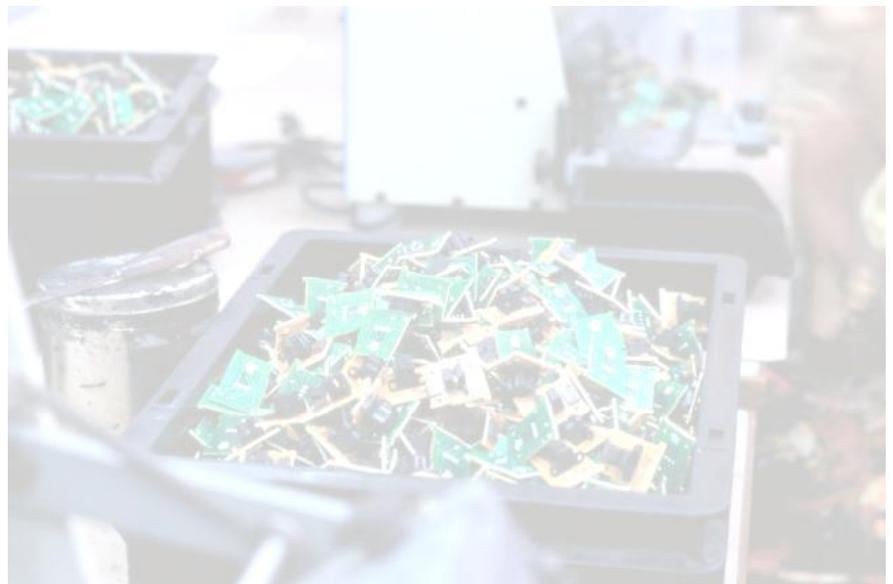# Exploiting improvement potential in managing reverse logistics

Trends and management practices in the European consumer electronics industry

Thesis Industrial Engineering and Management

B.J.M. Janse
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University of Twente
Enschede - The Netherlands

PRICEWATERHOUSECOOPERS

Exploiting improvement potential in managing reverse logistics

Trends and management practices in the European consumer electronics industry

Report of a graduation project, conducted from September 2007 till April 2008

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Executive summary

The consumer electronics market, more specific to IT & telecommunication and consumer equipment products, is changing in Europe. Consumers become more powerful, shortening product development cycles, supply and demand market become more global and increased use of outsourcing and off shoring of production activities. All trends have a direct impact on the movement of goods throughout the supply chain, and particularly on reverse flows. The existence of these flows generates the need for strategic decisions in the management of the supply chain. Further research directed at analysing the strategic aspects of reverse flows is needed.

In the Netherlands PricewaterhouseCoopers (PwC) is currently expanding its advisory services into the area of the supply chain. Fuelled by requests from its clients PwC did decide to start a research project on reverse logistics in the consumer electronics industry. To execute this project more scientifically PwC did offer the assignment as a graduation project to the University of Twente. As a student Industrial Engineering and Management I decided to involve in this research due to the fascinating topic and a previous working experience in the consumer electronics industry. This report is the result of the graduation assignment carried out parallel to the PwC project. Both projects started in September 2007 and lasted until April 2008.

In the European Union (EU) several Directives are in place, which make a producer of consumer electronics responsible for a product throughout its life cycle, including the disposal at the end-of-life. This induces us to take a producer view for our research. Review of existing literature furthermore illustrates the need for more holistic research on reverse logistics. We envision our findings to provide more insight in managerial implications for producers in managing reverse logistics that, in part, satisfy this need.

Considering the background of the research and the addressed need for further research, we create value to both PwC and the University of Twente by answering the following research question:

> *What does facilitate producers of consumer electronics to improve managing reverse logistics in the EU?*

To answer this question we carried out the research in the following phases: orientation, analysis I and II, design I and II and verification.
- Orientation: During the orientation phase, we shaped the literature landscape of reverse logistics (Chapter 2) and of business improvement in the supply chain (Chapter 3).
- Analysis I: With desk research and expert interviews we analysed trends, barriers and success factors in reverse logistics management (Chapter 2), together with available process-oriented reference models relevant for reverse logistics (Chapter 3).
- Design I: Validated by experts, we designed separate surveys for producers, retailers, logistics service providers (LSP) and service & repair companies (SR) (Appendix G).
- Analysis II: Outcomes of the surveys resulted in exploratory analysis of current reverse logistics in the EU (Chapter 4).
- Design II: As a result of our field visits and a round table session we observed a gap in literature for an appropriate reference model. Therefore we designed a new reference model that forms a part of the diagnostic model (Chapter 5). To enable competitive benchmarking we applied a first step of the Analytical Hierarchy Process (AHP) technique to distil focal points for producers (Chapter 6).
- Verification: Finally, managers verified strategic aspects of the diagnostics model (Chapter 5) and an industry interview validated the hierarchic structure of our AHP (Chapter 6).

Literature landscape
In literature, the terms reverse logistics and reverse supply chains are often used interchangeably, though reverse logistics can be regarded as a sub-process in reverse supply chains. Also the terms circular and closed loop supply chain are often found, both meaning the recovery of assets in the original and alternative supply chain.

For this study we use the following definition for reverse logistics: *The process of planning, implementing, and controlling flows of in-process inventory, and finished goods, from a manufacturing, distribution or use*

point to a point of recovery or point of proper disposal. Our European focus and agreement with the broad scope of reverse logistics are main arguments to use this definition.

Customers, employees, shareholders, suppliers, non-governmental organisations and the government each have a different interest in reverse logistics performance. In this view, senior management is responsible for the supervision of all stakeholder views, and shareholder's interest. After transportation and food consumption, the consumer electronics industry appeared as the third biggest source of environmental footprint. By actively managing reverse logistics a company can react to challenges facing society in terms of environmental and social concerns. Examination of business strategies revealed relationship between reverse logistics and design and development, production, marketing and post-sales service strategies. All interact strongly in determining the profitability of a product during its life cycle, fuelling the complexity in decision-making in the area of reverse logistics.

According to the contingency theory, companies must fit their changing environment so that effectiveness can be maintained. From a producer perspective, literature showed developments related to the field of external stakeholders and related to the internal playing field. This reinforces the need to further investigate trends and developments that cause challenges in managing reverse logistics. Next, managerial implications evolve from the many transactions in the reverse supply chain that call for strategic decision making. Review of recent literature on barriers to successfully manage reverse logistics exposed a variety in manageable topics. This reinforces the relevance to further investigate challenges in the current environment of producers.

Literature describes ways to define opportunities for performance improvement in the context of the supply chain. Self-assessment distinguishes from other approaches by the practical usefulness in identifying those areas that are most critical to success, and the focus on improving performance in these areas. It begins by analysing the structure of the supply chain and mapping supply chain processes. Examination of available reference models brought forward that the Supply Chain Operation Reference Model (SCOR) and the Global Supply Chain management Forum (GSCF) model were most appropriate for this study. Both include detailed process descriptions for reverse logistics, though the SCOR model mainly focuses on the functions of purchasing, manufacturing and logistics and the GSCF model includes also the functional areas of research and development, marketing, finance and service. Maturity stages comprise another key component for self-assessment. Such stages describe in a few phrases the typical behaviour exhibited by an organisation at a number of levels of maturity.

Making comparisons of management practices between actors in the same industry can be used as a technique to increase understanding what is required to improve performance. In literature the analytical hierarchy process (AHP) is renowned for its flexible and easily understood way for structuring complicated situations, and providing a basis for analysing key performance areas. The AHP applied for comparing management practices provides the basis for deciding what enables superior performance in these key performance areas.

Field research

To investigate management practices we used multiple sources for data collection and verification: 22 expert interviews, 42 exploratory surveys, 5 field studies, 7 pair-wise comparison surveys, and 1 round table session. We made use of single-sector surveys with 4 focus groups: producers, retailers, Logistics Service Providers (LSP) and Service & Repair companies (SR). The rationale to make use of these sources lies in the following findings in current literature:

- Less than 5% of reverse logistics articles published between 1995 and 2005 used a survey methodology
- Several opportunities are argued for survey-based research along all tiers of the reverse supply chain
- Field studies provide an opportunity to ask into more detail allowing further exploratory investigation

In total we sent surveys to 112 producers, 18 retailers, 20 LSP and 10 SR companies. By the end of February 2008, we received input from managers representing 22 producer, 5 retailer, 10 LSP and 5 SR companies. These numbers indicate response rates of respectively 19.6%, 27.7%, 50% and 50%. Across respondents the annual sales volume ranged from 3.3 million to 50 billion euros in the most recent fiscal year. Their input we integrated with findings of 5 field visits, in which we held full-day interviews with managers representing multinational producers in Germany, the United Kingdom and the Netherlands.

From a producer perspective, this study reveals that complexity in managing reverse logistics evolves from perceived barriers and success factors, but also from the pressure to fit contingencies in the changing environment. We capture our key findings in the following figure.
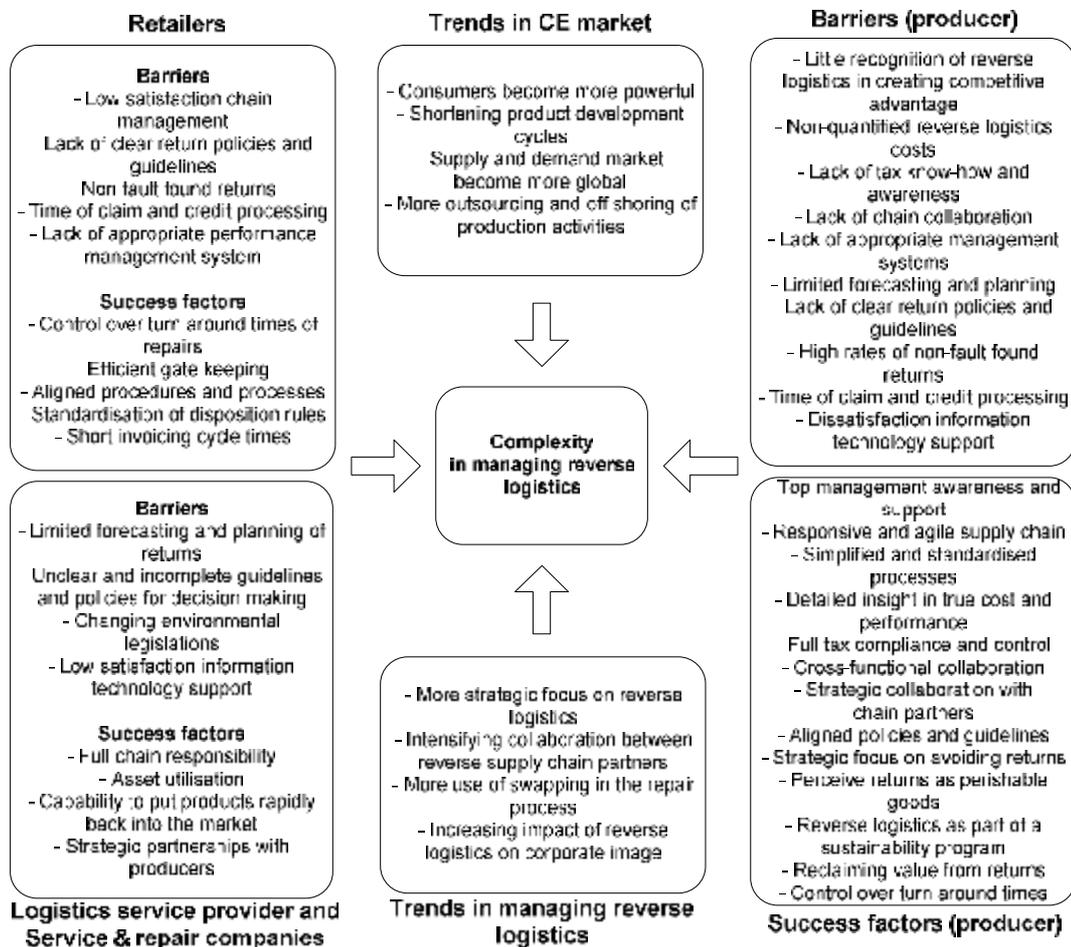

Diagnostic model

In our search for an appropriate reference model that matches the practices we studied, we run across limitations of our 'best fit' SCOR model and the GSCM framework. In our opinion a number of strategic aspects have been undervalued in these models in respect of capturing the 'as-is' state of reverse logistics management of a producer. We integrated our field research with current literature to substantiate the aspects which we propose to be relevant for our conceptual reference model. Most notable ratifications and additions include:

▪ *Product life cycle management*
We found that product life cycle management was used in a number of field studies as starting point in strategy formation for their reverse supply chain business model.

▪ *Reverse supply chain strategy*
45% of producer respondents indicate to have a reverse logistics strategy.

▪ *Closed loop management*
Interviewees indicate to actively manage reverse logistics with closed loops as leading principle, making a distinction between loops in the original and alternative supply chain.

▪ *Return acquisition*
The producer survey indicates that 23% of respondents have taken initiatives to increase the volume of returns in the last two years.

- *Tax planning (more specific value to added tax and customs)*
  Optimal tax structuring can provide significant cost benefits, and our field studies revealed that reverse supply chain managers are limited aware of this.
- *Swap management*
  Increasing use of product and component swapping brings along an extra dimension in inventory and spare part management.
- *Re-marketing*
  We observed practices proactively creating demand and generating higher sales prices by re-marketing.
  Performance management
  Non-quantified cost came forward as a main barrier to successfully manage reverse logistics. A worrying 34% of producer respondents indicate to have insight in cost related to reverse logistics management.

In our conceptual reference model we capture these aspects and place them between sender / giver of the product and future customer or disposer.
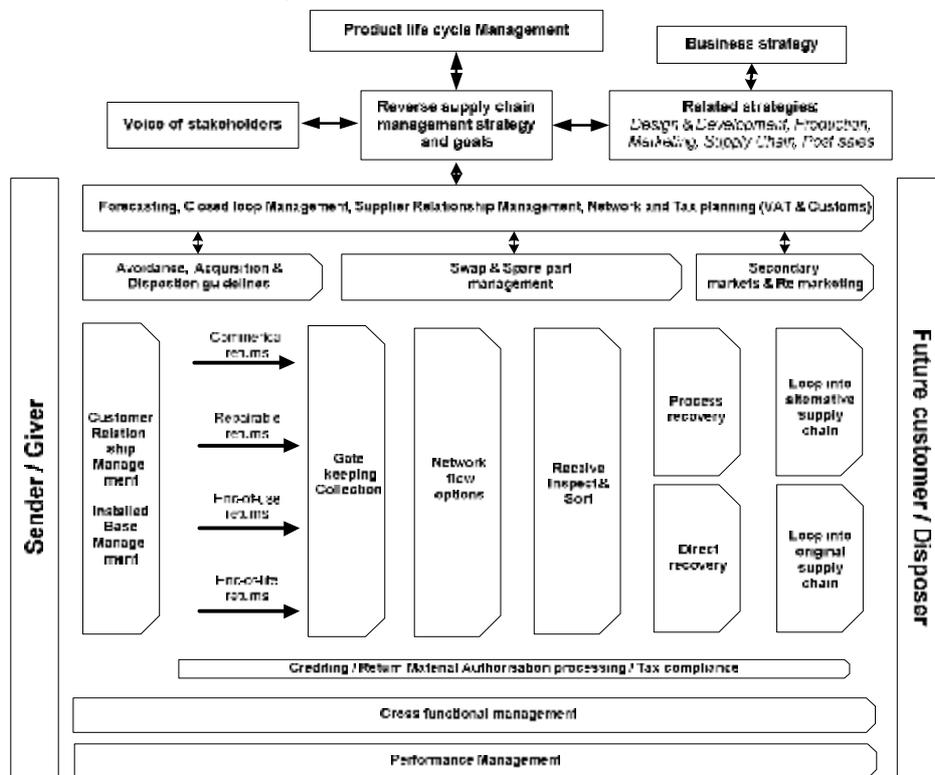

The usefulness of this model lies in combining numerous situational factors in managing reverse logistics in the consumer electronics industry. Hence, we used the model to determine relevant aspects to identify differences in maturity for reverse logistics management. For the maturity stages of these aspects we put profiles that a producer would recognise as descriptions of current practice.

Recommendations

From the field research we distilled various improvement actions to consider that we reproduce in a model on the next page. From a comprehensive view we cover the dimensions strategy, process, structure, people and technology.

We applied the analytical hierarchy process technique to facilitate prioritising these actions by calculating relative importance of identified success factors. To increase stakeholder value our expert panel gives relative high importance for the success factors *sustainable business model*, *responsive and adaptable chain* and *avoidance and gate keeping*. In ratification of the AHP technique, we believe that prioritising these improvement actions not only depends on the contribution of an action to achieve superior performance for

a success factor. In our view must the ability to reduce complexity in managing reverse logistics be another dimension. We relate complexity to managerial implications evolving from developments, barriers and success factors that this study revealed. Therefore we recommend producers to determine their individual urgency of improvement actions by means of two dimensions: contribution to critical success factors and the ability to reduce complexity.
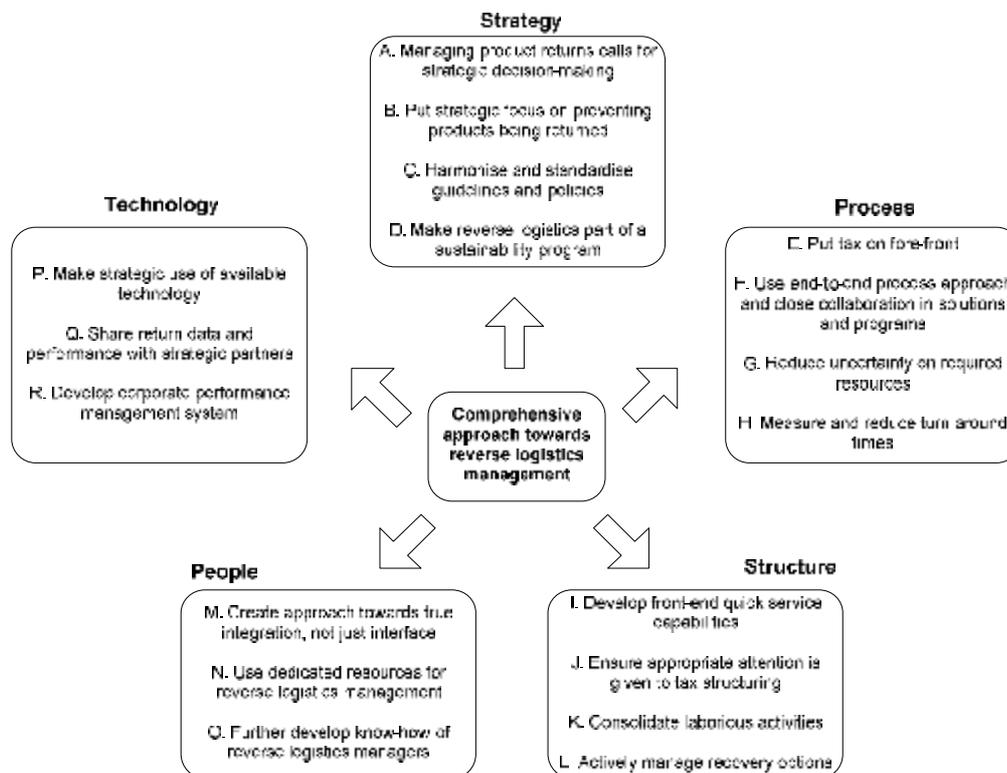
In addition, we give a number of general recommendations to producers to improve managing their reverse logistics.

- Critical start is to define the current internal situation. Identify the improvement areas and quantify the increase in stakeholder value thereof. The diagnostic model presented in this thesis can be used to create awareness of the 'as-is' state at senior management.
- Managing reverse logistics is not the activity of just one department or actor in a supply chain. In order to optimise the end-to-end chain, collaboration of all relevant departments (from research & development to finance / tax) and channel partners is fundamental in realising improvements.
- Proactively managing the entry points of the reverse supply chain. Preventing avoidable returns is a main focus area. Clear warranty conditions, harmonised and standardised return policies are basics. Measuring and rewarding avoidance initiatives can increase the predictability and manageability of products being returned.
- Reveal true costs, revenues and end-to-end performance. Visibility in 'clear' costs such as costs of rework, processing customer complaints, warranty claims and product recalls, is a first step. Extending the profit and loss account with 'hidden' cost, e.g. opportunity tied up in returns, cost of tax compliance and control, advances the insight in expenditures.

In this research interesting topics had to be scoped out. We provide a number of suggestions for further research.

- Very little literature, if any, is available on optimising reverse logistics jointly from a tax and operation perspective. We can imagine that, for example, compliance and control risk related to value added tax and customs can be variables in network design studies.

- Our success factors fully correspond to enablers that are part of the performance management approach suggested by European Foundation for Quality Management (EFQM). This calls for further research on applicability of the EFQM excellence model in reverse logistics.

- Further investigation is needed on our conceptual reference model, aiming to increase external validity by consensus on the relevance of our situational factors.

Finally, this research has its own limitations. The most notable include:

- The explicit focus on only one industry, the consumer electronics industry, presents limitations to the generalisation of the findings. Examining similar research questions in more industries should be considered.

- We deal with producers, retailers, logistics service providers and service and repair companies but do not consider other stakeholders, such as end-consumers and non-governmental organisations. Other papers consider a retailer or customer point of view more specifically. Thus, our work is complementary to these papers.

- The field research selected participants for the research for which we knew in advantage that they had knowledge on reverse logistics (judgmental sampling). This may not agree with true sample population.

In summary, the breadth of this research has resulted in a variety of concrete actions to consider and in general recommendations for producers. The designed audit scheme and management tool are direct applicable in practice and enable producers to prioritise both performance areas as well as improvement directions.

Acknowledgement

This report is the end result of my graduation thesis which I carried out for PricewaterhouseCoopers Operational Excellence, part of PwC Advisory Netherlands. With this thesis, I conclude the logistics track of the study Industrial Engineering and Management at the University of Twente. In my opinion is the result a report that grips your attention with an interesting research on an even more interesting topic. I hope that you will share this opinion with me after reading it.

The project started at the 17th of September and lasted until the 31st of March. I would like to take this opportunity to thank a number of people, for the support I received and the great time the project has been. First, I would like to thank PwC for giving me the opportunity to conduct this research. Especially I want to express my thanks to Hubert Verweij, who initiated the project from the very beginning and put huge effort in facilitating the research until the final end. Together with Nga Dang and Germaine Bonney he gave me a lot of new understandings and directions that were beneficial for a better process and result of the research. I am convinced that for all of us the research provided useful knowledge that we can use for many projects in the future.

From a methodology, guidance and support perspective my supervisors Peter Schuur and Marisa de Brito helped me to close doors and to structure my research. Peter provided me very helpful feedback, with clear vision on structuring and reporting, and actively participated in the round table session. As a subject matter expert gave Marisa a lot of new insights and directions, but always stressing to focus. Supervision from two universities converged into a fruitful collaboration and, in my opinion, even a unique thesis. I have experienced both of them as great persons, and I will remember our joyful chats and pleasant meetings.

In this opportunity I would also like to thank my other colleagues at PwC. Their enthusiasm and discussions on overlapping topics helped me further understand the content. But above all, for the enjoyable lunches, drinks and events we had together. This relieved me not to think about my thesis at certain times.

Finally, my word of thanks goes out to my relatives and friends. Their support and understanding, even from far away countries, kept me motivated in these busy times.

Pleasant readings,

Enschede, Amsterdam, Haarlem

Bastiaan Janse

May 2008

Index

List of figures

List of tables

1   The research assignment

This section describes the reason for the research. First, the background of the research provides insight in objectives in the project for PricewaterhouseCoopers (PwC). Second, we determine the objective for the graduation project based on the objectives set by PwC. In order to fulfil the research successfully, a clear delineation of the study is needed, together with a research framework to provide a structured backbone for the research process.

1.1   Background of the research

Fuelled by requests from clients decided PwC to start a multidisciplinary study, both tax and supply chain perspective, on reverse logistics practices in the European Consumer Electronics (CE) industry. Reverse logistics is defined by the European working group on reverse logistics (2002) as: *The process of planning, implementing, and controlling flows of raw materials, in-process inventory, and finished goods, from a manufacturing, distribution or use point to a point of recovery or point of proper disposal.* Knowledge on this topic had to build up from scratch, because advisory services just recently had expanded into the area of the supply chain. Unable to perform the study scientifically, PwC requested help for the project.

1.1.1   History

Many companies adopt industry best practices to stay competitive. A company's capacity to flourish depends in part on the ability to capture and embed best practices from within and outside the company (*Gratton and Ghosal,* 2005*)*. The business unit Operational Excellence of PwC Advisory helps organisations to improve performance and to deal with strategic and operational challenges. Broad knowledge has been gained in the areas of, amongst others, post merger integration, shared services and organisational design. Lack of experience concerning reverse flows in the supply chain caused limited insight in best practices for managing reverse logistics. Via a research project PwC aimed to close this gap. We decided to involve in the project, when exploratory analysis of literature revealed positive signals on need for further research (*Rubio* et al. 2006) on the topic, and relevance of the targeted industry as one the key sectors of reverse logistics developments (*Fleischmann* et al. 2004).

1.1.2   Today

Many companies struggle with the question how to translate their mission into Key Performance Indicators (KPI) that give them insight in their performance and control over their processes. Management consultants like PwC can help companies to achieve this control by a combination of asking the right questions, identifying the improvement potential, transferring knowledge and implementing improvement methodologies. *Guide et al.* (2003) argue that managers are unaware of opportunities for improving and measuring performance of reverse logistics, and just start to recognise and understand the value of product returns. As mentioned by *Herold* (2004) performance measurement is rated important by many companies, but had limited academic attention. From these articles the idea rose to set up the graduation project to explore relationships between competitive strategies, processes and management practices used in reverse logistics.

1.1.3   Future

Quite some literature can be found that focuses on strategic questions in reverse logistics (*Rubio* et al. 2006). However, review of existing literature showed that little is published on a holistic approach towards reverse logistics practices. *Verstrepen* et al. (2007) and *Bernon* et al. (2007) both stress the need for more holistic research. Therefore we envision our findings to provide more insight in managerial implications that in part satisfy this need. Furthermore, for PwC is a scientific research a unique opportunity to market their expertise, and to increase their expertise in supply chain management. Experience gained from this research can be used as take-off for more consulting services, possibly also in other industries where reverse logistics is an important issue (e.g. Car industry (*Alvarez-Gil* et al. 2006); Carpet industry (*Biehl* et al. 2007); Non-for-profit organisations (*Alshamrani* et al. 2007)).

1.1.4   PwC objectives

Before start of the project, PwC defined objectives for the research project, which were translated in the following research questions (*PricewaterhouseCoopers*, 2008):

A. *"What are the major trends, developments and challenges that supply chain & tax/accounting managers are facing concerning reverse logistics?"*
B. *"How do organisations, within the consumer electronics supply chain, perform reverse logistics? What are their main bottlenecks and who are 'world class' performers?"*
C. *"What are our recommendations to improve reverse logistics"*
D. *"How could PwC support her clients in realising reverse logistics excellence?"*

The main objective can be summarised as:

"Perform an academic & multidisciplinary study on reverse logistics within the 'Consumer Electronics' supply chain and translate the outcomes into a 'PwC RL Best Practice Framework' including a quick scan tool and an improvement methodology."

Mainly objectives A, B and C were the take-off for developing the research objective, strategy and questions for this thesis.

1.2   Research objective

Considering the background of the research and the identified needs in academic literature, we create most value by the following research objective:

Facilitate producers of consumer electronics to identify and exploit opportunities for improvement in managing reverse logistics in Europe.

Some terms we briefly explore to clarify the objective.

- A producer is someone who manufactures and sells under its own brand, resells under its own brand or import goods into EU member states (Directive 2002/96/EC);

- Main focus on categories within the consumer electronics lies on the *IT & telecommunication equipment* and *Consumer equipment* category (see **Figure 1.1**). Categories such as defined by the Directive 2002/96/EC of the European Commission.

To refine the general objective, we formulate a number of sub-objectives:
- Identify major trends and developments in reverse logistics and in the CE industry that have impact on reverse logistics
- Determine improvement opportunities in managing reverse logistics
- Develop a tool to exploit improvement potential in managing reverse logistics

Practical usefulness is an important aspect for PwC in all of the sub-objectives.

Dekker et al. (2004) distinguishes three categories for reverse logistics literature: Supply chain management, production and planning management and management of the recovery and distribution of end-of-life products. With this thesis we aim to contribute mainly to the stream of supply chain management issues in reverse logistics, although it has also some common ground with the other two categories.

The sub-objectives are translated into several research questions. The answers to the research questions form the solution for the problem formulation.

I.   *What complexity does literature describe for managing reverse logistics? (Chapter 2)*
- *What does current literature identify as reverse logistics?*
- *What added value for managing reverse logistics is identified in literature?*
- *What corporate objectives does literature describe that are influenced by reverse logistics operations?*
- *What major trends and developments in reverse logistics are described in current literature?*
- *What main implications and trade-offs in managing reverse logistics are described in literature?*

II. What does literature describe to be evaluated to identify and exploit improvement potential in managing reverse logistics? (Chapter 3)
- *What does current literature describe for business improvement in the supply chain?*
- *What approach for identification of improvement potential for managing reverse logistics can be taken?*
- *What technique can be used to exploit improvement potential of managing reverse logistics?*

III. What management practices related to reverse logistics are used in the CE market in the EU? (Chapter 4)
- *What main trends in the CE market cause implications for managing reverse logistics?*
- *What complexity are supply chain managers experiencing with managing reverse logistics?*
- *What are critical success factors for supply chain managers in managing reverse logistics?*

IV. What does facilitate identifying improvement potential in managing reverse logistics? (Chapter 5)
- *What situational factors can be used for diagnosing strategic aspects of reverse logistics?*
- *What are the levels of maturity for situational factors related to strategic aspects of reverse logistics?*
- *What is the usefulness of the diagnostic tool in practice?*

V. What does facilitate exploiting improvement potential in managing reverse logistics? (Chapter 6)
- *What model can be used to exploit improvement potential of reverse logistics?*
- *What is the usefulness of the designed model in practice?*

VI. What recommendations can be given to producers in managing reverse logistics? (Chapter 7)
- *What general recommendations can be given for managing reverse logistics to producers in the CE industry?*
- *What suggestions for further research can be given?*

These questions will generate the answer to the general problem formulation:

"What does facilitate producers of consumer electronics to improve management of reverse logistics in the EU?"

The answer will be reproduced in the following deliverables:
- Exploratory analysis management practices
- A diagnostic framework
- A management model

1.3   Research scope and delineation

In the consumer electronics industry creates the combination of huge market volume, short product life cycles, and a potential of repair processes results in a large potential supply for reverse logistics (*Fleischmann*, 2004). Product-market characteristics are relevant for design of reverse supply chain (*Krikke* et al. 2003), which is one of the many reasons that we find it relevant to structure the consumer electronics industry. **Figure 1.1** indicates on which products our main focus lies. A further delineation is taken by the focus on <u>finished goods</u>. Semi-products, carriers, packaging are not excluded from the study, but no specific attention is put on them.

Several regulations set by the European parliament are in force in the CE industry, directly influencing need and importance of reverse logistics. Such regulations are in force in all member states of the European Union, so we take the same geographic scope. Countries outside the EU are not excluded from the study, but key attention is put to EU member states. The research is executed by order of PwC Netherlands. Existence of business contacts within the Netherlands and its surrounding countries has resulted in the fact that the study mainly reflects the Western European situation.
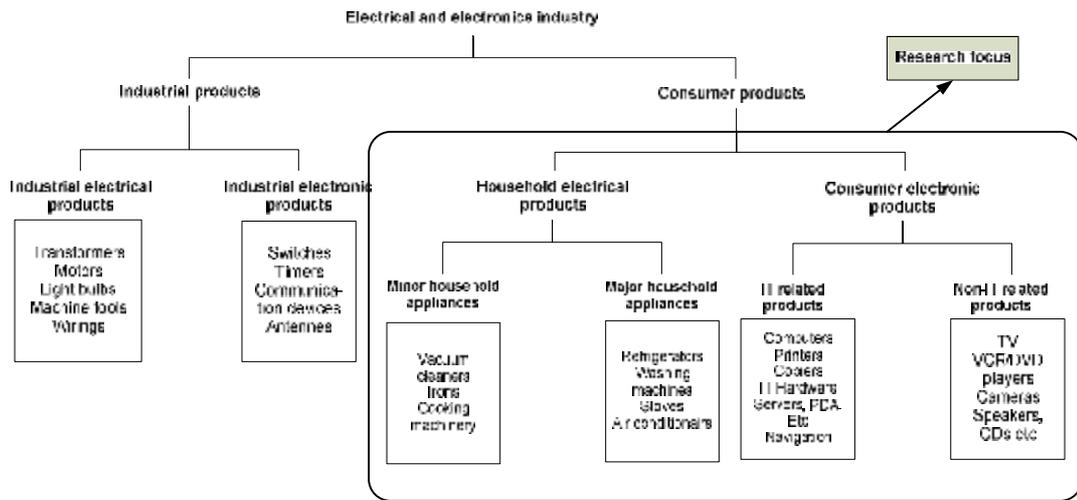
Figure 1.1: Consumer products in the electrical and electronics industry (Adapted from *Yellepeddi*, 2006)

1.4   Research approach

The research model structures the research activities, as it shows the logic steps during the research. We composed our research model based on literature of *Verschuren and Doorewaard* (1998). In the model a distinction is made between empirical data collection (uncolored ellipses), theoretical research (blue squares), data analysis (green squares) and modeling and verification (uncolored squares).
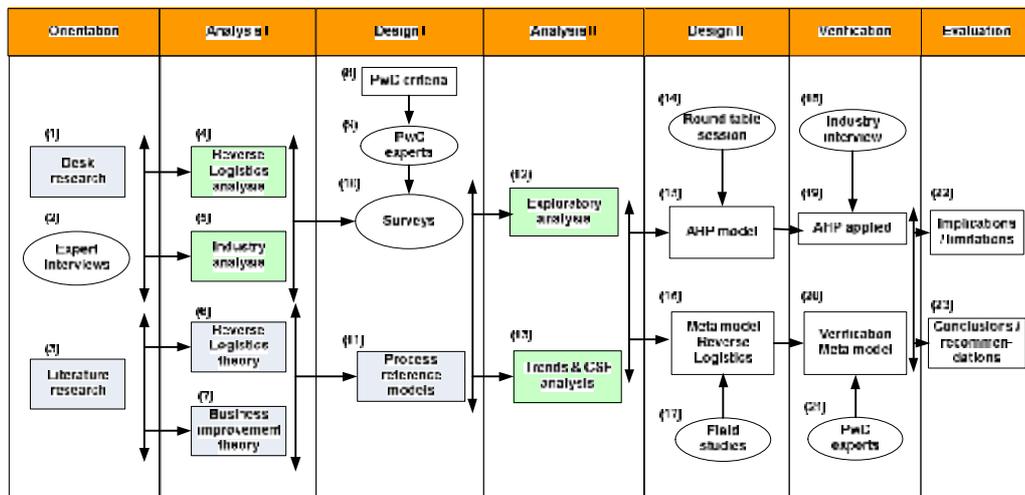
Figure 1 2: Research model

Orientation
In the orientation phase high level knowledge on the consumer electronics industry and reverse logistics practices is collected (1), main trends and developments within reverse logistics are discussed (2) and reverse logistics literature (3) is reviewed **(Chapter 2)**

Analysis I
An analysis of trends and developments, success factors, and bottlenecks for reverse logistics is performed (4) **(Chapter 2)**, complemented with an analysis of trends and developments in the CE industry (5). Literature is reviewed on strategic aspects that the existence of reverse flows generate in supply chain management (6), and literature on business improvement and methodologies applicable in supply chain management (7) **(Chapter 3)**.

Design I
The surveys (10) are constructed based on PwC criteria (8) and with help of PwC experts (9) that previously designed surveys. Various frameworks and publications are reviewed in order to identify applicable process reference models (11) (**Chapter 3**).

Analysis II
The output of the surveys provides exploratory analysis of reverse logistics in EU (12) (**Chapter 4**) and insight in t critical success factors for specific parts of the reference models (13) (**Chapter 5**).

Design II
Suggestions are made for executive level critical success factors related to the diagnostic management tool (15) and verified in a round table session (14) and applied to a case organisation (18) (**Chapter 6**). Next, field studies (17) triangulate the exploratory analysis in the design of the meta-model (16) (**Chapter 5**).

Verification
The meta-model is verified with PwC experts (21) (**Chapter 5**) and limitations and implications (17) of the AHP model we discussed with a case organisation (18) (**Chapter 6**).

Evaluation
We draw general conclusions and provide recommendations (23), together with evaluation of limitations and implications (22) of our research (**Chapter 7**).

1.5   Research strategy

Supply chain management uses a variety of research approaches and strategies. Qualitative case studies have become a more and more popular research strategy in business logistics literature (*Spens* and *Kovacs*, 2006). The logical reasoning of this thesis includes both abductive and inductive elements. Both start from an empirical observation. Inductive reasoning generalises based on the empirical observations, whereas abductive reasoning searches for the most appropriate explanation for the observations (*Spens* and *Kovacs*, 2006). Both inductive and abductive reasoning are recommended for studies where the objective is to improve understanding of a phenomenon with limited previous research (*Dubois* and *Gadde*, 2002). Literature review of *Rubio* et al. (2006) concluded that research on reverse logistic is to be directed at strategic aspects of reverse logistics.

Multiple sources enabled data collection and verification of results: internal and external expert interviews, descriptive surveys, field studies and a round table session. *Rubio* et al. showed that survey methodology was used in less than 5% of reverse logistics articles published between 1995 and 2005. *Prahinski* et al. (2006) argue that there are several opportunities for survey-based research along all tiers of the reverse supply chain.

