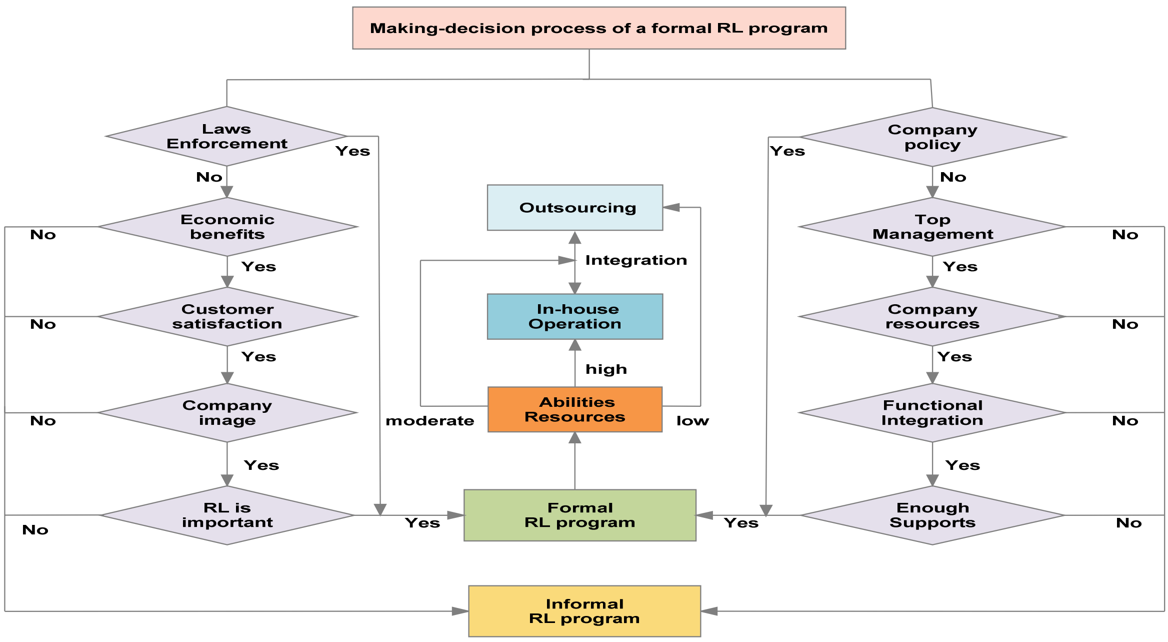

Figure 107: Making-decision process of developing a formal reverse logistics program

Source: Own Illustration

The adaptability at firm level through company policies is relatively evaluated as reactive level by identifying some main types of returns, setting up restrictive returns policy, developing guidelines for gate-keeping and RMA process, and developing disposition options. However, developing reverse logistics network, remarketability, and metrics of RL performance has not been concerned and invested strategically, except the case of company A. Top management support is observed as reactive level for reverse logistics management in four companies because they have not actively pursued competitive advantages through RL management in Vietnam. Some managers were not willing to talk about returns problems in their productions and distributions. Company resources including technology, personnel, and finance are not clarified clearly for reverse logistics operations. Cross-functional integration is limited, only flexible and opener for dealing with customer returns management between sales and accounting department. Therefore, it can be said that the adaptability to reverse logistics in the Vietnam electronics industry is at reactive level, except the case of company A. Firms in Vietnam, not only in the electronics industry, should firstly be aware of reverse flows and reverse logistics in their business operations. Secondly, it is necessary to identify the main motivations for them to implement reverse logistics management, the strategic roles, and status of RL in their business. If reverse logistics is important and have strategic roles in increasing competitive advantages and profit, it is essential to evaluate the drivers, the barriers, and internal supports to manage RL. Determining major drivers and supports help firms make strategic decision of developing a formal reverse logistics program. Developing a formal reverse logistics program may support firms in identifying the roles of reverse logistics in their firm, allocating resources for RL implementation, and making decision of in-house operation, outsourcing or integrated solutions.

8.5.2. Reference model of a formal reverse logistics program

By analyzing current reverse logistics management at both firm level and network level in Vietnam, it can be suggested that the degree of adaptability to reverse logistics in developing countries like Vietnam is reactive and at the infant stage. This level of adaptability is mostly due to the differences of external factors driving reverse logistics in developing countries such as the lower economic development, the lack of specific laws, and the lower customer awareness and demands. Moreover, the lack of viewpoints of strategic importance of reverse logistics, the shortage of company resources and supports are also barriers for developing a formal reverse logistics program. We contend that the theoretical foundations of organization, adaptability, resource allocations, and strategic returns management processes applied in the analysis of reverse logistics development in Europe can be also used to develop a formal reverse logistics program for firms in developing countries like Vietnam. Based on theoretical models proposed and examined in the previous chapters, as well as the current practices of RL management in Vietnam, this study develops a reference model of a formal reverse logistics program as a management tool for firms to deal with reverse flows and reverse supply chain management (See Figure 108).

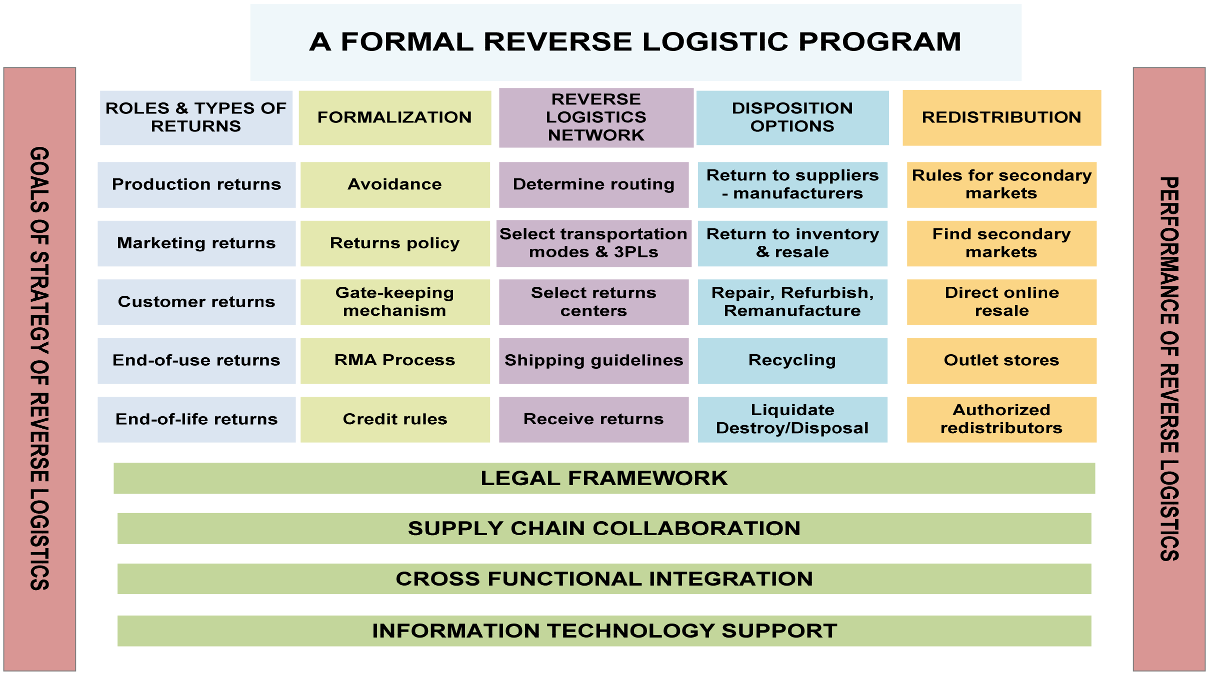

Figure 108: Reference model of a formal reverse logistics program - a management tool

Source: Own illustration

This management model is developed based on the model of identifying the drivers and internal supports for RL implementation. Under the pressures of external environments, and the internal supports, firms can determine their goals and strategy for reverse logistics programs based on their main types of returns and the volume of returns. For example, identifying a reverse logistics strategy for EoL products plays an important role in developing goals and strategy of RL for OEMs in the electronics industry because it may have impacts on their investments in product design, technologies for product recovery, and reverse logistics networks of collecting and recovering. A RL strategy of EoL management requires firms to produce environment-friendly products, reduces the use of hazardous substances in the design, and increases disposition options of reuse, redistribution, repair and remanufacturing, and recycling. They should make full use of sustainable materials and design to facilitate recycling and reuse of EoL products.

One of the key factors in determining the goals and strategy of reverse logistics is to understand the current enforcement of laws and regulations related to returns management such as laws on environment protection, take-back regulations, laws on consumer rights, and laws on quality of product. In European countries, environmental and legal requirement have been the major impetus for firms to implement reverse logistics management and adjust their company strategies, policies, processes to respond to external pressures. Companies in the electronics industry in developing countries like Vietnam should pay attention to the changing requirements of laws because many developing countries are preparing for the issuance and implementation of the specific regulations related to take-back responsibilities in the next coming years.[1181] Moreover, firms in developing countries should also concern in take-back regulations in other countries where their products are exported to implement extended responsibilities through their importers. For example, electronics manufacturers in Vietnam who wish to sell to the European market need to be aware of WEEE take-back and RoHS directive, as well as the Green Dot initiative for EU Packaging Waste Directive.

Understanding the constraints and capabilities at firm level related to reverse logistics operations should also be the important part of RL strategy. The model of decision-making process of implementing RL supports firms in identifying the extent of resources to which firms can commit and invest for RL. The case study findings found that most of the companies interviewed tend to integrate their in-house operations through cross-functional integration system with outsourcing some activities for returns management. However, the scale of outsourcing is still limited due to the small volume of returns. As in the case of reverse logistics in European countries, intensified collaboration between supply chain partners through outsourcing approach may likely be used more popularly in developing countries when reverse logistics is regarded as a source of long-term profit strategy. Information technology is also determined as an important supporting tool for developing a formal reverse logistics program. The roles of IT have been affirmed through empirical results of survey and the practical management of reverse logistics in Europe countries. Firms in developing countries should pay attention to improving network collaboration and investing IT for both forward and reverse logistics management.

In a formal reverse logistics program, formalizing returns policy plays an important role in strategic reverse logistics management. Formalizing a suitable returns policy can improve customer satisfaction, improve volume of sales, enhance the brand or corporate image, and therefore increase the profitability. The implementation of effective gate-keeping and screening supports firms in preventing unwanted returned products and eliminating the unnecessary costs in returns management. Moreover, the important step in formalizing returns policy that should also be paid attention is to implement "returns avoidance." Returns avoidance means developing and selling the product in a manner such that return requests are minimized, which can be implemented by improved quality of products put on markets and giving better instructions for customers' setup and usage. Firms in the Vietnam electronics industry have tried to avoid returns formalizing a restrictive returns policy without full credit refund. It is not a friendly returns policy and reduces the possibility of repetitive purchase. Developing a channel of customer services through wide range of authorized warranty centers as in the cases company A and company B is an appropriate solution to provide better instructions for customers in installation and usage. It supports customers in identifying the real defective products and "no-fault found" returns may be avoided. Developing reverse logistics networks and transport options should be determined in a formal reverse logistics program because it accounts for relatively large costs and requires the interfaces with other supply chain partners. Developing RL networks depends on many factors such as the volume of returns, types of returns, and the handling capabilities of the firms. In Vietnam, networks of informal collectors often collect EoL products discarded by end-consumers. Meanwhile the channel of

[1181] See Lee/Na (2010), p. 1632; Cf. also Kojima et al. (2009), p. 263

retailer stores mostly takes customer returns back. Firms should evaluate economies of scale in both transportation and facility investments to make decision of outsourcing take-back activities to logistics providers or collaborating with supply chain partners to increase the collection volume. Effective and suitable selection of transportation modes and LSPs for reverse logistics may transfer the risks and decrease the costs because collecting and transporting returned and discarded products are not core activities of many OEMs and distributors.

Shipping guidelines should be informed to customers because it relates to the responsibility of paying returns shipping costs. In returns shipping guidelines of four companies, almost of them declare to be responsible for paying returns shipping costs only in urban areas and do not provide detail information for carriers. When a selling firm is responsible for returns routing, the need to formally engage customers in the routing decision should be pronounced. A good starting point in gaining customer compliance with pre-determined routing policies is to convince them that the choice of carriers can affect return processing time and firm's ability to grant credit. The second step in getting customers to participate in determining the routing process is to provide them with clear routing procedures related to returning products.[1182]

Selecting returns centers or transformational locations where returned products are shipped back, sorted and consolidated, and then inspected is also very important in developing reverse logistics networks, especially when the volume of returns is large. All four companies interviewed utilized the backhauls for transporting the returns, especially for marketing returns, to reduce the transport costs. They combine forward and reverse logistics to form a close-loop supply chain by integrated logistics. No companies have established a network of central return centers to handle returned products separately from products moving forward toward customers because the small volume of returns. Most of them use the current warehouse and distribution centers for forward flows to store and handle with returns flows. However, firms should considerate the separate handling of returns when the returns volume is increasing and distribution channel is dispersion.