1.5.1   Expert interviews

For this research the expert population is chosen to be a mixture of industry, science and consultancy. In the *orientation* phase, we collected accumulated knowledge of several internal (PwC) experts in the area of corporate performance management, consumer electronics industry and supply chain management. This input helped in the preparation for interviews with external experts. The list of internal and external experts is presented in **appendix A**. For each interview the goal and related stage in research process is indicated.

Advantages of face-to-face interviews are the possibility to deal with queries about the meaning of a certain question, to correct a misunderstood question and to encourage respondents to provide deeper responses to open questions (*Brace,* 2004).

One of the main disadvantages of face-to-face interviewing is the cost of obtaining a sufficiently representative sample of the survey population. A survey population is the totality that the sample is to represent (*Dorefeev* and *Grant*, 2006). Resource restrictions force to pick few experts, chosen on their competence (consultants), their role within reverse logistics (industries) and related publications (science). Next to these criteria, more constraints for the panel comprise of the existing and non-existing business

contacts of PwC and simply the refuse to cooperate in a research. During the *orientation* phase we interviewed 13 experts, during *analysis* I and II 4 interviews and during *verification* 5 experts.

1.5.2   **Descriptive web-based surveys**

In addition to our main focus group producers, we selected three actors in the reverse supply chain as focus groups for data collection: Logistics Service Providers (LSP), retail chains, and service & repair companies. These are selected by their direct role in managing reverse logistics and direct relation to producers. Incorporating the main Service & Repair companies within the CE industry (e.g. Flextronics, Jabil) brings along a link to Original Equipment Manufacturers (OEMs) / Original Design Manufacturers (ODMs) who actually manufacture the products. We recognise that not incorporating end-consumers as a focus group is the biggest gap in our study. A study on consumer requirements and expectations for returning products would be a very valuable and an important direction for future research.

Each focus group we sent a different survey. 'The Guide' (PwC) provided a basic frame, consisting of five high level attributes: *Strategy, Structure, Process, People and Technology*. These dimensions facilitated to study organisations in a comprehensive manner (see **appendix F**). The content of the *producer* survey is based on four sources: previously used surveys in reverse logistics (a.o. *Rogers* and *Tibben-Lembke*, 1998 and *Yellepeddi*, 2006), desk research, literature study and expert interviews. Questions in the three other surveys are partly equal to those in the producer survey, party designed around producer practices. The surveys have been refined during expert interviews. The final versions of the surveys can be found in **appendix G**.

A total of 112 producers, 18 retailers, 20 LSPs and 10 service & repair companies received our surveys. By the end of February 2008, in total 22 producers, 5 retailers, 10 LSP and 5 service & repair surveys were completed, resulting in response rates of respectively 19.6%, 27.7%, 50% and 50%. Regarding the size of the surveys we consider these rates as high. All respondents held a management position and had direct professional background related to reverse logistics management.

1.5.3   **Field studies**

To gain more detailed information we executed what we call *field studies*. A field study is less extensive than a case study, but combines an opportunity to ask into more detail about specific topics. A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and the context are not clearly evident (*Yin*, 2003). Such studies are valuable because a certain phenomenon can be studied in its natural setting, with observations of actual practice. Second, it allows explorative investigation in situations where extra understanding of a phenomenon and the variables is very high level (*Meredith*, 1998).

In total we performed 5 field studies, spread out over the Netherlands, Germany and in the UK. For anonymity we have deleted the names of the companies that participated. The five companies are all multi-national companies in the European CE market, with each more than 1 billion euros annual turnover. In four visits we interviewed managers of both the producer as well as a service provider. In one visit we interviewed only the producer. Each manager completed the web-based survey beforehand. We analysed the answers and presented topics that in our opinion were typical in their context. This provided the possibility to follow-up on these topics and to understand how managers interpreted the survey questions, and their perception on best practices.

The rationale for the use of multiple-case methodology consists of three parts. First, typical management practices and lessons learned can be valuable for other managers. Second, we found it necessary to perform in-depth analysis than a web-based survey only. Although in some cases the depth was limited by company intellectual property policies. Third, adopting a holistic view for multiple visits strengthens the external validity of the case studies (*Voss* et al. 2002).

1.5.4   **Round table session**

On February 22nd a round table session was organised with 13 participants with academic, industry and consultancy backgrounds. Beforehand participants were surveyed for pair-wise comparison of high level success factors (**Chapter 6**). During the session management practices were rated on their maturity,

intermediate results from the web-based surveys were discussed and tips were provided for clear presentation of the results. A list of participants is presented in **appendix A.**

1.6   Thesis structure

This thesis is outlined as follows: Chapter 1 introduces the topic and the research questions. This includes research motivation, goal and methodology. In chapter 2 literature review is presented with the aim to position reverse logistics within supply chain management. In chapter 3 literature landscape on business improvement is reviewed and literature background is provided on improvement models. The process reference models and improvement techniques applicable to reverse logistics are also discussed in the same chapter. Exploratory analysis of reverse logistics in The EU is presented in chapter 4. Chapter 5 and 6 describes diagnostic and management tools on strategic aspects of reverse logistics management. The thesis ends with limitations and implications, direction for future research, and general conclusions and recommendations in chapter 7.

2   Literature on reverse logistics

In this section we discuss literature the landscape of reverse logistics to deal with the research question **what complexity does literature describe for managing reverse logistics**. The following sub-questions are answered:

> I.   What does current literature identify as reverse logistics?
> II.   What added value for managing reverse logistics is identified in literature?
> III. What corporate objectives does literature describe that are influenced by reverse logistics operations?
> IV.   What major trends and developments in reverse logistics are described in current literature?
> V.   What main implications and trade-offs in reverse logistics management are described in literature?

2.1   Definition and basic dimensions

For this study we use the following definition for reverse logistics, derived from the European working group on reverse logistics (2002): *The process of planning, implementing, and controlling flows in-process inventory, and finished goods, from a manufacturing, distribution or use point to a point of recovery or point of proper disposal.* Our focus on finished goods made the term 'materials' less appropriate. For a detailed discussion on the definition we refer to *de Brito* (2003). Here we confine to the arguments that our study is European based and aims to integrate with consensus as much as possible. In literature terms reverse supply chains and reverse logistics are often used interchangeably (*Le Blanc*, 2006), and this thesis they refer both to the presented definition. By answering the 'why', 'how', 'what' and 'who' questions, as proposed by *de Brito (2003),* we illustrate basic dimensions of reverse logistics.
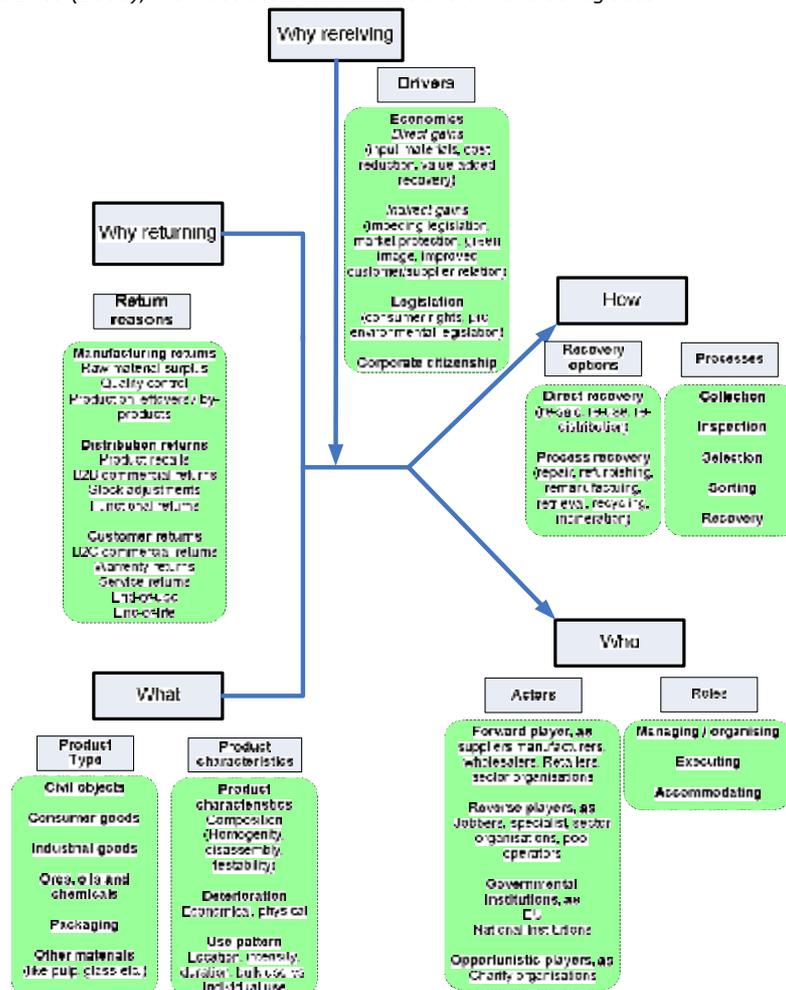
Figure 2.1: Basic dimensions of reverse logistics (*de Brito*, 2003)

2.1.1   Product return typology

This section provides literature on the 'why returning' dimension. Products, components, packages etc. are returned at different phases of the supply chain (manufacturing, distribution and consumer), resulting in different type of returns (see *Fleischmann* et al. 2000; *de Brito*, 2003; *Krikke* et al. 2003). Within this study, main focus lies on the following types of returns:

▪ **Commercial returns** are defined as all products returned from the market for which there is an immediate demand at some other market location or segment. Reasons for return can be customer dissatisfaction, catalogue sales, overstocking at retailers, promotional actions etc. Commercial returns occur in the sales phase or shortly after (*Krikke* et al. 2003).

▪ **Repairable returns** concern defects and suspect components (modules/parts) from field (exchange) repair activities or products under warranty or a recall. Under all circumstances the customer is entitled to have the same or a similar product (function) back (*Krikke et al.* 2003*)*.

▪ **End-of-use returns** are all products and components returned which are of no longer use to the original owner, but for which new customers can be found. Reasons for return include end-of-season, end-of-lease, trade-in and product replacements (*Krikke et al.* 2003).

▪ **End-of-life returns** are all items of no longer use to anyone, which need to be processed due to contractual or legislative take back obligations. These returns are often worn out and compulsory processed according to legislative prescriptions (*Krikke et al.* 2003).

Each return may be initiated in a Business-to-Business or in a Business-to-Consumer environment. For more descriptions on return types we refer to *Rogers and Tibben-Lembke* (1998) and *de Brito* (2003).

2.1.2   Actors in the consumer electronics industry

This section discusses literature on the 'who' dimension. The definition of reverse logistics indicates that reverse logistics management is interfacing with many functions, internal and external to the organisation. From a supply chain perspective, actors are interrelated by the common goal to create value for the end consumer (*Fleischmann* et al. 2004). It is helpful to determine the actors in the consumer electronics industry that somehow are related to reverse logistics. **Figure 2.5** takes three main attributes (business, environmental and social) to map actors and the field in which they are acting. External stakeholders identified by *Alvarez-Gil* et al. (2006) for reverse logistics complement other actors relevant for this study. *Freeman* (1984) defines a stakeholder as "any group or individual who can affect or is affected by the achievement of the organisation's objectives". The role that actors can play in reverse logistics we discuss throughout the following sections.
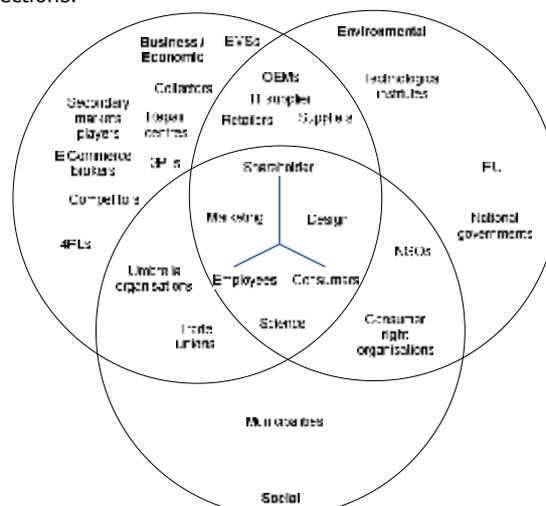
Figure 2.2: Actors in the European CE industry related to reverse logistics
(adapted from *Alvarez-Gil, 2006; de Brito*, 2007)

2.2   Reverse supply chains

This section discusses literature on the 'how' dimension. Figure 2.3 represents a basic flow diagram of reverse logistics activities within a reverse supply chain. We see that the scope is much broader than the narrow meaning of logistics and considers reversing the goods flows of both 'open' and 'closed' systems. A closed loop supply chain is defined as the integration of business processes that creates additional value for all original and new players in the supply chain through the closure of goods flows from the point of consumption back into a supply chain (*Le Blanc*, 2006).
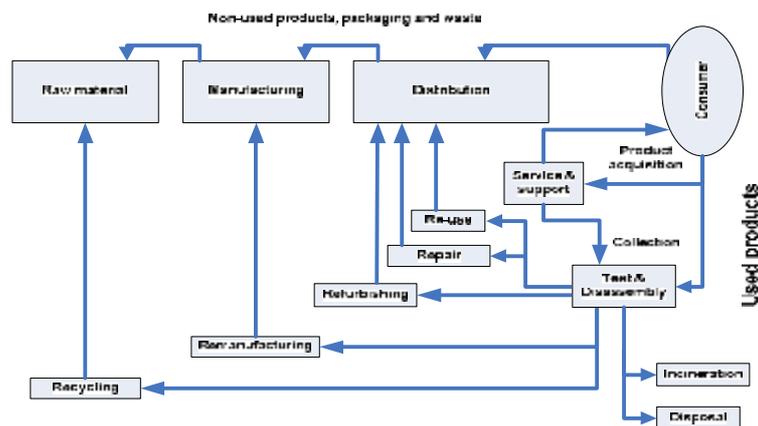
Figure 2.3: Flow diagram of reverse logistics activities (Adapted from *Le Blanc*, 2006)

2.2.1   Recovery options

Recovery is one of the many processes in the reverse supply chain (see e.g. *Guide and van Wassenhove*, 2002). In the remainder of this thesis, we use the following classification of options if and how products being returned are recovered. These include both direct and process recovery options (see **Figure 2.4**) (adapted from *de Brito,* 2003).

- Re-sale
    Products are sold again. Sell as-is, repack and sell as-is and sell to a broker are types of re-sale.

- Re-use
    Products are checked, cleaned and used again. An example is unused spare parts.

- Re-distribution
    Products like carriers are loaded or refilled and can be reused directly.

- Repair (at product level)
    The product is restored to working order by repairing and replacing defective parts.

- Refurbishing (at module level)
    The products are upgraded by replacing critical parts and components.

- Remanufacturing (at component level)
    A new product is manufactured by replacing the critical parts and components.

- Recycling (material level)
    Products are dismantled into several material fractions, for example shredding and sorting, and the material is reused in new products.

- Disposal / Landfill
    Products or materials are regarded as waste and sent to landfill sites without any further recovery.
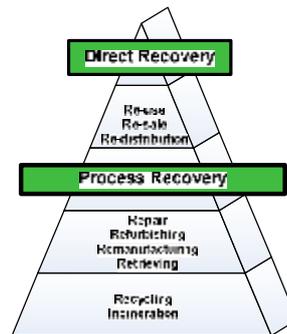
Figure 2.4: Hierarchy of recovery options (*de Brito*, 2003)

Recovery options can even be further categorised. An example, exploratory analysis of reverse logistics in Flanders used three destinations for the recovery option 'repair': repair for the original owner, repair for selling on original market, repair for selling on alternative market (*Verstrepen* et al., 2007).

2.2.2   Key processes

The reverse supply chain accompanies typical key business processes. Main processes distinguished by *de Brito* (2003) and *Fleischmann* et al. (2000) are:

- *Product acquisition*
The retrieval of the product back from the market. The timing, quantity, quality and composition of returned product need to be managed in close cooperation with supply chain parties.

- *Collection*
All logistical activities in the reverse supply chain to obtain the products back from the market and transport them to the facilities for sorting, disposition, disassembly or recovery. This includes processes such as transportation, consolidation, transhipment and storage.

- *Sorting, testing and disposition*
Returned products need to be classified according to quality and composition in order to determine the route in the reverse supply chain. Market conditions and strategic considerations must be taking into account in the disposition decision.

- *Recovery*
The process of recovering value from the returned product by reusing, repairing, refurbishing, recycling or other type of recovery option (see **2.2.1**).

- *Re-distribution and sales*
Basically, no value recovery has materialised until the recovered products, component or materials are brought back into a forward supply chain.

2.2.3   Factors affecting reverse logistics

This section provides literature concerning the 'what' dimension. Several determinants affect the design of the logistics concept and in various ways (*Carter and Ellram*, 1998; *Dowlatshahi,* 2000). We found it relevant for studying management practices to understand main determinants. Here we discuss literature on such determinants (see **Figure 2.5**).

A company's supply chain strategy has to be aligned with a company's mission and vision. The specific goals of the reverse supply chain on their turn have to be aligned with the general supply chain strategy. The structure of the forward supply chain is an important determinant of the reverse supply chain. Investments in both chains are related (*Kocabagoslu* et al. 2007).
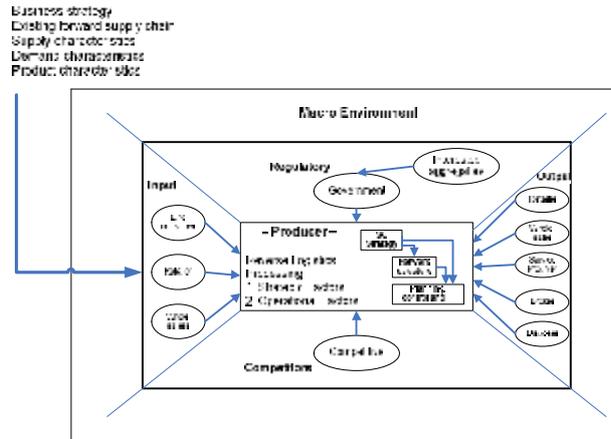
Figure 2.5: Conceptual model of factors affecting reverse logistics
(adapted from *Carter and Ellram*, 1998; *Le Blanc* , 2006)

In this context are supply characteristics the uncertainty in quantity, timing, quality and composition of returns. On the demand site is the reverse supply chain influenced by the availability of secondary markets, parallel markets and the risk of value decay due to changes in the market (*Le Blanc*, 2006). The composition, deterioration and use-pattern are relevant for the profitability of reverse logistics systems (*de Brito*, 2003). The product type e.g. spare parts or consumer goods, determine applicability and yield of recovery recovery options (*Mitra*, 2007).

2.2.4   Framework for reverse supply chain strategy

Krikke et al. (2004) propose a framework for a fit between required characteristics of a circular supply chain (CSC) and the value contained in the return. In this context, the terms circular supply chain refers to a closed loop supply chain. Three basic kinds of value contained in returns are distinguished:

- Negative value of possible externalities. This often refers to the impact on environmental and related disposal cost to be paid by taxpayer money. One wishes to avoid or minimise damage.

- Positive intrinsic value. This positive value of a return may lies in invested resources. The latter refers to materials, energy and labour.

- Positive or negative time based value. This value related to both previous ones, but deteriorates quickly over time. Positive time based value is most likely customer or market driven.

	Responsive CSC	**Efficient CSC**	**Control CSC**
Time Based value	Fit		
Intrinsic Value		Fit	
Negative Externalities			Fit

Table 2.1: Returns and circular supply chains (*Krikke* et al. 2004)

Le Blanc (2006) built further on these characteristics and proposed time-value framework to determine the reverse supply chain strategy. Chain characteristics of *Krikke* et al. 2004 are summarised as follows:

- Control reverse supply chains have a reverse supply chain strategy aiming at neutralisation of negative externalities in an efficient way. The returned products are pushed into the supply chain and processes are steady and focused on efficiency. Mainly environmental, safety or legislation driven.

- Efficient reverse supply chains utilise a strategy aiming at separation of valuable parts from the returned product in a cost-efficient way. The differences in cost structures between the forward and the reverse chain is the critical determinant in this type of chains. Mainly cost-driven.

- Responsive reverse supply chains adopt a strategy aiming at responsiveness and flexibility in order to keep throughput times for the returned products in the chain short. Throughput times refer to the time from the return from the market to the time the product is put back on the market. Mainly market-driven.

Blackburn et al. (2004) describes how a reverse supply chain should be managed by means of the marginal value of time. This metric indicates the loss in value per unit of time spent awaiting completion of the recovery process. Products with a high marginal value of time should be managed with a responsive reverse supply chain, assess the return as early as possible, decentralised, and thus differentiate processes as early as possible. In contrary, efficient chains are typically centralised to benefit from economies of scale.
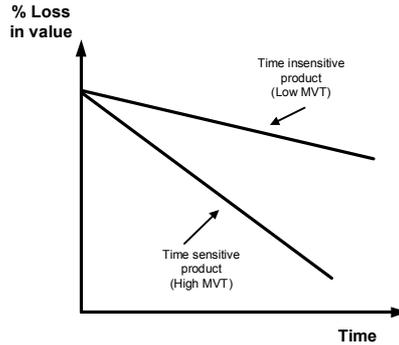
Figure 2.6: Marginal value of Time (*Rogers* et al. 2004)

The percentage loss in value per unit of time varies strongly across consumer electronics. Moreover, *Souza* et al. (2005) argues that choice of reverse supply chain network also depends on return rate, considerable recoverable value and proportion of returns that are new. We observe that determining an appropriate strategy depends on many variables.

2.3   Value of reverse logistics

This section discusses literature on the 'why receiving' dimension. *Toffel* (2004) describes several reasons why companies might get involved in voluntary take-back of product returns: reducing production costs, enhancing brand image, protecting after markets, and pre-empting regulations. The driving forces behind reverse logistics can be reproduced in a matrix form (*Yellepeddi*, 2006) with on one axis the management level involved and on the other axis the position of stakeholders that put claims on a producer (see also **section 2.4.2.**).
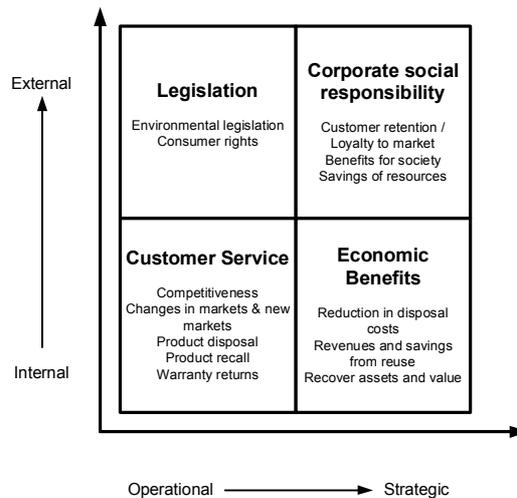
Figure 2.7: Driving forces to engage in Reverse Logistics
(adapted from Yellepeddi, 2006)

2.3.1   Customer service

Customers have become high demanding and expect presales and after sales services. High level motivations to give strategic importance to customer satisfaction are: satisfied customers are typically loyal and make repeat purchases; dissatisfied customers are likely to share this with others; attracting new customers can be much more costly than to keep an old one; it is more profitable to sell more to existing customers than it is to find new customer for the same level of sales increase (*Heskett* et al. 1994).

Customers respond to companies' behaviours, and the goodwill that can be developed through reverse logistics and proper disposal of products can create substantial customer loyalty. Although it is not generally possible to calculate the exact correlation between service and sales, literature indicates a positive relationship (*Lambert* and *Burduroglu,* 2000). In the area of service, *Srivastava et al.* (2006) argue that reverse logistics is becoming vital as a service management activity. Next, the existence, effectiveness and efficiency of service management depend heavily on effective reverse logistics operations (*Amini et al.* 2005). In this study the term service management refers to the sum of all customer interactions that follow a product's sale, delivery and installation and includes customer support, training, warranties, maintenance, repair, upgrades, product disposal and sale of complementary goods (*Dennis* and *Kambil*, 2003). Service management practices positively impact customer's total cost of ownership, hence part of the value of reverse logistics can be deducted from the direct impact it has on these costs.

2.3.2   Economic benefits

Various direct economic benefits are known that can be gained from product returns. The financial impact of reverse logistics can be related to costs, revenues and assets. Some examples illustrate direct economic benefits of reverse logistics:

- A survey performed by order of the UK department of Transport in 2005 estimated that cost for managing returns could be reduced in the order of 20% to 40% of the estimated 500 millions pounds spent (*Bernon and Cullen*, 2007). They argue that this may even underestimate the full potential, since most companies do not measure the total opportunity costs associated with reverse logistics.

- Increased revenues via 'secondary markets' sales and from reducing discounting levels by offering fresh stock in place of unsold or slow-moving stock. A producer can arrange to take back unsold stock from retailers and replace it with the new season's model to maintain retail prices and avoid markdowns, thus maintaining profit margins (*Mollenkopf and Closs*, 2005).

- Cost reductions from the reduced cost of goods sold (COGS) and lower operating expenses. Reclaiming parts and products may incur additional costs, but every product or component that can be reinserted into the forward supply chain for sale is one less unit that must be procured or manufactured (*Mollenkopf and Closs*, 2005). Better management of the flow of returns also improves returns processing and labour productivity. Effective returns management and processing can also reduce the costs of environmental compliance or waste disposal.

- Improve asset turn over. Effective returns management can help lower inventory of revenue-generating items and reduce the need to store items that do not generate revenue. Effective management can also convert damaged products to saleable products in a timelier manner (*Mollenkopf and Closs*, 2005).

Several costing and measuring methods for reverse logistics management are discussed in literature. Fassoula (2005) introduces a cost analysis model, but only approached reverse logistics from a Total Quality Management approach. The cost minimisation model of *Hu* et al. (2002) focused solely on one type of return, and proposed Activity Based Costing by *Goldsby* and *Closs* (2000) is mentioned to trace solely in-depth costs. Economic value-added (EVA) is proposed by *e.g. Guide* and *van Wassenhove* (2000) for determining the potential profitability of reuse opportunities, applied in reverse logistics by e.g. *Beullens* (2005). This method measures the difference between the return on a company's capital and the cost of capital. A positive EVA indicates that value will be created for the shareholders. We perceive this method as most suitable as it also incorporates tax discounts and the value perspective. **Figure 2.8** shows examples how reverse logistics can influence economic benefits and costs.
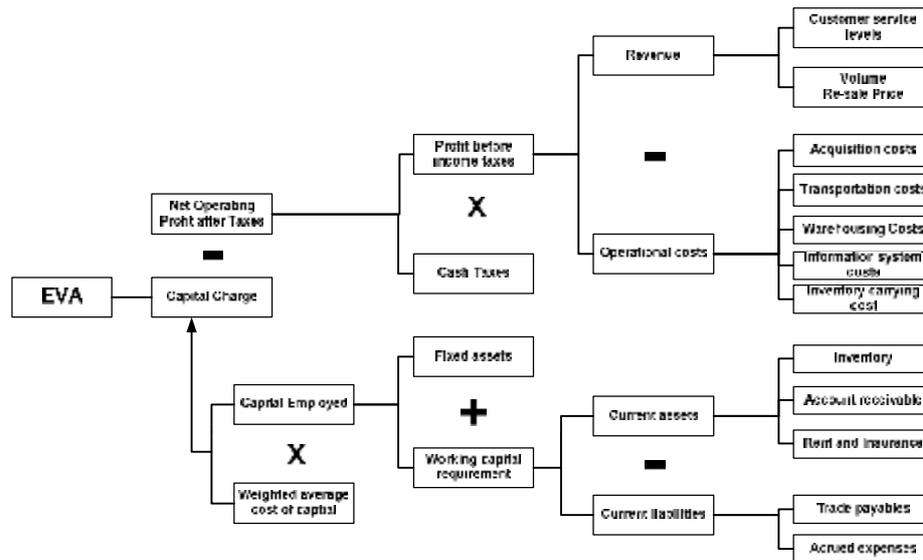
Figure 2.8: How reverse logistics can affect EVA (Adapted from *Young,* 1997)

Fassoula (2005) describes costs directly and indirectly related to reverse logistics in four categories:

- *Prevention costs* - the costs of all activities specifically designed to prevent poor quality in products or services. E.g. the costs of new product review, quality planning, supplier capability surveys, process capability evaluations, quality improvement team meetings, quality improvement projects, quality education and training.

- *Appraisal costs* - the costs associated with measuring, evaluating or auditing products or services to assure conformance to quality standards and performance requirements. These include the costs of incoming and source inspection/test of purchased material; in-process and final inspection/test; product, process or service audits; calibration of measuring and test equipment; and the cost of associated supplies and materials.

- *Internal failure costs* - failure costs occurring prior to delivery or shipment of the product, or the furnishing of a service, to the customer. Examples are the costs of scrap, rework, re-inspection, re-testing, material review and down grading.

- *External failure costs* - failure costs occurring after delivery or shipment of the product, and during or after furnishing of a service, to the customer. Examples are the cost of processing customer complaints, customer returns, warranty claims, and product recalls.

Essentially, it is difficult very hard to illustrate the total impact of reverse logistics on revenue (*Mollenkopf and Closs*, 2005), cost and assets. The study of *Goldsby and Closs* (2000) particularly revealed costs both at the retailer and producer side. For true cost of the end-to-end process we believe that multi-party information needs to be available. Within the scope of this research, we aim rather to reveal cost categories and total costs rather than cost of particular activities.

2.3.3   Corporate social responsibility

Companies are encouraged to offer environmentally and socially friendly products as part of their corporate social responsibility. After transportation and food consumption, the consumer electronics category appears as the third biggest source of environmental footprint. The production and usage of refrigerators, telecommunication devices, and video equipments, for instance, are responsible for approximately 8% of the overall generated global warming potential in a household (see *Quariguasi* et al. 2007).

Reverse logistics is a direct manner to mitigate environmental and social impact of product sales. By actively managing returns a company can react to challenges facing society in terms of environmental

concerns. A PhD thesis of *Herold* (2007) revealed that involvement of companies in end-of-life management is highest in the region where they are based. Companies perceive themselves to be a more integral part of society in their own country or region as opposed to another country. In addition, global environmental standards are developed and companies are listed on a number of sustainability indexes, e.g. Greenpeace Guide for Greener Electronics. These aim to stimulate the involvement in end-of-life management and in our opinion increase claims from NGO stakeholder group (see **Figure 2.10**) on producers.

Environmental and social gains are heavily dependent on the product under consideration. An example: for desk top computers is the production phase responsible for, approximately 75% of the overall energy consumed. Furthermore, the proportion of virgin material and energy that can be reclaimed for such equipments is very small. The most attractive alternative for reducing environmental impact for such equipment is increasing their lifespan. However, aging equipment is prone to be more energy consuming than new ones. Laundry machines, refrigerators and t.v. sets consume much more energy during their lifetime than during their production phase (*see Quariguasi et al. 2007*). We observe that finding the efficient border of environmental cost-benefit of sustainable initiatives is not as easy and straightforward as it may seem.

With these examples we address just a number of sustainability items that relate to reverse logistics. For further discussion concerning environmental and social issues we refer to *Centre of sustainable design* (2006), *Quariguasi* et al. (2007) and *Srivastava* (2007).

2.3.4   Legislation

Another reason to receive returns can be legislation and pre-empting future legislation (*Dowlatshahi*, 2000). Within the EU several Directives of the European Parliament are in force that set legislation related to Extended Producer Responsibility (EPR) in the CE industry. Producer responsibility is the act of making the producer of a product responsible for the product throughout its entire life cycle, including the disposal at end-of-life.

Several articles and studies are currently performed on the different Directives (*Huisman* et al. 2007). Here we highlight one that has much attention of policy makers (*Mayers*, 2007). In **appendix C** we include a table of developments and risk of Directive in force.

Waste Electrical and Electronic Equipment (WEEE EC/2002/96)
This Directive is designed to tackle the increasing waste stream of CE and complements European Union measures on landfill and incineration of waste. The size of WEEE in the EU is reflected by the estimations of quantities of WEEE put in the market, the amount of WEEE arising as waste and the amounts collected and treated. A study of the United Nations University points out estimates:

EEE put in the market	(1990s) 7 million in EU15	10.3 millions tonnes in EU27
WEEE arising as waste from the market	(1998) 6 million in EU15	Between 8.3 and 9.1 million tonnes in EU27

Table 2.2: WEEE estimations (*Huisman* et al. 2007)

From an environmental and social point of view, it is beneficial to collect more WEEE and to treat it more effectively. From the economic perspective, the study reflects that the economic impact arising of all WEEE in EU 27 are minimum 1.1. billion euros to a maximum of 10.6 billion euros in 2008. Although the interval is very huge, it indicates the amount of money involved. Costs are mainly made for collection, transportation and treatment of waste.

To visualise impact on operations we lay down a number of actions that this Directive requires from producers: marking a product; testing and certification of a product; compliance registration of management and control of the waste stream; compliance documentation for product disassembly for its end-of-life; compliance documentation of quantities of product put on the market; compliance documentation of waste collected. We observe that this Directive put many responsibilities to the producer.

When looking at the 'why-receiving' dimension, benefits gained by improved reverse logistics management are: increased customer satisfaction, direct economic benefits, sustainable business models, and compliance and pre-empting legislations.

2.4   Influence on strategic objectives

A multi-industry survey showed that between 9% and 14.6% of annual revenue is spent on reverse logistics management (*Aberdeen*, 2006). These numbers give a first motivation for the necessity to relate reverse logistics to strategic objectives. In this section we further explore the strategic role of reverse logistics and the role of reverse logistics in strategic objectives.

2.4.1   Strategic role of operations

By the role of operations we mean something beyond its obvious responsibilities and tasks within the company. Operations can be regarded as an *implementer* of business strategy, as a *support* to the business strategy and as a *driver* of business strategy (*Slack* et al. 2001). For each role, an operation which has developed the capabilities to cope with future market requirements, is providing the organisation the means for its future success.
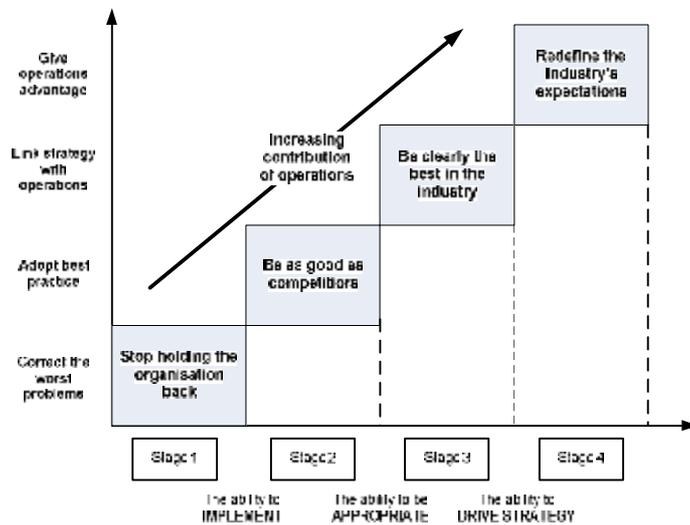
Figure 2.9: Four-stage model (*Hayes and Wheelright* 1984)

Implementer role
Most companies will have some kind of strategy, but it is the operation which puts it into practice. For example, in case a producer wants to design a failure analysis supply chain, operational systems will need to be developed to cater all customers and operations failure data (*Hebalkar*, 2007). The operations part of each function has the task of implementing the strategy.

Support role
A company develops its resources to provide the capabilities needed to allow the organisation to achieve strategic goals. For example, in case a producer uses customer experience as key differentiator, capabilities of the supply chain will have to be centred on support service management (*Cohen* and *Agrawal*, 1999).

Driver role
Operations role can drive strategy by giving it a long-term competitive edge. **Section 2.3** already outlined the driver role that reverse logistics can play for strategy.

The ability of any operation to play these roles within the organisation can be judged by considering the organisation aims of the operations function. The four-stage model traces the progression of the operations function from what is a largely negative role in stage 1 to it becoming the central element of the competitive strategy in excellent stage 4 (*Hayes and Wheelright,* 1984). We use these roles to apply maturity modelling in **section 3.2.6**.

2.4.2   Increase stakeholder value

At a strategic level, a useful classification for performance objectives which any operations may pursue is the identification of stakeholders (*Slack* et al. 2001). Different stakeholders have different interest in operations performance. In this view, management is responsible for the supervision of all stakeholder views, and the shareholders' interest. *Alvarez Gil* et al. (2006) argue that organisations can identify and prioritise different stakeholders by 3 determinants, namely the power to influence the organisation, the legitimacy of the stakeholder's claims, and the urgency of the stakeholder's demands as related to the organisation. We use their article or stakeholder view and identify possible interest of main stakeholders for reverse logistics programs in consumer electronics industry in **figure 2.10**.

In the reverse logistics concept salience of customers, employees, and the government have a significant influence on the final decision to implement reverse logistics programs. Conversely, shareholder salience impacts negatively. One possible explanation is that reverse logistics programs often require long term investments, which are likely to hinder short term profits (*Alvarez-Gil* et al, 2006).
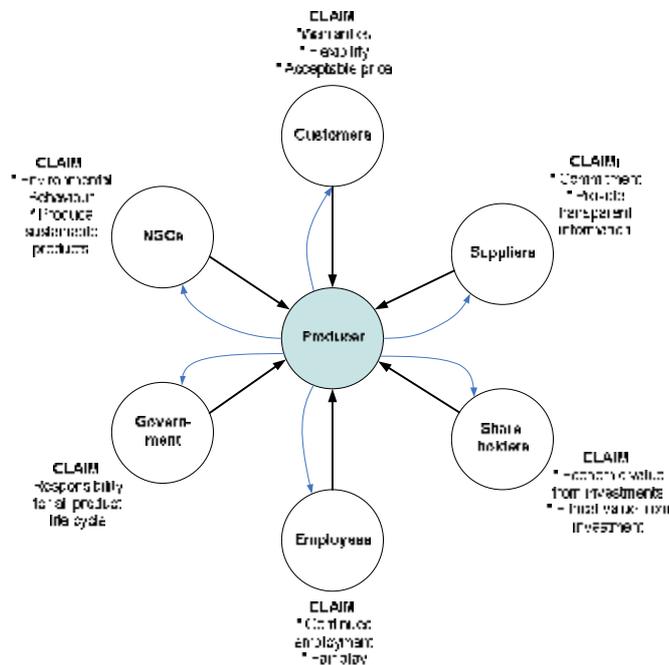
Figure 2.10: Pursuit to increase stakeholder value
(Adapted from *Slack* et al. 2001 and *Alvarez-Gil* et al. 2006)

The study of *Alvarez-Gil* et al. also found that past economic performance has a negative impact on the odds of implementing reverse logistics programs. Managers may opt to implement such programs in order to satisfy the claims of the customers or the community as a way to gain legitimacy with them when shareholders are negatively affected, that is, after a period of poor economic results. We conclude that reverse logistics directly involves the pursuit of producers to increase stakeholder value.