Disposition options are posited at the important place in developing a formal reverse logistics program because they relate to the decision about what to do with returned products. Making disposition options supports firms effectively in recapturing value and recovering the assets from returned products. Selecting a proper and quick disposition option for returned products, especially with short lifecycle products, saves costs for recovering and redistributing. The decision for disposition options should be made following rules regulated formally by firms in relationship with other members of supply chain such as customers, suppliers, distributors, and service providers. Disposition guidelines should be clear and employees should be well trained to assure that correct dispositions are made with different kinds of returns. Disposition options have not been paid much attention in returns management of four companies interviewed, especially with the disposition options for remanufacturing and recycling. Most of them have coped with disposition options through resale, repair, and refurbish with unclear instructions.

No four companies interviewed have involved directly in redistributing their returned and recovered products because of the dynamic secondary market in Vietnam. Many products with famous foreign brand name of electronics manufacturers are collected and refurbished to resell in the market by repair and secondhand shops, especially in rural areas. For companies in developing countries, it is wise to involve in redistributing through authorized redistributors who can accomplish recovery processes, e.g. collaboration with large repair centers or maintenance private companies.

Developing metrics of reverse logistics performance is necessary in implementing a formal reverse logistics program, especially when RL is strategic significance in business performance and received much resource investments. Metrics that might be used include return rates and financial impacts of returns. Most companies interviewed have not paid attention to measuring RL performance due to its low returns volume and insignificant roles in overall business. Therefore, performance metrics related to returns management should provide the insights of revere logistics management costs and the influence of effective reverse logistics. Developing measurement of RL performance is partly dependent on changing the mentality of top managers

[1182] See Genchev/Richey/Gabler (2011), p. 252

who view distribution in one way: supplier to end consumer. For example, better returns management can increase sales through removing risks from customers and transferring it back to the firm, as well as reduce the volume of obsolete inventory both within firm and through the supply chain. The use of remanufactured and refurbished products also reduces the cost of materials and production; and the costs of goods sold can be reduced through recycling. Therefore, it is essential to report periodically the volume and types of returned products and to measure return rates, the costs of returns handling, the cost of treatment, and the revenue of recaptured value.

Based on the analysis of current reverse logistics management at four companies, this study has presented a decision-making model of identifying motivations and supports for RL implementation as well as a reference model of a formal reverse logistics program for firms in developing countries like Vietnam to improve reverse supply chain management. We hope that these models can provide firms with a valuable managerial tool for better implementation of reverse logistics.

9. Conclusions and Implications

In this chapter, we take a retrospective look at the overall dissertation: motivations, objectives, research questions, and results. This chapter summarizes the previous chapters by discussing the theoretical and managerial implications of the models tested and the results analyzed in the dissertation. This chapter begins with the summary and review of the main results with regard to the research questions. Some contributions of this study related to academic aspects and managerial implications are provided in chapter 9.2. The limitations of this study and the recommendations for further research are discussed in chapter 9.3

9.1. Summaries of research questions

Our starting point for the motivation of this study was the observation of the notable development of reverse logistics from the viewpoints of both academics and practitioners in Europe. Nevertheless, studies on reverse logistics have been lack of strategic aspects and theory-based answers, especially for the viewpoints of adaptability to reverse logistics. The development of reverse logistics is affected by many external and internal factors that both motivate and hinder the implementation of reverse logistics in practice. Certainly, barriers to implementation of reverse logistics still exist and continuously prevent the effectiveness and efficiency of reverse logistics operations. However, the results achieved in Europe over the last decades in managing the different kinds of reverse flows indicate that there are more factors facilitating the performance of reverse logistics. Although many researchers have paid more attention to identifying factors influencing the performance of reverse logistics, they mainly focused on conceptual and descriptive anecdotal analysis that is based on the qualitative approach with case study and literature review. Previous studies have not clearly explained how external and internal factors interactively promote reverse logistics performance. Therefore, they have not specifically assessed the organizational adaptive capability of a firm to the challenges of managing reverse flows at both firm and network level. Moreover, the development of reverse logistics in Europe has not been addressed through the diffusion of reverse logistics management models to other countries. Consequently, our study aimed at narrowing research gaps by conducting the research project "Development of Reverse Logistics - Adaptability and Transferability" under strategic consideration and supply chain perspective with two main objectives:

- To investigate the adaptability to reverse logistics of firms in Europe, especially in the electronics industry
- To evaluate the transferability of reverse logistics management models from European countries to other economies, especially in the case of the SR Vietnam

First, we identified and analyzed three development fundamentals for reverse logistics in chapter 2 including the emergence of closed-loop economy, the development of logistics, and the development of supply chain management. Reviewing reverse logistics under different development fundamentals helped us in seeking the changes of concepts and the innovations of reverse logistics in academic research. Closed-loop economy emphasizes the greater use of logistics management processes for waste streams to meet the principles of sustainable development, while combining ecological and economic objectives. The evolution of logistics has passed different periods of outbound movements (physical distribution), cross-divisional function, integrated logistics, and supply chain management, which also motivates the development of reverse logistics as subsystem of logistics with cross-functional natures. Reverse logistics tightly interlocks with other logistics domains including procurement, production, and distribution, and becomes an important part in process chains of logistics. The development of supply chain management emphasizes the collaborative approach and the sustainable orientation, which contributes to innovating reverse logistics under the viewpoint of "Reverse Supply Chain." Reverse supply chain management views the whole picture of reverse flows through different tiers of supply chain, not only with an individual partner but also in the relationship with multiple stakeholders dealing with the return flows. The increasing inter-organizational collaboration in sustainable supply chain management also stimulates the development of reverse supply chain through the emergence of closed-loop and open-loop systems.

Second, we framed theoretical foundations for analyzing the adaptability to reverse logistics at firm and network level. Theory of social development is introduced as the general base for explaining the development process of reverse logistics that are affected by many factors. We used institutional theory and the resource-based view to explain how a firm is affected by the external factors in the implementation of reverse logistics. It provided useful insights to interpret the adjustments of company policies, the increased top management supports, the utilization of company resources, and the cross-functional integration for reverse logistics operations. The resource-based view was used together to look at the influences of organizational-related factors on the performance of reverse logistics and the adaptability to reverse logistics at firm level. Transaction cost economics was presented to explain strategic decision of transaction level between firms, regarding as the base for network formation. The "relational view" is introduced to understand comprehensively the adaptability behaviors of firms in a dyad or network relationship to obtain competitive advantages. We also used network-level approach of Provan (2007) to examine the adaptability to reverse logistics of a whole network through the capabilities of coordinating network members, governing network relationships, developing network capabilities, and achieving network outcome and competitive advantages. We also introduced some important concepts in the domain of adaptability to reverse logistics including RL performance, strategy formulation of reverse logistics, and the adaptability to reverse logistics at both firm and network level. The development of theoretical foundation, the clarification of some nomenclature, and the determination of interface between concepts in chapter 2 and chapter 3 served as the starting point for the subsequent chapters.

In this study, we combined confirmatory and exploratory research with both quantitative and qualitative assessments to investigate research questions. Whereas data in Europe were gathered by means of an internet-based survey due to the difficulty and constraints of time and finance, data in Vietnam were collected through cross-sectional survey and case study method. The obtained data sets together with the comprehensive content analysis of literature constitute a rich empirical basis for investigating six research questions presented in Chapter 1.2.

9.1.1. Research question 1: Influential Factors

Research question 1 addressed the issue of how external and internal factors influence the performance of reverse logistics. It contributed to clearly explaining how external environments act together with organizational-related factors to promote reverse logistics practices. In chapter 4, research question 1 was investigated:

***Question 1*: How are external and internal factors influencing the development of reverse logistics in Europe?**

This research question was investigated through the theoretical model of factors influencing the development of reverse logistics. The empirical results of the theoretical model show that both the external factor and the internal factor are significantly associated with performance of reverse logistics, explaining 66.2% the variance explained of RL performance. The external factor is more important variable for the predictive relevance of the model, contributing to nearly 55% of the variance explained of RL performance. Meanwhile, the internal factor contribution accounts for approximately 45% of the variance explained of RL performance that is not far less than the external factor. It means that there has been increasing adaptability to reverse logistics at both network and firm level.

Among the external factors, customer awareness and demands, information technology, and collaboration among supply chain partners are determined to be the most significant factors facilitating the development of reverse logistics, instead of laws and regulations. Laws and regulations were found to be an important driver in the previous studies for reverse logistics operations. However, in the aspect of facilitating the development of reverse logistics, the increasing customer awareness and demands, information technology, and collaboration among supply chain partners are more highly appreciated than the regulatory factor. The transposition and implementation of the WEEE and RoHS Directive varied among member states due to the differences of their legislation framework and operational infrastructures, which has made various requirements for electronics firms operating in Europe to take their responsibility of product take-back and recovery. Regarding physical responsibility, the unclear identification of responsibility put on producers, distributors, and municipalities in collecting EoL products has not motivated OEMs to proactively involve themselves in reverse logistics operations for EoL management. Furthermore, the current reporting systems run by governmental agencies in many countries still present several weaknesses and do not support the configuration and implementation of operational tasks from OEMs or their take-back system providers.[1183]

The increasing customer awareness and demands over the last decade contributed to the development of reverse logistics because customers in Europe are improving their awareness of green and environmental issues. The trend of "Green Consumers" has led to the growing behaviors of disposing properly, the preference of eco-friendly products, and the greater acceptance of products with recycled materials. This accelerates the collection rate of discarded products and the remarketabiliy of recovered products/materials. The increasing requirements of customers for after-sales services, exchanging, and returning products after sales have motivated firms in the European electronics industry to manage product returns more proactively. The accessibility of customers to related information about returns merchandise authorization, returns shipping guidelines and credit rules support firms in handling returns more quickly and efficiently. Moreover, information technology facilitates returns management, recovery of product, and redistributing in the market. Effectively using IT has helped firms create innovative solutions to returns handling, which is critical to firms' reverse logistics capabilities.[1184] IT has also supported firms in sharing and exchanging information between different companies in the relationship networks of reverse logistics. Increased collaboration among supply chain partners has motivated the emergence of dynamic networks for collecting, recovering, and recycling discarded and returned products, indicating the adaptability to reverse logistics at network level.

The empirical results also identified how the organizational related factor mediates the influence of the external factor on RL performance. The organizational adaptive capabilities of a firm to the changes of external environments in the implementation of reverse logistics improve the performance of reverse supply chain management, suggesting an important mediating variable. Regarded as the important mediating variable, the organizational related factor of company policies, top management support, company resources, and cross-functional integration were changed to adapt to managing product returns. The level of adaptability and changes are different from companies to companies because of different organizational-related environments. The considerable force of mediated effect of external factors through internal factors on performance of reverse logistics proved that there were more strategic focus and supports inside electronics firms in Europe for reverse logistics management. Today, reverse logistics is not optional; however, it is becoming a strategic component of firm success. Adaptability to reverse logistics does not stop at reacting with the external environment as a necessity to survive, but firms have adjusted themselves from developing company policies to utilizing company resources to be more competitive and successful in reverse supply chain management.

However, the effect size of indirect effect accounting for nearly 30% of total effect demonstrates that the changes and adjustments of organizational-related factors to reverse logistics have still lagged behind the requirements and pressures of external environments. This is due to the complexity and the increasing costs of reverse logistics operations, the likely unprofitable returns management, the protection of market share, and the necessities to focus on core business activities. In fact, profit is clearly the prime incentive and environmental benefits are a spin-off. Therefore, many firms incorporate the trade-off of implementing reverse logistics into consideration when making decisions of either reactive or proactive involvement in reverse supply chain management.

Research question 1 also explored the role of variables moderating the relationship mentioned in the conceptual model. Larger firms appear to be more adaptive to reverse logistics management than smaller firms because of their corporate image, collaboration capability, and their abundant resources. External factors have stronger impacts on the performance of reverse logistics for OEMs than distributors because their

[1183] See Gobbi (2008), p. 137; Cf. also Sarkis (2010), p. 899

[1184] See Hsiao (2010), p. 78

position in supply chain and their enforcement responsibility. For distributors, the position of being closer to end-customers and the point-of-sale has made them proactively adjusted their internal factors (e.g. formalizing a formal returns policy, using the availability of company resources, increasing cross-functional integration) to manage customer returns flexibly and efficiently. Firms located in Western Europe seem to be more adaptable to reverse logistics by changing and adjusting the internal factors to reverse logistics operations.

9.1.2. Research question 2: Adaptability at firm level

Research question 2 is motivated from the viewpoint arguing for the need to look at the organizational related factors, especially resources of a firm, in order to adapt to changing requirements of external environment and obtain superior performance. Since reverse logistics is not a core business activity of many firms, encompasses the wide stage processes of complex operations, and requires the intensiveness of resources for implementation, the appropriate allocations of resources to reverse logistics exhibited the adaptability to reverse logistics at the first glance. Therefore, we addressed this research issue in question 2 in chapter 5:

***Question 2*: How does a firm adapt to managing reverse logistics at firm level?**

To answer this question, we first analyzed the changes to reverse logistics at firm level over the last forty years through reviewing twenty four published case studies of firms in the European electronics industry. The awareness to reverse logistics has enhanced from no clear understanding of reverse flows, its benefits and the need of managing discarded and returned products to sound understanding, full law compliance, better customer returns management, and optimization of RL operations for profitability. The approach of adapting to reverse logistics has also been observed with the three levels of reactive, proactive and value seeking strategy, based on the enforcement of external environments, the firms' business strategies, the strategic importance of reverse logistics in overall business, and the availability of internal resources. In the 2000s, firms in the European electronics industry adapted to reverse logistics by developing internal capabilities to some extent. Furthermore, they integrated into relationship networks of reverse logistics to share information, resources, and capabilities to handle different reverse flows, especially for EoL management. Making strategic decisions of the level of involvement, the level of outsourcing, and joining an inter-organizational network for reverse logistics operations depend largely on the allocation of internal resources.

Then, we developed the theoretical model to explore how firms commit and allocate their resources to formulate strategy, align returns policies, and develop capabilities of reverse logistics to achieve the effectiveness and efficiency of reverse logistics performance. The degree to which firms in the European electronics industry increasingly allocated and reconfigured their resources, strategically formulated reverse logistics programs, more proactively set up liberalized returns policies, and improved capabilities and performance of reverse logistics may partly demonstrate the increasing adaptability to reverse logistics. The empirical results of the second theoretical model indicate that the changes of resource commitments, strategy formulation, and capabilities of RL have significantly substantial effect on performance of reverse logistics. Specifically, the effects of these factors have interpreted more than 70% of variance in performance of reverse logistics. The partial mediation effect reveals that resource commitments have both significant direct and indirect effects on the performance of RL. The wide stage processes of RL and the complexity of reverse flows require the intensiveness of resources for RL implementation. Therefore, the appropriate allocation of resources leads to more strategic focus on RL management, more attention in formalizing returns policy, more improved capabilities, and more effectiveness and efficiency of RL performance, suggesting the increased adaptability to reverse logistics.[1185]

However, the mediating role of RL capabilities with a small indirect effect on performance of RL suggest that firms have not become fully involved in developing their internal capabilities of RL operations due to complexity of product and material recovery activities, the requirements of substantial resource investments, and the existence of well-organized networks for reverse logistics operations.[1186] The high initial investment costs for product recovery activities have make the internal justification of these practices more difficult as

[1185] See Pfohl/Bode/Nguyen (2012b), p. 98

[1186] See Pfohl/Bode/Nguyen (2012b), p. 98

managers may give priority to other types of ventures that have more rapid and visible economic returns on investment of forward supply chain.[1187]

In particular, the empirical results presented that a greater indirect effect was reached through strategy formulation, suggesting that firms in the European electronics industry now focus more on strategic formulation of a formal reverse logistics program by utilizing the resources and capabilities from both internal and external environments to implement RL effectively. Allocations and commitments of resources, especially for management and finance, have made firms more proactive in finding the best solutions for managing different reverse flows. Formulating a proper strategy of RL may create significant effects on performance of RL because it supports firms in identifying the strategic roles of RL, eliminating ambiguity, and clarifying priorities of resources for RL in the process of integrated supply chain management. Therefore, managers can be aware of synergic effect of resource investments on forward and reverse supply chains, and make important decisions of in-house operations or outsourcing reverse logistics. For example, investments in new product development can incorporate product eco-design for easily disassembly and recycling; investment in improving customer after-sales services can bring direct benefits to both forward and reverse supply chain management; or joining collective take-back scheme can reduce the costs of RL in EoL management.[1188]

The strategic shift in management of reverse logistics has enhanced customer satisfaction, improved company image, reduced inventory, and saved resources, which therefore increase sales volumes, reduce costs, and improve profitability of firms. Strategic formulation of reverse logistics has also supported firms in understanding the importance of both intra-firm and inter-firm collaboration in order to manage integrated supply chain more effectively.[1189]

9.1.3. Research question 3: Adaptability at network level

The increasing enforcement of take-back laws, the growing customer demands, and the complexity of reverse flows have resulted in the growing outsourcing of reverse logistics to third party service providers, which increased the collaboration in reverse supply chain management. Firms have increasingly cooperated with their partners in the implementation of reverse logistics because they understand the competitive advantages and strategic roles of network relationships, e.g. sharing resource, improving capabilities, reducing costs, complying with the laws, and improving corporate image. The strategic motives and advantages from developing collaboration networks in reverse logistics operations have motivated the adaptability to reverse logistics at network level. Therefore, we approached the adaptability to reverse logistics at network level with research question 3:

***Question 3*: How do firms adapt to reverse logistics at network level?**

The adaptability at network level is defined in our study as the responses of firms in coordinating with supply chain partners, governing network relationships, combining network resources, developing network capabilities, and achieving network outcome to take competitive advantages from network relationships and adapt to fast-changing environments.[1190] The increased collaboration in reverse logistics operations have developed four main types of inter-organizational networks in the European electronics industry over the last decade including strategic network, regional network, operative network, and virtual network. The properties of high centralization, indirect ties, and structural holes in networks of reverse logistics operations have motivated the development of strategic networks in reverse logistics system. The strategic roles of hub firms, e.g. OEMs, producer consortia or PROs, LSPs, and recycling/waste management companies, in coordinating and governing network relationships, and developing capabilities of the networks have stimulated the effectiveness and competitive advantages of the whole network in reverse logistics operations.[1191] Strategic networks run by producer consortia or PROs have adapted to reverse logistics by governing network relation-

[1187] See Zilahy (2004), p. 311; Cf. also Gonzalez-Torre et al. (2010), p. 890
[1188] See Pfohl/Bode/Nguyen (2012b), p. 99
[1189] See Mollenkopf et al. (2011), p. 2
[1190] See Pfohl/Bode/Nguyen (2012a), p. 9
[1191] See Pfohl/Bode/Nguyen (2012a), p. 17

ships as network administrative organizations, coordinating with its members by collaborative agreements in member contracts, and exploiting and developing resources and capabilities of networks by contracting all operations of RL to general contractors. PROs work as certificate brokers in inter-organizational networks in reverse logistics system, leveraging their market power and industry expertise in order to offer competitively priced compliance packages to producers and importers.[1192] The network relationships in PROs have significantly contributed to innovations of inter-organizational collaboration and investments in the management of EoL products, indicating a high adaptability to reverse logistics at network level.

Strategic networks led by OEMs as lead organizations are coordinated and governed mostly by a hybrid form of long-term contracts and strategic partnerships with main service providers. The strategic network is mainly operated by high frequency of transactions, intermediate to high level of uncertainty, and high asset specificity, and frequently driven by economic value, e.g. high product recovery value, B2B returns, and customer returns. LSPs and recycling/waste management companies have adapted to and embedded themselves in network relationships of reverse logistics by becoming lead organizations or secondary hub firms to operate reverse logistics activities and coordinate subcontractors in the whole network. They are more proactive in network relationships of reverse logistics by performing both administration and operation tasks. By offering the full package of reverse logistics services, LSPs and recycling companies have increased their roles as lead organizations in operating, managing, and coordinating value-creating networks of inter-organizational reverse logistics system.

A regional network in revere logistics system is featured by the combination of municipal waste management companies, regional collection operators, carriers, and dismantling and recycling companies. It is more decentralized with the involvement of municipalities, retailers, carriers, and small dismantlers and recyclers. The high level of regional diversity has created opportunities for partners and stakeholders with the specialized knowledge of respective regions to increase their network collaborations, which bring the benefits for the whole network by high volume of returned products collected and recovered. In addition, the more centralized take-back system providers have increased the adaptability of small- and medium-sized disassembly and recycling companies by forming operative networks to bundle their resources, capacity, and acquisition processes for providing full packages of collecting and recycling with the economies of scale. The adaptability of SMEs in recycling industry increased productivity and capacity in collection and recycling for the whole network because of sharing resources, capabilities, knowhow and technologies. The decentralized collection and treatment systems have been preserved but under the renewed network of relationships with a central coordination unit, suggesting the adaptability to reverse logistics at network level.

9.1.4. Research question 4: Contextual differences

Reverse logistics is at the infant stage in many industries in Vietnam because firms have paid no much attention to increasing customer services and environmentally oriented business management. Reverse logistics operated in business practices are limited to only some capabilities of managing customer returns during the warranty period. Reverse logistics system for EoL management, especially for discarded UEEE, is informally operated with a mix of municipal waste management companies, manufacturers and distributers, private enterprises, and informal sectors. Development of reverse logistics in this study is also evaluated through the transferability of its management models to other countries, and Vietnam is a suitable destination for the assessment due to the embryonic stage of reverse logistics development. There are many contextual differences between Vietnam and European countries, complicating the evaluation of the transferability. Therefore, we addressed research question 4 in chapter 7 to analyze contextual differences and look for a similar context to evaluate the relevance and potentials for transferring reverse logistics management models.

Question 4: **What are the contextual differences in Vietnam and their influences on transferability of reverse logistics management models?**

The framework of transferability was developed to understand the concepts, the typologies, and the analysis methodology of transferability, which are the fundamentals for selecting cases for comparison, analyzing the

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[1192] See Bohr (2007), p. 128

current context, identifying contextual differences and similarities, and evaluating their influences on the transferability. This question focused on understanding current situations in Vietnam, determining contextual differences, and looking for similarities at network level for evaluating the transferability of reverse logistics management models for EoL management. Vietnam is a developing country that is remarkably different from many European countries in terms of politics, economic development, and socio-cultural bases. The method of analyzing the transferability in this study was based on seeking similar context and making comparisons to determine the implications of relevance and potentials for the transferability. Germany and Romania are selected based on some similar features with Vietnam, e.g. with Germany for geographic and demographic characteristics, and with Romania for economic development, the status of legal framework, and the degree of public awareness. The methodology for exploring this research question was the content analysis of secondary data and empirical results from cross-sectional survey with 181 Vietnamese households to analyze the opportunities and challenges for transferring and implementing a formal reverse logistics management model in Vietnam.

Vietnam is a country with a considerably large and highly dense population, which may be suitable for developing a formal reverse logistics system with the role of municipalities in regional network like in Germany. However, the differences of economic development, infrastructures, consumption pattern, and socio-cultural base are the challenges for Vietnam to successfully transfer reverse logistics management models of Germany. Romania and Vietnam have more similarities in the fundamental basis for the implementation of reverse logistics. Both countries are developing countries with high macroeconomic growth over the last decade that leads to higher disposable income. Moreover, the trend of urbanization and industrialization in these two countries has motivated the increasing consumption of EEE and the higher rate of discarded products. The situation of Romania at the time of transferring and implementing a formal management model of reverse logistics for WEEE is relatively similar in Vietnam in instances of legislation, infrastructures, and public awareness. There was no pre-existing legislation framework of EPR-based policy and take-back regulations in Vietnam or Romania. The infrastructures and facilities for collection and treatment of discarded UEEE have not been invested sufficiently in two either country. Especially in the case of Vietnam, the informal collecting and recycling system for EoL product has been a prevailing phenomenon. In addition, the public awareness of environmental issues and negative effects of improper WEEE management has been relatively low due to socio-cultural base and low income in both countries.

However, Romania has been successful in the transposition of take-back laws and in the implementation of a formal reverse logistics management model for EoL products to some extent. This country has conducted a formal reverse logistics management model by the collaboration of many stakeholders, the private initiatives for WEEE collection and recycling, the strategy and action plan for consciousness-raising campaigns, and some projects financed for WEEE management. Although there are more challenges and difficulties present in Vietnam than in Romania in the implementation of a formal reverse logistics management model for EoL products, the opportunities and strengths of current collecting and recycling system can advocate transferring reverse logistics management models to Vietnam. For example, the dynamic and effective networks of informal collectors and recyclers, the positive changes in legislation framework, the growing investments in infrastructure and technology, and the increasing consumer awareness and demands may be the important signals providing potentials for transferring a formal reverse logistics management model to Vietnam.