2.4.3   Role reverse logistics in business strategies

Reverse logistics operations play a role in several technical and operational strategies (*Murthy* and *Blischke*, 2006). Some of the strategies directly or indirectly related to reverse logistics include:

Technical strategies: outline goals, expectations and measures by which product performance can be ascertained and improved. Product returns provide valuable information for the performance of products (e.g. number of product failures) (*Furgeson* et al. 2005)

- Design and development strategies: concerned with product design, development and testing. Design initiatives may rise from evaluation in recovery activities (*Gehin et al.* 2007) and closed loops enable a producer to directly benefit from design changes.

- Material purchasing strategy: oversees the selection and quality of materials, parts and components from suppliers, and associated contractual issues. By material recovery from returns fewer resources have to be procured (*Fernandez and Kekäbor*, 2005)

Reverse logistics operations play also a role in several commercial strategies. Obviously, some are more related than others. We give some example how reverse logistics play a role in these strategies:

- Marketing strategy: involves assessing the potential market to ascertain what product features, process and warranty terms are in demand, and developing strategies for pricing and for advertising in response to these. Impact of a recall on corporate image, possible cannibalisation of current demand by refurbished products, green image from voluntary take back, are just some examples in which marketing strategy is related to reverse logistics.

- Post-sale servicing strategy: outlines procedures and objectives for warranty terms, extended warranty issues, and repair strategies. Obviously, sources for returns are warranty terms and offerings.

- Service strategy: developed to provide benefits to customers and deal with customer dissatisfaction. E.g. service contracts are a source of product returns and effective reverse operations directly affect profitability of the contract.

All strategies interact strongly in determining the profitability of a product over its life cycle. We perceive the high interactivity between these strategies as a clear call for cross-functional and cross-company approach to reverse logistics.
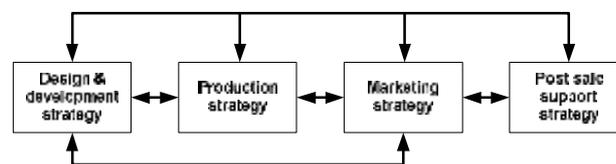
Figure 2.11: Interaction of reverse supply chain related strategies (*Murthy* and *Blischke*, 2006)

2.5   Role tax in reverse logistics

One of the functions related to reverse logistics is the finance function, and more specific to tax. In the context of reverse logistics, tax refers to Direct tax, such as corporate tax and transfer pricing, and Indirect tax, such Value Added Tax (VAT) and customs. The counter part of this study, the PwC research on the tax compliance perspective, revealed that especially VAT and customs cause highest tax burden. We briefly explain impact that these taxes can have in reverse logistics (PricewaterhouseCoopers, 2008).

Value Added Tax
Under a VAT system, output tax is collected on a transaction level from a customer by adding VAT to the amount charged. However a business also pays input tax to its suppliers on purchases that it makes. The business must pay the output tax on the value that it adds in the supply chain. The tax is ultimately borne by the end consumer. VAT rates and treatment vary from country to country for the same transaction on goods and services. The business therefore pays tax on the value it adds in the supply chain. Although VAT is in principle meant to be neutral with respect to the number of passages between producer and final distributor, a lack of knowledge and planning in the reverse supply chain can lead to unnecessary cascading of VAT costs.

Customs
This tax is a duty levied on the import or export of certain goods. Import duties are non refundable and form a cost to the company. Customs duties are in principle obligatory and payable by businesses to EU tax

authorities as goods enter (or re-enter) from outside the EU into the EU. Duties are calculated generally as a percentage of the value of the goods. The applicable duty rate depends on the nature of the goods imported and is pre-defined in the Customs Code, applicable to the whole EU. In the area of reverse logistics, goods and spare parts often enter and re-enter the EU after repairing, refurbishing, swapping, etc. In these cases, duties may be payable twice (or more) on the same goods.

Furthermore, the customs legislation includes systems that allow companies to handle their customs procedures in daily routine as a part of business. Therefore companies can handle customs systems without unnecessary delays and interference from the customs authorities, resulting in (major) supply chain advantages.

We conclude that the administrative burden of tax compliance can be felt throughout the reverse supply chain, but the benefit of potential savings and profit improvement isn't necessarily enjoyed (*PricewaterhouseCoopers*, 2008).

2.6   Trends and developments in managing reverse logistics

According to the contingency theory, companies must 'fit' their changing environment so that effectiveness can be maintained (*Donaldson*, 2001). We thus studied literature to gain insight in trends in managing reverse logistics to understand the environment in which producers operate. In this section we highlight trends and distinguish between trends related to the field of external stakeholders (external environment) and related to the internal playing field (internal environment).

Developments focused on **external** environment of a producer:

-    *Growing pressure for corporate social responsibility*
Increasing environmental and social concerns and growing consumer pressure for environmentally and socially friendly operations (*Kocabasoglu* et al. 2007; *Russel and Allwood*, 2007; *Srivastava, 2007)*.

-    *Changing environmental legislations*
Extended producer responsibility has been or is currently in the progress of being implemented in different countries following introduction of European Union directives (*Huisman et al. 2007; Mayers, 2007)*.

-    *Increasing impact of reverse logistics on corporate image*
Increasing attention on producer responsibility, environmental and social performance (*Huisman* et al. 2007) and integrating environmentally sound choices in supply chain management (*Srivastava*, 2007). Product liability and recalls create a challenge of crisis management, the effects can be catastrophic if not handled properly (*Reverse Logistics Association*, 2007).

-    *Growing knowledge base on reverse logistics management*
Especially since 2000 the number of articles has increased progressively. This confirms growing interest of academic and professional communities, including rise of professional associations (*Prahinski and Kocabasoglu*, 2006; *Rubio* et al. 2006).

-    *More availability of companies offering reverse logistics activities*
The Reverse Logistics Association currently has, writing in March 2008, over 300 third party service provider members offering reverse logistics activities for Europe and Central Asia (Reverse Logistics Association, 2008).

Developments focused on **internal** environment of a producer:

-    *Intensifying collaboration between supply chain partners in reverse logistics*
Collaboration between companies for standardisation of information over product life cycle (*Jun* et al. 2007), intensifying collaboration on collective take-back programs (*Mayers*, 2007) and sharing customer and product specific return and repair data with value chain counterparts (*Aberdeen*, 2006; *Kumar and Malegeant*, 2006).

- *More use of swapping in the repair process*

Product and component swap units are more used to directly exchange faulty reported items for a new one (*Sciarotta*, 2003; *Reverse Logistics Magazine*, 2006).

- *More use of Design for Environment*

Legislation encourages designers to develop products with recycling in mind and designers have started to integrate environmental and social stake during early design phase (*Gehin* et al. 2007).

- *More strategic focus on reverse logistics*

Reverse logistics has been regarded as the forgotten child of the supply chain, but more companies are now seeing reverse logistics as a strategic activity (*Mollenkopf*, 2005; *Aberdeen, 2006)*.

- *Development of best of breed packages*

Companies developed information packages in-house for specific parts of reverse logistics, e.g. returns planning, separate from Enterprise Resource Planning systems. Currently there is a trend going on of upcoming packages that provide specific functionality for reverse logistics (Aberdeen, 2007).

With this literature background we created a basis for main directions in developments that may be perceived as relevant by producers to their management practices.

2.7 Managerial implications in reverse logistics

Transactions between echelons in the reverse supply chain call for strategic decision making. In this section we draw attention to decision elements and implications at management level.

2.7.1 Management elements

Key management elements are identified by amongst others *Rogers and Tibben-lembke* (1998) and *Guide* and *van Wassenhove* (2000). Management of producers have to put shareholder value as focal point. For that reason we used literature that mainly took a managerial position in describing elements, and include only those elements that have had, in our opinion, had little attention in this thesis so far.

- *Avoidance*

The CE industry has many so called 'high learning products'. A high learning product is one that requires users to do more than simply unwrap it and simply turn it on. A company must design products to minimise returns. Preventive measures can include increased quality testing, or return agreements with dealers (*Rogers and Tibben-Lembke*, 1998).

- *Acquisition*

Guide and *van Wassenhove* (2000) introduce the term 'product acquisition management' referring to the control lever for the management and profitability of reuse activities and the acquisition of returned products. Proper management results in desired high return rates.

- *Gatekeeping*

Gatekeeping is the screening of defective and unwarranted returned merchandise at the entry point into the reverse logistics process (*Rogers and Tibben-Lembke*, 1998). This enables, for example, increased visibility of warranty liabilities.

- *Disposition product return*

Management can decide to create separate disposition guidelines for each product type. The disposition in this context is meant as 'the final destination for products inserted into the reverse logistics flow' (*Rogers and Tibben-Lembke*, 1998). Reduction in time to figure out what to do with a return enables shorter turn around times of returns.

- *Secondary markets*

The secondary market is a term for the collection of liquidators, wholesalers, exporters, brokers and retailers who sell product which has not sold through the primary sales channels (*Rogers and Tibben-Lembke*, 1998). The existence of a market for recovered products, components, or materials is a determinant of the profitability of product recovery. Recovering products in the absence of a market it hardly makes good business sense (*Geyer and Jackson*, 2004).

- *Reverse logistics information systems*

One of the most serious problems that companies face in the execution of a reverse logistics is the lack of good information systems. Most good existing systems have been developed internally (*Rogers* et al. 2004).

- *Financial management*

Financial management issues are the primary determinants in the structure of a reverse logistics system, and the manner in which product is dispositioned. Accounting problems might drive the actions of managers (*Rogers and Tibben-Lembke*, 1998). More specific to finance, tax can have big impact (*PricewaterhouseCoopers*, 2008).

- *Outsourcing*

Many companies are outsourcing part of their reverse logistics activities (*Rogers and Tibben-Lembke*, 1998). Strategic management theories applied predict under which circumstances a particular organisation of governance can be most appropriate (*Toffel*, 2004; *Williams*, 2005).

- *Product life cycle management*

The product life cycle strongly determines the expected amount of returns for a particular product over time (*Serrato* et al. 2003). A trade-off at every stage of a product life cycle has to be made between the cost of returning and reprocessing against the costs of making that item again (*Srivastava*, 2006; *Le Blanc*, 2006).

These elements comprise only a snapshot of crucial elements within the area of reverse logistics. With those presented we aim to provide first insight in what literature already revealed to be of importance for optimisation of the reverse supply chain.

2.7.2 **Barriers**

Literature presents many implications and barriers for successful reverse logistics management. Our research objective to identify improvement opportunities in producer management puts our focus on barriers that are manageable. This implies barriers for which management has a possibility to influence, either direct or indirect.

- *Lack of awareness concerning environmental legislations*

To meet environmental legislations, companies need to be aware of considerable implications for the company's legal, sales data administration, procurement, accounting, and product and packaging approval practices (*Mayers*, 2007).

- *Limited forecasting and planning of reverse logistics activities*

Strategic planning is the identification of reverse logistics goals and the specification of long-term plans for managing them. Lack of such planning holds a company back to use reverse logistics as a competitive weapon (*Ravi* et al. 2005).

- *Lack of clear return policies*

Return policies provide guidelines at every stage of a product life cycle on the trade-off between the cost of returning and reprocessing against the costs of making that item again (*Yellepeddi*, 2006). Exploratory analysis of reverse logistics in Flanders showed that various companies did not or partly have such return policy (*Verstrepen* et al. 2007).

- *Lack of appropriate performance management system*

Major problems in coordinating reverse supply chains due to not existent or poor quality information on product returns, lack of visibility of return and clear performance measures (*de Brito*, 2003; *Ravi* et al. 2005). To our knowledge, applications of corporate performance management such as the Balanced Scorecard (*Kaplan and Norton*, 1992), European Foundation for Quality Management (EFQM) (*Nabitz* et al. (2000) and Value Based Management (*Koller*, 1994) in reverse logistics have not yet published in literature.

- *Little collaboration between departments (e.g. design, manufacturing, marketing and sales)*

Many companies deal with returns in a reactive manner. Maximising a product's lifetime value requires a more proactive attitude (*Fleischmann* et al. 2004).

- *Little recognition of reverse logistics as a factor in creating competitive advantage*

Managers must choose between various alternatives that develop new capabilities, change interactions with customers and suppliers, and require adjustments in existing supply chain partnerships, which affect firm performance (*Kocabasoglu* et al. 2007).

- *Differences in Extended Producer Responsibility* between countries*

EU member state legislations favour national collective take-back systems to individual compliance. Countries are allowed to set national or regional legislation beyond European Directives, or have different penalties for non-compliance (*de Folter*, 2007).

- *Accounting issues*

Accounting has a role to play in financial management, but also on corporate social responsibility reports. There is a danger that traditional models of accounting and finance are actively supporting and encouraging unsustainable organisations (*Bernon and Cullen*, 2007).

- *Few senior management attention*

Special resource attention is needed for effective reverse logistics programs (*Richey* et al. 2005). The lack of top management is a chief barrier for successful reverse logistics (*Ravi* et al. 2004).

- *Uncertainty reverse chains associated with product recovery*

Reverse supply chains associated with product recovery are subject to much more uncertainty than forward supply chains 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 requirement for a reverse logistics network, (6) the complication of material matching restrictions, and (7) the problems of stochastic (random) routings for materials for repair and remanufacturing operations and highly variable processing times (*Toffel*, 2004). Reduction of uncertainty enables seamless and lean reverse logistics.

Overall, we observe that extensive literature is available on barriers which hinder or prevent successful management of reverse logistics. We found it relevant to provide this literature landscape on barriers before we can extract which barriers are perceived as most importance by managers in current consumer electronics industry.

2.8   Conclusion

In literature, the terms reverse logistics and reverse supply chains are often used interchangeably, though reverse logistics can be regarded as a sub-process in reverse supply chains. Also the terms circular and closed loop supply chain are often found, both meaning the recovery of assets in the original and alternative supply chain.

For this study we use the following definition for reverse logistics: *The process of planning, implementing, and controlling flows in-process inventory, and finished goods, from a manufacturing, distribution or use point to a point of recovery or point of proper disposal.* Our European focus and aim to integrate with consensus references are main arguments to use this definition.

Legislation and pre-empting legislation, customer service, corporate social responsibility and economic benefits drive engagement of companies in reverse logistics. Within the EU several Directives are in place, which make producers of consumer electronics responsible for the product throughout its entire life cycle, including the disposal at the end of life. After transportation and food consumption, the consumer electronics industry appeared as the third biggest source of environmental footprint. By actively managing reverse logistics a company can react to challenging facing society in term of environmental and social concerns. In the area of service, literature argues that reverse logistics has become vital for service management, in order to respond to high customer expectations in pre-sale and after-sale services. Literature is extensively available on the impact of reverse logistics on costs, revenues and assets. Even so we found that true business cases were scarce and that it was very hard to visualise the total impact of reverse logistics on revenue.

Customers, employees, shareholders, suppliers, non-governmental organisations and the government have each different interest in reverse logistics performance. In this view, senior management is responsible for the supervision of all stakeholder views, and shareholder's interest. Examination of business strategies revealed relationship between reverse logistics and design and development, production, marketing and post-sales service strategies. All interact strongly in determining the profitability of a product of its life cycle, fuelling complexity for decision-making in the reverse logistics area.

According to the contingency theory, companies must fit their changing environment so that effectiveness can be maintained. From a producer perspective, literature showed developments related to the field of external stakeholders and related to the internal playing field. This reinforces the need to further investigate trends and developments that might cause challenges in managing reverse logistics.

Finally, managerial implications evolve from the many transactions between echelons in the reverse supply chains which call for strategic decision making. Review on recently published articles on manageable barriers exposed variety in topics. This reinforces the relevance to further investigate challenges in the current environment of producers.

3   Literature on business improvement

The purpose of this chapter is to describe current literature landscape of business improvement. We present literature that describes **what needs to be evaluated in order to identify and exploit improvement potential in managing reverse logistics**. The following sub-questions are answered:

> I.   *What does current literature describe for business improvement in the supply chain?*
> II.   *What approach for identification of improvement potential for managing reverse logistics can be taken?*
> III.   *What technique can be used to exploit improvement potential of managing reverse logistics?*

3.1   Business improvement in the supply chain

No longer can companies compete effectively in isolation from their suppliers, customers or other actors in the supply chain. To succeed today, they need to create strong relationships with these links through the concept called supply chain management.

Supply chain management has changed in the last few decades. Increased transparency has caused a shift in the balance of power towards the customers. Cross-company concepts are necessary to meet these increasing demands (*Krikke* et al. 2003). Several definitions of supply chain management have been proposed (*Kannan and Tan*, 2005) and considering the specific topic of this thesis, is it not our intention to examine all. We confine with the observation that a common component in definitions is the integration of processes throughout the supply chain with the goal of adding value to the customer.

Lambert et al. (1998) argue that supply chain process integration and reengineering initiatives should be aimed at boosting total process efficiency and effectiveness across members of the supply chain. The Total Quality Management (TQM) concept aims at improving quality by developing and implementing a corporate wide culture emphasising customer focus (of which we address relevance in **section 2.4.3**), continuous improvement, employee empowerment and data driven decision making. Aligning product design with customer expectations and focussing on quality at all stages of development and production processes, are regarded as drivers for improved product quality and, in turn, improved business performance (*Knowles* et al. 2005). The support of TQM for a cross-functional approach to supply chain aspects (*Jan* et al. 1999) is a first main advantage. Second, we regard a joint approach as a means to take a more comprehensive view for defining opportunities for improvement.

Explicitly and effectively integrating TQM and SCM approaches can help companies in developing and implementing a comprehensive supply chain strategy (*Kannan and Tan*, 1999). For many companies, an essential first step in this process is to assess their supply chain capabilities (*Lummus et al.* 2000*)*. In addition, by comparing a company's operations to those of other organisations, there is potential to learn and improve performance (*Hanman*, 1997). Therefore we focus on self-assessment and benchmarking steps of **Figure 3.1,** which shows process to define opportunities for improvement in the supply chain.
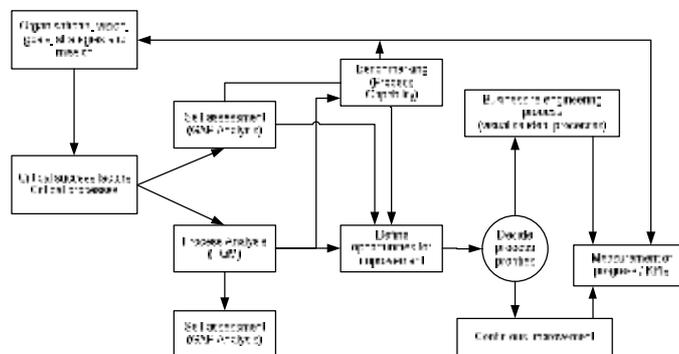
Figure 3.1: Business improvement process (*Hanman*, 1997)

3.1.1   Self-assessment

Self-assessment is an effective approach to identify improvement areas by focusing on questions such as presence of particular processes and the degree of best practice implementation (*Supply Chain Council*, 2006). Assessing the current capability of a supply chain is the starting point for change, the baseline against which future progress can be measured (*Lummus* et al. 2000). Self-assessment provides insight into which elements of supply chain management need improving, questions that can be addressed include:

- Where are we?
- Where do we need to be?
- How are we going to get there?

Self-assessment begins by analysing the structure of various supply chains and mapping the supply chain processes. From here, a company can establish a measurement framework to determine how well it currently performs each of the elements in the supply chain process (*Lummus* et al. 2000). S*tallinger* et al. (2006) propose a methodology how to answer before mentioned questions. They argue to construct a meta-model consisting of three distinct, but interplaying models that enable companies to identity improvement potential: a process reference model, a maturity model and an assessment model. **Figure 3.2** illustrates the interrelation between the three. Their methodology was aimed at assessing reuse practices, and for this study we broadened this to scope of managing reverse logistics.

A process-based model can be developed into two sorts of tools for companies: a self-assessment tool and a process framework. Essentially provides each a qualitative analysis of strengths and deficiencies in current processes. Next, each indicates where good processes might be found and provides a set of data for learning and managerial actions for improvement (*Voss* et al. 1997).
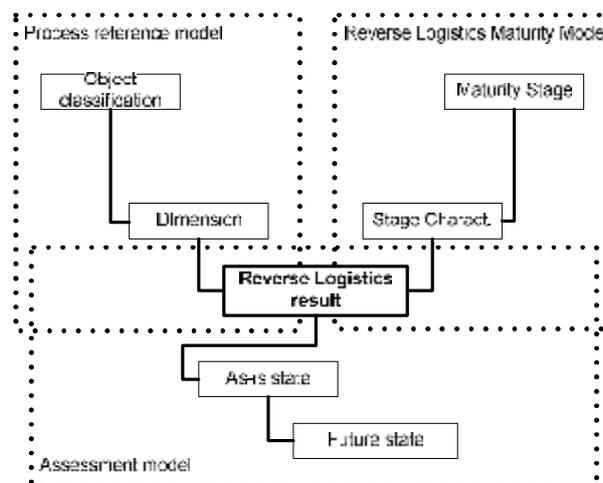
Figure 3.2: Meta-model for self-assessment of managing reverse logistics
(adapted from *Stallinger* et al. 2006)

3.1.2   Benchmarking

Benchmarking is a technique used to improve performance by understanding the methods and practices required to achieve world-class performance levels (*Camp*, 1995). Both in practice and literature benchmarking is a widely accepted improvement technique (*Kumar Dey,* 2002). *Spendolini* (1992) states various reasons for benchmarking:

- Gather relevant information to be used in strategic planning
- Forecasting trends in relevant business areas
- Generating new ideas and functional learning by exposing individuals to new work processes
- Collecting and using information about processes of excellent companies for making comparisons with similar products or services
- Setting performance goals in relations to state-of-the art practices

We believe that PwC had a good position to facilitate these goals for companies that somehow were in need of change. Hence we argued that this technique would be applicable within the research project.

Benchmarking practices can be generally classified according to the nature of the object of study and the partners whom comparisons are made. In term of the object of the study, benchmarking can be classified as (*Carpitti and de Melo*, 2002):

- *Process benchmarking*: used to compare operations, work practices and business processes.
- *Product benchmarking*: used to compare product and/or services.
- *Strategic benchmarking*: used to compare organisational structures, management practices and business strategies. In a sense, it posses some similarities to process benchmarking.

Another classification for benchmarking in terms on type of partner is presented by *Camp* (1989):
- *Internal benchmarking*: comparison of performance of units or departments within one organisation.
- *Competitive benchmarking*: comparison with direct product competitor. In this case, comparison can be made of products or services and business processes.
- *Functional benchmarking*. Specific function comparison with best practice. It is an application of process benchmarking that compares a particular business function in two or more organisation in the same industry.
- *Generic benchmarking*. Search for the best practices irrespective of industry. It is similar to functional benchmarking but the aim is to compare without regard of industry.

PwC has not performed earlier studies on reverse logistics. Knowledge thus needs to be build up from scratch. We aim with the outcome of this thesis to take a first step for both a process and strategic benchmarking. Therefore we compare the operations function, work practices and business practices (process) as well as organisational structures, management practices and business strategies (strategic). Next, we regard the position of PwC as beneficial to investigate direct product competitors, so that they can learn from each other. Hence, we can classify our effort also as a *competitive* benchmark.

3.2 Approach for identifying improvement potential
This section discusses the literature landscape of approaches to business improvement, and examines what literature describes on the specific role that process-oriented supply chain frameworks and maturity models can play in such approaches.

3.2.1 Process-oriented reference models
In contrast to *Flapper* et al. (2005) we do not assume one particular sequence for analysing managerial aspects of closed-loop supply chains. Conversely, an approach analysing aspects simultaneously we perceive as more relevant for the goal of this thesis.

Strategic management deals with decision-making with regard to all aspects of the product from an overall business viewpoint. It aims to integrate strategic objectives with shorter-term operational goals (*Murthy* and *Blischke*, 2006). Various academics approached strategic decisions in reverse logistics with established strategic management theories (*Toffel*, 2004; *Williams,* 2005).

Companies can be viewed as a collection of functional areas, but also a combination of highly integrated processes (*Hammer*, 1999). *McCormack and Lockamy* (2004) suggest that companies could enhance overall performance by adopting a *process view* of the organisation. Such view implies a set of physical, administrative, managerial and investment processes, the design and the management of which need to be aligned with a company's strategy. A business process is defined as the logical organisation of people, materials, energy, equipment and procedures into work activities to produce a specific end result (*Davenport and Short*, 1990). When comparing this view with other management views we observe the following similarities and differences in belief towards supply chain optimisation:

The resource based view (RBV) assumes that each organisation is a collection of unique resources and capabilities that provide the basis for its strategy and that is the primary source of its returns (*Wernerfelt,* 1995). An organisation's resources and capabilities include all of the financial, physical, human, and organizational assets used to develop, manufacture, and deliver products and services to its customers (Barney, 1991). According to the RBV, differences in organisation's performances across time are due primarily to their resources and capabilities. For our analysis of 'maturity' we agree with this view to interpret the vision of *Hayes* and *Wheelright* (1998) and translate this into the strategic role for reverse logistics as core competence, defined as those resources and capabilities that serve as a source of competitive advantage (*Hitt* et al. 2005). With respect of required agility to deal with returns (*Schuppen*, 2006) we perceive a lack on focus on dynamic aspects of an organisation as a major disadvantage for this theory.

Transaction Cost Economics (TCE) regard the transaction as the basic unit of analysis. A transaction occurs when a good or service is transferred across technologically separable interfaces (*Williamson*, 1985). *Wililamson* described three variables explaining the differences of transactions: frequency, uncertainty and asset specificity. When we apply TCE to reverse logistics, we observe that a company may choose to acquire assets when costs of conducting reverse logistics in the market are lower than the cost of organising activities within the company. Lack of a value perspective towards returns we consider as a major pitfall for this theory.

Contingency theory is different from previously discussed theories, by it's assertion that there is no one-way to organise. Their premise is that there is no universally appropriate structure or system which applies equally to all organisations. Rather, particular features of the structure and system depend upon the specific circumstances in which a company finds itself. The fit of organisational contingencies leads to optimisation (*Donaldson*, 2001). By means of trends (**section 2.5**) and influencing factors (**figure 2.5**) we already discussed literature that is in line with this theory.

We conclude that for our analysis an eclectic approach is most appropriate. Various strategic management theories can be applied to reverse logistics. As proposed by Stallinger et al. (2006) and reinforced by McCormack and *Lockamy* (2004) we argue that a process view towards organisations is most appropriate to capture the as-is state of an organisation.

In order to understand a supply chain and its complexities, reference frameworks can capture and model the supply chain structure. We refer to the term 'reference model' for business processes as a model representing dynamic aspects of an organisation, i.e. activity sequences, organisational activities required to satisfy customer needs, control-flow between activities (*Fettke* et al. 2005). Hence we examined reference models that would be general enough so that they can incorporate differences in strategies (as explained in **figure 2.5**). In addition, the model should be rich enough that it could include specific benchmark indicators so that also quantitative analysis would be able. *Lambert* et al. (2005) identified 5 frameworks, of which two specifically provided process descriptions claiming to achieve supply chain optimisation and were rich enough that reverse logistics was explicitly incorporated: Supply Chain Operation Reference (SCOR) model (*Stewert*, 1997) and Global Supply Chain Forum (GSCF) framework (*Lambert* et al. 1998).

In our vision other available process-oriented supply chain management approaches in literature are less appropriate for this study. For example:
- In a model proposed by *Mentzer* (2001) the processes related to reverse logistics are not specifically addressed
- Literature that reflected supply chain management mainly as the management of logistics (*Tan* and *Kannan*, 1998) narrows the scope to coordinating of logistics operations in the value chain while we support a broad approach
- Other frameworks such as discussed by *Lambert* et al. (2005) are argued not have sufficient level of detail or resemble components equal to SCOR or GSCM frameworks

3.2.2   Supply Chain Operations Reference model

The SCOR model lays down a tool to diagnose the business flow between an organisation's first and second tier customers and suppliers. The framework consists of four levels as the analytical stages leading to the implementation of an effective Supply Chain Management (SCM) strategy (*Supply Chain Council*, 2006). See **appendix D** for a reproduction of the different levels.

Reverse logistics is explicitly referred to in three parts of the SCOR model. Although literature argues a lack of completeness for reverse logistics (e.g. *Baumgarten* et al. 2005)) we consider version 8.0 rich enough to use described process steps, practices and indicators.

For the processes 'deliver return' and 'source return' the SCOR model distinguishes between:
▪   Return of defective products
▪   Return of maintenance, repair and overhaul (MRO) products
▪   Return of excess products

The usefulness of the model comes forward from the alignment between general objectives of PwC for this study and purposes of the mode: business process reengineering, benchmarking and best practice analysis. *Fettke et al* (2005) argue that the SCOR model is the unique reference model that has a specific focus on supply chain management.

Figure 3.3 shows the standard processes of returns. For *plan return*, *deliver return* and *source return* the model provides standard process definitions, best practices, performance metrics and related inputs and outputs. A main critique on SCOR is that the framework is mainly focused on functions of manufacturing, logistics and purchasing (*Lambert* et al. 2005). We observe a lack in involvement of other departments, such as research and development (see **section 2.4.3**).
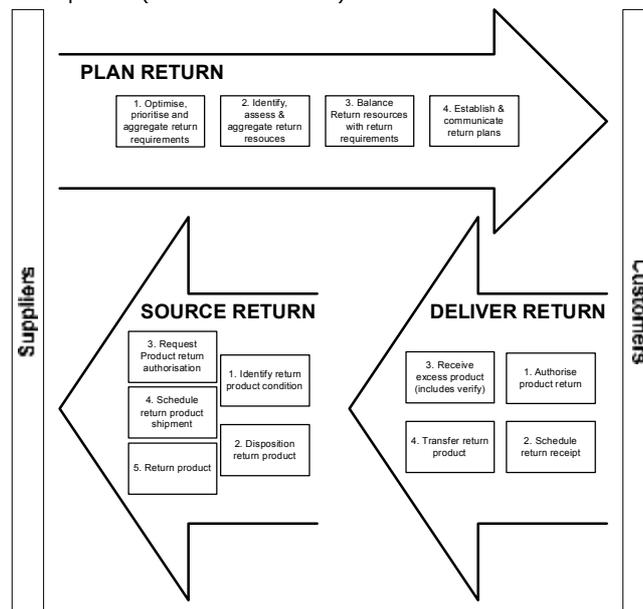
Figure 3.3: Standard processes of 'return' in SCOR 8.0. (*Supply Chain Council*, 2006)

3.2.3   Global Supply Chain Forum framework

The framework defines supply chain management as the "integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders" (*Lambert and Cooper*, 2000). Implementation is carried out through three primary elements, namely the supply chain network structure, the supply chain business processes, and the management components (see **Figure 3.4**).
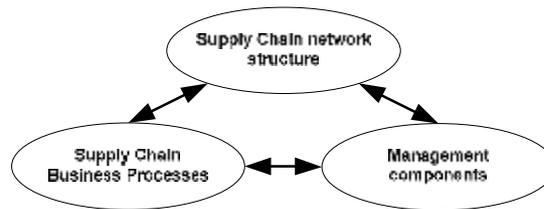
Figure 3.4: Primary elements of Supply Chain management (*Lambert* et al. 1998)

Returns management is one of the eight supply chain management processes and includes all activities related to returns, reverse logistics, gate keeping, and avoidance. Customer relationship management and supplier relationship management form the critical links in the supply chain and returns management is coordinated by them. For use of the framework it is critical to have participation from all functional areas. Exactly this breadth is, in our opinion, what makes this framework useful for reverse logistics management: involvement of all functions (including finance / tax) is required for optimisation of chain optimisation.

Rogers et al. (2002) defines the strategic portion of returns management in more detail. He described 6 strategic sub-processes as a structure for implementation for the process within an organisation and across key members of the supply chain. Literature on the frameworks argues that effective inter-company connectedness requires successful intra-company integration in order to align organisation-wide resources with the customers' requirements (*Lambert* et al. 2005). In our perception, optimisation for reverse logistics management does depend on the extent of integration and connectedness with chain partners. For this study, we use this reference models to cover not only producer practices, but also to incorporate interests and barriers for chain partners, such as retailers and service companies. This is part of our explanation for the research approach of the web-based surveys (see **section 1.5.2**.).

3.2.4   **Using both frameworks**

The GSCF framework is very broad in its scope. The framework touches various aspects of business functions, including marketing, finance, research and development. Operational measures are tied to the company's Economic Value-Added (see **figure 2.8**) and to profitability reports. *Lambert* et al. (2005) argue that the GCSF framework is intended to enable cost reduction and increased asset utilisation, as well as to identify revenue implications from more closely managing relationships with key suppliers and customers. For management consultants like PwC, *asset utilisation*, *revenue growth* and *operating margin* are three key generic value drivers to increase stakeholder value (*PricewaterhouseCoopers*, 2008). We observe that the intentions of the GSCF framework and value drivers of PwC correspond, and we perceive this as a convincing match for usefulness of the model in this research. However, the model does not provide any best practices or benchmark data to actually diagnose current as-is situation. Thus the usefulness of the model limits to a high level reference for returns management.

Objectives of the SCOR model are centred on operational efficiency, which we match with the value drivers of PwC '*operating margin'* and '*asset utilisation'*. The model focuses on activities in the purchasing (importance subscribed by e.g. *Johnson*, 1998), logistics, and manufacturing functional areas. We use the model for the expertise and completeness in these areas, with benchmarking data and best practices.

For the SCOR model we thus limit the usefulness to diagnostic aspects related to the purchasing, logistics and manufacturing functional areas. In **section 5.1** we further build on both models.

Within the limitations of each model we take both of best worlds and will further focus on strategic management components such as capability development, control in the supply chain (*Croon* et al. 2005) with process oriented supply chain literature.

3.2.5   **Maturity stages**

In the methodology of *Stallinger* et al. (2006) a maturity model is proposed. Even though literature presents a great number of maturity tests within specific disciplines of operation management (*McCormack and Lockamy*, 2004), there exist only a few targeting the management of the supply chain (*Netland*, 2007). In

this section we discuss literature that examines relevant usefulness of such maturity models. This is important to understand the expected use of models and what it means for a practice to be defined at a specific level.

Foggin et al. (2004) argue a comprehensive approach towards diagnosing the supply chain. The Guide (appendix f) has been widely applied by PwC to study organisations in a comprehensive manner. We argue that it is relevant assess practices for different dimensions of the Guide separately: so-called process maturity mainly for aspects related to 'strategy' and 'process' dimensions of *the Guide*, and so-called capability maturity mainly for aspects related to 'structure', 'people' and 'technology'.

Expected use of model
The principle idea of an assessment grid is that it describes in a few phrases, the typical behaviour exhibited by an organisation at a number of levels of maturity, for each of several aspects of the area under study (*Fraser* et al. 2002). Processes have a lifecycle, levels of maturity, which can be assessed by the extent to which the process is explicitly defined, managed, measured, and controlled. It also implies growth in the areas of process capability, richness, and consistency across the entire company (*Dorfman*, 1997). Process capability describes the range of expected results that can be achieved by following processes (*Paulk et al.* 1993).

Level specific meaning maturity ('structure' /' people' / 'technology')
Diagnostic models can be communicated in a two dimensional way, where the y-axis describes the processes or objects to be measured for maturity and the x-axis outlines the degree of maturity. *Fraser et al.* (2002) argue that a diagnostic model has several typical attributes:

   a. Number of maturity levels (mainly between 3 and 6)
   b. Descriptive name for each level
   c. Generic description of each level as a whole
   d. Number of dimensions or process areas (**section 5.1**)
   e. Number of elements or activities for each process area (**section 5.1**)
   f. Description of each activity as it might be performed at each maturity level (**section 5.2**)

We apply the attributes of the four stages of *Hayes and Wheelright* (see **figure 2.9**). In case senior management views reverse logistics as a factor in creating competitive advantage, explains the resource based view management perception as 'core competence'. The model of *Hayes and Wheelright* expresses this view by the strategic role of operations, and in our particular case, the strategic role for reverse logistics operations. We believe that companies go through strategic sub-processes based on senior management perception on the role and contribution of reverse supply chain operations in strategy. Other literature on maturity stages lack specific descriptions (*Netland*, 2007) or are limited suitable for organisations active in consumer goods (*Paulk* et al. 1993). We give generic descriptions of each level as a whole (adapted from *Hayes and Wheelright*, 1984):

Stage 1 – Internal neutrality
The other functions regard reverse logistics operations as holding them back from competing effectively. The operations function is inward looking and at best reactive with very little positive to contribute towards competitive success. Its ambition is to be 'internally neutral', a position it attempts to achieve not by anything positive but by avoiding the bigger mistakes.

Stage 2 – External neutrality
A company interested in measuring itself against its competitor's performance and trying to be 'appropriate', by adopting best practice from them and from the market. By taking the best ideas and norms of performance from the rest of its industry, it is trying to be externally neutral.

Stage 3 – Internal supportive
Gaining a clear view of reverse logistics' competitive or strategic goals and developing appropriate resources to excel in the areas in which the company need to be competing effectively. The operation is trying to be internally supportive by providing a credible operations strategy.

Stage 4 – Externally supportive
The company sees reverse logistics operations as providing the foundation for its competitive success. It looks to the long term, and it develops operations-based capabilities which will be required to compete in the future market conditions. Operations function is becoming central to strategy-making.

Level specific meaning maturity ('strategy' / 'process')
For the purpose of identifying issues most critical for reverse logistics improvements in the 'strategy' and 'process' dimensions of the guide, we argue that stage descriptions for maturity of business process orientation are most appropriate (*McCormach and Lockamy*, 2004). Our process-oriented approach towards reverse logistics management substantiates the use of these stages. They argue that with higher level of maturity the control, effectiveness and predictability of processes increase. In the **appendix E** we include a full description of stages of *McCormach and Lockamy*, and we base high level stages for reverse logistics optimisation on these descriptions, and these include:

Stage 1 - Ad hoc
Process measures are not in place and the jobs and organisational structures are based upon the traditional functions, not horizontal processes. Individual heroics and "working around the system" are what makes things happen.

Stage 2 - Defined
Basic processes are defined and documented. Changes to these processes must now go through a formal procedure. Jobs and organisational structures include a process aspect. Representatives from functions meet regularly to coordinate with each other concerning process activities.

Stage 3 - Integrated
Managers employ process management with strategic intent. The company, its vendors and suppliers, take cooperation to the process level. Broad process jobs and structures are put in place outside of traditional functions. Cooperation between intra-company functions, vendors and customers takes the form of teams that share common process measures and goals.

Stage 4 - Extended
Competition is based upon multi-company networks. Process measures and management systems are deeply imbedded in the organization. Advanced process management practices and mutual dependency are in place that allows transfer of responsibility without legal ownership. A horizontal, customer-focused, collaborative culture is safely in place.

In **section 5.2** we apply these maturity stages by a description of each aspect under analysis as it might be performed at each level of maturity. Capability and maturity models are sensitive for critique for inconsistency mapped onto the stages. Progression in maturity is difficult due to complex set of factors that contribute to the shift (*Holland* and *Light*, 2001). The models therefore should aim to facilitate a broad classification. Only by using the models in practice can the validity fully be explored.

3.3   Technique to exploit improvement potential

This section discusses the literature landscape of technique to exploit improvement potential, and examines what literature describes on the specific role that critical success factors and performance indicators can play in such techniques.

The complexity in managing reverse logistics (see **chapter 2**) forced us to concentrate on techniques that provide a flexible and easily understood way for structuring complicated situations. The analytical hierarchy process developed by *Saaty* (1980) is a multi-criteria technique that allows a systematic procedure for representing elements of any problem. *Korpula and Tuomen* (1986) demonstrated how the technique can be used for supporting generic benchmarking process.

3.3.1   Analytical Hierarchy Process (AHP)

AHP is a method of measurement for dealing with quantifiable and intangible criteria that has been applied in a numerous areas (*Vaidya and Kumar*, 2006) amongst others in decision making in reverse supply chains (*Yellepeddi*, 2006; *Efendigil* et al. 2007). An AHP framework provides the basis for analysing key performance areas, and deciding what enables to achieve superior performance in these areas. A disadvantage of AHP is the fact that human assessment on the relative importance of individual customer requirements is always subjective and imprecise. The linguistic terms that people use to express their judgements are generally vague. Furthermore does the scale not take into account the judgement to a number, and thus provides a constrained choice of limited numerical ratings to various attitudes of decision makers (*Efendigil* et al. 2007).

Korpula and *Tuominen* (1996) used critical success factors (see **section 3.3.2**) as the basis for the benchmarking logistics management. **Figure 3.6** reproduces different steps they proposed for the process.
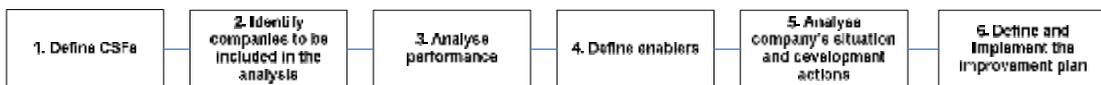
Figure 3.5: Competitive benchmarking process (Adapted from *Korpula and Tuominen*, 1996)

A.   Problem decomposition
The problem is decomposed into elements which are grouped on different levels to form a chain of hierarchy, and each element is further decomposed into sub-elements until the lowest level of the hierarchy (**Figure 3.7**)
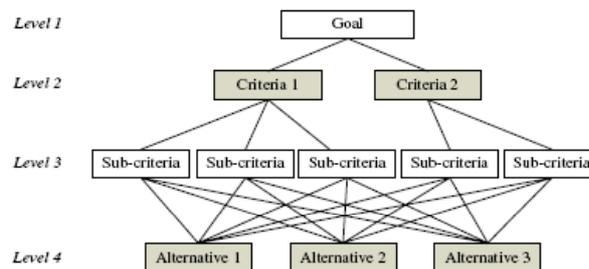
Figure 3.6: The AHP hierarchy structure (*Saaty*, 1988)

B.   Comparative analysis
The relative importance of each element at a particular level is measured by a procedure of pair wise comparison. The decision makers provide numerical values for the priority of each element using a rating scale.

The AHP approach requires the translation of perceptions into numerical scales. A frequently used scale is the nine point Likert scale (1-3-9 or 1-5-9) to quantify the decision makers strength of feeling between any two attributes with respect to any given criterion (*Coyle*, 2004).

CSF	Importance one CSF over another									Other CSF
	Strongly		Weakly		Equal		Weakly		Strongly	
	(9)	(7)	(5)	(3)	(1)	(1/3)	(1/5)	(1/7)	(1/9)	

Figure 3.7: Nine point rating scale (*Coyle*, 2004)

A comparison is a numerical representation of a relationship between two elements that share a common parent. The set of all judgements can be represented in a square matrix in which the set of elements is compared with itself. Each judgement represents the dominance of an element in the column on the left over an element in the row on top. Usually it reflects two answers: which of the two elements is more important with respect to a higher level criterion, and how strongly. For a set of n elements in a matrix one

needs n(n-1)/2 comparisons because there are n 1s on the diagonal for comparing elements with themselves and of the remaining judgments, hence the reciprocals.

C.   Synthesis of priorities

The priority weights of elements at each level are computed using eigenvector or least square analysis. The process is repeated for each level of the hierarchy until a decision is finally reached by overall composite weights. There are several methods for calculating the eigenvector. Multiplying together entries in each row of the matrix and then taking the nth root of that product give a good approximation (*Coyle*, 2004).

3.3.2   **Critical success factors**

Critical success factors (CSF) are an explicit representation of the key performance areas of an organisation. In this context, CSFs define those sustaining activities that an organisation must perform well over time to accomplish its mission. They are found on every level of management, from executive to line management. Each organisation also has a set of CSFs that it inherits from the particular industry in which it operates (SEI, 2004).

Rockhart and Bullen (1981) provided a number of initial definitions of a CSF. Their work is still widely recognised as the initial definition of a CSF and the CSF method. Some definitions they argued are: key areas where things must go right for the business to flourish; factors that are critical to the success of the organisation; key areas of activities that should receive constant and careful attention from management; a relatively small number of truly important matters on which a manager should focus attention. The numerous definitions speak to the elusive nature of a CSF.

Here we outline literature background on types of CSFs that we perceive relevant for producers. We believe that the categorisation in types can help to structure the urgency and manageability of a certain factor.

-   *Industry CSFs*

Every organisation inherits a particular set of operating conditions and challenges that are inherent to the industry (or segment of the industry) in which it chose to do business. This results in a unique set of CSFs that organisations in a particular industry must achieve to maintain or increase their competitive positions, achieve their goals, and accomplish their missions.

-   *Competitive-position CSFs*

Peer-group CSFs are a further delineation of industry-based CSFs. They define those CSFs that are specific to the organisation's unique position relative to their peer group in the industry in which they operate or compete.

-   *Environmental CSFs*

To be successful, an organisation must be mindful of the macro environment in which it operates (see also **Figure 2.5**). A closed organisation or one that does not fully interact with its external environment cannot survive in the long term.

Environmental CSFs reflect factors over which the organisation has very little control or ability to actively manage. By making these factors explicit, the organisation can at least be mindful of them and actively monitor their performance relative to them.

-   *Temporal CSFs*

Every organisation encounters temporary conditions or situations that must be managed for a specific period of time, while continuing to maintain its performance in all other areas. These temporary conditions or situations can result in temporal CSFs or areas in which the organisation must temporarily perform satisfactorily.

- *Management CSFs*

Managers have different focuses and priorities depending on the layer of management in which they operate. This translates into a set of CSFs that reflect the type of responsibilities required by the manager's position in the organisation.

During the research we mainly focused on senior management level. The study on trends and developments aims to identify temporal CSF, and **Chapter 5** and **6** discuss our vision on competitive CSF for producers in the consumer electronics industry.

3.3.3   Success factors for managing reverse logistics

Literature support use of the analytical hierarchy process prescribes identifying CSFs. Here we examine literature on a number of CSFs that we perceive relevant for the dimensions of the *Guide* (see **appendix F**). With emphasize we mention that this list is not exhaustive, but preliminary shapes the CSF field that literature argues to be relevant for managing reverse logistics. The stream of literature that described reverse logistics from a comprehensive view we use our main input.

<u>Strategy</u>
- *Strategy focus on avoiding returns*
  Liberal return policies, safety stock policies, purchasing policies and customer non-fault-found are a number of drivers for reverse logistics operations. Strategy focus on avoiding returns will lead companies to examine how they can reduce returns arising (*Rogers* et al. 2004; *Bernon et al. 2007*).

- *Reclaiming value*
  Reverse logistics operations reclaim (part of) product value. Companies should recognise returns as a value stream and maximise revenue from smart and fast disposition, proper asset recovery, and prompt resale through the appropriate channels (*Guide* et al. 2005).

<u>Process</u>
- *Efficient gate keeping*
  We discussed gate keeping previously in section **2.6.1.** Failure in gate keeping can create significant fraction between supplier and customers, not to mention loss in revenues (*Rogers and Tibben-lembke*, 1998).

- *Detailed insight in cost and performance*
  Yellepeddi (2006) argues that there seems to be a gap in developing effective performance measures for reverse supply chains. Overall, performance measures and metrics have an important role to play in setting objectives, evaluating performance and determining future courses of actions for supply chain management (*Gunesekaran* et al. 2004).

<u>Structure</u>
- *Capability to put returned products rapidly in the market*
  Recognising that returns are perishable assets emphasises quickly extracting value from returns flow. The percentage of asset value recovered is directly proportional to the speed of recovery and disposition of returned product (*Blackburn* et al. 2004).

- *Strategic partnerships with supply chain partners*
  Collaborative agreements between retailers and producers are needed to manage final product disposition effectively. Third party providers offer capabilities for maximising value recovery from product returns (*Bernon* et al. 2007)

- *Strategic partnerships with other producers*
  Collaboration may also extend to companies operating shared services. For example, shared collection and sorting of returns. Collaborative returns management programmes can be effective solutions (*Bernon* et al. 2007)

People
▪ *Top management awareness*
  Management must establish high priority for the returns process and perceive it as an supply chain responsibility. In this way, returns become an integral part of the supply chain management process (*Blackburn* et al. 2004)

Technology
▪ *Visibility of quality and value over the product life cycle*
  Product life cycle management provide opportunities to reduce inefficiency and gain competitiveness. Product embedded information devices (PEID) allow to have visibility of product information over the whole product lifecycle (*Jun* et al. 2007).

▪ *Automating returns process*
  Improving information flow has a major impact on service performance. Information support for authorising, tracking and handling returns can positively impact both economic and service quality-related performance (*Daugherty* et al. 2006).

▪ *Track and trace capabilities*
  Information can be of value in reverse logistics (*Ketzenberg* et al. 2004). Product recovery decisions can be enhanced through enhanced product information. Tracking and tracing capabilities are a manner to obtain information throughout the entire life cycle of a product (*Jun* et al. 2007).

3.3.4 **Performance indicators**

To our knowledge, current literature has not provided a widely accepted Balance Scorecard (*Kaplan and Norton*, 1992) for reverse supply chain management. Basic idea of this scorecard is that is can allow managers to look at the business from four important dimensions: Customer perspective, internal business perspective, innovation and learning perspective and financial perspective. We choose not to describe each perspective in detail. For more literature background and use in performance measurement we refer to *Yellepeddi* (2006).

Performance indicators are suitable for competitive benchmarks (*Carpitti and Melo*, 2002). We cite *Korpula and Tuominen (*1996) for our definition of indicators (or ratings): "qualitative or quantitative descriptions about a possible performance level of a company with regard to companies included in the analysis". Corporate performance management of PwC requires indicators to be Specific, Measurable, Achievable, Relevant, Time-bound (SMART), valid, simple and controllable. When studying available literature, we found that only little indicators for competitive benchmarks were available to inherit from all four perspectives, which would allow us to look at the business with a holistic framework (*Ravi* et al. 2005). For that reason we adapt metrics proposed by other authors and already outline our vision on shortcomings and implications for each indicator.

Internal business perspective: mainly relate to critical internal operations in which reverse logistics operations must excel at (*Ravi* et al. 2005). *Ferguson* et al. (2005) define false failure returns as products that have no functional or cosmetic defect.

1. *Number of product returns that have no functional or cosmetic defect as percentage of total number of product returns (%)*
   This indicator refers to the so called non-fault-found rate. In practice products are returned that are actually not broken but do enter the reverse stream.

Throughput times refer to the time from when a product is returned from the market to the time the product is put back on the market (*Le Blanc*, 2006). We define the return cycle time as the time from when a customer returns a product until it is available again to be put back on the market.

2. *Average return cycle time (days)*
   Type of customer (consumer or business, sales channels or end-user) creates first limitations. Next, it assumes that a product keeps its own identity. Again, the scope of responsibility of the respondent is directly influencing the score. Nevertheless, we regard the indicator as an evidence for the differences in perception for treating returns as perishable goods.

Customer perspective: mainly what the customer expects from the reverse logistics operations (Ravi et al. 2005). *Amini* (1998) introduced cycle time metrics as a means for improving customer service quality. We define customer cycle time as the time from when a customer ships a package until the customer receives the repair, refund or exchange.

3. *Customer cycle time*
   Type of customer creates again difficulties. We are aware that each kind of inter-modal contract and several other factors do not allow direct comparison between two companies. By providing upper bound and lower bound we want to show differences in front end cycle times.

4. *Invoicing cycle time*
   We define cycle time as the time from when a Return Material Authorisation is given until the payment of all invoices of that authorisation is completed. Different financial flows might evolve from the authorisation: between supplier and producer, between producer and retailer, between producer and repair centre, between producer and end-user. We perceive it relevant to gain insight in differences in cycle times at different parts of the reverse supply chain.

Innovation and learning perspective: mainly to whether reverse logistics operations can continue to improve, both from sustainability and total quality perspective (*Ravi* et al. 2005). *Yellepeddi* (2006) used as a measure for asset recovery what he called recovery rate. He defined the recovery rate as "the number of units scrapped divided by total of products inducted in the reverse logistics process in a period of time".

5. *Average recovery rate (%)*
   Product composition, use pattern and deterioration directly influence this rate (*de Brito*, 2003). Goal of this indicator is to get high level insight in asset recovery involvement.

6. *Total number of product returns within the initial warranty period as percentage of total sales volume (%)*
   This indicator was introduced by *Aberdeen* (2006). We incorporate the metric to get a rough estimation of the volume of the return flow of commercial and warranty returns. *Hebalkar* (2007) used 2.5% as benchmark for this indicator.

Financial perspective: mainly indicate how shareholder objectives are catered by reverse logistics operations (*Ravi* et al. 2005). We use two indicators used in the industry-benchmark study of *Aberdeen* (2006).

7. *Total reverse logistics cost as percentage of total sales revenues (%)*
   For total reverse logistics costs we used the definition of *Fassoula (2005)* for internal and external failure cost. The difficulty of this indicator is the definition of 'overall Reverse Logistics costs', regarding lack of measures for e.g. opportunity costs, irrecoverable VAT costs etc. Despite this disadvantage, we aim with this metric to indicate at least (part) of the total cost involved with reverse logistics. The percentage multiplied by total sales revenues gives a very rough estimation of the size of the market. *Yellepeddi* (2006) cites a rate of 2% of this indicator for a CE producer he studied.

8. *Average percentage of initial value reclaimed by reverse logistics operations (%)*
   With initial value we mean the cost of the product when it was sold for the first time (cost of goods sold). A major pitfall of this indicator is that value is in many cases is non-quantified (*Yellepeddi*, 2006), and the scope of responsibility of the respondent. E.g. within the same company, a manager responsible for after sales returns would rate differently for another manager responsible for the

commercial returns. Our goal of this indicator is to show the potential of value recovery for reverse logistics.
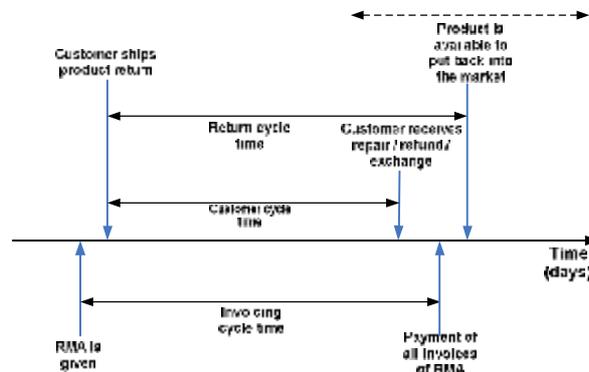
Figure 3.8: Time related indicators (Consolidated)

Coverage of the four dimensions of the balanced scorecard does not align with other articles on supply chain performance measurement. For example, *Beamon* (1999) argues that any supply chain measurement system must involve resource measures, output measures, and flexibility measures. For the indicators presented flexibility is not covered. Next, measuring the performance of a reverse supply chain as a whole is preferred than just the performance of the individual supply chain actors.

3.4   Conclusion

This chapter examined the literature landscape of business improvement, and more specific on identifying and exploiting improvement potential in managing reverse logistics.

In the context of the supply chain literature describes a variety of manners to define opportunities for improvement. Self-assessment distinguishes from other approaches by the practical usefulness in identifying those areas that are most critical to success and focus on improving performance in those areas. It begins by analysing the structure of the supply chain and mapping supply chain processes. Examination of available reference models brought forward that the Supply Chain Operation Reference Model (SCOR) and the Global Supply Chain Management Forum (GSCF) model were most appropriate for this study. Both include detailed process descriptions for reverse logistics, though the SCOR model mainly focused on functions of purchasing, manufacturing and logistics and the GSCF model included also functional areas of research and development, marketing, finance and service.

Maturity stages comprise another key component for self-assessment. Such stages describe in a few phrases the typical behaviour exhibited by an organisation at a number of levels of maturity. Review of current maturity models showed that two types of maturity stages can be best applied to management practices in reverse logistics. We found that for some practices the stages that reflect senior management's view on the strategic role for reverse logistics operations are most relevant. Maturity stages of other management practices can best reflected by the extent to which practices are explicitly defined, managed, measured and controlled.

Making comparisons with actors in the same industry, in literature referred to as a type of benchmarking, can be used as a technique to increase understanding what is required to improve performance of managing reverse logistics. The analytical hierarchy process (AHP) is a multi-criteria technique that provides a flexible and easily understood way for structuring complicated situations. It allows a systematic procedure for representing elements of complicated situations and has previously been demonstrated as a technique that can be used for supporting the competitive benchmarking process. This implies to search for best practices between direct product competitors by decomposing the problem, comparative analysis of elements under study and synthesis of priorities.

Finally, literature describes to concentrate on critical success factors (CSF) as there are explicit representations of key performance areas of an organisation. From our competitive benchmark we derived to investigate a set of CSFs that senior management of producers inherits from the consumer electronics industry. Evaluation of available literature revealed that only little quantitative indicators were available for benchmarking management practices.

4   Field results

In this Chapter empirical we present results from the web-based surveys, from field studies and expert interviews. These results answer the research question **what management practices related to reverse logistics are used in the European CE market.** This main question we discuss in more detail by means of the following sub-questions:

I.   What are man trends in managing reverse logistics?
II.   What is the complexity supply chain managers are dealing with in managing reverse logistics?
III. What are critical success factors for supply chain managers in managing reverse logistics?

For anonymity we hided some names of companies that cooperated in the study and some we changed into fictive names. In some parts we use abbreviations for terms that we repeat very often: *reverse logistics* by RL, *Logistics Service Provider* by LSP and *Service & Repair provider* by SR.

4.1   Respondent group

In the following sections we separate most of the findings per survey group. The benefit of separation is the fact that it enables analysis of management practices from different perspectives in a reverse supply chain, as proposed by *Prahinski* et al. (2006). We use descriptive statistics regarding our research approach, and we present the results as an exploratory analysis of European reverse logistics regarding experience of PwC with this topic.

4.1.1   Web-based surveys

In total we sent surveys to 112 producers, 18 retailers, 20 LSPs and 10 SR companies. PwC offered incentives as a reward for filling in the questionnaires: participants receive the report of the whole study, an invitation for the closing seminar held in May 2008 and to producers an option to have one-to-one meetings. By the end of February 2008, we received input from managers representing 22 producerd, 5 retailers, 10 LSP and 5 SR companies. These numbers indicate response rates of respectively 19.6%, 27.7%, 50% and 50%. Because each survey consisted of 70 questions or more we consider these rates high. All respondents are considered sufficiently knowledgeable: all held a management position and had direct professional background related to managing reverse logistics.

50% of producer respondents sold mainly products that fall in the category *IT & telecommunication* equipment, and 46% that mainly fall in the category *Consumer equipment*. Our analysis is thus mainly based on perceptions of managers responsible for products in these categories. 4% of producer respondents sold mainly products that fall in the *Large household appliances* category. This categorisation is less relevant for other survey groups, which offer services for products in all categories.

Across these categories, value and value depreciation of products vary. The middle fifty percent of producer respondents indicated that their products have an average percentage of value depreciation between 3 and 10% per month. We observe that economic life cycles are short.

Majority of the producer, LSP and SR respondents indicated to fill in the survey for a Pan-**European** or EMEA level (respectively 91%, 80% and 80%). The managers representing retailer chains had mainly responsibility for the national operations (80%). Countries represented are Belgium (20%), Germany (20%), Spain (20%) and the Netherlands (20%). 20% of respondents indicated to answers for Western European scope.
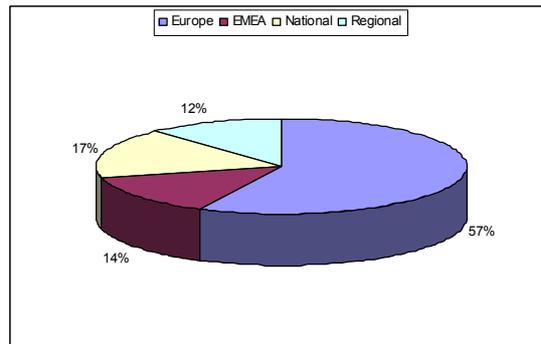
Figure 4.1: Scope or responsibilities - All

The annual sales volume across respondents ranges from 3.3 million up 50 billion euros in most recent fiscal year. The middle 50% of the consolidated respondent group have higher then 10 and lower than 500 million euros annual sales volume. In term of sales volume, this reflects respondents to be medium to large sized companies (see **figure 4.2**).
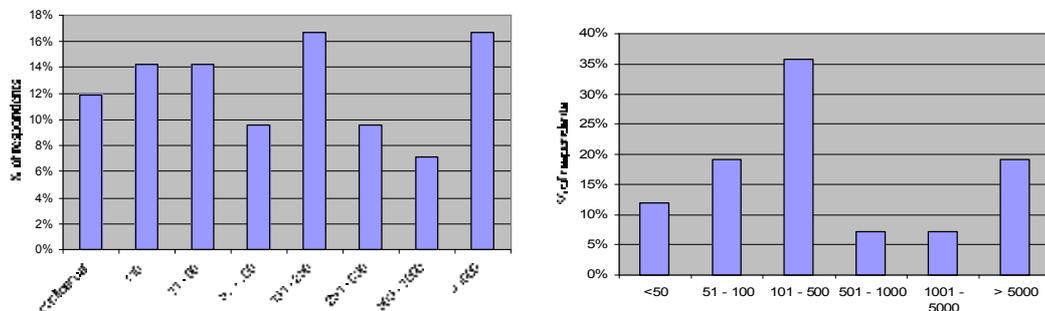
Figure 4.2: Annual sales volume (*left*, in million Euro) and workforce (*right*, in number of employees) – All

Sales channels
From the surveys we observe that producers have different models to sell products:

- 14% of producer respondents is directly involved in leasing products to businesses (Business-to-Business model)
- 86% of respondents generate less than 10% of annual sales volume directly to the consumers, with retailers, wholesalers and distributors form their sales channels.
- Among the producers that use mainly importer' or distributor' sales channels (32%), is the expectation for internet sales in two years very near to 0. This rate increased from 5 up till 20% for respondents mainly selling via retail chains and directly to the consumer (55%).

Participating retailers primarily sell via retail stores and have currently little internet sells. Asking for expected proportion of total sales revenues generated via the internet, in two years, estimates range between 5 and 10%, with a highest expectation of 30%. These are interesting rates regarding the relative high return rates for internet sales (*Rogers and Tibben-lembke,* 1998*)*

Main customers of the LSP participants are Original Equipment Manufacturers, producers and to lesser extent wholesalers, importers and retailers. In terms of annual turnover, 80% had more than 1 billion euros sales revenues in the most recent fiscal year. This indicates that globally operating LSPs have participated, strengthening the relevance of answers.

Main customers for the SR respondents are retailers, distributors and other service & repair centres. Among the many contract manufacturers 5 stand out because of their size and global reach (*Van Lemt*, 2007). Our respondents represent 40% of these 5, illustrating the relevance of our data sources.

4.1.2   Field studies

In total 5 multinational producers were visited. For anonymity we refer to these visits by naming them visit A, B, C, D and E. We give a very brief description of the studies.

Visit A

In this visit we interviewed managers of an asset recovery plant. By means of long term partnership a LSP is providing the forward logistics, customs formalities and also the reverse logistics. Part of the recovery strategy of Company A is the refurbishment of internal returns (dead on arrival), end-of-lease returns and general customer returns. It has chosen to form a closed loop with reverse logistics, refurbishment and re-marketing into the consumer market. Tenders are sold to controlled brokers in Western Europe.

Visit B

We conducted interviews with spare parts, customer care and LSP managers. In this visit we interviewed European management of after-sales operations. They manage all after-sales activities, dealing mainly with returns under warranty. A central warehouse provides spare parts for all service engineers and workshops throughout Europe, and received items being returned back. The warehouse serves as a hub between front end and back end of the repair network. Company B manages the operation (e.g. stock levels) and the LSP is executing the tasks.

Visit C

We interviewed operations managers of Company C and European managers of the LSP. Company C receives high volume of returns due to a 'accept everything' return policy. It collects commercial, repairables and end-of-use returns centrally for the whole EMEA region. Particular products are economically viable to remanufacture and recycle. However, majority of products is sent into the waste stream. Products with a reasonable quality are *re-sold as-is* via internet tenders. A LSP takes care of the external logistics, and another LSP is managing and operating internal testing, sorting, recovery and disposal.

Visit D

We interviewed managers of company D and the LSP responsible for European returns management. Mainly leasing products in the B2B market, managers of Company D are responsible to deliver service levels of sales agreements. Reverse logistics brings used service parts and end-of-lease products back to the European consolidation centre. Disassembly services and retrieving service parts from products is provided by a LSP, while company D is managing and operating in-house service part stocks and flows.

Visit E

We interviewed the hub manager and a global service part manager. In this study we visited a UK logistics hub. The hub is operated by a LSP that provides testing, grading, and sorting for commercial and warranty returns. Next, the hub receives also repaired or refurbished products back, re-tests them again and takes care of re-distribution. Company E's policy of guaranteed repair turn around time requires quick repair or use of swap units.

Section 1.5.3 already discussed methodological background for each of the studies. Analysing the studies, we see already the diversity in solutions and models that supply chain managers are responsible for.

4.2   Trends and developments

In this section we present findings on changing contingencies in the environment of producers, which managers indicated to cope with. We make a distinction between developments in the CE market and in managing reverse logistics.

4.2.1   Consumer electronics market

Changes in the CE market are ongoing. We are aware that identifying all directions in which the market is moving would take huge effort. For that reason we aim to highlight major trends that show market implications relevant for producers in managing reverse logistics.

From desk research and expert interviews we identified major trends. The surveys asked to rank these trends from most important to fifth most important. The most important we give 5 points and fifth most important 1 point. X-axis of **figure 4.3** comprises the relative score for each trend. This score we calculated by dividing the sum of points for a trend by the total amount of points given by all respondents.
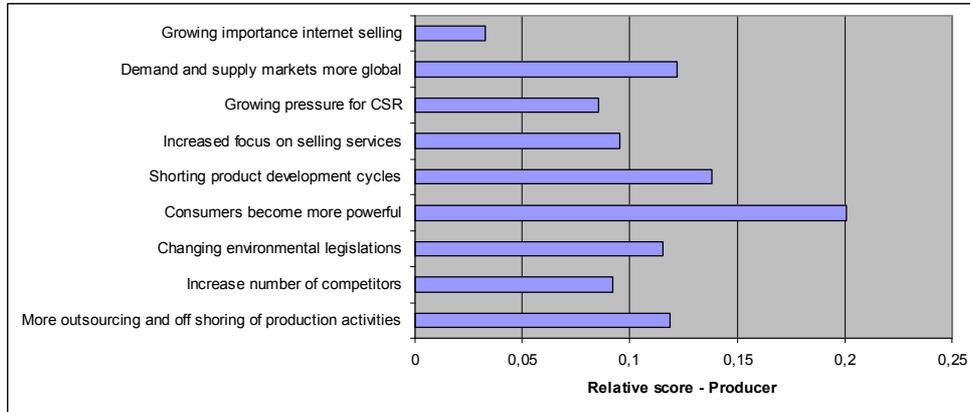
Figure 4.3: Main trends in the CE market - Producer

For trends with highest relative scores we give our vision on its impact on complexity for managing the reverse supply chain. The left box contains a description of the development, and in the right box we mention a number of related challenges that supply chain managers indicated to experience. These challenges we base mainly on expert interviews and field studies.

Consumers become more powerful

Transparency in the CE market is caused by almost unlimited access to product information. Consumers can easily switch between brands, and prices are easily compared.

- Consumer experience is nowadays the leading concept enhancing service levels (e.g. warranty liability) to secure brand loyalty
- New service models such as swapping, household servicing, remote servicing change success factors in the front end of the reverse supply chain
- Impact of a recall can be dramatic if not carried out well
- Urgency of public pressure for corporate social responsibility, e.g. proper end-of-life disposal

In all field studies we observed that customer satisfaction was a key focus in after-sales management. Western Europe is perceived as a very high demanding market. Few years ago management was mainly focused on 'solving the problem'. Nowadays must the entire organisation be focused around customer experience.

Shortening product development cycles

Economic life cycles of CE products may be even less than six months. Products are developed in little time shortening product development cycles.

- Quick introduction of new products increases pressure for lean channels
- Extensive use of product information management for quick feedback
- Little time for quality testing increases risk of quality issues or even a recall
- Very complex forecasting and planning of service parts
- Increasing number of products in-warranty

With increasing number of products in-warranty, managers find it more challenging to meet service levels. This is fuelled by the dependency of producers on front end partners, i.e. retailers, service engineers. Service part managers face the risk of stock outs against high value of stocks. Lean channels can only be achieved when sales channels are cooperating for a seamless end-to-end warranty process.

Supply and demand markets become more global

Economic developments in new markets such as China and India provide sales opportunities for new and recovered products. Global supply of products and services has increased.

- Developing countries skip certain technology steps (e.g. no use of fax by developing countries)
- Supply of services (e.g. call centre, RMA processing) in far away countries complicates exception management
- Global supply and demand for service parts puts pressure on global stock control

Service parts that are already in Europe can be of value in developing markets. Linking European service part stock levels to global service part demand requires global control. Geographical dispersion of support activities makes exceptions management tough. For example:

- The exception takes physically place in Europe, while the information flow is managed in a low cost country (e.g. Philippines).
- Little errors in information flow have large consequences on physical flow. Shipments that do not match a RMA claim cannot be processed, with complete write-off as consequence.

More outsourcing and off shoring of production activities

Increasing part of production of CE products is outsourced to third parties (*van Lemt*, 2007). These vendors have moved their production locations to countries with lower labour costs.

- Large transportation distances increase risk of pre-sale product damage, loss or obsolescence
- Different companies bearing warranty liabilities increase the number of service contracts
- Burden for remanufacturing due to loss of technical knowledge and skills
- Service parts are bought directly with the production batch, increasing the risk of service part stock out or overstock

For example, triangular invoicing complicates front end and back end cost allocations: invoicing between production vendor – producer - service & repair companies; invoicing between dealer (or service engineer) – producer - service & repair company. Managers indicated that warranty claims, reconciliation of chargeback and compliance documentation are issues for their back-offices.

Overall, we conclude that several changing contingences in the environment affect the complexity for supply chain managers, of which we addressed those with an increasing impact.

In short we present other developments we found in **appendix I**.

4.2.2   **Producer perspective on developments in reverse logistics management**

The surveys asked to rank major trends from most important to fifth most important. **Section 2.5** provides literature that described developments in reverse logistics. From our findings, we aim to highlight major developments. The trends are ranked on outcome of importance indicated in the producer survey in **figure 4.4**. The same scoring method is used as for trends in the CE market. Results from other questions of the surveys provide a solid base for these trends.

Difference in relative score is lower than for the trends in the CE market (see **figure 4.3**), that shows less uniformity in answers. We present four trends with highest score. As before, the left box contains a description of the development. In the right box we mention a number of challenges that managers indicated to experience, that we relate to affect complexity.
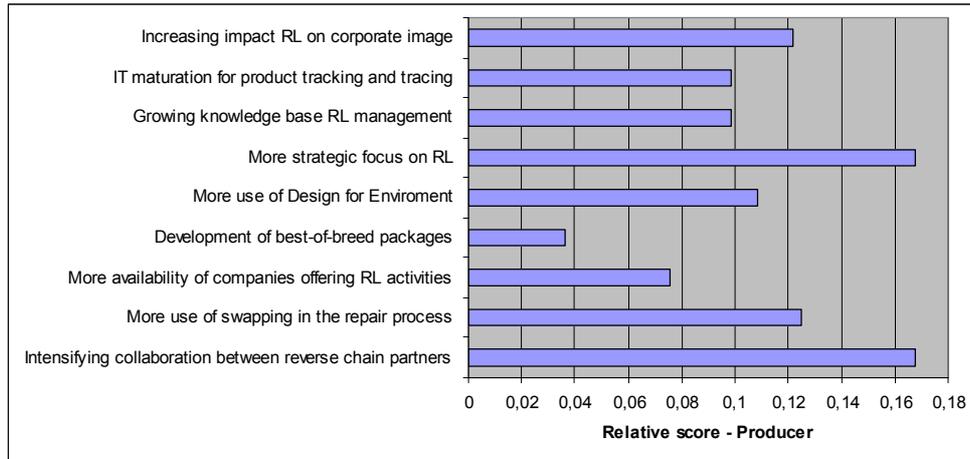
Figure 4.4: Trends in managing reverse logistics - Producer

More strategic focus on reverse logistics

Throughout the CE market senior managers are getting aware of strategic importance of product returns. Roughly speaking, managers in the IT & telecommunication category have more strategic focus than managers in the consumer equipment category.

- Senior managers aware of the impact want to actively manage returns, but do not always know how to do this
- End to end process optimisation is hold back by channel partners with less strategic attention
- First mover advantage has vaporised, forcing leading companies to search for new improvements

We found that reverse logistics is part of the corporate agenda of majority of companies under study. We observe that managers of consumer equipment have put effort to learn from practices used for IT & telecommunication equipment. We substantiate this trend by the fact that majority of the companies have dedicated functional units for reverse logistics management. 31.8% of producer respondents do not have a dedicated functional unit, and only 4.5% is managing IT & telecommunication equipment. **Figure 4.5** presents for all groups the results on dedicated functional units, illustrating that for each role in the chain majority of participants indicated to have dedicated functional units.
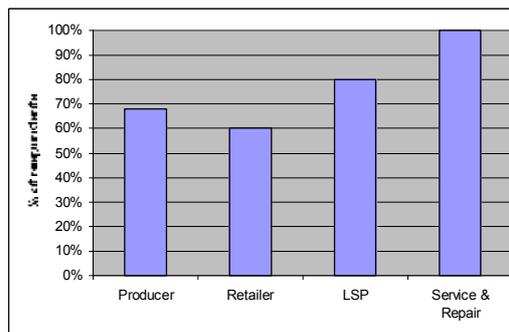
Figure 4.5: Functional unit fully dedicated to reverse logistics management - All

Intensifying collaboration between supply chain partners

Improvements in managing the reverse supply chain are achieved by intensifying collaboration with service providers and channel partners.