9.1.5. Research question 5: The likelihood of adoption

The transferability of reverse logistics to Vietnam is also evaluated through the likelihood of adoption of a formal reverse logistics program in electronics firms in Vietnam because producers and distributors play an important role in implementing returns management to comply with the laws and improve customer satisfaction. Therefore, we addressed the issue by solving research question 5:

***Question 5*: How is the acceptability of implementing a formal reverse logistics program at firm level in the Vietnam electronics industry?**

We used a qualitative research method through in-depth comparative case studies to explore the current practices of reverse logistics management and understand firms' acceptability of implementing a formal reverse logistics program for both EoL and customer returns. All four company interviewed have applied reverse logistics to returns management in their daily business, especially for customer returns in warranty time. They have paid more attention to identifying types of returns, formalizing returns policies, and developing disposition options. They have increasingly concerned in formalizing returns policy and emphasized their bias towards restrictive returns policies with rules regarding exchanging products instead of returning products with full refund. They solved the issues related to returned products through the operations of after-sales customer services in marketing or sales departments. All four companies used their distributors/retailer stores and warranty centers to take back returned products. Although they have not developed a separate comprehensive strategy for customer returns management, they have still worked with returns through their strategies of marketing and sustainability. Developing reverse logistics network for returned and discarded products has not been formally established in all four companies. Measurement metrics of RL performance have not been also developed in returns management.

All four companies asked complained about the shortage of specific regulations and instructions for extended producer responsibility, the lack of infrastructure for collecting and recycling, the weakly coordinative and supportive mechanism from governmental agencies. Although legislation framework for producer responsibility has not been used as an impetus for establishing a formal reverse logistics system for EoL management, manufacturers and distributor are voluntarily taking back EoL products from customers due to economic benefits obtained from increasing sales of new products. However, reverse logistics system at firm level for EoL management was conducted limitedly and spontaneously following the marketing campaign with “old for new” programs.

The empirical results indicate that there is the moderate likelihood of adopting a formal logistics program in electronics firms in Vietnam for both customer returns and EoL products, suggesting the transferability of reverse logistics to Vietnam. Reverse logistics management models are likely being transferred to Vietnam to some extent. Economic development, globalization, and information technology supports have made the transplantation of these management models is being borrowed and learned more quickly before they are acknowledged.

9.1.6. Research question 6: Solutions of transferring

Although reverse logistics is being transferred to Vietnam to some extent, reverse logistics has been in its embryonic stage of development in Vietnam. It is evident that there are many opportunities for Vietnam to select different reverse logistics management models in Europe countries to implement. However, not all management models of reverse logistics at both firm level and network level are suitable for the case of Vietnam. A number of factors should be taken into account when considering the transfer and implementation of any management model as analyzed in research questions 4 and 5. Therefore, we approached to this issue in chapter 8 by research question 6:

***Question 6*: Which aspects of reverse logistics management model should be transferred to Vietnam?**

Some practices of a formal reverse logistics management model transferred and applied in some Asian countries were presented to evaluate the diffusion of reverse logistics from European countries to other economies. For contribution to the successful implementation of reverse logistics at network level, a PRO-based model was proposed in this study based on collective responsibility and collaborative mechanism between government, enterprises, and consumers due to their important roles in the implementation of a formal reverse logistics management model. The roles of governmental agencies is extremely important in Vietnam for developing a RL management model at the first stage because they can operate as coordination center for producers' registration and clarify the specific responsibilities of different stakeholders. They also motivate the private initiatives for investing in collection and treatment, and create incentives for the enthusiastic participation of consumers, enterprises, and informal sectors in a formal RL system. Some solutions for developing a formal reverse logistics system for EoL management are recommended in this study including building sufficient framework legislation, improving public awareness, motivating network collaboration and investments, and developing a formal collecting and recycling network. At firm level, a model of making-decision process to identify external motivations and internal supports for developing a formal reverse logistics program are suggested. Determining major drivers and supports for the implementation of reverse logistics is important for firms in Vietnam at the first stage of developing a formal reverse logistics program because reverse logistics operations are resource intensive and costly. Moreover, the reference model of a formal reverse logistics program was recommended in this study as an effective management tool for the implementation of reverse logistics in developing countries like Vietnam.

9.2. Research contributions

The research main objectives are to evaluate the adaptability to reverse logistics in the European electronics industry at both firm level and network level as well as assess the transferability of reverse logistics to Vietnam. Different questions are formulated to address these objectives with specific findings and research implications extensively discussed in eight chapters. The research results presented in this dissertation contribute to academic and managerial implications in some ways.

9.2.1. Major academic contributions

First, we developed and tested two theoretical models to investigate the adaptability to reverse logistics at firm level in the European electronics industry. Conducting an internet-based survey as an empirical study to investigate these theoretical models has made this research work partly move beyond the case-based and normative prescriptive analysis. Therefore, this study contributes to validating empirically and showing the generalizability of the previous assumptions.[1193]

Second, the empirical results obtained from PLS path modeling supported broadening the theoretical understanding of the adaptability to reverse logistics in practice. This study makes some academic contributions to enriching the applications of the organizational theories in the specialized field of reverse supply chain management. The empirical results in chapter 4 enriched to the theoretical implications of institutional theory because the application of this theory is rather limited in reverse supply chain management. The empirical results of mediation effect indicate that institutional theory and the resource-based view have laid a promising foundation for studies in reverse supply chain management because they contribute to explaining how external and internal factors interactively promote the development of reverse logistics. Using the RBV in this study contributed to understanding the roles of resource allocations to formulate strategy, formalize returns policy, and to improve capabilities and performance of reverse logistics. The institutional theory and the RBV complemented each other to make contribution to explaining the adaptability to reverse logistics at firm level by converting theoretical concepts to latent variables and observed concepts into indicators in research models.

Third, this study emphasized the collaborative approach in supply chain management to explore the adaptability to reverse logistics at network level. Using the TCE, the relational view, and network-level approach, the concept of adaptability at network level is firstly explored to understand the response of firms in a dyad/network relationship. Whereas the TCE suggests that as environmental uncertainty, frequency, and asset specificity of transaction between organizations increase, firms tend to follow vertical integration with more hierarchical form. The analysis of outsourcing trends and the practices of inter-organizational collaboration in strategic, regional and operative networks in reverse logistics have indicated that organizations in the process of RL implementation tend to rely on closer inter-organizational relationships such as service contracts, long-term contracts, collaborative agreements and strategic alliance than vertical integration. Therefore, relationships through outsourcing contracts and collaborative agreements have still brought benefits for network members. The practices of outsourcing and collaboration in reverse logistics operation have extended the theoretical implications of the TCE.

The practices of intensified collaboration in the implementation of reverse logistics, especially for strategic partnership between supply chain partners, have affirmed the theoretical implications of the relational view

[1193] See Carter/Ellram (1998), p. 99

in identifying the adaptability behaviors of firms to look for competitive advantages from network relationships.

The network-level approach initially used for explaining the network relationships in reverse supply chain contributed to expanding the theoretical understanding of this approach in supply chain management. Reverse logistics may be a potential field to exploit the theoretical implications of network-level due to the trend of increased outsourcing and collaboration in the implementation of complex processes of product take-back, recovery and recycling. Moreover, the increasing centralization tendencies of reverse logistics operations requiring the management mechanism by hub firms, e.g. network administrative organizations and lead organizations, indicated that the activities and interaction of the goal-directed networks should be governed as a whole to obtain the competitive advantages from inter-organizational relationships. By using network-level approach, this study can partly evaluate the development and effectiveness of inter-organizational networks through combining resources and developing capabilities in relationship networks of reverse logistics operations. By analyzing the adaptability to reverse logistics at network level, this dissertation provides the evidence that firms in the European electronics industry have also benefited from network relationships to take competitive advantages and respond to fast changing environments. The propositions suggested in this study for the adaptability at network level may make a foundation for further research related to this topic.

Finally, developing a framework for analyzing the transferability of reverse logistics to Vietnam is also our contribution to evaluating the diffusion of reverse logistics management models in Europe to other countries. The methodology of analyzing the transferability of reverse logistics can be employed as a useful tool for other countries, especially for developing countries, to identify opportunities and challenges in the implementation of a formal reverse logistics model for EoL management, and to learn experiences form countries with similar context. Moreover, we also believe that both the decision-making process model and the reference model of developing a formal reverse logistics program at firm level are useful management tool for firms in developing countries to manage reverse logistics operations.

9.2.2. Major managerial contributions for Europe

This study emphasizes the development of reverse logistics with two objectives of adaptability and transferability. The findings extracted from survey data, case study and content analysis of literature review may provide some important implications for practitioners in both European countries and in developing countries like Vietnam. Therefore, this section gives out the recommendations to the main stakeholders of reverse supply chain in Europe including producers, distributors, and service providers.

9.2.2.1. Managerial implications for producers and distributors

The insights from the two proposed theoretical models exploring the adaptability to reverse logistics at firm level indicate that reverse logistics performance of firms will be improved when firms can match the organizational adaptive capabilities with the changing requirements of external environments. Moreover, firms should identify the critical factors facilitating the implementation of reverse logistics in both external and internal environments. Firms should determine the critical factors of external environments most affecting their reverse logistics performance. Therefore, they can exploit the opportunities from them, limit their internal resource investments in those fields, and determine the priorities in resource allocations. For example, joining a collective take-back scheme or individual contracting with service providers is the most appropriate strategy for managing EoL product from end consumers. Firms in this case can only allocate managerial resources for administrative staff to develop their capabilities of selecting service providers, controlling, and managing contracts. For participating in PROs in different countries in Europe, firms should pay attention to legal tracking of different national EPR requirements, formulation of a company strategy or policy for EoL management, and ongoing review and management of PROs.

With high recovery value returns, e.g. returns from forward supply chain and market-driven system, firms should select an appropriate strategy that optimal exploits both internal and external resources. Reverse logistics should be given special resource attention in this case due to the high initial resource investments for direct involvement. The RBV can be applied here to support firms in evaluating current resources and internal capabilities for in-house operations of reverse logistics. Moreover, developing a specific product recovery strategy (e.g. direct reuse/resell, repair, refurbishing or remanufacturing), and reverse logistics networks (e.g. transportation mode, location of handling, storage, and process, and relationships with service providers) may also help firms to make decision of the involvement level. The current development of specialized service providers and increased inter-organizational collaboration in reverse logistics operations can help firms dealing with different processes of returns management more proactively and efficiently. Integrating both internal and external resources and capabilities for RL operations with high recovery value may be the best solution for firms in practices to reduce costs and obtain profitability.

Both producers and distributors should pay more attention to the factor of customer awareness and demands in reverse supply chain management because this external factor has large impacts on performance of reverse logistics. Firms should translate customer behaviors and requirements into beneficial instruments for reverse logistics operations. For example, firms can take advantages of the trend of "green consumers" by conducting voluntary take-back programs of end-of-use products, stimulating the acceptability of refurbished products or products with recycled materials, and increasing the proper disposal of EoL products. Firms should pay attention to developing formal returns policies and a proper process of returns handling because the trend of more powerful customers has led to a higher returns rate. A more lenient returns policy with customer orientation and a good return handling may make firms more customer-friendly, promote better relationships, and therefore increase sales. Firms should invest more managerial resources to support returns handling because it needs time and efforts to formalize gate-keeping and disposition guidelines, and to identify the rules of days to return, days to refund and related fees.

Firms should pay attention more to cross-functional integration in reverse logistics management because managing reverse logistics is not the activity of just one department or actor in the chain. Upstream decisions heavily influence downstream operations, which influence the effectiveness and efficiency of RSC. Especially, the cross-functional integration at the marketing, logistics, and operation interface can lead to better alignment of corporate resources for returns management and thus create higher levels of customer satisfaction, cost reduction, and improved profitability.[1194] For example, sharing and understanding the total costs of returns among functional departments may help firms develop an appropriate returns management policy to avoid returns, reduce the handling costs, and decrease the inventory cycle.

Firms should identify the importance of information technology in their reverse logistics management and the gap between current information systems and their expectation to exploit the external opportunities of information technology advances for improving RSCM, e.g. ERP systems, EDI, warehouse management systems, transportation management systems, and customized solutions integrating with ERP. For many companies, the development of information technology for forward logistics has developed significantly, but the same development cannot be observed for returns.[1195] Therefore, companies should also improve their information system concerning the data flow of returns, e.g. bar code and scanning, RFID, and satellite. Efficient information systems are necessary for tracking and tracing product returns, forecasting return products and inventory management, and coordinating with different partners in RSCM. Inter-organizational collaboration in reverse logistics operations can be optimized by high-quality information sharing, which may lead to the superior performance of reverse logistics.