- Difficult evaluation what part of after-sales network is applicable for outsourcing
- Conflicting interests across the chain
- Required core competences within the company heavily depend on e.g. on level of outsourcing, kind of partnership, number of vendors
- Capturing and sharing knowledge from outsourced processes
- Administration and documentation that follows cross-company processes and exchange of information and goods

Chain partners intensify collaboration and strive to improve in win-win situations. Some initiatives we encountered:

- Joint rethinking of warranty process between producers and retailers
- Participants approached non-competitors to share knowledge on reverse logistics and consider use of shared services
- Enhanced mutual trust between producer and vendor by more sharing of information, both on performance as well as on cost

In all field studies a third party was involved in reverse logistics operations. **Figure 4.6** shows that producer respondents make extensive use of third parties for reverse logistics. Pan-European producers use several vendors for their reverse logistics operations, to spread risk and mitigate vendor dependency. Outcomes indicated that the ratio in-house / third party will be even lower for process recovery (see **figure 2.4**). Activities planned to outsource within the coming 2 years for disassembly, refurbishment, remanufacturing and recycling are respectively 34.5, 16.7, 14.5 and 43.2%. From a management perspective, this has led to a shift towards vendor management. Notable observations from **Figure 4.6** include:

- Respondents perform activities that relate directly to customer experience more in-house. For example, call centre and repair
- Remanufacturing scores lowest overall involvement (72%)
- Activities related to the end of a product life cycle are hardly performed in-house. For example, recycling (5%) and waste management (11%)
- Financial activities are mainly performed in-house (87%)
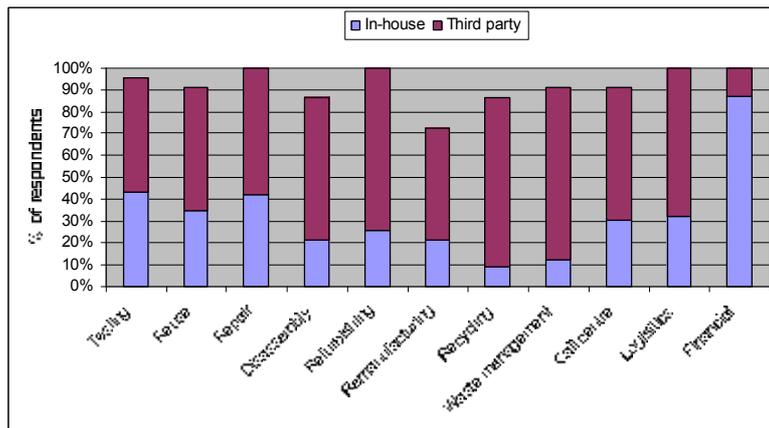
Figure 4.6: Third party use for reverse logistics activities – Producer

More use of swapping in the repair process

Reliability and accuracy of repair turn around times are achieved by more use of swapping of components and products.

Manage availability and cost of swap stock throughout the service network
- Updating validity swap guidelines and swap products
- Allocation of ownership of swap stock to group companies and third parties
- Administration and documentation that follows cross-company processes and exchange of information and goods

Companies B, C and E all held local swap stock of finished products for the repair process. For instance, company E is able to meet the fixed repair turn around time for 80% of repairables. For the other 20% it uses swap units. Efficient use of swap stocks brings along an extra dimension for inventory management.

- General inventory rules are complicated by high uncertainty on timing and quantity of swap stock needed.
- Updated swap guidelines are a necessity to gain from the swap benefits at low costs. With high number of products in-warranty this is a challenging task.

- Consigned swap stocks create local control over stocks, but limits central optimising.

A number of managers indicated to experience not to have optimal inventory models for swap stocks.

| *Increasing impact reverse logistics on corporate image*

Recalls, low quality (repair) products or little prove of environmental consciousness have increasing impact on corporate image. | - Document and report on reverse logistics activities to collect proof for sustainability purposes
- Risk of a recall always exists, but companies are not always ready for it
- Prevent that unauthorised parties remanufacture or refurbish products at low quality and harm brand reputation |

End-users blame the brand owner for a good or bad warranty process. Front end parties delaying or underperforming repair activities damage brand image. Non-repairable products can be made dysfunctional, but unauthorised companies acquire used products from the market. In the consumer market it is very hard to get control over the product once it is sold. In 4 field studies we observed that programs had been introduced to acquisition of sold products. However, **Figure 4.7** shows that minority of respondents have undertaken initiatives to increase returns in the last two years. We observe that 45.5% of producer respondents is not aware of return acquisition initiatives. When programs are in place, competition from market players forms an important challenge.
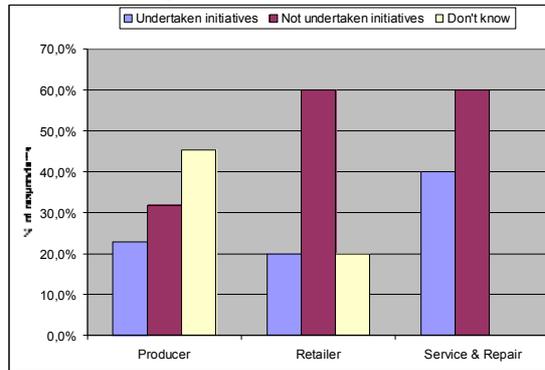
Figure 4.7: Initiatives to increase volume of returns – Producer, Retailer and Service & Repair

Environmental consciousness is increasing, but companies are sceptic towards global sustainability reporting and ranking systems. **Figure 4.8** shows that 50% of producer respondents rated importance of such systems *low* to *extremely low*. Survey results however show that 81.8% of respondents do have a sustainability program in place. Competitive advantage is the major driver of such programs. In addition, we found that 50% of respondents has undertaken design initiatives to enhance reverse logistics, with Design-for-Repair and Design-for-Recycling as applied principles. We observe high rate as a clear signal that producers are making use of design initiatives to enhance reverse logistics.
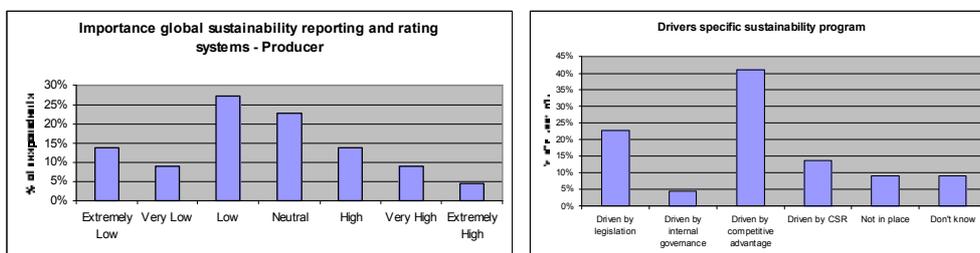
Figure 4.8: Importance sustainability reporting and rating systems (Left) and drivers specific sustainability program - Producer

In short we present more developments in managing reverse logistics in the **appendix I**.

4.2.3   Chain perspective on developments

Each actor in the reverse supply chain has an own role and may rank importance of a development different than a producer. We clarify the chain perspective with outcomes of retailer, LSP and SR surveys. Findings contribute to gain insight in their perspective on reverse logistics. We discuss the chain perspective more in summary, because our main focus group are producers.

Retailer perspective

Producer and retailer respondents rank the same top 3 trends in the CE market as most important: *Consumer become more powerful, shortening product development cycles* and *more global supply and demand markets*. Additionally scores *growing importance of internet selling* relative high. We are aware that an equal top 3 does not mean similar challenges in managing reverse logistics related to these trends. For example, a retail manager wanted to maintain direct contact with the consumer, but experienced that more producers were arranging warranty liability directly with the end-consumers. This practice relates to the trend that consumers become more powerful. At the same time this reflects an example of conflicting challenges that can rise from changing contingencies in a company's environment.

Retailers are heavily related to the producer for management of the warranty process. Quick and accurate repair process depends e.g. on producer return policies, producer requirement for turn around time of a service centre. All respondents indicated that they would like to increase visibility in the repair process, and perceive product tracking and tracing as an important improvement initiative. **Figure 4.9** shows outcome of trends in reverse logistics management.
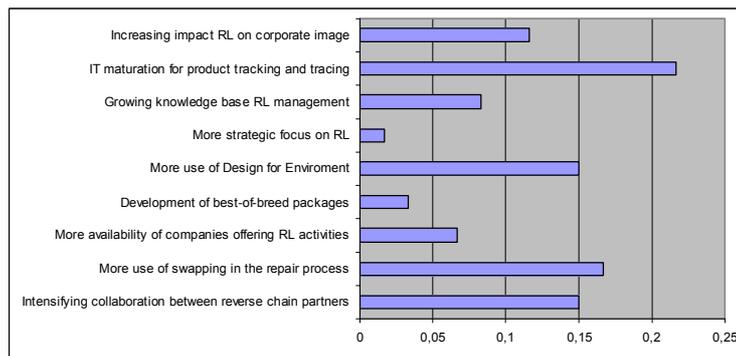
Figure 4.9: Trends in reverse logistics management – Retailer

We observe that *more use of design for environment* scores relatively high compared to the producer respondents (0.11 against 0.15). Retail managers indicated that, to a certain extent, may be used as marketing tool to sell products and at the same time they could benefit in recovery activities they performed by order of a producer (see **figure 4.10**). Notable observation from **figure 4.10** includes that reuse, refurbishment and waste management score high overall involvement. We conclude that use of design for environment is important for retail respondents.
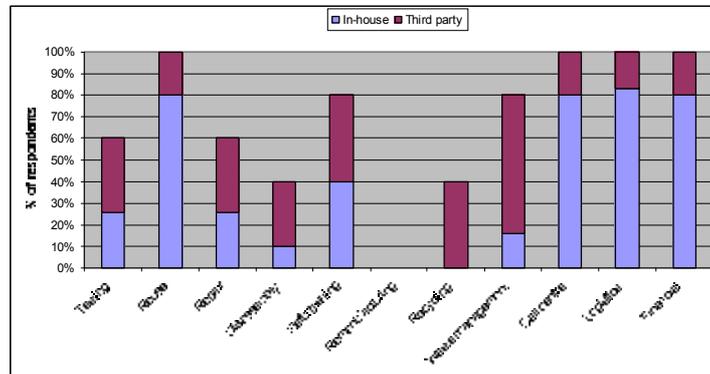
Figure 4.10: Activities performed by order of a producer - Retailer

LSP perspective

For this group *changing environmental legislations* scores more than double than all other trends. In interviews we observed that strict regulations on labour, transport, treatment and disposal caused implications for their operations. Concerning EPR compliance, outcome of the survey showed three areas in which LSP experience major difficulties: Registration of management and control of the waste stream, documentation for product disassembly for its end-of-life and documentation of waste product collected (see **appendix I.3.4**). When we compare this with results of the producer survey, we see that more than 70% of respondents experience also minor or major difficulties with the registration of management and control of the waste stream. We notice that this action required by EPR legislation is causing relatively most difficulties for both the producer and their vendors.

For trends in managing reverse logistics the top 3 is equal to those ranked by producers: *more strategic focus on reverse logistics, increasing use of swapping the repair process* and *intensifying collaboration between reverse supply chain partners.* We perceive this outcome as an additional proof for relevance of our analysis presented in **section 4.2.2.** In interviews it came forward that both at LSP customers as well as within the company the strategic focus on reverse logistics has increased. For 90% of LSP respondents reverse logistics is managed as a profit centre, from which we reinforce relevance of reverse logistics.

SR respective

Respondents rated *more outsourcing and off shoring of production activities* with highest score for trends in the CE market. We observe that this trend has ambivalent impact on their operations. Outsourcing and off shoring of production towards e.g. Asia transfers the technical knowledge and capabilities for product recovery to that region. On the other hand, high demanding customers drive short turn around times that increases demand for regional service & repair activities.

Also SR companies give *increased strategic focus on reverse logistics* highest score for trends in managing reverse logistics. Another high scored trend is the *growing knowledge base for reverse logistics management*. All SR respondents had a dedicated functional unit for reverse logistics management, and 80% had a culture for continuous improvement of the reverse logistics process. In interviews providers said to actively visit seminars and trade shows on the topic, such as the *Reverse Logistics Trade Show*.
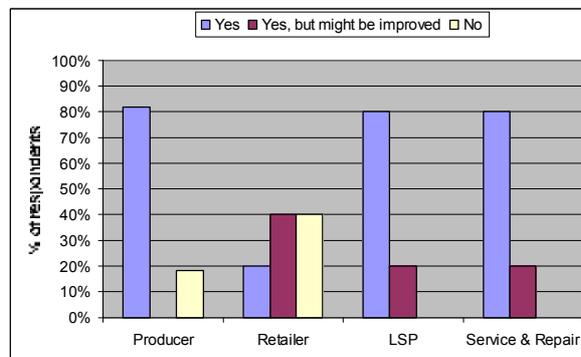
Figure 4.11: Culture for continuous improvement of reverse logistics process – All

4.3   Complexity for supply chain managers

Interview questions on barriers and success factors provided us further understanding of current complexity in management of reverse logistics. We use the outcome of the surveys as a frame to present results from a producer and a chain perspective. In some case we integrate outcomes on similar questions from different surveys.

4.3.1   Producer perspective on barriers

We asked respondents to rank major barriers from most important to fifth most important. **Section 2.6.2** provided literature background on barriers. **Figure 4.12** illustrates relative score for each barrier that we calculated by the same scoring method is for trends.
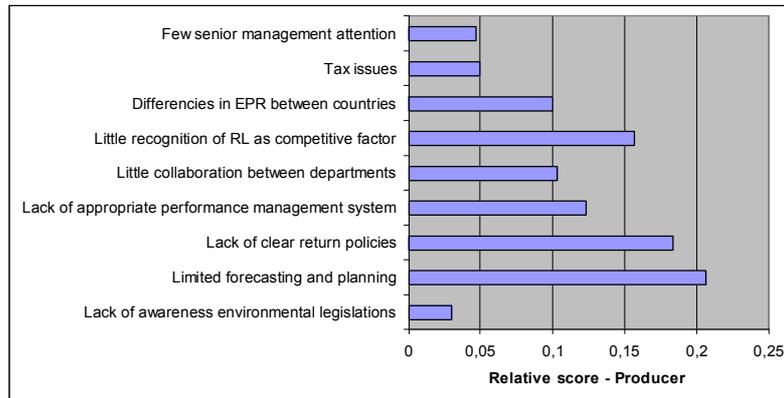
Figure 4.12: Experienced barriers in managing reverse logistics - Producer

For barriers with highest scores we explain our findings what managers experienced (left box), and we state a number of strategic reasons that managers indicated as the need to overcome a barrier (right box).

Limited forecasting and planning

Accurate return forecasts are hardly available. This is a direct barrier for both strategic and operational planning. Some managers use mid-term forecasts that are mainly based on basic return rate percentage and on historic data.

Utilisation of assets and resources in the reverse supply chain can be increased when accurate forecasts exist
- Return forecasts help to determine optimal return policy and gain economies of scale throughout the network
- Reduction in buffer inventories

For producer respondents is the importance of forecasting and planning to successfully manage reverse logistics not univocal. 55% of respondents rated importance *high* to *extremely high*, against 36% rated importance *low* to *very low*. Forecasting of future returns is done by 50% of respondents (see **figure 4.14**). Reasons mentioned not to forecast were unavailability of sales data, unbelief of necessity and complexity to integrate in systems. LSP and SR respondents clearly show that from their perspective forecasting and planning is important. **Figure 4.13** illustrates a gap in importance between producers, LSP and SR respondents.
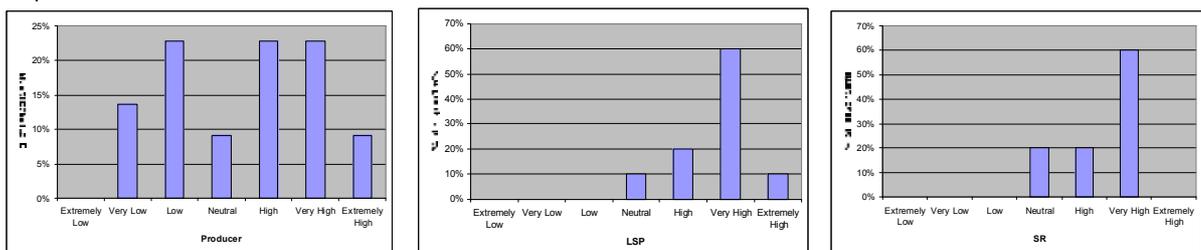
Figure 4.13: Importance forecasting and planning – Producer, LSP and Service & Repair

In addition, 41 % of producer respondents have not incorporated forecasting and planning into IT and shared forecasting and planning with supply chain partners is performed by less than 20%. Other notable observations from **Figure 4.14** include:

- Forecasting and planning of product returns is scarcely incorporated in information technology
- 14% of producer respondents use shared planning and forecasting of returns with supply chain partners for process control
- Retailer respondents show relatively low scores for forecasting of future arrival of returns, planning of required capacity and incorporation of forecasting and planning in IT

- Inventory management and quantitative cost analysis show highest overall scores amongst all respondent groups

Above bullets substantiate managerial implications that relate to forecasting and planning.
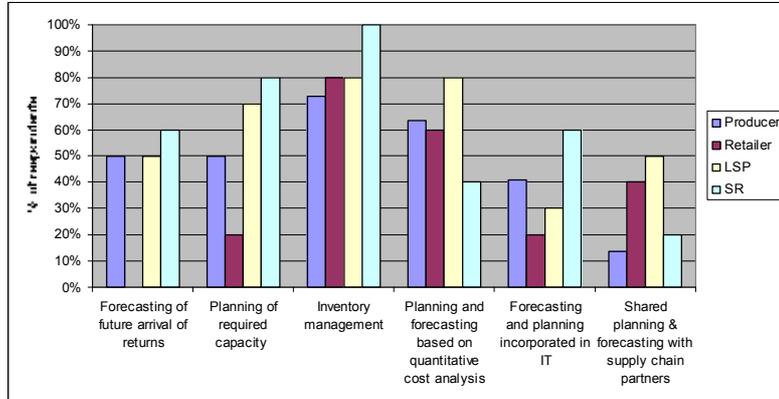
Figure 4.14: Process control of reverse logistics - All

Lack of clear returns policies	With unclear return policies dealers and channel partners can send products easily back
Sales departments are often not held responsible for commercial returns. This results in unclear warranty conditions, varying service levels and take-back policies in commercial agreements with channel partners.	- Unclear return guidelines result in 'accepting everything back' - Clear policies prevent disputes between channel partners - Clear communication on policies enhances agility to respond to market changes

We found that reducing the number of returns that are driven by commercial agreements is on the agenda of several producers. In field studies service managers mentioned to struggle to make sales understand what are consequences for customer service of commercial agreements and unclear warranty conditions. When asking which departments frequently discuss performance of reverse logistics, indicated 55% of respondents the sales and marketing department. Overall, **Figure 4.15** illustrates that majority of respondents discuss performance of reverse logistics with *finance*, *logistics*, *service*, *supply chain management* and *marketing & sales* departments. We observe that majority of respondents approach reverse logistics cross-functionally.
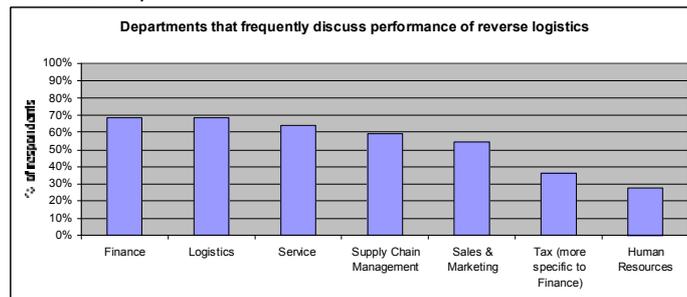
Figure 4.15: Departments that frequently discuss performance of reverse logistics

We did not held combined sessions with sales and service departments. We are aware that this touches limitations of our findings.

Little recognition of reverse logistics as a factor in creating competitive advantage	- Customers directly benefit from improved reverse logistics
Companies are organised around the forward flow of goods. Returns are perceived as the appendix of the company, and treated as such by several departments.	- Reverse logistic can be an important process for Total Quality Management - Maximising value from returns requires collaboration of many departments (e.g. design/manufacturing/marketing) - Skilled resources and time are needed to exploit improvement potential

Majority of participants indicated to see a differentiating role for reverse logistics. **Figure 4.15** shows that importance of reverse logistics to the company is centred on *high* score. We observe a gap between the importance and the lower score for satisfaction of reverse logistics management. Interviews pointed out that improvements in reverse logistics are partly hold back by little recognition and available resources for reverse logistics.
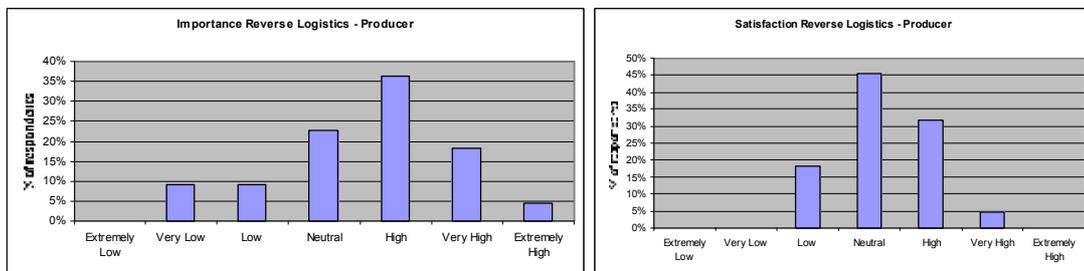
Figure 4.15: Importance and satisfaction of reverse logistics - Producer

Lack of appropriate performance management system

Managers find measuring and managing the true performance of reverse logistics is very hard. Internal and operational metrics are in place, but metrics for end-to-end process performance are seldom used or available.

Insight in end-to-end process performance is necessary to justify investments, guidelines and policies and gain recognition
- Only with insight in total reverse logistics cost full control is gained
- Management systems provide tools for effective decision making
- Prevent local optimising and gain from full chain performance

We refer to field study examples to illustrate this barrier. Managers of company E indicated to measure the same metrics for the last ten years, while processes and programs had totally changed. In discussions with Companies C and D we found that metrics were measured in different units than objectives set for programs. For example, work in progress was only reported in days, while the objectives were put on number of units. Next, managers indicated that their management systems were not able to integrate performance of different echelons in the reverse supply chain. When asked what management systems are in place for reverse logistics management, show all respondent groups 60% or more existence of a KPI dashboard. **Figure 4.17** illustrates lower use of corporate performance management such as the Balanced Scorecard (*Kaplan and Norton*, 1992). All above reinforces the relevance of the barrier of a lack of appropriate performance management systems.
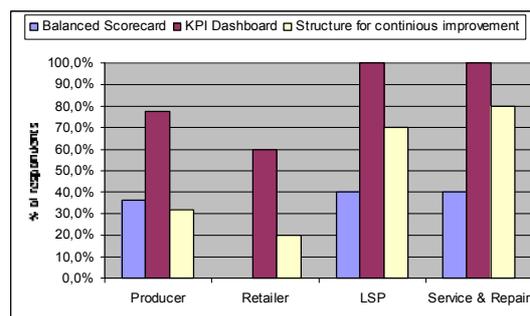
Figure 4.16: Management systems for reverse logistics management - All

Technology support

Outcomes of the surveys indicated need to separately discuss technology support for reverse logistics. For reverse logistics management we found a gap between importance and satisfaction of current Information Technology support for reverse logistics management: 96% of respondents rated importance *high* to *extremely high*, conversely 36% rate satisfaction *high* to *very high* (see **Appendix I**). Companies make

extensive use of systems which are run independently to their corporate Enterprise Resource Planning (ERP) systems. Notable observations from figure 4.17 include:

- Product embedded information devices such as Radio Frequency Identification are in the infancy stage of use for reverse logistics
- Retailers show lower use of hardware technologies than other respondent groups
- High use of serial number identification clears the path for installed base management
- 68% of producers actually do have ERP technologies installed. The gap between importance and satisfaction shows however IT inadequacies.

Overall, we observed that differences between installed hardware can complicate end-to-end process approach. In addition, installation of CRM packages was on the agenda of many companies, as currently only first movers have installed such packages for reverse logistics.
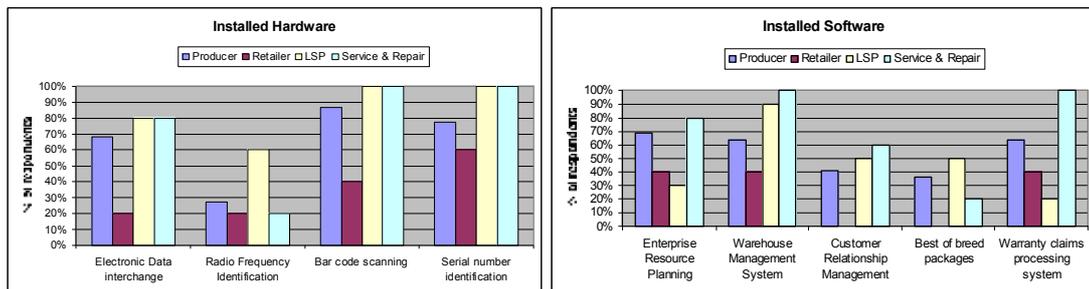
Figure 4.17: Installed hardware and software for reverse logistics management

4.3.2 Chain perspective on barriers

In this section we highlight barriers that participants explicitly indicated relevant to overcome.

Retailer perspective
80% of respondents indicated to manage reverse logistics as a cost centre. The satisfaction level of current management of these respondents was either *low* or *very low.* Satisfaction of reverse logistics management in the whole supply score range from *neutral* to *very low*. We observe that 0% of respondents is somehow satisfied with internal or external management. This can be a signal for producers to eliminate corresponding (external) barriers.

In terms of chain management, we found *lack of clear return policies* as a key barrier, which evolves from:
- Managers indicated that one brand can have already over 20 different take-back procedures. Retailers selling dozens different brands illustrate the challenge
- Some policies may not be applicable in local stores. For example, direct replacement policy may be not executable when a store does not have access to local stock.
- Policies for decision making after acceptance of a return also vary greatly per producer. For example, some producers want the retailer to dispose un-repairable products while others want to sell it themselves to the recycling industry.

Respondents give clearness and visibility of return policy highest score as desire for improvement initiative (see **Appendix I.3.3**).

In line with previous findings, for internal management the lack of an *appropriate performance management system* came forward as main barrier. 60% actually do have a KPI dashboard. In contrary, 0% has real-time insight in cost related to reverse logistics management. We observe that mainly detailed insight in costs of reverse logistics is lacking.

LSP perspective
For 70% of respondents is reverse logistics a leading differentiator. 10% indicated that reverse logistics is not profitable for the company, but all manage reverse logistics as a profit centre. 90% of respondents

rated importance of reverse logistics to the company *high* to *extremely high* and 70% rate satisfaction level for current management *high* to *very high*. All respondents expected increase in reverse logistics revenues in the coming two years, with varying growth expectations from 5 up to 40%. We observe that for LSP respondents reverse logistics is profitable with reasonable growth potential.

Limited forecasting and planning of returns is given highest score as barrier. We observe a gap in importance of forecasting and planning between producers and LSP (see **Figure 4.14**). Producers require flexibility of LSP as part of their SLA. Securing high utilisation of resources with daily varying volumes and quality of returns puts a direct challenge for the LSP, and indirectly on complexity for producers.

Service & Repair (SR) respective
For all SR respondents the importance of reverse logistics to the company is rated *neutral* to *extremely high* and the satisfaction of current reverse logistics management *neutral* to *very high*. Those respondents representing top-5 EMS providers (see **section 4.1.1**) indicated that 60 and 95 % of total sales revenues is represented by reverse logistics revenues. 40% of respondents representing smaller companies reported a ratio of 100%, and 20% of respondents indicated a 5% rate. We observe that for SR respondents reverse logistics is their core business and is important for their company.

SR respondents indicated to have difficulties with unclear and incomplete procedures and policies for decision-making in their processes, while a producer is the decision maker. Dealing with exceptions and extraordinary cases is time consuming and requires much communication effort. We found that the *lack of clear return policies* is perceived as a main barrier.

Same as for LSP gave SR respondents high scores to *limited forecasting and planning* of returns as an important barrier (see **figure 4.13**). 80% of respondents do not perform shared forecasting and planning of returns with supply chain partners, and this affected availability (and risk of stock out) of service parts. Managers receive service parts from other parties, have consigned parts or have taken ownership. In each case availability and turn over against cost control was causing challenges and we found that limited forecasting and planning amplified these challenges.

All respondent rated the importance of IT systems to support the reverse logistics process as *extremely high.* We found that improvement projects such as IT support for tracking and tracing, ERP and integration of CRM package were on the agenda of respondents. We observe that respondents are in the process of expanding use of IT to support reverse logistics.

4.3.3   Producer perspective on critical success factors

We asked respondents to rank CSF from most important to fifth most important. **Section 3.3.4** provided literature background on these factors. To discuss success factors and performance indicators we use survey outcomes (see **Figure 4.18**) as a frame. We consider these factors as *industry* CSFs: highest scores indicate a unique set for respondents in the CE industry.
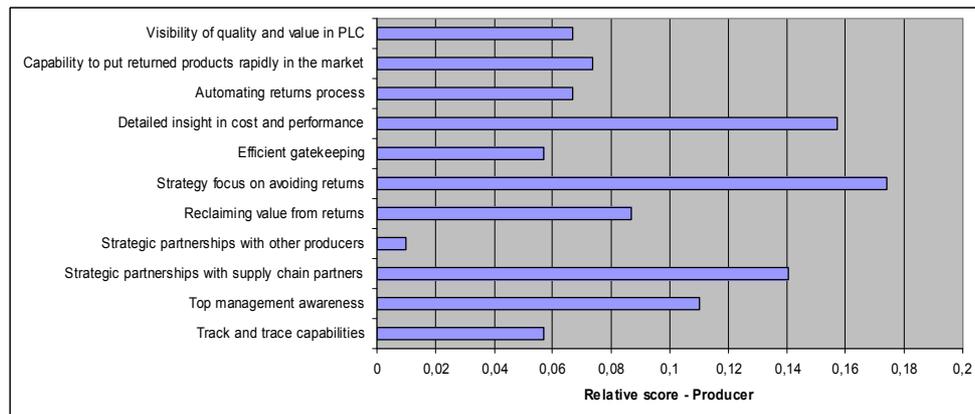
Figure 4.18: Importance critical success factors – Producer

In the left box we clarify the success factor, and in the right box we outline our findings on the potential contribution that the CSF can have in creating competitive advantage.

Strategy focus on avoiding returns Attention and focus at strategic level to prevent channel partners and end-users to return products. Avoidance is part of a clear reverse logistics strategy	Prevents unnecessary shipment and handling of products - Makes the service demand more predictable - Harmonises and standardises return policies and warranty conditions - Make it easier to qualify and control channel partners

As above, we illustrate this factor with field study examples. Company B has put this CSF in practice. Design and after-sales departments intensively have been working together to focus on home-servicing. New sold products have the possibility to be serviced remotely, and overall, products are made simpler. A box may contain a USB-pen that can be connected to the product, so that software updates or reset programs can be run via air.

When asking producer respondents to indicate if they have a specific reverse logistics strategy, we found that 45% actually did have a specific strategy, 18% was not aware and 37% said there was no such. We believe that a clear strategy should be in place and aligned with, amongst others, avoidance initiatives.

Return rate
For the purpose of estimating return volumes we asked respondents to indicate the average return rate within the initial warranty period. All respondents estimated their answer, ranging from 0.5% up till 9.5%. Notable observations from **Figure 4.19** include:

- Middle 50% of respondents scored between 2.1 and 4% of total sales volume being returned
- 54% of respondents have a percentage equal or lower than what is on average perceived as 'best performance' of retailer respondents

It is obvious that for respondents with annual sales volume of millions of units the volume of returns is significant.

Retailer	Best	Average	Worst
Average	3,5	6,3	23,3
St Dev	2,38	3,30	15,56
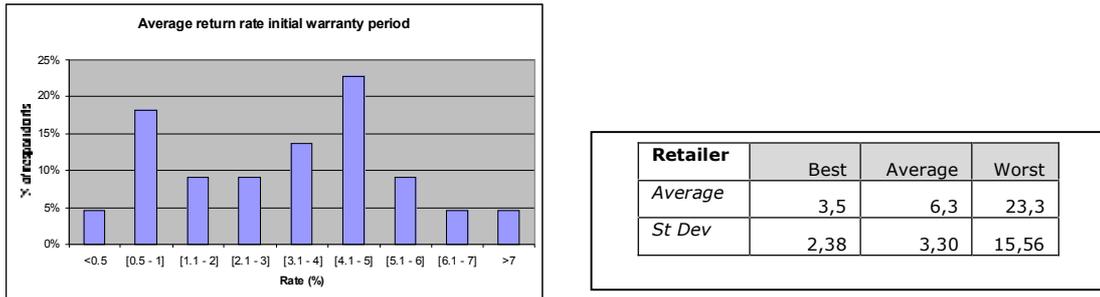
Figure 4.19: Average % of products being returned within initial warranty period (left); Perceptions on indicator (right)

Non-fault found rate

In practice, some returned products are in fact in working condition when they enter the reverse stream. We found that the non-fault found rate (see **section 3.3.5**) is used in practice as performance indicator. 14% of respondents indicated to answer exactly. We understand that the rate is very much related to amongst others type of products sold, return policy and effort in avoidance and gate keeping. In **figure 4.20** we present results of this indicator. Notable observations from **Figure 4.20** include:

- 63% of producer respondents score in the interval 'best – average' (up to 25%) of SR respondents
- Retailer respondents perceive lower rates as 'best' and 'average' than SR respondents
- Variations of SR answers are relatively low, indicating matching perceptions
- 27% of producer respondents score higher rates than SR 'worst' performance (45%)

We explain lower rates of SR respondents by their role in the returns process, actually making money out of the stream of returns, whereas retailers with reverse logistics as a cost centre struggle with return volumes and want to avoid this.

Overall, results are twofold: the 63% suggest a rather encouraging picture, while for 27% non-fault found seems to be an onerous issue, regarding cost borne in respect of these returns.

Retailer	Best	Average	Worst
Average	2,5	7,3	22,5
St Dev	1,91	8,54	31,76
SR	Best	Average	Worst
Average	13,0	27,0	45,0
St Dev	6,70	7,58	8,66
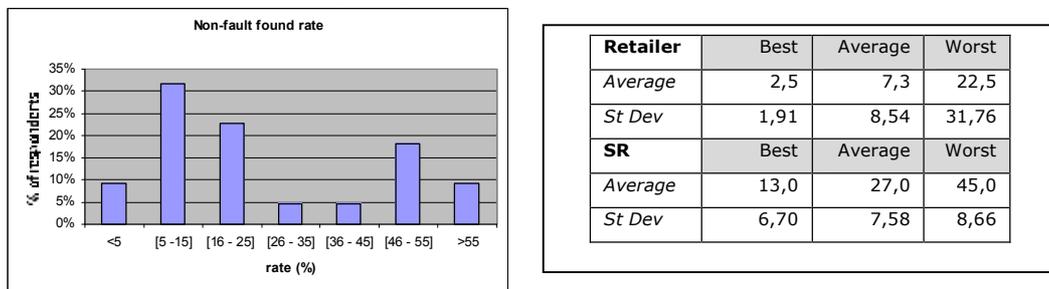
Figure 4.20: Average % of products inducted in the reverse flow that have no cosmetic or functional defect (left); Perceptions of indicator (right)

Detailed insight in cost and performance Insight in internal failure and external failure costs, both *clear* and *hidden*. Measuring the right indicators and understanding what indicator' performance implies	Focus on customer needs (doing the right things) prevents over-delivering customer expectations - Alignment of activities with focus secures doing things right - Enables sound strategic decision making based on real cost, revenues and performance

Cost

Internal and external failure cost we explain in **section 3.3.5**. We learned that availability does not imply accuracy or completeness. With 'clear' cost we imply costs that participants found obvious part of reverse logistics costs, e.g. pick-up costs, recovery processing. With 'hidden' costs we imply costs that participants did not directly related to reverse logistics, but after discussions did see as part of reverse logistics costs,

e.g. write-off due to faulty RMA registration, non-recoverable VAT. **Appendix I** contains a table of 'clear' and 'hidden' costs.

All producer respondents (100%) managed reverse logistics as a cost centre. Nevertheless, has only 36.7% availability of real-time insight in cost related to reverse logistics management (see **figure 4.21**). Also other actors show worrying low scores of availability and use.
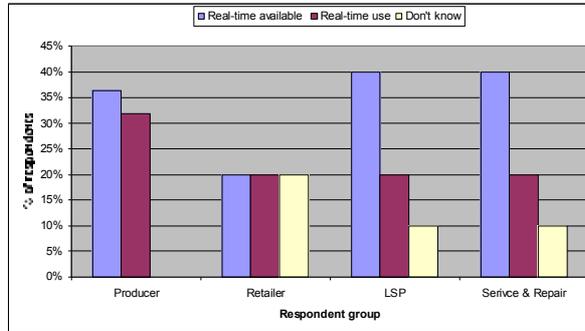
Figure 4.21: Availability of real-time insight and use of cost of managing reverse logistics - All

Figure 4.22 presents answers on total internal and external failure cost as part of total sales revenues. A worrying 14% of producer respondents indicated to answer exactly, with ratio of 2.6%, 2.8% and 7%. Notable observations from **Figure 4.22** include:

- Average answer was 4.1% with a standard deviation of 2.5%
- 40.1% of the results fall out of the 1.6 – 6.6% interval, indicating the spread of answers
- Only 9% of respondents were unable to provide an answer

We recognise that this indicator is volatile for critique as it is not SMART defined. Still we perceive the result as an indication for money spent on reverse logistics. For example, the exact answer 2.6% related to annual sales revenues of 7.5 billion euros. Early calculation result in an indication of 195 million euros was spent on reverse logistics in the most recent fiscal year. These numbers indicate the amount of money involved.
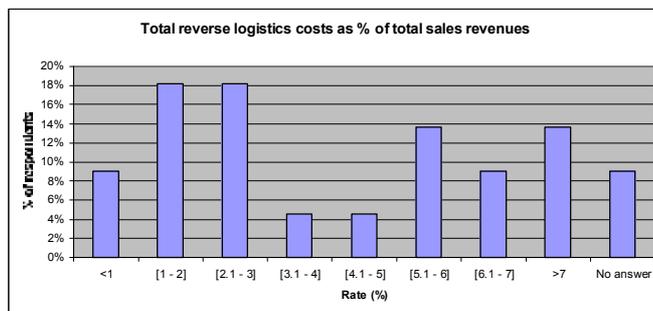
Figure 4.22: % Reverse logistics costs of total sales revenues – Producer

More performance indicators
Consumers become more powerful and this makes companies aim to measure end-customer satisfaction. In the field studies we found that only Company B had actually developed a KPI related to end customer satisfaction: a numerical indicator whether a customer would recommend the product to its friends and family.

In none of the field studies corporate policy was in place to document and report operations for sustainability purposes. Producers put time metrics for their providers, manage on throughput volume and turn around times, and mainly use activity based costing methods in service level agreements. Other KPIs used to manage reverse logistics: spare part availability, bufferstock availability and abandon rate calls.

Strategic partnerships with supply chain partners	New knowledge and dedicated resources increase control over reverse supply chain
Collaboration with suppliers, sales channel partners and third party service providers on strategic level	- Chain alignment towards customer experience - Fully explore opportunities of recovery options - Enables sustainable solutions

Many companies make extensive use of third party services (see **figure 4.6**). LSP survey results indicated that main reasons for clients to make use of third party services were: concentrate on core business (41%), relying on technology and specialism of third party (21%) and risk & control over the reverse chain (21%). During several interviews LSP indicated to start to offer also more laborious activities such as remanufacturing, aiming to provide a full solution. Other LSP position them mainly as a 4 PL, offering purely logistics activities with drop-off solutions.

Credit processing
The financial transactions related to reverse logistics can be very complex. Return Material Authorisation and evolving claims and credit processing is cumbersome. For customers of producers it is important to reduce credit processing time. Conversely, producers are aiming for maximisation of their working capital and prompt issuing of credit notes does not support this objective. We present results on average invoicing cycle time in **Figure 4.23**. Notable observations include:

▪ Two clear peaks, with a first centre of 41% of respondents indicated an invoicing cycle time between 26 and 30 days, and a second of 21% between 5 and 10 days.
▪ Clear increase in times from retailer to LSP respondents, and from LSP to SR respondents in perception of 'best' and 'average' performance

Need less to say that reducing invoicing cycle times increase cash flow positions of service providers. We observe a tension on length of cycle time that can implicate relationship in the reverse supply chain.

Retailer	Best	Average	Worst
Average	5,5	15,8	31,5
St Dev	3,00	10,72	21,44
LSP	Best	Average	Worst
Average	10,5	22,5	51,3
St Dev	8,37	18,10	35,17
SR	Best	Average	Worst
Average	17,0	34,0	73,0
St Dev	12,04	17,46	62,01
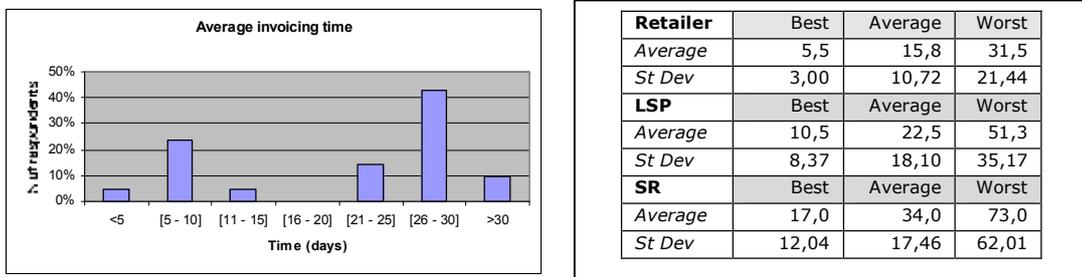
Figure 4.23: Average invoicing time – Producer (left); Perceptions of indicator (right)

Return information sharing
Many participants struggled to manage information flows related to returns. We found supply chain managers committed to cross-functional information sharing, but in many cases other departments, such as marketing, reluctant to data sharing. Same reluctance we found across sales channel partners (see also **figure 4.14**). Several producers indicated to aim to service end-customer directly, skipping their sales partners to get more return data.

Importance of IT support for reverse logistics is rated *high* to *extremely high* by 95% of producer respondents. **Figure 4.24** illustrates that 55% of producer respondents rated their ability to integrate with chain partners *high* to *very high*. 70% of LSP and 100% of SR respondents rated ability of customer' IT systems to integrate *high* to very *high*. This rate was only 40% for retailer respondents. From a chain perspective, we observe that integration of IT systems producer – retailer is lowest. We observe that for this link cross-company return information management can be a focal point in the future. *Chouinard* et al.

(2005) argue in favour of a total network approach to improve cooperation and collaboration amongst various actors.
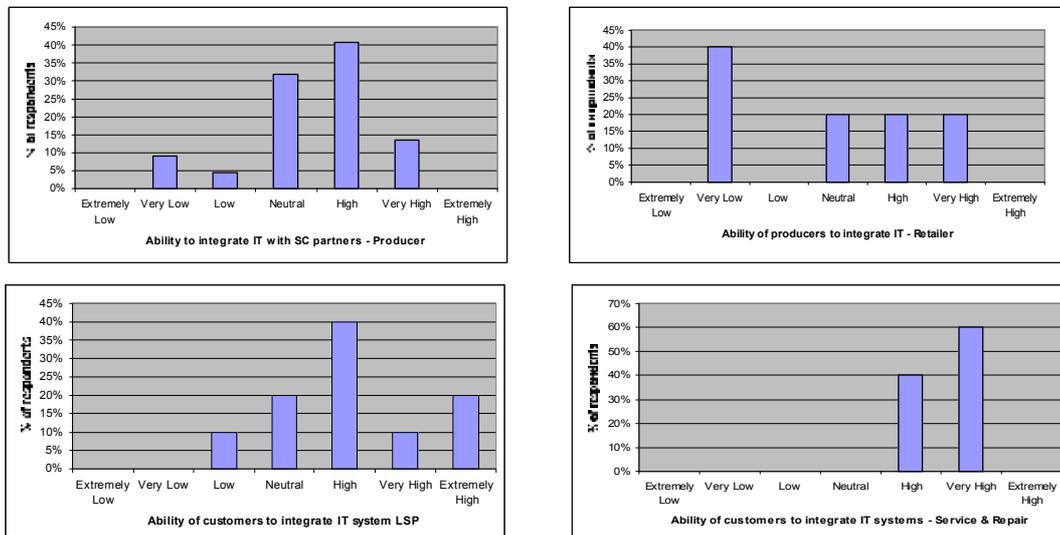
Figure 4.24: Ability of IT systems to integrate with supply chain partners – All
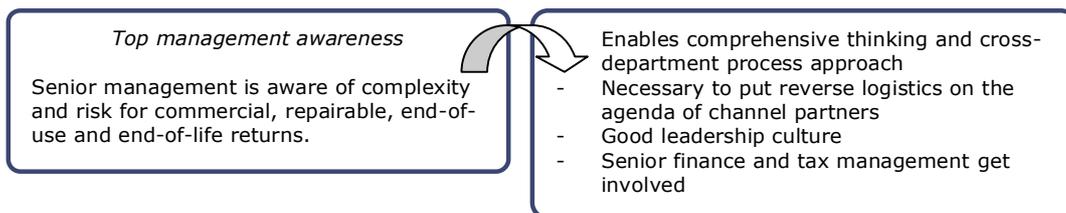
In many interviews we observed that supply chain managers reported directly to senior management, and that managers perceived that as important factor for their success. This is in line with analysis of *Aberdeen* (2006) that 92% of best-in-class had senior director or executive overseeing reverse logistics.

Involvement of finance / tax department in managing reverse logistics was much less found.
We substantiate the need for cross-department approach with results on cross border flows.

Cross border flows
In line with the trend of global supply and demand market, we asked producers for the locality of their reverse logistics activities. Results reproduced in **Figure 4.25** illustrate:

▪ Many cross-border flows take place for reverse logistics activities
▪ Highest non-EU located recovery activities are repair, refurbishment and remanufacturing, with scores of respectively 20, 19 and 18% of respondents
▪ Majority of activities are performed within EU
▪ Percentage that perceives impact of Tax on reverse logistics *high* or *very high* (32%) is much lower than percentage of that have cross border flows

Especially from a tax perspective, these cross-border flows have high exposure to VAT and customs regulations (see **section 2.4.4**). An example, testing activities in a certain country may be eligible for a zero VAT rate. Expanding service with more laborious activities may force the company to charge normal rate. We perceive that the 32% contradict the high rates of cross-border flows. We observe a gap in perception of tax impact and possible tax implications resulting from cross border flows. We believe therefore that increase of tax know-how on reverse logistics can be a focal point for the near future. In the

field studies we observed that managers from different finance and supply chain departments scarcely discussed reverse logistics, and used our visit as a first start to approach each other on the topic.
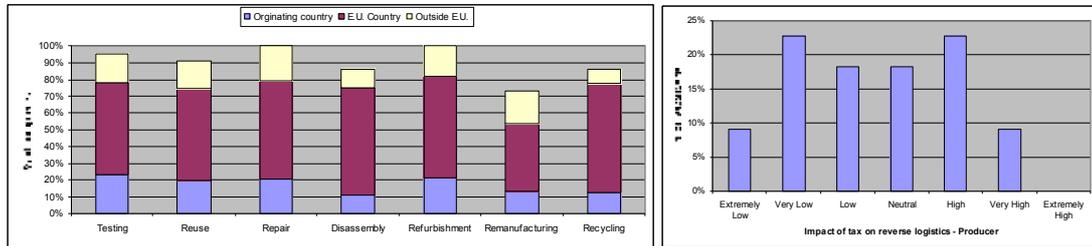
Figure 4.25: Locality reverse logistics activities (left) and impact of tax on reverse logistics (right) – Producer

Tax know-how

We found that sometimes tax managers were not at all involved in decisions made in reverse supply chain. Main reasons indicated were differences in focal points, performance focus, 'professional language' and paradigm. In the surveys we asked the extent of collaboration between tax and supply chain departments on reverse logistics. Producer survey showed that collaboration was rated *high* by 32% of respondents, LSP 40% rated *high* to *very high* and for retailers this percentage was 0%. Outcomes are rather worrying considering the cost burden companies can face due to unawareness of customs procedures and planning, cash flow risks and funding for VAT payments (*PricewaterhouseCoopers*, 2008).
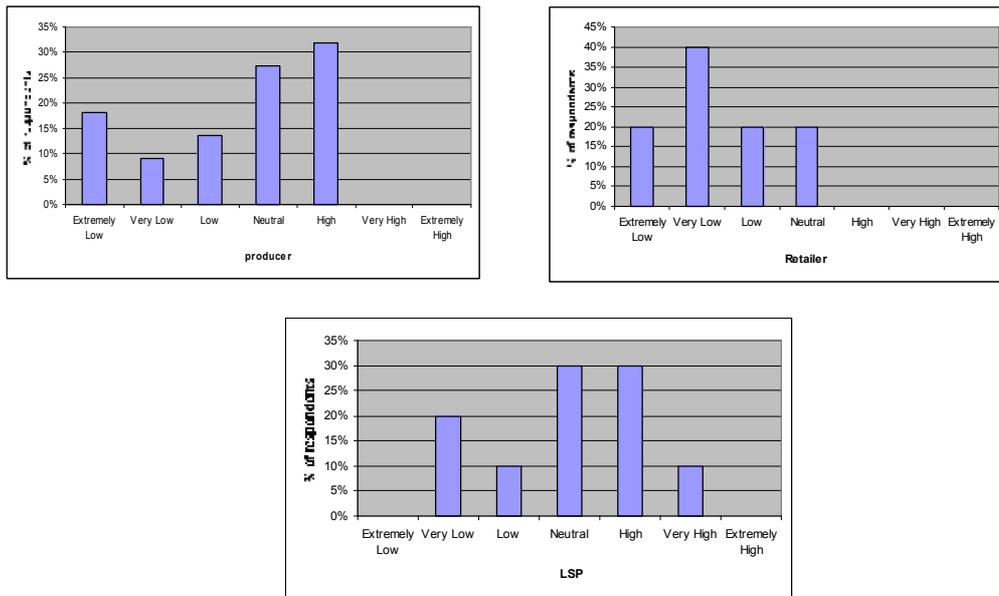
Figure 4.26: Extent of collaboration between tax and supply chain departments – Producer, Retailer and LSP

Reclaiming value from returned products

Part of cost of goods sols can be reclaimed by collection of returns and asset recovery from them.

Increases the profitability of reverse logistics programs
- Advances environmental commitment
- Exploits both technical and economic life cycles of products
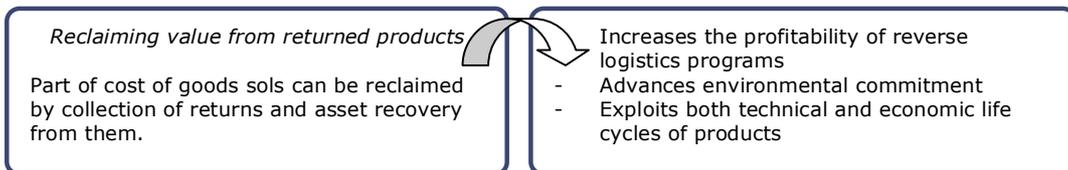
Literature described that product characteristics heavily influence applicability of asset recovery *Geyer* et al. 2007; *Mazhar* et al. 2007). Our interviews showed that senior level awareness of benefits, both economical as ecological, for asset recovery was a determining factor. Operations managers experienced burdens to

convince higher level management that in their perception more recovery could be explored. Survey participants indicated to find it difficult to answer the percentage of value reclaimed (see **section 3.3.5**) due to not taking a value perspective towards returns. We found specific programs that were actually managed as a profit centres, and for us this substantiates the argument that managers should see returns as valuable assets (similar to *Guide* et al. 2005). **Figure 4.27** shows estimations on value reclaimed by reverse logistics, and we observe:

- 27% of respondents in the *IT & telecommunication* category approach the perception of 'best' performance of SR respondents
- 45% of respondents in the *other* category scored lower than the perception of 'worst' performance of SR respondents
- Non of the respondents indicated to answer exactly

From these numbers we see that SR respondents believed that producers have opportunities to actually reclaim higher percentages of initial value. Interviewees mentioned that improved recycling techniques and well established secondary markets contributed to the potential. From the 0% of exact answers and comments from interviewees we conclude that this value indicator is not very practical, and we recommend re-evaluating this indicator in case of future use.

SR	Best	Average	Worst
Average	75,0	32,2	7,4
St Dev	20,82	27,46	3,71
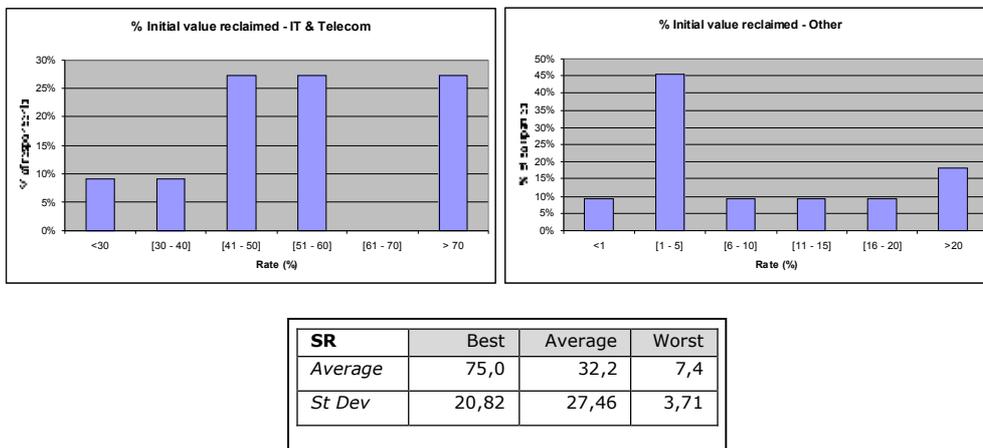
Figure 4.27: % of initial value reclaimed (IT & telecommunication (upper left); other CE (upper right)); Perceptions of indicator (under)

Recovery rate
We deduct involvement in higher level of asset recovery, e.g. refurbishment, remanufacturing, from the percentage of units scrapped of the total volume entering the reverse supply chain (see **section 3.3.5**). None of the respondents indicated to give an exact answer, and notable observations from results presented in **Figure 4.28** include:

- 50% of producer respondents scrap less 25% of products inducted in the reverse flow
- 45% of producer respondents score higher rates than SR perception of 'worst' performance

We observe that SR respondents believed that a number of producers can increase level of involvement in higher level of asset recovery. Interviewees mentioned that activities after scrap were actively controlled to secure authorised disposal. From a corporate social responsibility perspective, we perceive this as a positive sign.

Average Recovery Rate

SR	Best	Average	Worst
Average	15,0	21,3	45,0
St Dev	10,00	10,31	26,46
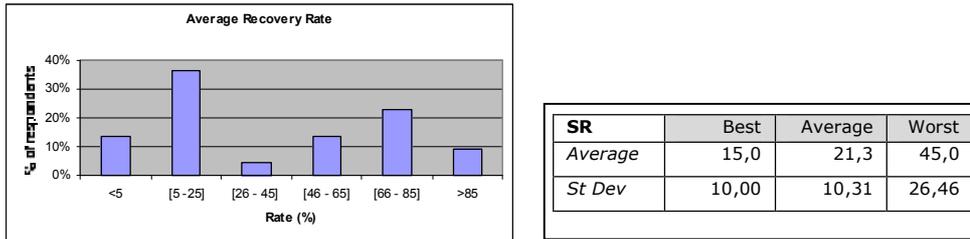
Figure 4.28: Average recovery rate – Producer (left); Perceptions of indicator (right)

Capability to put products rapidly back into the market

Mainly for products in early phase of the economic life cycle can value deprecation be an issue. Responsive reverse supply chain can put returns rapidly back into the market

- Increase profitability of reverse logistics program
- Time based management prevents costly delays
- Closed loop monitoring

With products loosing value several percent a month the return cycle time (see **section 3.3.5**) can be a key indicator for management of returns operations. We found that cycle times in practice depend on stage in product life cycle, type of rework required, company policies on reselling and to a large extent availability of spare parts. We present results on average return cycle times in **Figure 4.29**, and observe that:

- 86% of respondents indicated to have a shorter return cycle time than perception of 'average' performance of retailers
- Variations are relatively high, indicating the spread of answers

This suggests a rather positive picture of correspondence with retailer needs. In addition, participants indicated that product value looses between 3 and 10% per month. Need less to say that a reduction from 52 to 23 days (from 'worst' to 'average') can increase expected market value.

In general, other valuable metrics for performance would be variation in cycle time (shortest and longest time) and a percentage of returns processed within policy level agreements.

Average return cycle time

Retailer	Best	Average	Worst
Average	6,8	23,0	52,8
St Dev	7,09	16,19	32,22
LSP	Best	Average	Worst
Average	7,6	16,3	40,1
St Dev	8,46	17,44	35,00
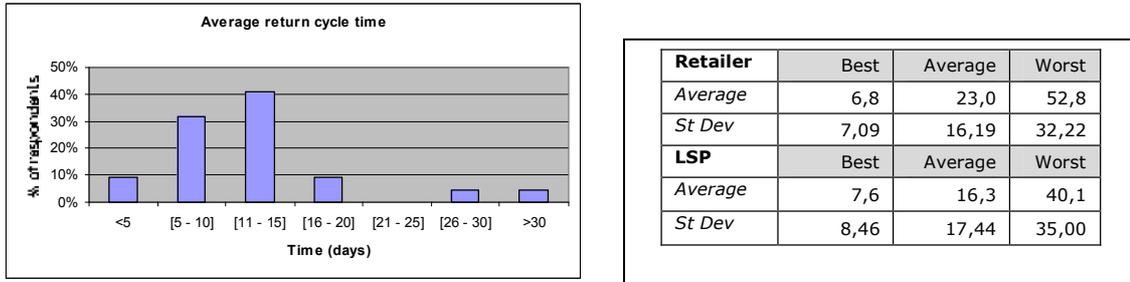
Figure 4.29: Average return cycle time in days – Producer (left); Perception of indicator (right)

Customer cycle time

We observed that managers dealt with products under warranty by various service models and approaches towards customer service. Managers indicated to design service models highly customised per country and, especially in Western Europe, with high standards compared to service levels in other continents.

We asked producer respondents to indicate their average customer cycle time (see **section 3.3.5**). We present results in **Figure 4.30**, and notable observations include:

- 77% of producer respondents scored times in the interval 5 – 15 days, which matches the perception interval 'best – average' of retailers
- 54% of producer respondents scored times in the interval 5 – 10 days, which corresponds with perception interval 'best – average' of LSP

These results suggest a rather encouraging picture that majority of producer respondents were delivering against expectations of retailers. Managers indicated that they were currently re-assessing the customer cycle times, to get to know if they were actually not over delivering customer expectations.

Similar as for other time metrics, we believe an extension of the metric with variability in times (shortest and longest times) and on-time rates are value for future research.
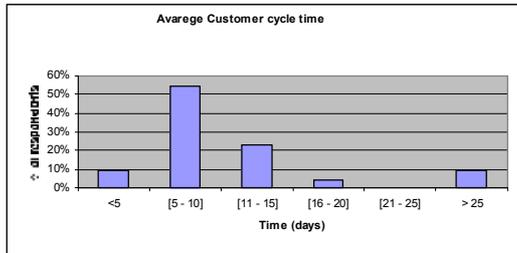
Retailer	Best	Average	Worst
Average	6,3	14,3	34,0
St Dev	5,74	7,41	16,79
LSP	Best	Average	Worst
Average	4,4	8,7	21,7
St Dev	3,41	5,72	11,38
SR	Best	Average	Worst
Average	2,8	10,0	34,8
St Dev	2,49	6,28	32,17

Figure 4.30: Average customer cycle time – Producer (left); Perceptions on performance (right)

Disposition guidelines
45% of producer respondents indicated to have a decision support system in place for determining the disposition of a returned product. We observe equal rates for end-customer or retailer locality of the decision made.
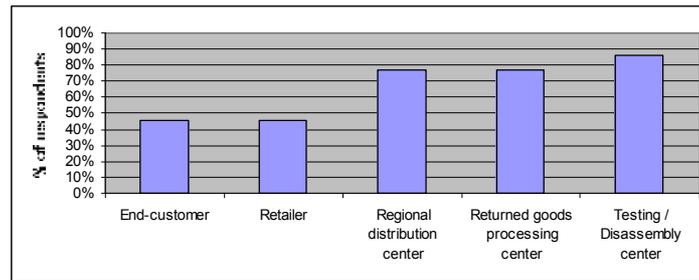
Figure 4.31: Decision made on disposition - producer

Literature argue that disposition speed is essential for good reverse logistics (*Rogers* et al. 2004). We observe from the relative low rates for decentralised decision making that there is potential for faster disposition.

4.3.4   Chain perspective on critical success factors

In our analysis we found that success factors for chain partners can correspond or conflict with interest of the producers. By highlighting the chain perspective on CSF we stress the complexities that supply chain managers explicitly indicated to experience.

Retailer perspective
Win-win
- Reduction in non-fault found rate. Respondents rated strategy focus on avoiding returns as important CSF (see **Appendix I.3.3**). For the producer this implies avoidance of both pre-sale and after-sale returns. A retailer is mainly concerned not to have internal stock adjustments or after-sale returns.
- Automating returns process. Integration of procedures and alignment of processes between reduces effort to deal with returns from both sides, from a producer as well as a retailer side.

Conflict of interest
- Control over repair turn around times. Participants indicated that the benefit to have control of turn around times: Keep their channel lean and promise predictable service to customers. Producers aim to provide repair services at lowest cost and make use of low cost providers that are not under control of

the retailer. Furthermore gave retailer respondents high importance to track and trace capabilities which underlines their interest in visibility and control.

- Standardisation and harmonisation of return policies and guidelines. We found that sales departments of producers used customised agreements, while retailers indicated that clear policies reduce effort in their return handling. We observe tension in interests.

LSP perspective

<u>Win-win</u>

- Transparency of information flow next to the product flow. Participants indicated the desire to link the product to the customer, identify decision hierarchy and to control the process. Obviously, a decrease in activity costs that LSP foresee by such transparency can be beneficial for producers.
- Direct contact between producer and customer. Skipping echelons brings control to the producer, and various LSP interviewees indicated to have explicitly developed (profitable) services for this demand.

<u>Conflict of interest</u>

- Strategic partnerships with supply chain partners. Multinational producers indicated reluctance to rely on one service provider, and therefore made use of several third parties. Strategic commitment and end-to-end contracts were in contrary favoured by LSP participants.

SR perspective

<u>Win-win</u>

- Preventing product recovery by unauthorised parties. Low quality rework or recovery with unofficial parts can damage brand image, and dismantling as a solution for this was for SR participants an extra (profitable) activity.
- Integral cost-benefit analysis for use of low-cost countries. Locality of activities was continuously under review. Cooperation with producer was part of relocation studies, and both parties indicated that less costly activities were beneficial for both sides.

<u>Conflict of interest</u>

- Capability to put products rapidly back into the market. Producers wanted to keep cost per return as low as possible, while SR wanted to achieve high throughout of the processes.

4.3.5   Reflection upon existing literature

During the previous section we already referred to numerous articles. We review more extensively literature in **section 5.1**. For here, we confine to some similarities and difference we perceive most notable.

- Barriers limited forecasting and planning and lack of clear return policies correspond with barriers for reverse logistics in other industries (*Ravi and Shankar*, 2004).
- Confirm success factor described by *Rogers and Tibben-Lembke* (1998) that reducing the reverse logistics flow should be part of the corporate agenda.
- Avoidance also has been identified as a key focus point by *Rogers* et al. (2004).
- Perception of product returns as potential sources of revenue: at least if the time between product return and resale are short (*Guide* et al 2005).
- High level of third party used reinforces relevance of articles on factors that complicate selecting and evaluation of third party providers, such as *Meade and Sarkis* (2002).   `
- This research suggest are rather disappointing picture on use of technology to achieve speed at lower cost, such as proposed by *Blackburn* et al. 2004.
- Without in-depth explanation, we argue that each enabler the EFQM model (i.e. people, policy, strategy, leadership, partnerships, resources and processes) can be matched with a CSF revealed by this study. This calls for future use of this model to build further on our results.

4.4   Actions to consider

Producer respondents were surveyed on topics they would like to improve within the company and in the total supply chain. 45% of producer respondents gave their opinion on desire to improve, that can a signal

of disagreement with options. We further explore limitations of our research approach in **section 7.3**. Still, we interpret outcome as initial improvement direction.

From **figure 4.32** we observe that answers are in line with barriers of **section 4.2** concerning return policy, financial management and better control and insight throughout the returns process. Another observation is that track and trace of returned products is an improvement direction that corresponds with CSF of retailers for product tracking and tracing.
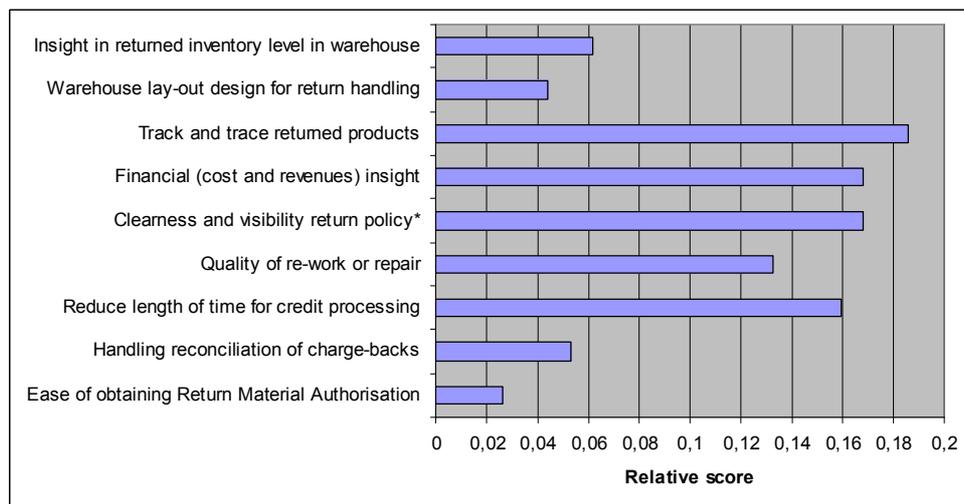
Figure 4.32: Improvement potential within the company - Producer

When asked in an open question, other initiatives mentioned were reduction in number of returned products, better forecasts on return rates, more reliable turn around time of returned goods, simplification of the process and cost reductions.

We expand our analysis with formulating useful actions to consider, building further on both previously presented results and more field results. Again, we concentrate on producers of CE products. To structure we use dimensions of *the Guide* (see **appendix F**), strategy, process, structure, people and technology.

Strategy
A. *Managing reverse logistics calls for strategic decision-making*
   Successfully managing reverse supply chain performance requires precision, commitment and effective communication of management strategies. Essentially, clearly stated reverse supply chain strategies are aligned with business strategies and voice of the customer. To achieve this, a close collaboration between tax and operations functions is essential.

B. *Put strategic focus on preventing products being returned*
   Front-end filtering and self-servicing. Understanding drivers of returns is a prerequisite for effective avoidance. Essentially, the reward structure should remunerate avoidance and gate keeping efforts.
.
C. *Harmonise and standardise guidelines and policies*
   Focus to standardise and harmonise warranty conditions, service levels and take-back policies and guidelines. Next, avoidance and gate keeping guidelines should be aligned with management strategies.

D. *Make Reverse Logistics part of your sustainability program*
   Control, document and report on sustainability initiatives to show environmental and social consciousness.

Process

E. *Put tax at fore-front*
    Streamlining and aligning Tax processes with Reverse Logistics operations.

F. *Use end-to-end process approach and close collaboration in solutions and programs*
    Reverse logistics cannot be assessed as a mutually independent activity. It is essential to incorporate all related business and financial connections to Reverse Logistics in order to compare business practices.

G. *Reduce uncertainty on required resources*
    Technology enabled running of parallel forecasting scenario's, advanced supply chain planning and integration with value chain partners are initiatives with potential to increase accuracy and quality of data.

H. *Measure and reduce turn around times*
    Management decisions based on expected value of returns form the basis for maximising value recovery. Make use of lean techniques to reduce turn around times.

Structure

I. *Develop front end quick service capabilities*
    Categorise returns under warranty regionally on level of required repair activity. Decentralised quick and easy repair activities reduce return flows.

J. *Ensure appropriate attention is given to Tax structuring*
    From very initial design phase consider complexities and impact for Tax management and risk.

K. *Consolidate laborious activities*
    Well-known benefits of centralisation can be gained for the back end of reverse supply chain. Consolidate partners and services for various products and brands. Evaluate potential of shared services.

L. *Actively manage recovery options*
    Expectation of future demand and yield of asset recovery is volatile. Proactive management anticipates on these changes. Next, constantly rethinking locality of recovery activities can lead to substantial cost reduction.

People

M. *Create approach towards true integration, not just interface*
    The evolution from complete functional independence within each company in the reverse supply chain to a truly integrated reverse supply chain is still not the focus point. Integration unlocks full potential of product and process design changes. Collaborate with tax managers and use tax as a driver for the design and execution of operations.

N. *Use dedicated resources for reverse logistics management*
    Efficient managing in-house and vendor activities asks for dedicated resources. Senior management support and commitment is necessary to see returns as valuable assets.

O. *Further develop know-how of reverse logistics managers*
    Increase knowledge base and provide finance and tax-specific training for supply chain managers.

Technology

P. *Make strategic use of available technology*
    Automating physical, information and financial flows fosters a seamless reverse supply chain. Use of technology streamlines processes and procedures across chain partners. Evaluate cost-benefits of product embedded information devices for value monitoring and track & trace.

Q. *Share return data and performance with strategic partners*
Return information management enables identification of the drivers of returns, increases visibility throughout the process, and is a prerequisite for efficient process control. Knowledge on installed base supports decision making.

R. *Develop corporate performance management system*
Almost all companies are struggling what and how to measure performance of reverse logistics. Use best practice indicators on internal and external performance for full cost control, and understand value of visualisation of 'true' cost.

4.5   Conclusion

This chapter empirically investigates management of reverse logistics in the consumer electronics market in European Union. We present the outcome of single-sector surveys with four focus groups: producers, retailers, Logistics Service Providers (LSP) and Service & Repair companies (SR). In total we sent surveys to 112 producers, 18 retailers, 20 LSP and 10 SR companies. By the end of February 2008, we received input from managers representing 22 producer, 5 retailer, 10 LSP and 5 SR companies. These numbers indicated response rates of respectively 19.6%, 27.7%, 50% and 50%. Because each survey consisted of 70 questions or more, we consider these rates high. Across respondents the annual sales volume ranged from 3.3 million to 50 billion euros in the most recent fiscal year. The middle 50% of respondents had higher than 10 and lower than 500 million euros annual sales volume. This reflects respondents to be medium-size to large companies. Their input we integrated with findings of 5 field visits. We had follow-up interviews with managers representing multinational producers and with responsibility of European consolidation centres, an asset recovery plant and a logistics hub, geographically spread over Germany, United Kingdom and the Netherlands.

We provide insight in managerial implications by describing 4 research topics. First, we described challenges that managers indicated to cope with that related to trends in the consumer electronics market. Similarly we described challenges that managers indicated to experience that related to developments in reverse logistics management. Third, the need for improvement came forward from findings on main barriers to successfully manage reverse logistics. Complexity in the reverse supply chain we further investigated by identifying a number of industry success factors and their potential contribution in creating competitive advantage.

4.5.1   Conclusion trends

Producer perspective
We aimed to highlight major trends in the consumer electronics market that show implications for producers in managing reverse logistics. Consumer becoming more powerful brings along urgency of public pressure for corporate social responsibility and have introduced new service models such as product swapping, household servicing and remote servicing. Customer experience is nowadays the leading principle. Next, shortening product development cycles increases pressure for lean channels, reduces time for quality testing and thus increases risk of quality issues or even a recall and makes forecasting and planning of service parts very complex. Subsequently, supply and demand markets becoming more global complicated exception management and puts pressure on global stock control. Finally, more outsourcing and off shoring of production activities increase risk of pre-sale product damage, loss or obsolescence, increase number of service contracts to manage, and puts a burden for remanufacturing due to loss of technical knowledge and skills.

As before, we aimed to also highlight developments in reverse logistics management resulting in challenges for managers, which we relate to complexity in the reverse supply chain. More strategic focus on reverse logistics has vaporised fist mover advantage, forcing leading companies to search for further improvements. And end to end process optimisation is hold back by chain partners with less strategic attention. Next, intensifying collaboration between supply chain partners influences required competences within the company and puts pressure on administration and documentation that follows cross-company exchange of information and goods. The potential of third party use makes it difficult to evaluate what part of reverse

supply chain should be seen as core competence. Overall, respondents perform activities that relate directly to customer experience (e.g. repair activities) more in-house than end-of-life activities (e.g. recycling). Subsequently, more use of swapping in the repair process affects management of availability and cost of swap stock throughout the service network, allocation of ownership of such stocks and updating validity swap guidelines and swap products. Finally, increasing impact of reverse logistics on corporate image force to prevent unauthorised parties remanufacture or refurbish products at low quality and harm brand reputation, increase need for complete recall recovery plan and need to document and report on reverse logistics activities for sustainability purposes. 82% of respondents indicated to have a sustainability program in place and 50% had taken design initiatives to enhance reverse logistics.

Chain perspective
Each actor in the reverse supply chain experiences different challenges evolving from trends in the CE market and in managing reverse logistics. Retailers scored more use of design for environment relatively high, as it makes their reverse logistics activities performed by order of producers more profitable. LSP experience challenges with changing environmental regulations, such as waste shipment regulations and batteries directive. In general, respondents experienced relatively most difficulties with the registration of management and control of the waste stream. SR respondents rated outsourcing and off shoring of production activities highest score, with ambivalent motivation: on the one hand is the transfer of knowledge and capabilities to other regions causing challenges concerning recovery activities, while on the other hand this trend increases the demand for regional repair activities. Finally, we observed that managers of different focus groups indicated to experience both corresponding and diverging challenges related to trends as indicated by producer respondents.

4.5.2 Conclusion barriers

In addition to previous described challenges, we highlight main barriers experienced to successfully manage reverse logistics. In the producer survey indicated 100% of respondents to perceive such barriers. Respondents rated 4 barriers as most important. First, *limited forecasting and planning* creates a barrier for both strategic and operational planning. For this topic we observe that LSP and SR respondents rated importance higher than producer respondents. Shared forecasting and planning of returns with supply chain partners is hardly performed. Second, respondents experience *lack of clear return policies* as an important driver for returns. Managers struggle to make sales understand what consequences commercial agreements and unclear warranty conditions have for customer service. Third, we observe a gap between importance of reverse logistics to the company and satisfaction of current reverse logistics management. *Little recognition of reverse logistics as factor in creating competitive advantage* is a main barrier that holds back improvements in reverse logistics. Finally, we found that corporate performance management systems are applied by few participants for reverse logistics management. This results that respondents perceive the barrier *lack of appropriate performance management system* as important.

Notable observations causing barriers include:
- Only 34% of producer respondents indicated to have real-time insight in cost related to managing reverse logistics, we observe a barrier of non-quantified reverse logistics costs.
- For all reverse logistics activities over 70% of respondents indicated to have cross-border flows, but 32% rated impact of tax on reverse logistics high to very high, we observe a lack of tax know-how and awareness.