9.2.2.2. Managerial implications for service providers

This study highlighted the collaborative approach to address the adaptability to reverse logistics at network level. Collaborative approaches require effective joint management and information exchange among partners. Therefore, this part suggests some managerial implications for service providers in coordinating network members to optimize reverse logistics operations in the whole network.

[1194] See Mollenkopf et al. (2011), p. 401
[1195] See Bernon et al. (2011), p. 495

Most reverse logistics operations rely on centralized decisions made by coordination centers and hub firms in the network, e.g. government bodies, OEMs, producer consortia or PROs, large LSPs and recycling companies. The content analysis of case study literature in strategic networks in chapter 6 has partly demonstrated the positive economic and ecological outcomes of inter-organizational collaboration in reverse logistics systems, indicating the adaptability of reverse logistics at network-level. The intensified inter-organizational collaboration can help the system obtain higher economic benefits (e.g. cost reduction of collection and treatment) and higher ecological benefits (e.g. the higher volume of returned products collected and recovered). However, there have been issues in coordinating partners and stakeholders in different level of a network due to lack of information sharing and the economic conflicts of interest between stakeholders. For example, at the institutional level, it may be the lack of collaboration between government body, producers, distributors and municipalities related the allocation of physical responsibilities in collecting the discarded products, or the weakness of reporting system to transfer the information from producers or their take-back system providers to governmental agencies. At the operative level, the coordination between OEMs, distributors, PROs, logistics service providers, waste management companies, and municipalities has certainly suffered the miscommunication because the participants act at different stages of reverse logistics processes with different responsibilities and objectives. The logistics costs are still high and some unnecessary handling and transportation stages exist.[1196] Therefore, it is necessary to improve communication and collaboration between supply chain partners to optimize collection process. For example, PROs and local operators, e.g. municipalities, regional carriers and recyclers, should act together to look for the most economical ways of organizing collection. The managerial implications for service providers in this study emphasize the role of information sharing in coordinating the network members.

In a strategic network, the selection of spoke firms or partners providing reverse logistics services should be taken into consideration with enough information regarding resources and capabilities. As partners participating in a strategic network are in form of both direct and indirect ties with different and individual interests and objectives, it is impossible to have hierarchic controlling for all network relationships. Therefore, it may be risky if companies, especially with general contractors or focal firms, try to push their interests in partial cooperation due to information asymmetries and adverse positions of power. For example, outsourcing development of reverse logistics gives more power to larger LSPs and waste management companies. Consequently, it can result in the fact that decisions are not generally made through a mutual trust and intensive information of partners, especially in case of small disassembly and recycling companies. The needs for information about potential and current network actors are necessary for improving the capabilities of coordinating and governing network relationships. In fact, independent service providers joining the networks and performing their contract exchange only restrictedly their information and this may cause asymmetric and insufficient information for the whole network to operate effectively. Therefore, service providers acting as network administrative organizations or lead organizations should use more supports from IT applications to store data and increase communication with network members, to exchange and share information for effectively coordinating and developing network resources and capabilities. They should effectively exploit their general contractors' information sources to access and evaluate the capabilities of their partners' subcontractors, which contribute to the quality of services offered by the whole network they are controlling.

9.2.3. Major managerial implications for Vietnam

The transparence of cost and performance should be also the important requirements for improving the competition in strategic networks. For example, benchmarking and comparison of costs and performance of different service providers at primary and secondary level should be conducted and controlled to ensure the efficiency and effectiveness of the whole network. For example, the comparison of costs and performance between different general (primary) contractors in strategic networks can support OEMs and PROs to reduce the costs of operations, increase the quality of services, and improve the competitiveness for the whole network. The costs and performance of different regional operators should also be compared and examined

[1196] See Pfohl/Bode/Nguyen (2012a), p. 14

through the standardized requirements of auditing and certifying. For operative network of recycling companies, the coordination unit should pay attention to complication by the spatial variation of the density of resources and heterogeneous attitudes of agents towards participating in recycling activities for coordinating the capacity for collection and physical treatment of discarded products. The multiple independent recycling companies joining the network should be more willing to reveal sensitive information like the costs of treatment, the current technology and facilities, and the inventory of recycled materials, which makes centralized management of recycling processes within the network more efficient. For example, more information of cost and capacity will help the network offer the treatment services with competitive price and better capabilities for the whole network to acquire the contracts from centralized take-back systems. Moreover, the allocation of discarded products to recycling companies, the options of disassembly levels, and the allocation of material fractions to recovery facilities[1197] become more effective. Information sharing of recycled material inventory from multiple recycling companies in the network can also help them to be in a powerful position in redistributing and offering recycled materials.

Related to the objective of analyzing the transferability of reverse logistics to Vietnam, some managerial implications are recommended for producers and policy makers to implement reverse logistics in the coming years.

9.2.3.1 Managerial implications for producers

Based on the content analysis of literature review and the findings of case studies, we found that reverse logistics is being transferred to Vietnam to some extent, and firms in Vietnam take a mostly reactive stance towards the issues of reverse logistics management, especially for EoL management. It is due to the low enforcement of laws, the low customer awareness and demands, and the low value of economic benefits from product recovery. However, in the scenario of environmental oriented management following sustainable development strategy in almost all countries in the world, and the current development of Vietnam in the institutional and economic aspects, it can easily be foreseen that the enforcement of laws related to environmental issues, especially for extended producer responsibility, will be applied in the coming years. Moreover, Vietnamese customers are increasing their awareness to environmental issues and their demands for quality and services of products after purchases. Therefore, firms should take more strategic considerations in decision-making process of implementing a formal reverse logistics program, e.g. economic benefits, legal concerns, improved customer services and customer satisfaction, company image, internal resources and capabilities, and cost-benefit analysis of implementing returns management.

For firms in Vietnam, it is very important at the infant stage to increase the awareness of reverse logistics, the strategic roles of returns management, and strategic motives for RL management. Identifying the factors driving RL operations and the barriers hindering firms from the implementation is also necessary at the early stage. Financial consideration including resource investments, benefits, and costs should be carefully evaluated because reverse logistics operations are complicated and resource intensive. Management skills, e.g. the knowledge of reverse logistics and the capabilities of managing and controlling the processes of RL, the flow of material, information and money, and the people associated with RL operations, should be gradually learned and improved through the best practices from other countries. Firms in Vietnam, especially for local companies, should increase good communication with each other and strengthen a collaborative relationship with foreign companies that have more experiences in dealing reverse flows to learn and improve capabilities of RL, e.g. knowledge, knowhow, management skills, and technology. The increased collaboration with service providers through outsourcing or collaborative agreements should also be given more consideration in the near future to improve the capabilities of reverse logistics to comply with the laws and meet customer demands.

9.2.3.2 Managerial implications for policy makers

The findings in chapter 7 and chapter 8 indicated that the barriers of external factors mainly affect the transferability of reverse logistics to Vietnam and the implementation of reverse logistics in Vietnam. It is due to

[1197] See Walther et al. (2008), p. 335

no specific regulations and low enforcement of laws, no comprehensive collection and treatment infrastructures, low public awareness and the popularity of informal sectors, and the lack of collaboration at network level. The study proposed a reverse logistics management model for EoL management in Vietnam and gave out some solutions for policy makers to foster the development of environmental oriented reverse logistics operations in Vietnam. The most important managerial implication that we want to highlight in this study for policy makers is how the governmental agencies can collaborate with different stakeholders involved in reverse logistics processes, e.g. producers (including distributors and importers), industry associations, private service providers, consumers, NGOs, and informal sectors to motivate their involvement.

More intensified collaboration with these stakeholders will increase public awareness, improve collection and treatment infrastructures, and therefore motivate RL implementation at both firm level and network level. The governmental agencies should increase their roles as initiators, coordinators, and facilitators for RL processes. For the case of Vietnam, it is very important to develop a sufficient framework of take-back laws and issue the specific regulations with detail instructions. Defining clear responsibilities of different stakeholders as well as increasing incentives and subsidies for private and informal sectors can integrate informal collectors and recyclers into formal sectors, and thus increasing the capabilities of the whole system. For example, the government should develop the initiatives to call for the investments from municipalities, private collecting firms, and recycling companies for collection points, recycling infrastructure and technology, and regional centralized processing centers to achieve economies of scale of collecting and recycling valuable discarded products.

9.3. Limitations and recommendations for further research

Although this research was conducted with high concentration and great care, some limitations should be addressed because all research designs are flawed and possess limited validity.[1198] This part focuses on reviewing some limitations of the study, and suggesting directions for future research.

First, this study focused on the electronics industry; therefore, it may be limited to the generalized conclusions for other industries regarding adaptability to RL. Although the electronics industry has greater motivations in implementing RL for both EoL management and customer returns management than other industries as mentioned in chapter 2, future research should take other industries into consideration to provide greater generalizability and expand current knowledge of adaptability to RL, e.g. garments and textiles industry, automobile industry, and publishing industry.

Second, this study was also somewhat constrained by the sample size and relatively low response rate due to financial and time constraints. Although, the fit indices of our measurement model were relatively accepted, suggesting the results are fundamentally significant and relevant, future research should try to increase the number of respondents by different ways in collecting survey data, e.g. internet-based survey, email contact, telephone contact, and in-depth interview. If future research extends to other industries, it can lead to greater generalization and secure larger sample size, thus in turn higher value of significance.

Third, survey method is very useful to maximize the generalizability and supports testing the research hypotheses, but it is weaker in the areas of precision in control and realism of the context.[1199] Although the questionnaire in this study was carefully edited to ensure the understanding of company respondents regarding the meaning and objective of each question, we suggest future researchers to combine qualitative analysis through case study to explore the adaptability to reverse logistics in Europe. There are some reasons for this recommendation from our own experiences in doing the research under strategic consideration and supply chain management. Using case study can help researchers soundly investigate managerial attitudes of company respondents firms toward reverse logistics management in practice. Exploring the research related to adaptability to reverse logistics require the comprehensive understanding of managers' attitudes toward strategic decisions of RL implementation, e.g. resource commitments, strategy formulation, policy adjust-

[1198] See McGrath/Brinberg (1983), p. 115
[1199] See McGrath (1982)

ment, and improvement of internal capabilities. Qualitative research method can also be used to extract the profound insights of adaptability to reverse logistics.

Fourth, we used cross-sectional survey in this study for investigating the adaptability to reverse logistics in Europe and understanding the consumer awareness and demands in Vietnam related to discarding and returning products. The use of cross-sectional survey may limit us from capturing long-term effects and changes, both of which are very important for the evaluation of adaptability to reverse logistics and the variations of consumer awareness and demands. Therefore, we suggest future researchers to conduct a longitudinal study about the relationships proposed in this thesis to check how particular aspects of the adaptability, as well as the consumer behaviors, change over time because reverse supply chain management is new and young field for both academics and practitioners.

Fifth, although content analysis seems to be suitable for analyzing the adaptability at network level, it also has some limitations. The case studies extracted from different literature did not contain all the information required for analyzing the adaptability to reverse logistics at network level. The comprehensive information related to the combination and development of the resources at network level is not clearly identified in the literature of case studies. Network outcomes are not clearly measured in many published case studies. Therefore, the comprehensive understanding of adaptability dimensions at network level should be explored in greater depth by case study, focus group, in-depth interview, or cross-sectional survey. Further case study research is highly encouraged for this topic because it may provide the insights of the complicated network relationships in reverse logistics operations.

Sixth, this study addressed a young and rather complicated field in SCM research - Reverse Supply Chain Management - under both strategic considerations and supply chain perspective. Therefore, the theoretical variables developed and validated in theoretical models in chapter 4 and chapter 5 should be more carefully examined in future research. Although the statistical results obtained from PLS path modeling provided satisfactory indications for all constructs in these models, the construct validity and the common method variance can only be accomplished through a series of studies that further refine and test the measurements across population and settings.[1200]

Finally, reverse logistics is a significant topic with both developed and developing countries because of the increasing concerns in sustainable development, the regulatory pressures on extended producer responsibility, and the growing customer demands. However, reverse logistics has still received less attention than forward logistics due to the requirements of substantial resource investments, the uncertainty and complexity of reverse flows, and the likely unprofitable returns management. This study has attempted to investigate the development of reverse logistics with two main objectives of adaptability and transferability in different contexts. I hope that this study may contribute to enriching theoretical and empirical understandings on this topic for further research and increasing the public awareness of strategic importance of reverse logistics.

[1200] See Pan-Theo (2009), p. 116

Appendix 1: Allocation of physical and financial responsibilities for WEEE management in European countries

#	Member State	Physical Responsibility	Financial Responsibility	EEE put on market per capita (kg)	WEEE collection (%)
1	Netherlands (NL)	D/M	D/M	NA	58.64
2	Sweden (SE)	P* (M)	P	25.05	58.42
3	Norway (NO)	D/M	P	40.31	54.33
4	Luxembourg (LU)	D/M	D/M	16.93	48.45
5	Germany (DE)	M	M	22.28	41.04
6	Austria (AT)	D/M/P	D/P	18.97	39.34
7	Denmark (DK)	M	M	31.96	34.73
8	Spain (ES)	D/M	P	11.71	32.96
9	Estonia (EE)	D/P	D/P	13.62	31.96
10	Belgium (BE)	D/M	D	23.76	30.51
11	Cyprus (CY)	P	P	19.48	30.21
12	Finland (FI)	D/P	P	26.45	28.54
13	Lithuania (LT)	D/M/P	D/P	14.63	18.68
14	Hungary (HU)	P	P	13.47	17.71
15	Slovakia (SK)	D/P	D/P	9.56	16.71
16	Greece (EL)	P	P	15.81	6.45
17	Portugal (PT)	D/M/P	D/P	11.66	3.42
18	Poland (PL)	D	D	22.68	1.98
19	France (FR)	D/M/P	D/P	23.52	1.02
20	Romania (RO)	M	M	6.52	0.8
21	Italy (IT)	D/M	D/M	NA	NA
22	Bulgaria (BU)	P	P	NA	NA
23	Czech R. (CZ)	D/P	D/P	NA	NA
24	Ireland (IE)	D/M	D/P	NA	NA
25	Latvia (LV)	P	P	NA	NA
26	Malta (MT)	D/P	D/P	NA	NA
27	Slovenia (SI)	D/M	D/M	NA	NA
28	The UK (UK)	D/P	D/P	NA	NA

Source: Sander et al. (2007), p. 5; Cf. also Tojo/Fischer (2011), p. 12 - 13

Legend:
- Above 50% for overall collection rate
- Above 30% for collection rate
- Above 15% for collection rate
- Less than 10% for collection rate

Appendix 2: Examples of using E-commerce supporting for reverse logistics management in the European electronics industry

Website	Supply chain type	Products	Functions supporting for reverse logistics management
www.shop.miele.de www.miele.co.uk/store	Manufacturer	New products, accessories, spare parts business	Information about returns policy, RMA process, guidelines of shipping returns, online support and recycling points, spare parts supports
www.bosch-eshop.com	Manufacturer	New accessories and spare parts business	Information about repair and maintenance services, returns policy, guidelines of shipping returns, spare parts supports
www.siemens-eshop.com	Manufacturer	New home appliances, accessories and spare parts business	Information about returns policy, Information about RMA process, guidelines of shipping returns, spare parts supports
www.sonnyericsson-shop.de	Manufacturer	New telephones, accessories, and for unsold products with special discount (outlet store)	Information about returns policy, guidelines of shipping returns, and trading for commercial returns (outlet), spare parts support, instructions for product disposal
www.shop.sennheiser.de	Manufacturer	New product, accessories and spare parts business	Information about repair service, returns policy, guidelines of shipping returns, spare part supports
www.mediamarkt.de	Retailer	New products	Information about returns policy, RMA process, guidelines of shipping returns, online support
www.euronics.de	Retailer	New products	Information about returns policy, RMA process, and guidelines of shipping returns
www.hoh.de	Retailer	New products, and refurbished ones	Information about returns policy, guidelines of shipping returns, and trading refurbished products
www.darty.com	Retailer	New products	Information about returns policy, guidelines of shipping returns, collection channels for disposal of used electronic products
www.ebay.com	Online auction & shopping website	New, used, refurbished or remanufactured products of different brand names	Online auction for trading new and used products; Information about returns policy, guidelines of shipping returns, online support
www.qxl.com	Online auction	Used and refurbished products of different brand names	Online auction for trading used products; information about returns policy and online support
www.re-furbished.de	Remanufacturer	Used, refurbished or remanufactured products of popular brand names	Trading for refurbished and remanufactured products

Appendix 3: Examples of current returns policies in some European electrical and electronic firms

Returns policy	Days to return product	Restocking fee[1201]	Nonrefundable shipping & handling fee[1202]	Reimbursing shipping cost for returning products	Days to refund money	Overall evaluation of returns policy
Electrolux	14	Yes	✓	o	30	Restrictive
Miele[1203]	30	No	✓	✓	30	Liberalized
Bocsh	28	Yes	o	o	NA	Restrictive
BSH[1204]	30	Yes	✓	✓	28	Fairly liberalized
Siemens[1205]	30	Yes	✓	✓	28	Fairly liberalized
Sony[1206]	14	NA	NA	✓	30	Restrictive
Canon Europe[1207]	14	NA	o	o	30	Restrictive
Otto	14	No	o	✓	30	Fairly liberalized
Alteco	28	No	o	✓	30	Fairly liberalized
Mediamarkt[1208]	14	NA	o	✓	30	Fairly liberalized
Euronics[1209]	7	No	✓	✓	30	Restrictive
Datart	28	No	o	o	28	Fairly liberalized

o : No refund

✓ : Refund

NA : not announced clearly in their returns policy for all cases

Source: Published information in the website (2010)

[1201] See Thorsten et al (2008), p. 209: Restocking fee: Amount charged by a seller for accepting returned merchandise due to non-defective reasons and paying a refund. The fee is not charged only for returns due to damaged or defective (10 - 30% of total price)

[1202] Shipping and handling fee: Delivery charges for sending product to customers

[1203] Miele dictated clearly in their returns policy: When Miele confirms customer's entitlement to a refund, Miele will refund customer in full for the Product, including a refund of the delivery charges for sending the Product to customer and the cost incurred by customers in returning the Product

[1204] BSH Bosch & Siemens will be happy to refund the handling and packaging charge paid by customers if they are required to return the goods to BSH because of BSH's mistakes.

[1205] Siemens AG will however be happy to refund the handling and packaging charge paid by customers if customers are required to return the goods to Siemens because of Siemens's mistake.

[1206] In case of Sony: Customers have to bear the cost of return shipment if the delivered goods ordered and if the price returned the case of an amount not exceeding €40 or if customers are at a higher price the thing is not at the time of full payment or a contractually agreed part payment provided. Otherwise, the return is free for customers.

[1207] In case of Canon Europe: For fully functioning product, customers can return without any reasons within 14 days, and will be refunded the price of product and VAT, except shipping costs and returning shipping costs. For product not working from the beginning, customer can return with 14 days, free returns shipping carriers appointed by Canon Europe, and only request warranty repair of the product or exchange not a return for refund

[1208] In case of Mediamarkt: Customer have to bear the normal costs of return if the delivered goods ordered and if the price of the goods a sum of not exceeding 40 Euros. Otherwise, the return is free of charge.

[1209] In case of Euronics: Customers can return goods within the seven working day cooling-off period, and Euronics will refund the price of goods in full, including any delivery of charges. In case, customers return due to their faulty, they will responsible for the cost of returning Goods to Euronics, or where applicable of Euronics collecting goods from customers.

Appendix 4: Literature review of published case studies in the European electronics industry regarding reverse logistics management

#	Reference	Type of Firm 1=Manufacturer 2=Distributor	Drivers 1=Legal requirement 2=Economic benefits 3=Business requirement 4=Company image	Sources of returns 1=Returns from forward SC 2=Market-driven stream 3= Waste stream	Collectors 1=Municipalities 2=OEMs/Distributors 3=LSPs	Recovery options 1=Reuse/resale 2=Refurbishing 3=Remanufacturing 4=Recycling	Involvement in recovery 1= Collective contracting 2=Individual contracting 3=Individual recovering 4=Vertical integration	Adaptability Level 1=reactive 2=proactive 3=value seeking
1	Meijer (1998) Canon (2010)	1 - Canon	1, 4	2, 3	2, 3	3, 4	2, 3, 4	3
2	Philip (1999)	1 - SNI Germany	2, 3	1, 2	1, 2, 3	3, 4	2, 3, 4	2
3	Philip (1999)	1 - Acer Germany	1, 2, 4	1, 2	1, 2, 3	2, 3, 4	2, 4	2
4	Philip (1999)	2 - France Télécome	3, 2	1, 2	2, 3	1, 2, 4	2	2
5	Slot/Ploos (1999)	1-NA	1, 3	3	1, 2	4	1, 2	1
6	Krikke et al. (1999)	1 - Océ	2,3	2	2	2, 3	3, 4	3
7	De Koster et al. (2000)	1 - NA	1	3, 2	1, 2, 3	4	1	1
8	Toktay et al. (2000)	1 - Kodak Europe	2	2, 1	2 4	3	2, 4	3
9	Ayres et al. (1997), Maslennikova/ Foley (2000), Kerr/Ryan (2001)	1 - Xerox Europe	3, 4, 1	2, 1	2, 3, 4	1, 2, 3	4, 3	3
10	De Koster et al. (2001)	2 - NA	3, 2, 1	1	2, 4	1	2	2
11	UK Department of Transport (2004)	2 - Safeway	3, 1, 2	1, 3	2, 3	1, 2	2	2
12	Verweij et al. (2008); Fergusson and Toktay (2004)	1 -Lexmark	1, 4, 2	2, 1	2, 3	1, 4	2	2

#	Reference	Type of Firm 1=Manufacturer 2=Distributor	Drivers 1=Legal requirement 2=Economic benefits 3=Business requirement 4=Company image	Sources of returns 1=Returns from forward SC 2=Market-driven stream 3= Waste stream	Collectors 1=Municipalities 2=OEMs/Distributors 3=LSPs	Recovery options 1=Reuse/resale 2=Refurbishing 3=Remanufacturing 4=Recycling	Involvement in recovery 1= Collective contracting 2=Individual contracting 3=Individual recovering 4=Vertical integration	Adaptability Level 1=reactive 2=proactive 3=value seeking
13	Verweij et al. (2008); Flei-schmann (2004), Gibbo (2008)	1 - IBM Germany	2, 1, 4	2, 1, 3	3, 2, 1	1, 2, 3	2, 3, 4, 1	3
14	Herold (2007), Henzler et al. (2008)	1 - Fujitsu & Siemens	2, 4, 1	2, 1, 3	3, 2, 1	1, 3, 4	2, 4, 1	3
15	Herold (2007), Janse et al. (2009), BSH (2009)	1 - BSH	1, 2, 3	1, 3	1, 3	1, 4	1,2	2
16	Herold (2007), Electrolux (2010)	1 - Electrolux	2, 3,1	2, 3, 1	1, 3, 2	1, 2, 3	1, 2, 3	2
17	Herold (2007); Philips (2010)	1 - Philips	1, 4, 3	3, 1, 2	1, 2, 3	4	1, 2, 3	2
18	Herold (2007); Nokia (2010)	1 - Nokia	1, 3	3, 1, 2	2, 3	1, 2, 4	1, 2	2
19	Verweij et al. (2008); Herold (2007); Philip (1999)	1 - HP Europe	2, 1, 4, 3	1, 2, 3	1, 3	4	2,1, 3	2
20	Miele (2008)	1- Miele Germany	1, 2, 3	3, 1	1, 3	4	1, 2	2
21	Saibani (2010)	1- Company A	2, 3	1, 2	2	2, 3, 4	2, 3	3
22	Saibani (2010)	1-Company B	4, 2	1	2, 3	1, 2	2	2
23	Saibani (2010)	1-Company C	3, 2	1	2, 3	1, 2	2, 3	2
24	Saibani (2010)	1-Company E	1	2, 3	3	4	2, 3	2

Appendix 5: Examples of logistics service providers offering reverse logistics services in Europe

LSPs	FL	RL	Reverse logistics services	Source
Geodis	✓	➢	Overall logistics solutions for returned and used IT products; refurbishment and profitable resales; environmentally friendly recycling	ERP (2009) Verweij et al. (2008) Gobbi (2008)
DB Schenker	✓	➢	Spare parts logistics (spares network with central/regional centers); Reverse logistics (collection, inspection, exchange and repair, asset recovery and recycling); central recall centers for returns management	Verweij et al. (2008) Website
Anker Leschaco	✓	➢	Logistics solutions for refurbishment, trade-in, sales take-back, resale, replacement service, returns management, remarketing	Website
Wincanton	✓	➢	Integrated returns management solutions from collection, investigation, sorting, recovering, recycling, repackaging or reworking to maximize the retail and recovered value of the returned and used product.	Website Wincanton (2004)
Hermes Logistics	✓	➢	Complaint management, pick-up, handling, repair/refurbishing, repackaging, disposal and recycling	Website
DHL	✓	➢	Returns management, receiving, sorting, inspection, repairing, repackaging	Webiste Verweijet al. (2008)
TNT	✓	➢	End-to-end management of used parts returned for repair, replacement, recall or reuse	Website
Rhenus Logistics	✓	➢	Material flow logistics for disposal and recycling	Website
Exel logistics	✓	➢	Product restocking, manufacturer returns, recycling and disposal of goods	
Kuehne + Nagel	✓	➢	Managing commercial returns and WEEE, repairing, and recycling by order management system and customized collection network	Website
Cycleon Logistics		➢	Returns management and after sales take-back solutions for overstock returns, commercial returns, warranty returns, service parts, product recalls, EoL returns	Webiste
CCR Logistics		➢	Manage individual solutions for the take-back, recycling and remarketing of products, components and raw material	ERP (2009)
RECLAY Logistics		➢	Compliant take-back and recycling of WEEE	Website

Note: *The related websites are reported in Appendix 9*

Appendix 6: Questionnaire of the internet-based Survey in Europe
Code: 00/EU

DEVELOPMENT OF REVERSE LOGISTICS IN EUROPE

PROJECT PURPOSE

Dear Sir or Madam,

The Department of Management and Logistics (FGUL) at the Technical University of Darmstadt conducts a survey in the current research project "Development of Reverse Logistics in Europe"

Because of the increasing proportion of returns management costs in total logistics costs, many companies have made efforts to reduce the costs in the overall system. In today's saturated markets, the efficient management of reverse logistics offers strategic opportunities to increase customer satisfaction and competitive advantages. This study addresses the main topic related to development of reverse logistics under strategic considerations and supply chain perspective

By participating in this survey, you will help us to explore your company's concerns regarding to reverse logistics management. The survey will take approximately 10 minutes of your time to complete. It is important that you can provide any comments or insights that you feel are appropriate in responding to the questions.