From the chain perspective, we observe that 0% retail respondents were somehow satisfied with internal or external management. This can increase pressure on producers to eliminate barriers. A main barrier is the *lack of clear return policies.* Retail managers indicated that one brand can have already over 20 different take-back procedures. In addition, retail participants rated *lack of appropriate performance system* most important. We observe that mainly detailed insight in costs of reverse logistics was lacking: 0% of retail respondents had real-time insight in cost related to reverse logistics management.

We observe that for 90% of LSP respondents and 100% of SR respondents reverse logistics was profitable with reasonable growth potential. Both SR and LSP respondents rated *limited forecasting and planning* as a main barrier in reverse logistics. Securing high utilisation of resources with daily varying volumes and

quality of returns puts a direct challenge. This came forward in practices used for process control: only 20% of SR respondents indicated to perform shared forecasting and planning with supply chain partners, and 30% of LSP respondents had incorporated forecasting and planning in information technology.

4.5.3   Conclusion success factors

We analysed success factors that were ranked as most important in the producer survey. These factors included *strategy focus on avoiding returns, detailed insight in cost and performance, strategic partnerships with supply chain partners, top management awareness, reclaiming value from return* and *capability to put products rapidly back into the market.* For several factors we discussed managerial implications and possible tension fields between actors in the reverse supply chain. We summarise most notable findings:

- 37% of producer respondents indicated not to have a specific reverse logistics strategy and 18% was not aware of such strategy. We find this worrying numbers.
- On average return rates within initial warranty period range from 0.5% to 9.5%, and 54% indicated to have a percentage equal or lower than what is on average perceived as 'best performance by retailers (3.5%).
- 27% of producer respondents have a higher non-fault found rate than on average perception of 'worst' performance by SR respondents, in our opinion a risk regarding the unnecessary costs borne in respect of these returns.
- All producer respondents indicated to manage reverse logistics as a cost centre, nevertheless has only 37% availability of real-time insight in internal and external failure costs. Exact answers of percentage of total sales revenues spent on reverse logistic costs, range from 2.6 to 7%. Annual sales volume of billions of euros indicates of amount of money involved.
- Invoicing cycle times increase from retailer to LSP respondents, and from LSP to SR respondents in perception of 'best' and average' performance. The tension to change these times can implicate relationships.
- We found supply chain managers committed to cross-functional information sharing, but in many cases other departments, such as marketing, reluctant to data sharing.
- Many cross border flows take place for reverse logistics activities, with majority of activities performance in the EU. Though such flows have high tax exposure to customs and value added tax regulations, only 32% of producer respondents rated impact of tax on reverse logistics *(very) high.*
- SR respondents believed that a number of producers can increase level of involvement in high level of asset recovery, e.g refurbishment and remanufacturing
- 86% of respondents indicated to have a shorter return cycle time than perception of 'average' performance of retailers. This suggests a rather positive picture of correspondence with retailer needs.
- 77% of producer respondents scored customer cycle times in the interval 5 – 15 days, which matches the perception interval 'best – average' of retailers. This suggests a rather positive picture of correspondence with retailer needs.

Finally, we found that success factors can comprise win-win or conflicting situation, which can complicate decisions made by supply chain managers.

For clarity we reproduce our findings that affect complexity of producer practices in managing the reverse supply chain in a figure.
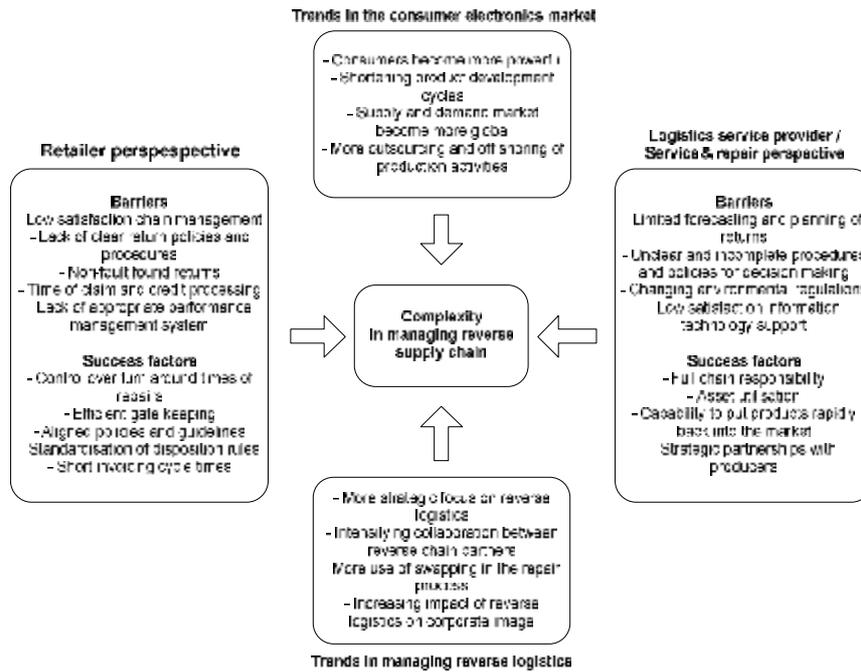
Figure 4.33: Complexity for producer practices in the reverse supply chain

4.5.4   Conclusion actions to consider

Previous findings formed the basis for identification of potential directions for improvement. Approaching producer companies in a comprehensive manner resulted in potential for the strategy, process, structure, people and technology dimensions of the Guide (PwC). The main actions we capture in **figure 4.34**.
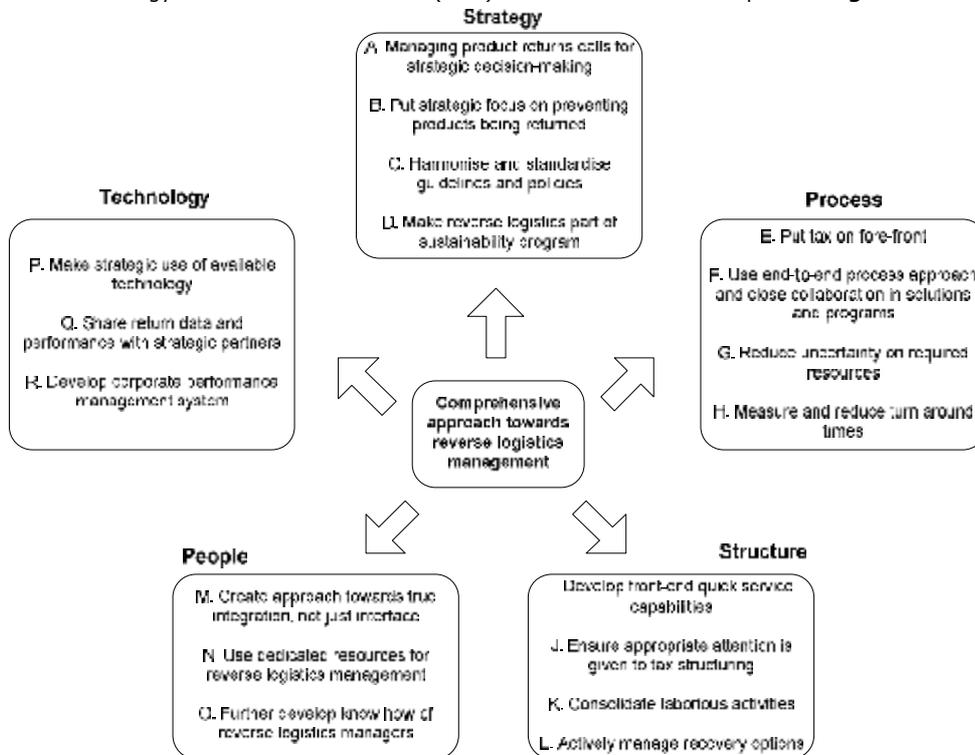
Figure 4.34: Potential improvement for producer management

5   Diagnostic model

Based on the results of the field research we have developed a diagnostic **model for identifying improvement potential for managing reverse logistics**. In the following sections we present the answer to the following research questions:

> I.   What situational factors can be used for diagnosing the strategic aspects of reverse logistics?
> II.   What are levels of maturity for situational factors related to strategic aspects of reverse logistics?
> III. What is the usefulness of the designed matrices in practice?

5.1   Conceptual reference model

Rubio et al. (2006) argue that research on reverse logistics is to be directed at analysing the strategic aspects of reverse logistics. The topic supply chain management in reverse logistics concerns those studies that analyse the strategic decisions, which the existence of reverse flows generates in the management of the supply chain. So, for diagnosing strategic aspects we include areas such as long-term behaviour of closed-loop supply chains, engagement in voluntary take-back, strategic network planning.

When we call back the key attributes of the SCOR and GSCM frameworks (see **section 3.2**), we run across overlap but also limitations of these reference models when compared with our field research. More explicit in respect of our findings on how producers currently manage reverse logistics. The SCOR model is very rich in process descriptions and best practices, but is already focused on implementing operational processes. In version 8.0 the focus lies on the functional areas of purchasing, manufacturing and logistics (Lambert et al. 2005) and return strategy development is not specifically incorporated. The basic process 'return' lacks, to our perception, various possible diagnostic aspects. For example:

- Enhanced reverse logistics by incorporation of end-of-life strategies in early phase of product design. Research and development is not explicitly expressed in the model
- Avoidance of unnecessary returns due to commercial agreements, related to the marketing/sales function. Also the marketing function is not implicitly expressed in the model

We therefore favour to build further on the GSCM frame than on to the SCOR model. The strategic sub-processes of *Rogers* et al. (2002), based on the GSCM framework, have been proven to be each relevant in strategic decision making. We substantiate our vision on most important ratifications or additions to these strategic sub-processes, relevant for diagnosing strategic aspects.

- *Develop returns management strategy and goals*. Only 45% of producer respondents had a reverse logistics strategy, and we believe that producers should develop a reverse logistics strategy, to decide which course of action to pursue above others. A **recovery strategy** should be part of a reverse supply chain strategy (*Fleishmann* et al. 2004).
- *Develop avoidance, gate keeping and disposition guidelines*. Ratified by highest score for strategic focus on avoiding returns as success factor, and spread in locality where producers determine disposition of returned products (see **figure 4.30**). In this step however, we missed guidelines or a program for acquisition. Our results indicated that 23% of producer respondents have taken initiatives to increase the volume of returns in the last two years. Hence, we propose to add **acquisition** as strategic aspect to our reference model. Works of *Guide* and *van Wassenhove* (2000) and *Beullens* (2005) argue that acquisition of used product is the control lever for the management and profitability of reuse activities.
- *Develop returns network and flow options.* Additionally, optimal tax structuring can provide significant cost benefits, and our field studies revealed that reverse supply chain managers are not aware of this. We thus add **tax planning** to our reference model, more specific value added tax and customs, as these are most relevant in respect of reverse logistics (*PricewaterhouseCoopers*, 2008).
- Develop *Credit rules.* Additionally, decisions have to be made concerning payment of **Return Material Authorisation**, and senior management bears **tax compliance** risk, thus we add these factors to our model. Two examples illustrating strategic decisions: invoicing cycle time of RMAs directly influences the cash position of a company; VAT structure and focus to have close relation with local authorities prevent non-recoverable VAT and supports smooth customs process.

- *Determine secondary markets.* Strategic decision of our interviewees involved for example co-locality of recovery activities with home base of brokers for recovered assets. Additionally, we observed that creating demand or generating higher sales prices can be fuelled to use re-marketing at strategic level, capitalising on going green strategies. Hence, we add **re-marketing** to our model.
- Develop *framework of metrics.* From corporate performance management consultants we learned that metrics should be preceded by translating strategy and objectives in success factors, and that this is an ongoing process for senior management. Only after this step metrics can be determined and defined. Next, non-quantified cost came forward as a main barrier for successfully managing reverse logistics. So we incorporate **performance management** instead of 'framework of metrics' to cover this area more completely.

To our knowledge, literature provides no other reference model that purely focuses on diagnosing strategic aspects of reverse logistics in context of the whole supply chain. Therefore we reproduce our vision in a new conceptual model, consisting of our empirical findings and insights distilled from literature. **Figure 5.1** reproduces the process reference model.
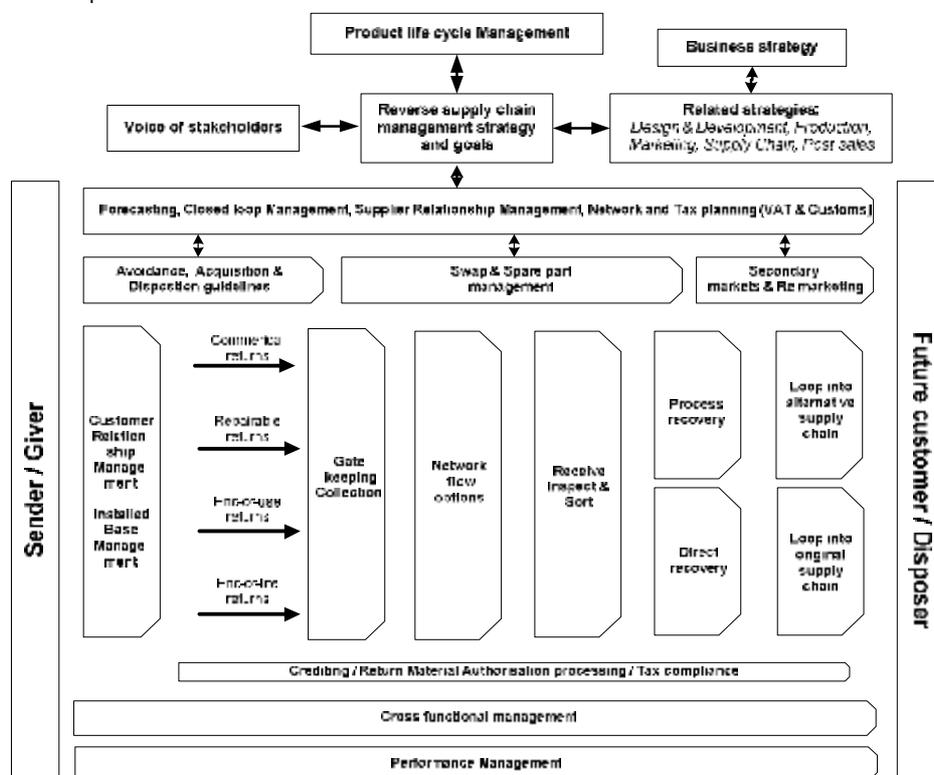
Figure 5.1: Conceptual reference model

In our case, we envision the role of sender / giver (*de Brito*, 2003) to be either the consumer or business customer at supply side. We disagree with the argument of *de Brito* to regard only an accommodator role for them, because in practice exchange of information or capital actually does take place. Two examples: service strategy of studied companies aimed to provide track and trace of returns during repair to the giver; focus on higher quality for information on expected tender date of recovered products to future customers increased value of such tenders. At the demand site, future customer includes original sender / giver, new customers (internal or external to the company) or disposer.

Our vision on how producers approach strategic decisions contains also the following aspects.

Product life cycle management (PLM) was in a number of field studies used as starting point in strategy formation for their business model including returns. For our reference model, we use a closed-loop perspective to PLM with aim to incorporate, in citation of *de Brito* (2003), the 'encircling aspect of the

process as a whole'. With such view on the supply chain our research embraces the idea of *Jun* et al. (2007) that companies can gain competitiveness by using closed-loop PLM systems.

Corresponding to the trend of demand and supply markets become more global, we believe that success factors in strategic decisions differ between closed loops in the alternative or original supply chain. We found that a **loop into alternative chain** can imply strategic decisions on forwarding assets to non-European markets, or change from business-to-business to business-to-consumer market.

Strategic use of swapping and exceeding customer expectations in high demanding Western European markets are examples of aspects related to **loop into original supply chain**. Additionally, for both the alternative and original chains we found strategic aspects used in practice for closed loop management: products design, network design and facility locations *Krikke* et al. (2001).

Strategic decision to use swap solutions brings along a whole new dimension in inventory and **spare part** management. To our knowledge, literature that takes swap management perspective to reverse logistics is scarce. *Minner* (2005) recommends future research for use of returns at several processes, implying swap units, for the use of strategic safety stocks in the reverse logistics supply chain. Strategic aspects of related strategies (see **section 2.4.2**), forecasting (*Toktay* et al. 2004; *Supply Chain Council*, 2006) and network planning (*Fleischmann*, 2001; *Srivastava*, 2007) have had more attention in literature and their relevance we already discussed in **chapter 4**.

Customer relationship management (CRM) is a focal point for managers in the CE market. Identifying and fulfilling customer-service requirements is essential (*Dowlatshawi*, 2000). We found that in practice, improving data quality for forecasting was on occasion related to monitoring customer's base. ERP suppliers indicated to see increasing use of installed base management for strategic decision support at their customers. *Lambert* et al. (2005) argue that CRM and supplier relationship management (SRM) form the critical links in the supply chain. For producers, imply suppliers not only OEMs or ODMs, but also service and repair companies, logistics service providers and spare parts vendors. Several articles discuss strategic decisions concerning collaboration with third parties in product recovery, i.e. contracting, joint ventures or vertical integration (*Toffel*, 2004; *Williams* et al. 2005). High rate of respondents using third party services for reverse logistics (see **figure 4.5**) outlines the importance of SRM. In addition, we support the philosophy of the GSCM framework to relate processes to the functions of purchasing, production, R & D, logistics, marketing & sales, finance and service. It is key in the realm of supply chain management that business processes are cross-functional (*Lambert* et al. 2005), and that supply chain managers align strategies and implementations with strategies in the areas of finance, operations, marketing, new product development, and sales (*Jan* et al. 1999). Managers contemplating product recovery strategies should consider which of these drivers currently apply to their company and industry. This will likely require discussions with managers from a variety of functions, since knowledge about production costs, brand reputations, customer expectations, and legislative agendas is typically diffused across an organisation (*Toffel*, 2004). Tax (more specific to finance) is in many cases part of the finance departments, but deserves specific attention in regard of the gap in tax awareness and know-how in reverse logistics (*PricewaterhouseCoopers*, 2008).

Products requiring easy service before they could be fed into the market are treated separately from returns demanding more action, i.e. a form or re-processing. For that reason we use the distinction of *de Brito* (2003) of **direct** and **process recovery**. Distinction seems even more relevant regarding difference in hold-up risks, sharing proprietary information and high environmental uncertainty (*Toffel*, 2004). *Fleischmann* et al. (2000) argue that there are classes of product recovery networks and that each should be evaluated separately, because "re-usable item networks, remanufacturing networks, and recycling networks appear each to have their own typical characteristics." As such, process and direct recovery necessitate individualised analysis.

Our model includes all strategic factors described by *Dowlatshahi* (2000), but extends strategic costs with management cost for avoidance, gate keeping and tax costs. We capture *overall quality* in product life cycle management and related strategies, customer service in customer relationship management and related strategies, environmental and legislative concerns in voice of stakeholders (see **figure 2.3**). Thus our model we view our model more complete than

5.2   Diagnostic model

We focus on developing a diagnostic model that describes qualitatively our vision on maturity for management practices, related to a specific factor. We use descriptions of maturity stages of **section 3.2.6** to develop profiles of strategic aspects that a producer would recognise as descriptions of possible current practice. The model is designed to use as a threshold model, where one cannot move to next higher levels without having fulfilled all conditions of the lower level (*Ridley* et al. 2004). Neither we have the intention to measure levels precisely, nor try to certify that a level has exactly been met. The maturity assessment is likely to result in a profile where conditions relevant to maturity levels are met.

The reference model captures our vision on relevant dimensions or process areas under analysis. In **appendix J** we include a preliminary schema that contains elements for each process area. With this matrix we intend to give initial impetus to a comprehensive 'best practice' framework. Here we confine to give background on how we came to different levels of the aspects included.

We take process area *reverse supply chain management strategy and goals* as example, with 'core business' and 'clear goals' as two relevant aspects under analysis that came forward during interviews. Thereupon we reviewed in which dimension of the Guide (PwC) we could position these practices to identify most appropriate level specific meaning of maturity (see **section 3.2.6**). The aspect 'core business' we position in the dimension 'people', because participants indicated that senior management should perceive product returns as such. We thus formulate conditions of the maturity stages based on senior management perception of role and contribution of reverse logistics as core process, based on *Hayes and Wheelright* (1984). Lowest maturity level describes reverse logistics as best reactive and very little to contribute to competitive success. Highest level of maturity describes the reverse supply chain to be the foundation for competitive success and central in strategy-making. Our translation of the aspect under analysis 'core business' thus results in the following levels:

	Maturity stage			
	1	2	3	4
Core business	Product returns are perceived as irrelevant and managed as purely cost driver	Importance of product returns is recognised but no awareness about how to handle	Strategic focus on product returns and manage both as cost and value driver	The reverse supply chain is a strategic, profit generating core business process

Table 5.1: Aspect under analysis as part of reverse supply chain management strategy and goals

A second aspect relevant for analysis is 'clear goals'. After review we position this practice in the 'strategy' dimension of the Guide. We thus formulate conditions for maturity stages based on *McCormach and Lockamy* (2004) with increasing level of control, effectiveness and predictability of processes. At lowest level of maturity process measures are not in place. In the highest level of maturity competition is based on multi-company networks, with process measures deeply embedded in the organisation. Our translation of the aspect under analysis 'clear goals' thus results in the following levels:

	Maturity stage			
	1	2	3	4
Clear goals	Reverse Logistics management goals are not in place	Reverse logistics management goals are in place for parts of internal returns processes	Reverse logistics management goals are in place for all internal processes	Reverse logistics management goals are in place for all end to end processes

Table 5.2: Aspect under analysis as part of reverse supply chain management strategy and goals

For each factor of our reference model we exploratory investigated practices that we encountered during our research. For these practices we formulated conditions for maturity stages as illustrated above.

5.3   Usefulness in practice

The main advantage of the designed diagnostic scheme is the width in which it approaches organisations. We believe that the conceptual reference model is rather rich, and that the diagnostic model builds further with various 'best practices' per area. PwC can convert the stage descriptions easily in an excel-based audit

scheme which can serve as a quick scan to visualise 'current state' and show potential directions for 'future state'. Ease of understanding is a main benefit of such scheme. With quick we imply a simple assessment rather than large cause and effect analysis which would require several weeks to fulfil.

Regarding the exploratory character of the framework, we also encounter limitations. The framework does not give any answers, it only poses questions. In order to develop reverse supply chain strategy strategic discussions are needed to evaluate the test results. Such discussion can acknowledge strategic priorities and provide more in-depth support for long term decisions.

5.4   Conclusion

To our knowledge, no specific reference model was present that fits practices that we studied. In our opinion a number of strategic aspects have been undervalued in studied reference models (SCOR and GSCF forum) in respect of capturing 'as-is' state of a producer. In this chapter we therefore developed a conceptual reference model that reflects our findings on situational factors we found relevant for diagnosing strategic aspects of managing reverse logistics. We integrate our findings with current literature to substantiate relevance of proposed aspects. Most notable ratifications and additions include:

- *Product life cycle management*
  We found that product life cycle management (PLM) was in a number of field studies used as starting point in strategy formation for their reverse supply chain business model.
- *Reverse supply chain strategy*
  45% of producer respondents indicated to have a reverse logistics strategy.
- *Closed loop management*
  For our reference model, we use a closed-loop perspective to product life cycle management with the aim to incorporate, in citation of *de Brito* (2003), the 'encircling aspect of the process as a whole'. We distinguish loops into the original supply chain and into alternative supply chains.
- *Return acquisition*
  Our results indicated that 23% of producer respondents had taken initiatives to increase the volume of returns in the last two years. Works of *Guide* and *van Wassenhove* (2000) and *Beullens* (2005) argue that acquisition of used products is the control lever for the management of reuse activities.
- *Tax planning (more specific value added tax and customs)*
  Optimal tax structuring can provide significant cost benefits, and our field studies revealed that reverse supply chain managers are not aware of this. More specific to value added tax and customs, as these are most relevant in respect of reverse logistics (*PricewaterhouseCoopers*, 2008).
- *Swap management*
  Strategic decision to use swap solutions brings along a whole new dimension in inventory and spare part management. To our knowledge, literature that takes swap management perspective to reverse logistics is scarce. *Minner* (2005) recommends future research for use of returns at several processes, implying swap units, for the use of strategic safety stocks in the reverse logistics supply chain.
- *Re-marketing*
  We observed that creating demand or generating higher sales prices can be fuelled by use of re-marketing at strategic level*,* capitalising on going green strategies.
- *Performance management*
  Non-quantified cost came forward as a main barrier for successfully managing reverse logistics. A worrying 34% of producer respondents indicated to have insight in cost related to reverse logistics management. Additionally, the fact that lack of appropriate performance management system was ranked as a main barrier reinforces relevance of performance management.

Then we used the conceptual framework to review management practices we analysed in our field research, to collect exploratory areas to diagnose. Maturity stages of these areas contain profiles of strategic aspects that a producer would recognise as descriptions of current practice. PwC can translate these maturity stages in an excel-based audit scheme which can serve as a quick scan to visualise 'current state' and show potential directions for 'future state'. Ease of understanding is a main benefit of such scheme. With quick we imply a simple assessment rather than large cause and effect analysis which would require several weeks to fulfil. The diagnostic framework does not give any answers, it only poses questions. Further discussions are needed to evaluate the test results and actually take decisions on directions for future improvement.

6 Management tool

In this section we provide answer to the question ***what does facilitate exploiting improvement potential in managing reverse logistics?*** We derive answer to this question from the following sub-questions:

> I. *What model can be used to exploit improvement potential in managing reverse logistics?*
> II. *What is the usefulness of the designed model in practice?*

Chapter 3 provided arguments for the analytical hierarchy process as a technique to facilitate benchmarking. We consider our field research rich enough to actually apply this technique and herewith include a first quantitative component to facilitate prioritising improvement actions.

6.1 Hierarchical structure for management practices

Similar to *Korpula and Tuominen* (1984) we use identification of critical success factors as initial step of the benchmarking process. Regarding the aimed use we focus on CSFs at senior management level. Environmental CSFs are excluded from the model as it is our intention to propose those factors that managers actively can manage.

6.1.1 Problem decomposition

In the highest level of the hierarchy we put the overall goal for improvement initiatives: increase the value for stakeholders. Companies should individually rank stakeholder groups on their power to influence the organisation, the legitimacy of the stakeholder's claims, and the urgency of the stakeholder's demands as related to the organisation (*Alvarez-gil* et al. 2006).

In the second layer of the hierarchy we position main success factors that PwC uses for all their clients, namely *revenue growth*, *operating margin* and *asset utilisation*. These generic factors have come forward after years of consulting work and validated by many organisations.

The third layer comprises of industry and competitive critical success factors that this research proved to be most relevant for producers. The main success factors concluded in **chapter 4** we refine into eight factors that we validated during the field studies. In short we give our description of the CSF:

- *Responsive and adaptable chain*
  The agility of a reverse supply chain in responding to marketplace changes, to gain or maintain competitive advantage (*Supply Chain Council*, 2006) and to put returned goods speedily back into the market.

- *Lean and seamless returns process*
  Streamlining the returns process through simplifying processes, increasing flexibility, (spare part) inventory reductions and reducing sources of waste and delay.

- *Sustainable business model*
  Integrating environmental and social thinking and considering society interest into supply chain management by taking responsibility for the impact of activities on customers, employees, shareholders, communities and the environment in all aspects of operations.

- *Tax compliance & control*
  Ensuring the quality, accuracy and completeness of value added tax and customs compliance and the effective control of this compliance.

- *Efficient asset recovery*
  The efficient disposition of returned goods, surplus, obsolete, scrap, waste and excess material products, in a way that maximises returns to the owner, while minimising costs and liabilities associated with the dispositions (*Rogers and Tibben-lembke*, 1998).

▪ *Collaboration*
Cross-functional and inter company collaboration in managing reverse logistics.

▪ *Avoidance & Gate keeping*
Strategic focus on preventing products being returned and the screening and testing of products at the entry point of the reverse flow.

▪ *Transparency*
Insight in true performance, yield and cost of managing reverse logistics.

In the fourth level we position our actions to consider as discussed in **section 4.4.** We reproduce our decomposition of the problem to increase value for stakeholder by managing reverse logistics in **figure 6.1**.

6.1.2   Comparative analysis

Foregoing to the round table session we sent to participants a web-based survey to investigate their perception of relative importance of each CSF. The AHP approach requires translation of the perception into numerical scales, for which we used the scale as proposed in **section 3.3.1**. We present a set of all judgements in a square matrix that contains approximation of eigen vectors. For detailed description of calculation of such vector we refer to **appendix K**. The column most right contains the so-called consistency ratio that we use to investigate the consistency of the answers. The lower the ratio, the more consistent the comparisons have been answered.

	Responsive / adaptable chain	Lean returns process	Sustainable business model	Tax compliance & control	Efficient asset recovery	Collaboration	Avoidance & Gate keeping	Transparency	*Consistency Ratio*
Included									
Expert advisory consultant	0,274	0,148	0,075	0,129	0,065	0,075	0,129	0,106	*0,083*
Expert tax consultant	0,064	0,043	0,245	0,344	0,064	0,091	0,126	0,023	*0,135*
Expert logistics service provider	0,130	0,197	0,197	0,075	0,086	0,066	0,150	0,099	*0,136*
Expert information technology provider	0,127	0,146	0,370	0,032	0,079	0,073	0,069	0,104	*0,137*
Expert service & repair company	0,112	0,169	0,222	0,097	0,085	0,056	0,147	0,112	*0,158*
Expert academic	0,163	0,153	0,116	0,116	0,187	0,101	0,083	0,083	*0,166*
Excluded									
Expert logistics platform	0,114	0,101	0,162	0,152	0,198	0,072	0,152	0,051	*0,400*

Table 6.1: Synthesis of priorities

Most notable observations from **table 6.1** include:
▪ Only one expert scored consistency ratios under 0.1, indicating that his set of judgements was truly reliable
▪ Ratios of five experts did not exceed the 0.1 very vastly, and we perceive their answers as not too inconsistent to be perceived unreliable. Only the expert of logistics platform we do not use for analysis
▪ *Collaboration* and *efficient asset recovery* score relatively low
▪ *Sustainable business model*, *responsive / adaptable chain* and *avoidance & gate keeping* score across all experts relatively high
▪ Our case example, the SR company, scored tax compliance & control relatively low

After discussions of the round table session managers representing the case example found out that they were not in control of their Value Added Tax payments. When visiting the managers two weeks later, they admitted that if they would answer the survey once again, they would rate tax compliance and control much

higher than they did before. This proves the usefulness of the model in revealing possible lack of attention or awareness.
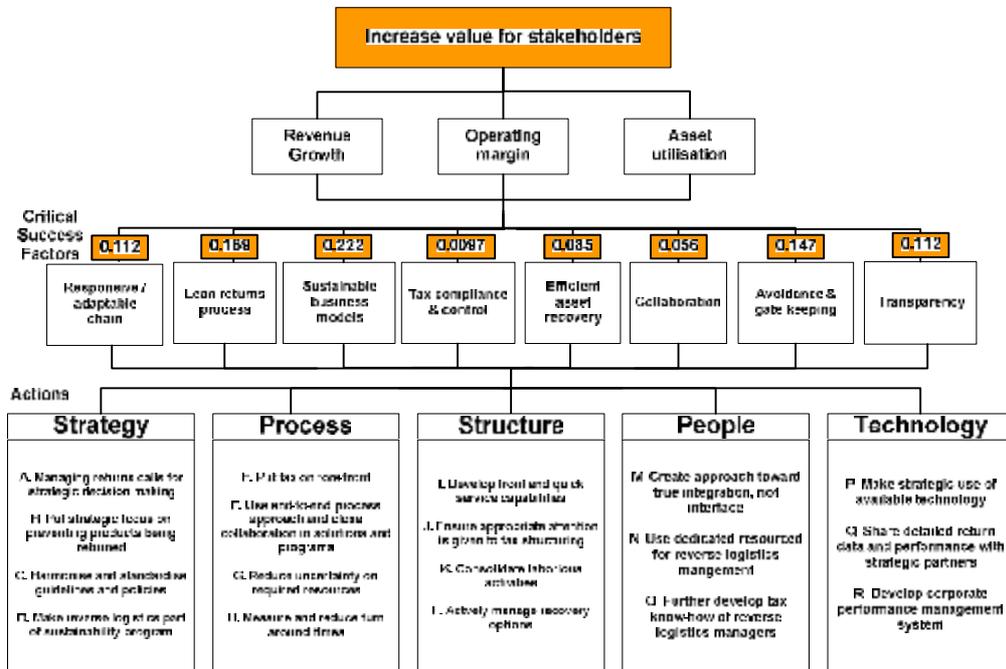
Figure 6.1: AHP structure management analysis (case example)

6.1.3   Urgency actions to consider

The hierarchy developed so far can facilitate producers to exploit improvement potential in managing reverse logistics. Within boundaries of this research, we did not calculate relative importance for each action to consider in respect of the relative importance for each success factor. In ratification of the AHP technique, we believe that the contribution of an action to achieve a superior performance of a success factor is just one dimension for the urgency of such action. In addition we propose also a second dimension. **Chapter 4** brought forward managerial implications evolving from developments, barriers and success factors both for a producer and a chain perspective. For that reason we believe that the ability of an action to reduce complexity in managing reverse logistics should be another dimension for urgency. Hence we propose to position actions in a two dimension matrix, which managers can use to prioritise actions. The need for customised prioritising is reinforced by differences in relative importance for CSFs as presented in **table 6.1.** Next, **chapter 4** already revealed that producers differ largely in practices they use in reverse logistics, and in our opinion also in level of maturity as formulated in the audit scheme of **chapter 5.2**. Current maturity stage determines the potential to reduce complexity that an action can have, which is an additional argument for customised prioritising. As example we outline our interpretation of urgency for the actions to overall industry CSF and perceived complexity in **figure 6.2**. The letters relate to potential actions explained in **section 4.4**.
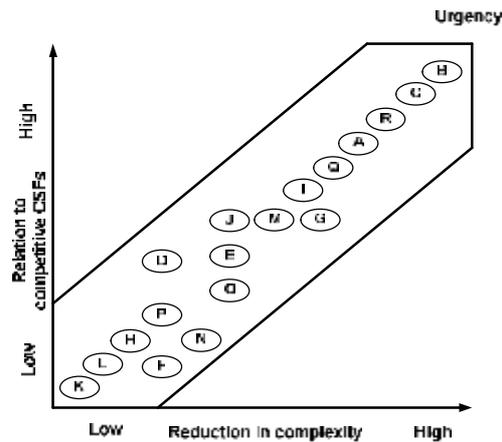
Figure 6.2: Prioritising actions to consider

6.2   Usefulness of the model

Our research experienced similar limitations for use of the analytical hierarchy process as a multi-criteria decision making method that literature described (see **section 3.3.3**).

During validation managers indicated that it was difficult to fully understand meaning of a particular success factor, though they interpreted the model as complete. The lack of clearness fuels even more impreciseness and subjectivity of human assessment. We underline that it is very critical to explain all definitions and terminology in univocal detail.

Also managers indicated that the round table session clarified some definitions, though they were still subject to critique. Additional feedback argued that the AHP technique would be favoured in a situation with live group discussions rather than via a survey approach. Incorporating 8 factors in the survey for pair-wise comparisons further complicated judgement, due to the large concentration span needed. Survey results showed that experts gave much more 'equal importance' answers to comparisons asked by the end of the survey as opposed to those in the beginning of the survey.

Due to these pitfalls we argue that it is questionable, even hardly imaginable, that PwC will propose to clients to fully apply the AHP technique to calculate relative importance throughout all layers of hierarchy. The designed model is easy to communicate and provide clear structure to the many findings of our research. Managers of field studies also indicated that appropriate factors had been included. For the purpose of this thesis, the added value has been to provide exploratory insight in relative importance of these factors. The alternative to prioritise actions explained in **section 6.1.3** is less time-consuming than full application of the AHP technique, and thus a practical alternative.

6.3   Conclusion

In this chapter we applied the analytical hierarchy process technique to facilitate prioritising improvement actions. In the highest level of the hierarchy we put overall goal of companies to increase stakeholder value, which we translated in the following level 2 criteria: asset utilisation, operating margin and revenue growth. These generic factors have come forward by years of consulting work at PwC and were validated by many organisations, illustrating relevance for our hierarchy. From field research we distilled 8 industry success factors, which have been validated as factors representing key performance areas for reverse logistics in the current consumer electronics market. *Responsive and adaptable chain, lean and seamless returns process, sustainable business model, tax compliance and control, efficient asset recovery, collaboration, avoidance and gate keeping* and *transparency.* Comparative analysis of these factors by 7 experts showed that collaboration and efficient asset recovery scored relatively low. Compared to the other success factors these were perceived to contribute less to increase in stakeholder value. Higher contribution was rated for sustainable business model, responsive and adaptable chain, and avoidance and gate keeping.

The synthesis of priorities for the 8 sub-criteria was already a time-consuming and laborious work. Within the boundaries of this thesis, we completed the hierarchy with potential actions clustered alongside the five dimensions of the Guide (PwC): strategy, process, structure, people and technology. However, we did not apply the AHP technique to these actions. Feedback on limitations and pitfalls of the AHP technique made us realise that it was questionable that PwC would propose to clients to fully apply the technique throughout all layers of the hierarchy. In addition, we believe that contribution of an action to achieve a (competitive) success factor is just one dimension for urgency of such action. Therefore we propose also a second dimension, which implies the ability of such action to reduce complexity in managing reverse logistics. We relate complexity to managerial implications evolving from developments, barriers and success factors that this study revealed. Hence we propose to position actions in a two dimensions: contribution to critical success factors and the ability to reduce complexity. This alternative for prioritising has the main advantage that it is less time-consuming.

7   Conclusion and recommendations

In this chapter we conclude the thesis by providing general conclusions, recommendations and potential for future research.

7.1   General conclusions

This study highlights and reinforces the importance of reverse logistics. An important area, though the numerous publications and studies still have a number of underexposed areas. We investigated current status of reverse logistics in Europe and explore the complexity and improvement potential for producers of consumer electronics. The major contribution of this research lies in developing a conceptual reference model for diagnosing strategic aspects and providing useful managerial insights.