If you are interested in receiving a summary of the survey results, please provide your e-mail address. Your e-mail address will not be informed and used for other purposes. If you have any questions, please feel free to contact Ms. Nguyen Thi Van Ha (nguyen@bwl.tu-darmstadt.de)

We look forward to your response.
Thank you in advance.
Yours sincerely,

Prof. Dr. Dr. h.c. Hans-Christian Pfohl
Nguyen Thi Van Ha, MBA (nguyen@bwl.tu-darmstadt.de)
Department of Management and Logistics
Technische Universität Darmstadt

S 1/03 162
Hochschulstrasse 1
64289 Darmstadt
Germany

CLASSIFICATION

1. How would you classify your company?

- ☐ Manufacturer
- ☐ Wholesalers
- ☐ Retailer
- ☐ Other (please specify)

DEVELOPMENT OF REVERSE LOGISTICS IN EUROPE

PART 1: RETURNS MANAGEMENT

A formal reverse logistics program is defined as a strategic returns management process that is obtained the commitments and allocations of resources, specifically formulated with strategy, carefully developed with written policies and procedures, and clearly assigned with RL operations.

2. Has your company implemented a formal reverse logistics program?

- ☐ Yes, we have implemented it for years
- ☐ Yes, we have started implementing it
- ☐ No, we have not implemented it formally
- ☐ Other (please specify):

3. What are the main reasons for returned products in your company? (multiple answers possible)

- ☐ Marketing returns (seasonal products, overstock, or unsold products)
- ☐ Consumer returns (damaged delivery, not meeting customer expectations, technical problems)
- ☐ Warranty returns
- ☐ Product recalls
- ☐ End-of-lease returns
- ☐ End-of-life returns
- ☐ Other (please specify):

4. Please evaluate the importance of the following drivers for implementing reverse logistics
(1=very important, 2=important, 3=less important, 4=neither important nor unimportant, 5=unimportant)

Drivers	1	2	3	4	5
Customer satisfaction					
Corporate image					
Cost reduction					
Corporate profitability					
Compliance with the laws					
Minimizing negative impacts on environment					

5. To what extent do you agree with the following statements related to the conditions in implementing returns management?
(1=strongly agree, 2=agree, 3=partly agree, 4=disagree, 5=strongly disagree)

Conditions	1	2	3	4	5
We have enough information about related laws and regulations					
We have sound awareness of reverse logistics					
We have a definite strategy of reverse logistics					
Our top managers facilitate improving returns management					
We have an effective information system for returns management					
We apply E-commerce for returns management					
We have separate warehouse to receive and check product returns					
We have physical technologies for product recovery					
Our functional departments are fully integrated with each other to manage product returns					
We have good collaboration with supply chain partners for returns management					
We have measurement metrics of reverse logistics performance					

Other (please specify)

PART 2: FACTOR INFLUENCING THE DEVELOPMENT OF REVERSE LOGISTICS

6. Please rate the importance of the following external factors influencing the development of reverse logistics (1= very important, 2=important, 3=less important, 4=neither important nor unimportant, 5=unimportant)

External Factors	1	2	3	4	5
Laws and regulations (EPR, WEEE, RoHS, and Packaging Waste Directive)**					
Awareness and customer demands					
Information technology					
Collaboration among supply chain partners					
Globalization (global market and global regulations)					

**EPR: Extended Producer Responsibility
WEEE: European Directive on Waste of Electronic and Electrical Equipment Directive
RoHS: European Directive on the Restriction of the Use of Certain Hazardous Substances

7. Please rate the importance of the following internal factors influencing the development of reverse logistics (1= very important, 2=important, 3=less important, 4=neither important nor unimportant, 5=unimportant)

Internal Factors	1	2	3	4	5
Clear company policies for returns management					
Top management supports for implementing reverse logistics					
Availability of current resources for reverse logistics					
Cross-functional integration for returns management					

PART 3: ADAPTABILITY TO REVERSE LOGISTICS

8. To what extent do you agree with the following statements related to the activities in formulating a formal reverse logistics program in your company?
(1=strongly agree, 2=agree, 3=partly agree, 4=disagree, 5=strongly disagree)

Strategy Formulation	1	2	3	4	5
We determine goals and strategies for product recovery					
We develop gatekeeping and disposition guidelines*					
We develop reverse logistics network**					
We develop returns policy and credit rules					
We determine appropriate metrics for reverse logistics					

* Screening procedures to identify how and which products can enter the returns stream and looking for quick routing solutions for products entering the returns stream.
** Strategic decisions of locating transformation processes for returns, selecting modes of transportation, and choosing partners for outsourcing (if necessary)

9. To what extent do you agree with the following statements related to returns policy in your company?
(1= strongly agree, 2=agree, 3=partly agree, 4=disagree, 5=strongly disagree)

Returns Policy	1	2	3	4	5
Our return policy is more restrictive than our competitors					
We carry out a liberalized returns policy					

10. To what extent does your company make resource commitments to reverse logistics implementation?
(1= very much, 2=much, 3=some, 4=a little, 5=not at all)

Resource Commitments	1	2	3	4	5
Managerial resource commitments					
Financial resource commitments					
Technological resource commitments					

11. Please evaluate your company's internal capabilities in implementing reverse logistics
(1= very capable, 2=capable, 3=less capable, 4=neither capable nor incapable, 5=incapable)

Internal capabilities	1	2	3	4	5
Product acquisition (product collection and procurement)					
Product recovery capability (repairing, refurbishing, remanufacturing)					
Material recovery capability (recycling)					
Marketability of recovered product					
Ease of credit return to customers (time and procedures)					
Quality of rework and repair					

12. Please evaluate your company's efficiency and effectiveness in implementing reverse logistics
(1=very effective, 2=effective, 3=less effective, 4=neither effective nor ineffective, 5=ineffective)

Effectiveness and Efficiency	1	2	3	4	5
Customer satisfaction					
Improved competitiveness					
Cost reduction					
Improved profitability					
Reduced inventory investment					

PART 4: OUTSOURCING REVERE LOGISTICS OPERATIONS

13. Which kinds of services are currently provided by service providers for your company in managing reverse logistics? (multiple answers possible)

- ☐ Collecting and Transporting
- ☐ Inspecting and sorting
- ☐ Repairing
- ☐ Refurbishing and Remanufacturing
- ☐ Recycling
- ☐ Waste management
- ☐ IT Management
- ☐ Customer service
- ☐ Consultancy
- ☐ Other (please specify): ______

14. Please rate the importance of the following factors influencing the decision of outsourcing reverse logistics in your company
(1= very important, 2=important, 3=less important, 4=neither important nor unimportant, 5=unimportant)

Decision Factors	1	2	3	4	5
Tendency to focus on core competencies					
Company's resources and policies for reverse logistics					
Trend of collaboration among partners in supply chain					
Complexity in controlling product returns					
Increasing cost of reverse logistics operations					
Returns volume					
Product characteristics					

PART 5: COMPANY INFORMATION

15. Where is your company located?

- ☐ Northern Europe
- ☐ Western Europe
- ☐ Eastern Europe
- ☐ Other, please specify:

______

16. Please identify the turnover of your company in the last financial year (in Euro)

- ○ Less than 10 million
- ○ 10 - 49,99 million
- ○ 50 - 99,99 million
- ○ 100 - 249,99 million
- ○ 250 - 499.99 million
- ○ 500 - 999,99 million
- ○ 1 - 10 billion
- ◉ More than 10 billion

17. How many staff does your company employ in the last financial year?

- ○ Less than 50
- ○ 50 - 249
- ○ 250 - 499
- ○ 500 - 999
- ○ More than 1000

18. What is your position in your company?

- ○ General manager
- ○ Logistics manager
- ○ Manager for corporate sustainability and environment
- ○ Operation manager
- ○ Marketing manager
- ○ Customer service manager
- ○ Reverse logistics manager
- ○ Specialized staff

THANK YOU AND FEEDBACK

Many thanks for your help in completing this survey!
If you want to add more information, please send us through Email (nguyen@bwl.tu-darmsadt.de)
If you are interested in receiving a summary of the survey results, please provide your email address

Appendix 7: Questionnaire of the cross-sectional survey with Vietnamese households
Code: 01/VN-HH

To whom it may concern!

Customer behaviors after purchase, e.g. exchanging and returning, and consumer behaviors of discarding products at the end of a useful life are increasingly paid more attention by manufacturing and trading firms in their reverse supply chain management, especially in the electronics industry. Electronic and electrical equipment discarded at the end of life may have negative effects on our environment and community health if they are not disposed and managed properly. This survey is conducted following the second objectiveof the research project "Development of Reverse Logistics, Adaptability and Transferability" to understand consumers' behaviors of returning and discarding electronic and electrical products in Vietnam.
Thanks in advance for your participation!

PART 1: Household information

1. Name: ....
2. The number of people in the your household:..
3. Estimated income of the household:..
4. Address:...

PART 2: Behaviors of discarding electrical and electronic equipment (EEE) at the end of life at Vietnamese household

5. Do you implement the classification of broken and used EEE at home?
   ☐Yes, we do
   ☐No, we don't
   ☐ Other, please specify...
6. What are the reasons for your classification of broken and used EEE at home?
   ☐Reselling for more income ☐Reusing and Recycling
   ☐Cleaning the environment ☐ Other, please specify: ....
7. How do you deal with broken and used EEE at home?

(1=repair and reuse, 2=sell to informal collectors, 3=sell to repair/secondhand shops, 4=give to other people, 5=in storage and disposal)

Types of EEE	1	2	3	4	5
Large household appliances (refrigerators, washing machine,...)					
Small household appliances (Cooking equipment, Fryers, Hair dryers)					
Information and telecommunication equipment (PCs, Mobile phones)					
Consumer electronics (Television sets, Radio sets, digital camera)					

8. Please describe electrical and electronic equipment being used in your household following the criteria:

Electronic and Electrical Equipment		Refrigerator	Washing machine	Television set	Radio and Stereo	Computer (PC and Laptop)	Mobile phone	Air conditioner
Quantity								
Brand name	(1) Vietnam brand name							
	(2) Foreign brand name							
Product type	(1)Imported products							
	(2)Produced or assembled in Vietnam							
Purchase type	(1)New purchase							
	(2)Secondhand purchase							

9. Do you concern in usage period of electronic and electrical equipment presently used in at home?
   ☐No concern ☐Concern
   ☐Little concern ☐Much concern

10. If there is a specific regulation that requires producers are responsible for collecting and recovering their electrical and electronic equipment at the end of life, do you agree to implement the classification and to deliver the products to the designated collection points for disposal?

☐Yes

☐No

☐ Other, please specify:..

11. Please evaluate the appropriateness of three options for the implementation of collecting electronic and electrical equipment discarded by households

	Options of collecting	Very unsuitable	Unsuitable	Suitable	Very suitable
1	Drop-off collection points				
2	Curbside collection				
3	"Old for New" program				

PART III: Customer behaviors of exchanging and returning electrical and electronic equipment after purchase

12. Which kinds of distribution channel do you buy electrical and electronic equipment?

☐Direct channel (Manufacturers' stores, marketing staff)

☐Indirect channel (Wholesalers, supermarkets, and retailer stores)

☐Online shopping

13. Do you frequently exchange or return electrical and electronic equipment after purchase?

	Behavior	Frequently	Sometimes	Rarely	Never
1	Exchanging				
2	Returning				

14. What are the reasons do you exchange or return electrical and electronic equipment after purchase?

☐Not meet customers' expectation (color, design, size)

☐Bad product quality

☐Not know how to function (complicated techniques)

☐ No specific reasons

15. Do you concern in companies' policies for exchanging and returning electrical and electronic equipment when purchasing them? (Conditions for returning or exchanging, days to return, financial responsibilities, and returns shipping fees)

☐No concern ☐Concern

☐Little concern ☐ Much concern

16. Do you have any comments of companies' attitudes and procedures for exchanging and returning electrical and electronic equipment? (1=very willing, 2=willing, 3=partly willing, 4=unwilling, 5=very unwilling)

	Activities	1	2	3	4	5
1	Returning products and being refunded					
2	Exchanging products without refund					

Thanks for your participation in our survey.

If you want to add more information or have any questions, please send us through Email (nguyen@bwl.tu-darmsadt.de).

Nguyen Thi Van Ha, PhD Candidate
TU Darmstadt, Germany

Appendix 8: Interview instructions for case study with four companies in the Vietnam electronics industry

Part	Main contents of in-depth interview	Note
Part 1	**Opening**	
	• Introduce interviewer and supporters	1 Interviewer
	• Introduce the main objectives of the interview	1 Supporter
	• Ask for record permission	No permission
	• Ask for observation in office and factory	No permission
	• Ask for making photos	No permission
	• Introduce some major terminology	
Part 2	**Demographic data**	
	• Position and responsibilities of interviewee • Company business and main products • Company business orientation • Company sales and employees (Estimated in 2010)	Logistics, Marketing, and Operation
Part 3	**Main questions**	
	• What types of returns are occurring in your company's daily business?	Main returns
	• What is the rate of returns in your company in general?	
	• How does your company conduct customer returns management process?	In average
	• Could you provide me some information about returns policies and rules in your company?	
	• Why does your company involve in customer returns management?	
	• Do you know the Article of extended producer responsibility in the Law on Environment Protection?	
	• Does your company implement product take-back and recovery for EoL returns from customers? How about the results?	**More questions asked**
	• What are the drivers and barriers for your company to implement reverse logistics for EoL management?	
	• How do you think about the reverse logistics management model suggested by MONRE (2008a)?	
	• What are the challenges for firms in the Vietnam electronics industry to implement EoL management?	

Appendix 9: List of firms and organizations mentioned in the thesis

Name used in the thesis	Full name	Origin	Products or Responsibilities	Websites
AEHA	Association of Electric Home Appliances	Japan	Ensure the obligations of Take-back and benefits of responsibility	www.aeha.or.jp
AEE	Association of Electronics Environment	Korea	Minimize the environmental pollution and maximizing the recycling	www.aee.or.kr
Acer Germany	The Acer Group (Acer Inc.,)	Taiwan	Electronics, Computer hardware/systems	www.acer.de
Alba	ALBA Group	Germany	Recycling, Waste Management, Recyclables Trading	www.albagroup.de
Alteco	Alteco Computer AG	Germany	Computer products and equipment	www.alteco.de
Anker Leschaco	The Leschaco Group (Lexzau, Scharbau GmbH & Co. KG)	Germany	Logistics service providers	www.leschaco.com
Appliances Recycling S.A	Appliances Recycling S.A	Greece	Take-back system provider (single)	www.sarecycling.com
BDE	Bundesverbandes der Deutschen Entsorgungswirtschaft	Germany	Federal Association of the German Waste Management Industry	www.bde-berlin.de
BITKOM	Bundesverband Informationswirtschaf, Telekommunikation und neue Medien e.V	Germany	Federal Association for Information Technology, Telecommunications and New Media	www.bitkom.org
Bocsh	Robert Bosch Hausgeräte GmbH	Germany	Home appliances	www.bosch-home.com
BSH	BSH Bosch und Siemens Hausgeräte GmbH	Germany	Home Appliances	www.bsh-group.com
BVSE	Bundesverbandes Sekundaerrohstoffe und Entsorgung	Germany	Federal Association for Secondary Raw Materials and Waste Management	www.bvse.de
Canon Europe	Canon Inc.	Japan	Cameras, and equipment of cameras	www.canon-europe.com
CCR Logistics	CCR Logistics Systems AG	Germany	Reverse logistics services provider	www.ccr-revlog.com
Cycleon	Cycleon B.V	Netherlands	Reverse logistics providers	www.cycleon-revlog.com
Datart	Datart International A.S	Czech Republic	Specialized seller of consumer electronics	www.datart.eu
DB Schenker	DB Schenker	Germany	Logistics providers	www.dbschenker.com
DHL	DHL Express (Deutsche Post AG)	Germany	Post delivery, express, package	www.dhl.com
DONRE	Department of nature Resources and Environment	Vietnam	Provincial Environment Management	www.donre.hochiminhcity.gov.vn
DSD	Duales System Deutschland GmbH	Germany	Take-back system provider	www.gruener-punkt.de
EAR	Stiftung Elktro-altgeräte Register	Germany	German National Clearing House	www.stiftung-ear.de

EARN	European Advanced Recycling Network	Germany	Take-back system provider (recycling network)	www.earn-service.eu
EC	European Commission	Europe	Coordination and Integration	www.ec.europa.eu
ECOTREL	ECOTREL ASBL	Luxembourg	Take-back system provider (single)	www.ecotrel.lu
EES-RINGLUS	EES-Ringlus system	Estonia	Take-back system provider (single)	www.esra.eesringlus.ee
EL RETUR	Elretur A.S	Norway	Take-back system provider (single)	www.elretur.no
Electrolux	AB Electrolux	Sweden	Home appliances	www.electrolux.com
ERP	European Recycling Platform	Germany Italy	Take-back system provider	www.erp-recycling.org
EPA	Environment Protection Administration	Taiwan	Administration of environment protection	www.epa.gov.tw
EPF	Vietnam Environmental Protection Fund	Vietnam	Management of environmental protection charges	www.vepf.vn
Euronics	Euronics International Ltd.	Netherlands	Electrical retailers	www.euronics.com
Exel	Exel Logistics	USA	Logistics providers	www.exel.com
France Telecome	France Telecom S.A	France	Fixed line, mobile phone, internet, IT services	www.francetelecom.com
Fujitsu-Siemens	Fujitsu Siemens Computers GmbH	Japan and Germany	IT products and solutions	www.fujitsu.com
Geodis	GEODIS GROUP	France	Logistics services	www.geodis.fr
GfK	Growth from Knowledge Group	Germany	Research company	www.gfk.com
GLS	General Logistics Systems B.V.	Netherlands	Postal services	www.gls-group.eu
GSO	General Statistics Office of Vietnam	Vietnam	State management of statistics	www.gso.gov.vn
Hermes Logistics	Hermes Logistics Group	Germany	Logistics Providers	www.hermesworld.com
HP Europe	Hewlett-Packard Company	USA	Computer hardware/software, IT services/consulting	www.hp.com/uk/
IBM	International Business Machines Corporation	USA	Computer hardware/software, IT services/consulting	www.ibm.com
ICT Milieu	ICT Milieu (ICT Environment)	Netherlands	Take-back system providers (single)	www.ictoffice.nl
ISPONRE	Institute of Strategy and Policy on Natural Resources and Environment	Vietnam	Forecast and strategy formulation of environment management	www.isponre.gov.vn
Kodak Europe	Eastman Kodak Company	USA	Digital imagining and photographic materials	www.kodak.com
Kuehne + Nagel	Kuehne + Nagel International AG	Switzerland	Logistics providers	www.kuehne-nagel.com
LOGEX System	LOGEX SYSTEM GmbH & Co. KG	Germany	Take-back system provider (recycling network)	www.logex.de
Lexmark	Lexmark International, Inc.	USA	Printers, Scannesr, Printer ink	www.lexmark-europe.com
Mediamarkt	Media-Saturn Holding GmbH	Germany	Retailer of consumer electronics	www.mediamarkt.com

Miele	Miele & Cie. KG	Germany	Domestic appliances and commercial equipment	www.miele.com
MOI	Ministry of Industry and Trade	Vietnam	Management of Tndustry and Trade	www.moit.gov.vn
MOC	Ministry of Construction	Vietnam	Management of construction works	www.moc.gov.vn
MOH	Ministry of Health	Vietnam	Management and guidance of the health, health care and health industry	www.moh.gov.vn
MONRE	Ministry of Natural Resources and Environment	Vietnam	Management of environment, air, land, water resource, and waste	www.monre.gov.vn
MOT	Ministry of Transport	Vietnam	Governing rail transport, road transport, and water transport	www.mt.gov.vn
MPI	Ministry of Planning and Investment	Vietnam	State management of planning and investment	www.mpi.gov.vn
Nokia	Nokia Oyj	Findland	Mobile phone, smartphones, mobile computer, networks	www.nokia.com
NVMP (Wecycle)	NVMP Foundation	Netherlands	Take-back system provider (single)	www.wecycle.eu
Océ	Océ AG	Netherlands	Photocopier, Printers	www.global.oce.com
OECD	Organization for Economic Cooperation and Development	France	Stimulate economic progress and world trade	www.oecd.org
Otto	Otto GmbH & Co. KG	Germany	Online retailers	www.otto.com
Philips	Royal Philips Electronics	Neiherlands	Consumer electronics, domestic appliances	www.philips.com
Rank-Xerox (Xerox Europe)	Xerox Corporation	USA	Information Technology	www.xerox.com
RECUPEL	RECUPEL Asbl.	Belgium	Take-back system provider (single)	www.recupel.be
Reclay	Reclay Holding GmbH	Germany	Reverse logistics providers, recycling, waste management	www.reclay-group.com
Remondis	Remodix AG & Co. KG	Germany	Waste management & recycling	www.remondis.de
RENE EUROPE	European Recovery and Recycling Networks	Germany	Take-back system provider (recycling network)	www.rene-europe.com
Rhenus Logistics	Rhenus AG & Co. KG	Germany	Logistics service providers	www.rhenus.com
Safeway	Safeway Inc.	USA	Supermarket chain	www.safeway.com
SENS	SENS recycling system	Switzerland	Take-back system provider (single)	www.sens.ch
Siemens	Siemens GA	Germany	Communication system, power generation, medical technology	www.siemens.com
SITA	SITA Deutschland GmbH	Germany	Recycling and resource management	www.sita-deutschland.de
SNI Germany	Siemens Nixdorf Information System	Germany	IT System developer	www.siemens.com
Sonny	Sony Mobile Communi-	Japan	Mobile phones, mobile	www.sonymobile.com

	cations AB		music devices, wireless system	
Suez Environment	FONDS SUEZ ENVIRONNEMENT INITIATIVES	France	Environmental services, recycling, waste management	www.suez-environment.com
SWICO	SWICO recycling system	Switzerland	Take-back system provider (single)	www.swicorecycling.ch
TNT	TNT Express N.V	Netherlands	Express, package, post delivery services	www.tnt.com
URENCO	Urban Environment Company	Vietnam	Waste treatment and management	www.urenco.com.vn
UNIDO	United Nations Industrial Development Organization	United Nations	Improve living conditions of people and promote for sustainable development	www.unido.org
Wincanton	Wincanton company	UK	Logistics service provider	www.wincanton.co.uk
VEA	Vietnam Environment Administration	Vietnam	Administration of environment	www.vea.gov.vn
VEIA	Vietnam Electronic Industry Association	Vietnam	Support and guidance for electronics firm	www.veia.org.vn
ZENTEK	Duales Zentek System	Germany	Take-back system provider (recycling network)	www.zentek.de

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Declaration of Honor

I hereby confirm on my honor that the doctoral thesis submitted herewith is my own work.

All resources and aids that are used in my dissertation have been cited according to the rules for academic work and by means of footnotes or other precise indications of source.

The academic work has not been submitted to any other examination authority.

Hiermit melde ich mich bei meiner Ehre, zu bestätigen, dass die vorliegende Arbeit selbständig angefertigt habe.

Alle Ressourcen und Hilfsmittel, die in meiner Dissertation verwendet werden, sind nach den Regeln für die wissenschaftliche Arbeit und durch Fußnoten oder andere präzise Herkunftsangaben zitiert worden.

Die wissenschaftliche Arbeit hat keiner anderen Prüfungsbehörde vorgelegt worden.

Darmstadt, August 25, 2012

Nguyen Thi Van Ha

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