Data collection by web-based surveys, expert interviews and field studies provided basis for analysis of trends and developments, barriers and success factors. From the producer perspective, complexity in managing the reverse supply chain evolves from perceived barriers and aimed success factors, but also from the pressure to fit contingencies in the changing environment. In summary we present our key findings in **figure 7.1**.
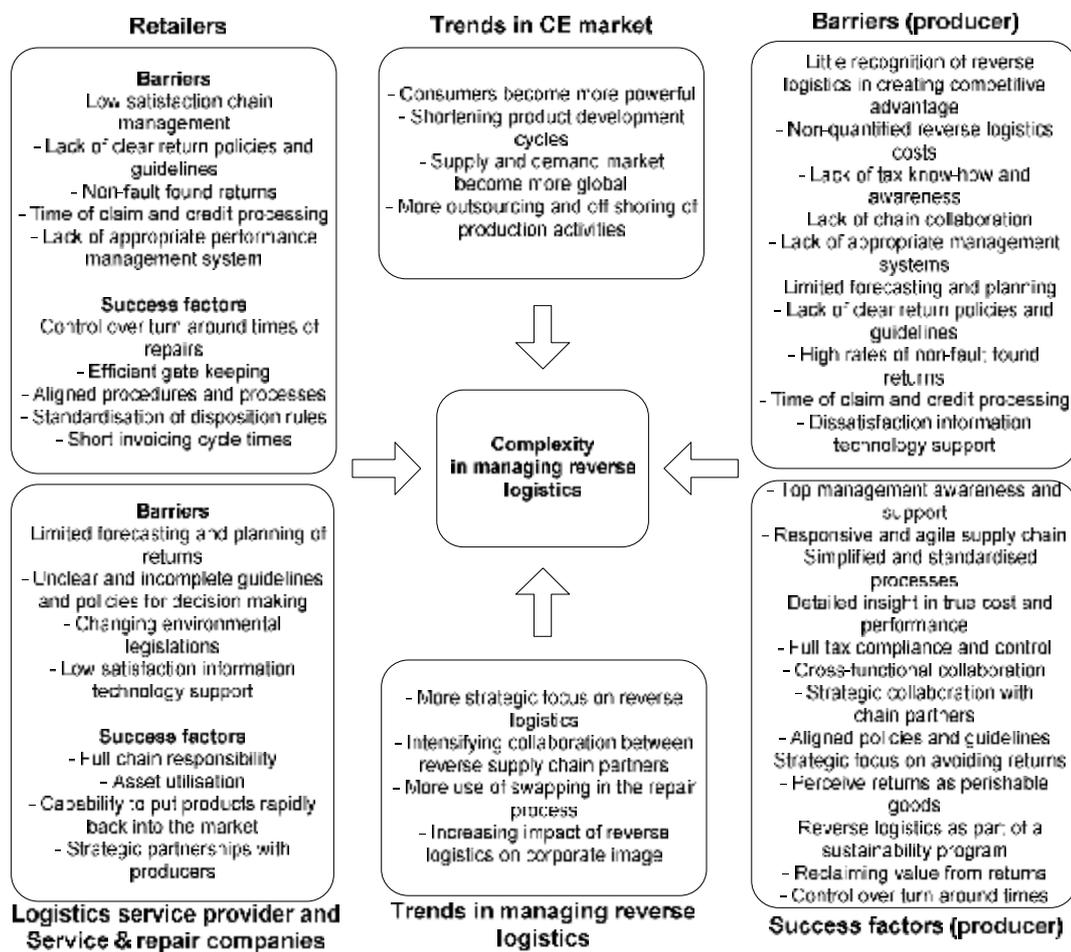
Figure 7.1: Exploratory analysis of factors influencing complexity in managing reverse logistics

7.2   Recommendations and research opportunities

To exploit the findings of this research, we set out below a list of recommendations and suggestions for further research in the area of reverse logistics. In addition, we set out some limitations and implications that this research has. We end with a brief description of notable lessons learned.

7.2.1   Producer recommendations

A.   Critical start is to define the current internal situation. Identify the improvement areas in managing reverse logistics and quantify the increase in stakeholder value thereof. Important is to create awareness at senior management. They must perceive a need for change and notice the potential improvement opportunities and financial benefits.

B.   Create awareness that a customer-centric approach can add value. By adopting such an approach, companies assure that they have the right focus for their customers. The key is to translate customer requirements into a strategic role for reverse logistics operations.

C.   Optimise reverse logistics from both an operational and tax perspective simultaneously. Combining both aspects increases awareness and know-how on impact and risks.

D.   Choose appropriate competitive success factors for the reverse supply chain and align the entire organisation accordingly. Responsiveness, efficiency and control are concepts to consider. Use a comprehensive approach to include all relevant aspects.

E.   Managing reverse logistics is not the activity of just one department or actor in the chain. Upstream decisions heavily influence downstream operations. In order to optimise the end-to-end chain, collaboration of all relevant departments (from R&D to finance / tax) and channel partners is fundamental.

F.   Create more awareness of the corporate impact of voluntary and compulsory take-backs. It is important to maximise stakeholder value from efforts in sustainability initiatives and take-back innovations.

G.   Proactively manage the entry point of the reverse supply chain. Preventing avoidable returns is a main focus area in managing reverse logistics. Clear warranty conditions, harmonised and standardised returns policies are basics. Measure and reward avoidance initiatives to enhance the predictability and manageability of the supply of returns.

H.   Acquire appropriate management systems to enable visibility and standardisation in reverse logistics processes. This study revealed a clear gap between importance and satisfaction of IT support for reverse logistics management and lack of appropriate management systems.

I.   Use advanced forecasting and planning techniques to enhance cross-company management of reverse logistics. Many producers hardly forecast or plan reverse logistics.

J.   Reveal true costs, revenues and end-to-end performance. Measuring the true cost and revenues related to reverse logistics is hard. Visibility of 'clear costs' such as costs of rework, downgrading, processing customer complaints, warranty claims, product recalls, is a first step. Extending the profit and loss account with 'hidden cost', such as opportunity tied up in returns and cost of tax compliance and control, advances insight in expenditures. Elaborate indicators presented in this study to learn from practices used by other producers.

7.2.2   **Suggestions for further research**

In this research interesting topics had to be scoped out. We provide a number of suggestions for further research.

- Add a risk analysis as well as a cost – benefit analysis to the areas under study in the diagnostic framework. Insight in costs and benefits of improving a particular area provides valuable information for determining future improvement directions. Another option is to add marginal values, which point out which action has highest marginal costs or risk.

- Build further on quantitative performance indicators. Overcome the shortcomings of metrics in this study and develop additional metrics based on new knowledge. Options are total cost per warranty, variability in process lead times, (swap) stock availability, and measures for end-customer satisfaction.

- Expand research scope. This research has purely focused on consumer electronics. Interesting would be to investigate how our findings relate to developments and practices in other industries. More options for expansion are inclusion of carriers and packaging materials, or to perform similar research in other continents. PwC operating in more than 150 countries unlocks global research potential.

- Independency put PwC in the position to bring together competitors and other actors in the chain to discuss conflicting interest and pain points. Suggestions for such round table sessions include:
  - Alignment of procedures between retailers and producers. Effort of retailers can help for return data collection, avoidance and quick repair.
  - Business contacts with IT providers can be used to point out the gap between IT support and satisfaction.
  - R&D managers and service and repair companies. Possibilities of strategic collaboration so that both producers and SR companies mutually benefit from design changes.

- Use the end-customer as research focus. Insights in and understanding of customer needs are important aspects for producers to determine reverse supply chain strategies. A study on their perceptions and experiences would be very valuable. Directly executable can be the rating of the relative importance of identified CSF by these end-customers.

Our field results revealed a number of interesting topics that, in our knowledge, had limited attention in current literature. Some suggestions for future research in this respect include:

- Very little literature, if any, is available on optimising reverse logistics jointly from tax and operation perspective. We can imagine that compliance and control risk for value added tax and customs can be variables in network design studies. Transfer pricing between multi-group companies and transfer of legal ownership can be variables to incorporate in inventory optimisation and studies on effectiveness of reverse logistics programs.

- Producers make extensively use of third parties for reverse logistics activities, and many articles are present on outsourcing practices. However, in some cases we found that producers perceive reverse logistics activities as core business, and managers indicated that activities actually had been in-sourced. In literature, we did not find many articles or case studies that investigated in-sourcing of reverse logistics activities.

- Our success factors fully correspond with enablers that are part of the performance management approach suggested by the European Foundation for Quality Management. This calls for further research on applicability of the EFQM excellence model (*Nabitz* et al. 2000). Further development of key performance indicators is part of this suggestion.

- Further investigation is needed on our conceptual reference model, aiming to increase external validity by consensus on relevance of the situational factors.

7.3   Limitations and implications

This research has its own limitations. Most notable include:

- We deal with producers, retailers, logistics service providers and service and repair companies but do not consider other stakeholders, such as end-customers and non-governmental organisations. The paper of *Bernon* and *Cullen* (2007) more specifically considers a retailer point of view, and the paper of *Harrison* and *Godsell* (2002) considers customers explicitly. Thus, our work is complementary to these papers.

- The explicit focus on only one industry, the consumer electronics industry, presents limitations to the generalisation of findings. Examining similar research questions across multiple industries should be considered.

- Sample size represents another possible limitation. This issue is explicitly important when we split findings of producers into *IT & telecommunication* and *other* categories. Sampling sizes of 11 producers limits external validity of findings.

- Selecting respondents from which we knew in advance that they had knowledge on reverse logistics (judgmental sampling, *Verschuren and Doorewaard*, 1998), may not agree with true sample population.

- Our surveys contained predefined trends, barriers and success factors, which limits the freedom and creativity of respondents.

- Another limitation is the use of perceptual data that exhibit a snapshot at a certain time, whereas 'strategic implications can be better assessed and interpreted over longer periods of time' (in citation of *Richey* et al. 2005).

- In none of the case studies we managed to discuss reverse logistics with sales or marketing departments of producers. Often own these departments the commercial agreements and determine return policies and procedures, and insight in their perceptions would have enriched this research.

- For a more in-depth analysis of logistics service providers and service & repair companies we should actually have asked for what kind of clients they mainly service. A computer manufacturer is demanding totally different things than a distributor of large house hold appliances.

- In the beginning of each site visit, we asked the producer and service provider if they would like to be interviewed together or separately. In all cases they preferred to do the interviews in a group session. We realised that this might not have always resulted in the exposure of sensitive barriers or bottlenecks.

7.4   Lessons learned

You always find out that things can be done easier, more understandable and more aligned with overall goals than you actually did. For this issue I mainly refer to the full cycle of the web-based surveys. Some experts gave advice to keep the surveys as simple, univocal and core focused as possible. I didn't realise that requesting one hour time of senior managers asked for such a commitment, that some managers withdrew their willingness to cooperate. Next to that, I would reduce surveying sensitive data to a minimum. Mainly retailers perceived this is a main struggle. In this perspective I am very grateful to Hubert as he has been the main driver to convince managers to fill in the surveys.

Also during the field studies we found ourselves in a learning curve. Managing expectations from both sides and delivering towards these expectations was something that we were more capable off during the later visits. Taking into account the cultural difference between a German, Dutch and English business environment is something that we cannot underestimate. On the other side I look back on a very joyful, enthusiastic and professional team with whom I had the pleasure to work with and learn from. I am proud on all the interviews, case studies, web-based surveys that we executed and the findings we have been able to distil. Also organising, presenting and follow-up a round table session has been an instructive experience.

A   Research participants

A.1   Expert interviews

The list of internal and external consulted experts is provided. For each expert the goal and phase within the research project is indicated. The experts are mixture of industry, academics and consultancy.

Orientation

Interview	Goal	Group
D. Hoogenboom (PwC)	Corporate performance management CSF	Consultancy (internal)
E. Jager (PwC)	Supply chain trends CSF Barriers	Consultancy (internal)
P. Hulleman (PwC)	CE Trends Survey respondents	Consultancy (internal)
Ron Wezel (PwC)	CSF Barriers Six Sigma	Consultancy (internal)
N. Diepeveen (PwC)	Survey design	Consultancy (internal)
Dr.ir. S.D. Flapper (University of Eindhoven)	Reverse logistics trends CSF Barriers	Academic (external)
Dr.ir H. Krikke (University of Tilburg)	Reverse logistics trends CSF Barriers	Academic (external)
Dr.ir A. van der Laan (Erasmus University Rotterdam)	Reverse logistics trends CSF Barriers	Academic (external)
M. de Brito (TU Delft)	Survey design	Academic (external)
ERP supplier	Technology Trends Technology CSF Technology Barriers	Consultancy (external)
Retailer	Reverse logistics trends (Retail perspective) Retail CSF (Retail perspective) Barriers (Retail perspective)	Industry (external)
Producer	Trends CSF Barriers	Industry (external)
Logistics platform	Trends CSF Barriers	Industry (external)

Table A.1: Expert interviews during orientation phase

Analysis

Interview	Goal	Group
2X Service and repair company	Trends CSF Barriers	Industry (external)
Producer	Reverse logistics trends CSF Barriers	Industry (external)
ERP supplier	Reverse logistics trends CSF Barriers	Consultancy (external)
Logistics service provider	Reverse logistics trends CSF Barriers	Industry (external)

Table A.2: Expert interviews during orientation phase

Verification

Interview	Goal	Group
Service and repair company	Usefulness AHP model Limitation and implications	Industry (external)
E. Jager (PwC)	Maturity levels	Consultancy (internal)
R. Lodder (PwC)	Maturity levels	Consultancy (internal)

Table A.3: Expert interviews during verification phase

All phases

Weekly meetings		Group
H. Verweij (PwC)	All	Consultancy (internal)
N. Dang (PwC)	All	Consultancy (internal)
G. Bonney (PwC)	All	Consultancy (internal)

Table A.4: Expert interviews in all phases

A.2   List of round table attendants

Venue: PwC office Amsterdam
Date and Time: February 22, 12:30 – 17:00h.

Participant	Group
Academic	Academic (external)
Service and repair manager	Industry (external)
Service and repair manager	Industry (external)
Manager ERP supplier	Consultancy (external)
Manager Logistics service provider	Industry (external)
Manager Logistics service provider	Industry (external)
Manager logistics platform	Industry (external)
G. Bonney (PwC)	Consultancy (internal)
R. Feen (PwC)	Consultancy (internal)
J. Verstraten (PwC)	Consultancy (internal)
R. Fennen (PwC)	Consultancy (internal)
H. Verweij (PwC)	Consultancy (internal)
N. Dang (PwC)	Consultancy (internal)

Table A.5: Participants round table session

B Interview use

In short we discuss a number of whereabouts for the use of interviews.

B.1 Face-to-face interviews

Considering the explorative character of the expert interviews we used a majority of:
- open questions (no finite number of answers)
- spontaneous (respond can be given in own words)
- open-ended (answer is recorded verbatim).

One can state that this type of questions worse the biases effects of interview surveys, but we believe that the expertise of the respondents compensate these draw-backs for a large degree.

Define objectives that the study is to answer
The goal of the interviews varies per category of the expert panel. Goal of the scientist group is mainly to determine trends and developments in the field of reverse logistics, new scientific ideas and concepts, and a first exploration of critical success factors and performance measures.

Consultants add value to this research with experiences in one specialisation applied at different practices and broaden our look on certain developments. Furthermore they provide insight in business practices and major issues rising from the industry. Hence, for consultancy the goals are determination of development in the electronics industry and a first exploration of critical success factor and performance measures.

Employees from different companies in the industry provide practical knowledge, in-depth insight in general ideas and concepts, and give a first direction towards improvement possibilities by identifying barriers for reverse logistics. Hence, for the industry group the aim is to determine trends and developments in the electronics industry, to get insight in barriers for reverse logistics, and a first exploration of critical success factors and performance measures.

In what way can the effects of biases of data collection be minimised?
The role of the interviewer is critical in achieving the goal of the questionnaire. Some of the major pitfalls for an interview are considered to minimise the biases of this way of data collection (*Brace,* 2004):
- Questions need to be asked accurately
- Respondent needs to fully understand the questions
- Answers need to be recorded accurately and completely
- Prepare general answer list to provide a first direction of the answer, with in mind that answers are prompted after a spontaneous response
- Attention to the interview (prevent boredom and fatigue)
- Ask subjects for which the respondent hold a conscious attitude

B.2 Questionnaire design

Questionnaires are written in many different ways, can be used in many different situations and with many different data-gathering media. One should consider *what* is trying to be achieved before being able to *how* that can be achieved (*Brace,* 2004). The steps that should be taken to complete a survey are outlined below.

Define objectives
Survey objectives:
- General information on reverse logistics practice: supply chain and reverse logistics strategies, determinants influencing reverse logistics concept, reverse logistics network structure, planning and control, and IT support
- To determine major trends and developments for reverse logistics
- To determine challengers supply chain managers and tax/finance managers are facing
- To determine the bottlenecks and barriers for managing reverse logistics
- Validate success factors and collect data on performance indicators of reverse logistics

In what way can the effects of biases of data collection be minimized?
Minimize the problems of ambiguity of the question, order effects between the questions, order effects within the question, inadequate response codes and wrong questions asked because of poor routeing. Challenge for the survey is to minimize these effects. Before the surveys were send out refinement and testing was performed by several PwC consultants and graduation supervisors who have experience in the design, analysis and use of written surveys. In the ideal situation the surveys would also have been pre-tested by some respondents. Due to loss of time with the on-line programming of the surveys this has not been possible.

How can the research goals be achieved?
The type of survey chosen for this research can be described as a web-based self-completion survey (*Bradly*, 1999). Online surveys have achieved higher effectiveness for sensitive issues compared to interviewer-based surveys. This means that data on 'threatening' issues, such as barriers, challenges and implications, are likely to represent better how the survey population really feels, although this is not yet proven (*Brace*, 2004). Other advantages supporting this type of questionnaire are fast data analysis and relative few data entries.
Designing a web-based survey requires a.o. answering the following questions (*Dorefeev* and *Grant*, 2006):
  1. Does the information from the respondent represent the knowledge/information from the company?
  2. What effects do omission or under-represented groups in the survey population are likely to have on the results?
  3. Is the existing information about the size and nature of the defined survey population reviewed by the right people?

Survey structure
First part of the questions is dealing with factors affecting reverse logistics processes. Selection of the processes for benchmarking is preceded by diagnose of the current situation and an analysis of top priority dimensions of product or process performance to deliver expected value to customers (*Carpitti* et al, 2002). By identifying internal and external factors affecting reverse logistics a check is created for the survey to oversee which dimension of reverse logistics are relevant to benchmark. Within a company, both strategic factors as well as operational factors are affecting reverse logistics systems. Strategic factors consist of strategic costs, overall quality, customer service, environmental concerns, and legislative concerns. These are critical and needs to be considered before operational factors. Latter consists of cost-benefit analysis, transportation, warehousing, supply management, remanufacturing and recycling, and packaging (*Dowlatshahi,* 2000*)*

The overall level of competition in a firm's primary industry, will, by providing the impetus for a critical evaluation of business practices, affect its performance. For the purposes of this research, the competitiveness of the environment is therefore operationalised in terms of the intensity of competition (*Tan* et al. 1999).

C   Directives in force for the consumer electronics industry

For this thesis consumer electronics products are grouped in four categories as defined in the European Directive (Directive 2002/96/EC): large household appliances (e.g. refrigerators, washing machines, micro waves), small household appliances (e.g. vacuum cleaners, irons, toasters, fryers), IT and telecommunications equipment (e.g. personal computers, notebooks, copying equipment, telephones, cellular telephones) and consumer equipment (television sets, video cameras).

Article 95 Directives intend to eliminate diverging national laws between member states that might constitute a barrier to trade. However, the EU has no influence on how these directives are enforced or the penalties set by individual countries.

Article 175 Directives allows the EU commission and parliament to establish a set of common requirements among the member states, while also allowing each country to go beyond the provisions of the Directive when developing national legislation.

EU legislation	Key targets timeline	Company risks + company solutions
Batteries and accumulators directive		Company risks
Prohibition of placing on the market of batteries and accumulators > 0,0005% of mercury > 0,002% of cadmium	**2008** Transposition by member states and applicability of substance bans **2009** Compliant treatment and recycling schemes in operation, marking of battery capacity **2010** Rules on calculation recycling efficiencies **2010** Efficiency requirements for recycling **2016** Minimum of 45% collection rates	• Enforcement resulting in a ban to bring to EU market • Liability at disturbance of continuity of delivery • Repressive action taken in inspections of exports • High costs in registering and reporting • High costs in take-back of products • High technical costs of substance phase-out • Export of goods designated as waste (reputation risks) Company solutions • Business impact assessment • Only representative scan • Awareness seminars • Coaching • Implementation management Data capture, cost modelling and tracking compliance • Eco-efficient chain management - supply chain (eco-design) - goods under guarantee chain - waste equipment chain - processing chain
Waste shipment regulation		
Criteria for the disposal and recovery of shipments of waste	**2007** Producer records for minimum 3 years on the quantity, nature, origin, treatment, destination, frequency of collection and mode of transport of hazardous waste which is transferred to others	
Packaging and packaging waste		
Introduce systems for the return and/or collection of used packaging	**2001** 25 - 45% by weight of the totality of packaging materials contained in packaging waste to be recycled **2008** At least 60% by weight of packaging waste to be recovered or incinerated at waste incineration plants with energy recovery; 55 and 80% by weight of packaging waste to be recycled	
REACH		
Registration, evaluation and authorization of chemical substances	**2008** Pre-registration (existing substances) **2018** Registration new substances **2010** Registration band I (pre-registered only)	
RoHS		
Restriction of the Use of Certain Hazardous Substances in EEE	**2006** RoHS Directive is enforced **2006** Member states to meet recycling targets	
WEEE		
Disposal of e-waste	**2004** WEEE is enforced **2005** Producers liable for financing WEEE, processing systems set up **2006** Member States to meet recovery/recycling targets set in the directive **2008** Establish new targets for recovery/recycling	

Table C.1: EU legislations in reverse logistics (PricewaterhouseCoopers, 2008)

D   Supply Chain Operation Reference model

The Supply Chain Operations Reference-model (SCOR) is the product of the Supply-Chain Council and captures the Council's consensus view of supply chain management. By the key steps plan, source, make, deliver and return it tries to structure process, metric, best practice and technology features to support communication among supply chain partners and to improve the effectiveness of supply chain management and related supply chain improvement activities (Supply Chain Council, 2006).
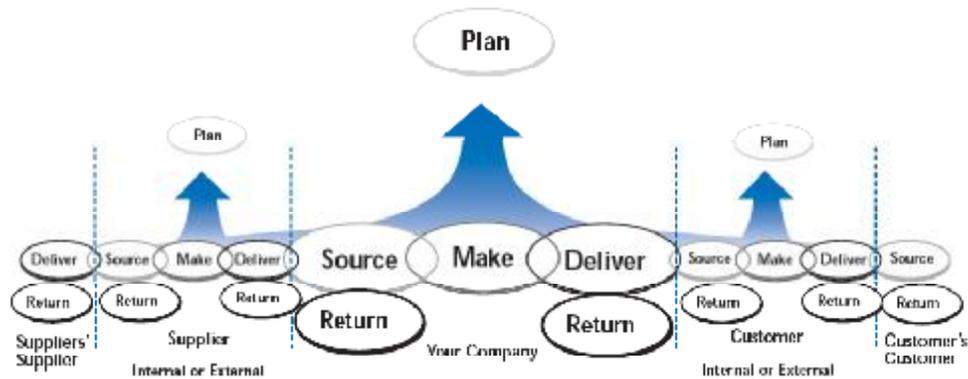
Figure D.1: Management processes SCOR model (Supply Chain Council, 2006)
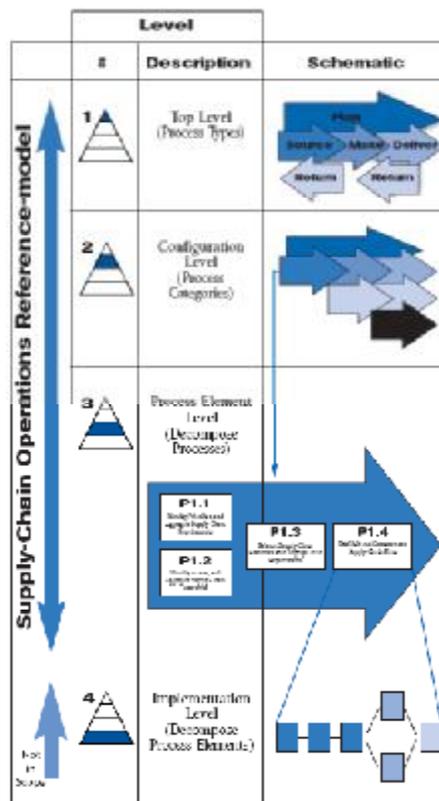
Figure D.2: Process decomposition into process components (Supply Chain Council, 2006)

E   Business Process Orientation maturity stages

Figure E.1 reproduces stages of process maturity as described by *McCormach* (2000).

Divisional	Inter company	Intra company	External	Total business system
I **Ad Hoc**	**II** **Defined**	**III** **Linked**	**IV** **Integrated**	**V** **Extended**
Process measures are not in place and the jobs and organizational structures are based upon the traditional functions, not horizontal processes Individual heroics and "working around the system" are what makes things happen.	Basic processes are defined and documented Changes to these processes must now go through a formal procedure Jobs and organizational structures include a process aspect, but remain basically traditional Representatives from functions meet regularly to coordinate with each other concerning process activities, but only as representatives of their traditional functions	Managers employ process management with strategic intent Broad process jobs and structures are put in place outside of traditional functions Cooperation between intra company functions, vendors and customers takes the form of teams that share common process measures and goals	The company, its vendors and suppliers, take cooperation to the process level Organizational structures and jobs are based on process, and traditional functions, as they relate to the supply chain, begin to disappear altogether Process measures and management systems are deeply imbedded in the organization Advanced process management practices take shape	Competition is based upon multi firm networks Collaboration between legal entities is routine to the point where advanced process practices that allow transfer of responsibility without legal ownership are in place Trust and mutual dependency are the glue holding the extended network together A horizontal, customer focused, collaborative culture is firmly in place

Figure E.1: Levels of business process orientation maturity (*McCormack*, 2000)

F   The Guide

A framework is a 'basic conceptual structure' which can be used to simplify the overall situation of a company and describes different parts of the situation. By using different views, specific parts of a company can be isolated for focus and reduce the complexity of the company as a whole.

Figure F.1: The Guide (PwC)

Each view considers a different aspect of the company's situation and allows electronics companies to isolate and focus on a single view to identify value delivery to stakeholders in the as-is and best practices that can be adopted to improve value delivery in the to-be situation.

Strategy view considers company's business model, business strategy, internal and external policies that impact the company, alignment among policies, strategy and organisation, management of the business, continuous improvement and design principles applied within the business. The strategic importance of reverse logistics as described by (*Rogers and Tibben-Lembke*, 1998) substantiates the use of these generic strategy topics (*Rogers* et al. 2002).

Structure view considers the network design of supply chain (e.g. *Krikke* et al. 2001), optimisation of the supply chain, reverse logistics design, inventory management, financing activities and outsourcing related decision making. This view recognises that the configuration of an operating network has major implications for its cost structure, asset utilisation, delivery lead times, stability, responsiveness, flexibility, customer services and the company's financial performance.

Process view considers key processes and activities of the reverse logistics process. This includes processes that are directly involved in acquisition, gate keeping of products, grading of products (the sorting of the product stream into fractions of different quality and their allocation to different reuse options), re-processing that prepare products for their future use, and re-distribution to deliver the product to a new market (*Fleischmann,* 2004). It also includes major tax issues related to the whole end-to-end process.

People view considers the ownership and structure of the company within the group, alignment across the company, cultural elements involved in managing cross-functional processes.

Technology view considers the hardware, software, communications, and knowledge management systems that support the group. In the context of the reverse supply chain, this considers amongst others process automation, historical returns information and product knowledge captured during the lifecycle.

G   Web-based surveys

The design took much thinking effort and the programming, testing and sending much time-consuming effort. After a confirmation of a company to participate in the research, we sent an email with a link to the web-based survey. After sending the emails we made follow-up calls to ask attention for the study.

As a reward for filling in the questionnaires, PwC offered companies a free report of the whole study, an invitation for the closing seminar and for producers the possibility to have one-on-one follow up meetings.

G.1   Introduction

Some of the questions ask for financial and non-financial performance indicators of the Reverse Logistics process. It is advised to gather some high level data before you start with the survey.
A producer's perspective is chosen as starting point for the Reverse Logistics Framework. A producer is defined as someone who manufactures and sells under its own brand in the Europe, resells under its own brand in Europe or import goods into a European country.

Throughout the survey you are interviewed with rating questions, ranking questions and open questions. For your convenience we have clustered the questions around the following themes:

1.   General
2.   Strategy
3.   Structure
4.   Process
5.   People
6.   Technology
7.   Performance indicators
8.   Closing questions

This structure is based on the principle of The Guide, which is a framework that provides a structure for looking at company topics in a comprehensive manner.

G.2   Producer survey

<div align="center">1. General</div>

In this section you are asked on general topics of your company.

1.   *Which company are you representing*?
      ► <name>

2.   *What is your name and what is your function within the company*?
      ► <name> and <function>

3.   *What is the scope of your responsibilities concerning reverse logistics management?*
      ► National
      ► Regional, please specify (e.g. Benelux, Nordics, UK and Ireland): …
      ► Europe

4.   *For what scope of your company are you filling in this survey?*
      ► National
      ► Regional, please specify (e.g. Benelux, Nordics, UK and Ireland): …
      ► Europe

Please answer all following questions according to the scope indicated in question 4.

5. *What is the total number of employees?*
    ▶

6. *What were the annual gross sales in euros of your business during the most recent fiscal year?*
    ▶

In questions 7 and 8 you are asked to estimate indicators. It is our intention to get a general idea, so you are asked to answer in round figures.

7. *Please estimate the percentage of total sales revenues that your company sells via the following sales channel:*
    ▶ Via distributors   %
    ▶ Via wholesalers   %
    ▶ Via retailers   (including on-line retailers)   %
    ▶ Directly to end-consumer (e.g. on-line selling)   %

8. *Please estimate the proportion of total sales revenues that will be sold via the internet in two years.*
    ▶ Two years   %

2. Strategy

In this section you are interviewed on topics concerning the strategic environment of your business as well as strategic aspects of reverse logistics.

9. *What is the leading differentiator concerning your business strategy?*
    ▶ Price
    ▶ Quality
    ▶ Innovation

10. *What is the leading differentiator concerning your supply chain strategy?*
    ▶ Responsive *
    ▶ Lean *
    ▶ Hybrid (mixed) *

11. *What is the leading differentiator concerning your warranty strategy?*
    ▶ Cost control
    ▶ Customer satisfaction
    ▶ Hybrid (mixed)
    ▶ No warranty strategy in place

12. *Does your company have a specific reverse logistics strategy?*
    ▶ Yes, please indicate the leading differentiator:
    ▶ No
    ▶ Don't know

13. *What is the leading differentiator for your reverse supply chain*?*
    ▶ Control *
    ▶ Efficiency *
    ▶ Responsiveness *

14. *How does your company manage reverse logistics?*

- As a cost centre
- As a profit centre

15. *On a scale of 1 = low to 7 = high, rate the importance of reverse logistics to your company.*

    Low   1   2   3   4   5   6   7   High

16. *On a scale of 1 = low to 7 = high, rate the level of satisfaction of your current reverse logistics management.*

    Low   1   2   3   4   5   6   7   High

Preliminary research of PricewaterhouseCoopers has identified several developments in the Consumer Electronics Industry (Datamonitor 2007*, Mayers 2007*, PricewaterhouseCoopers sources).

17. *Which five developments are most important to your reverse logistics management? Rank from 1= most important to 5 = least important.*

- More outsourcing* and off shoring* of production activities
- Increase of number of competitors
- Changing environmental legislations
- Consumers are becoming more powerful
- Shortening product development cycles
- Increased focus on selling services
- Growing pressure for corporate social responsibility*
- The demand and supply markets become more global
- Growing importance of internet selling
- If other, please specify ...

Preliminary research of PricewaterhouseCoopers has identified several developments in reverse logistics (De Brito 2003*, Flapper 2005*, Srivastava 2006*, Yellepeddi 2006, Li 2007*, PricewaterhouseCoopers sources).

18. *Which five developments do you perceive as most important? Rank from 1= most important to 5 = least important.*

- Intensifying collaboration between supply chain partners in reverse logistics
- More use of swapping* in the repair process
- More availability of companies offering reverse logistics activities
- More use of Design for Environment*
- Development of best-of-breed packages*
- More strategic focus on reverse logistics
- Growing knowledge base on reverse logistics management
- IT maturation for product tracking and tracing
- Increasing impact of reverse logistics on corporate image
- If other, please specify…

Preliminary research has identified several barriers to successfully manage reverse logistics (Aberdeen 2006, Yellepeddi 2006, Li 2007, PricewaterhouseCoopers sources).

19. *What are the most important barriers you experience in managing your reverse logistics? Rank from 1= most important to 5 = least important.*

- Lack of awareness concerning environmental legislations
- Limited forecasting and planning of reverse logistics activities
- Lack of clear return policies

- Lack of appropriate performance management system
- Little collaboration between departments (e.g. design, manufacturing, marketing and sales).
- Little recognition of reverse logistics as a factor in creating competitive advantage.
- Differences in Extended Producer Responsibility* between countries
- Tax issues (e.g. Customs, accounting, Value Added Tax)
- Few senior management attention
- If other, please specify…

Preliminary research of PwC has identified several success factors for reverse logistics management (Aberdeen 2006*, Yellepeddi 2006*, Mollenkopf 2005*, PricewaterhouseCoopers sources).

20. *What are the most important success factors in managing your reverse logistics? Rank from 1= most important to 5 = least important.*
- Track and trace capabilities
- Top management awareness
- Strategic partnerships with supply chain partners
- Strategic partnerships with other producers
- Reclaiming value* from returned products
- Strategy focus on avoiding products to be returned
- Efficient gate keeping*
- Detailed insight in cost and performance of reverse logistics activities
- Automating returns processes
- Capability to put returned products rapidly back in the market
- Visibility of the quality and value of a product throughout its life cycle

- If other, please specify…

3. Structure

In this section you are interviewed on topics concerning organisational logic and control principles of your reverse logistics.

21. *How is the management of reverse logistics activities organised within your company? Check all that apply.*

	Centralised	Decentralised
National		
Regional (e.g. Benelux, Nordics, UK and Ireland)		
European		

In questions 23 and 24 you are interviewed on outsourcing and relocating of reverse logistics activities.

22. *Which of the following activities are outsourced to a third party? If partly, please check both. Second, which are planned to be outsourced to a third party* within two years?*

	In-house	Third party	Planned to outsource	N/A
Testing* activities				
Reuse* activities				
Repair* activities				
Disassembly* activities				
Refurbishing* activities				
Remanufacturing* activities				
Recycling* activities				
Waste management activities				
Call centre activities				
Logistics activities				
Financial activities				

23. *Where does your company perform the following activities? If partly, please check all that apply. Second, indicate if they have been relocated in the last two years.*

	Originating country	EU country*	Outside EU	Relocated	N/A

▶ Testing activities
▶ Reuse activities
▶ Repair activities
▶ Disassembly activities
▶ Refurbishing activities
▶ Remanufacturing activities
▶ Recycling activities

4. Process

In this section you are interviewed on topics concerning operational processes and management processes of reverse logistics.

24. *Which of the following, if at all, management systems has your company in place for reverse logistics management?*

▶ Balanced Scorecard*
▶ KPI dashboard*
▶ Structure for continuous improvement
▶ If other, please specify…

25. *Is there a decision support system to determine the disposition* (e.g. refurbish, recycle or scrap) of a malfunctioning product?*
▶ Yes
▶ No
▶ Don't know

26. *What does your company use for process control of product returns?*
▶ Forecasting of future arrival of product returns
▶ Planning of required capacity (equipment and people) to deal with product returns
▶ Inventory management of returned products
▶ Quantitative cost analysis*
▶ Incorporation of forecasting and planning of product returns in information technology
▶ Shared planning and forecasting of product returns with supply chain partners

27. *Where in your reverse supply chain do you decide the disposition of a returned product? Second, where do you expect that this decision is made in two years? Check all that apply.*

	Now	In two years

▶ At the consumer
▶ At retailer
▶ At regional distribution centre
▶ At a returned goods processing centre
▶ Testing / Disassembly centre
▶ If other, please specify…

Reverse logistics cost is referred to as the cost occurring prior to delivery to the consumer (e.g. re-boxing, re-testing, down grading) and after delivery to the consumer (e.g. cost of processing customer complaints, customer returns, warranty claims, product recalls and discarding costs).

28. *Does your company have real-time insight into cost related to reverse logistics management? Second, is cost information used in managing daily operations?*

	Yes	No	Don't know

▶ Real-time available

> Real-time use

29. *On a scale of 1 = low to 7 = high, rate the importance of forecasting and planning of product returns to successfully manage reverse logistics.*

<div align="center">

Low   *1*   *2*   *3*   *4*   *5*   *6*   *7*   *High*

</div>

30. *On a scale of 1 = low to 7 = high, rate the impact of tax* on reverse logistics.*

<div align="center">

Low   *1*   *2*   *3*   *4*   *5*   *6*   *7*   *High*

</div>

31. *On a scale of 1 = low to 7 = high, rate the practical burden of customs formalities* on your daily reverse logistics operations.*

<div align="center">

Low   *1*   *2*   *3*   *4*   *5*   *6*   *7*   *High*

</div>

32. *On a scale of 1 = low to 7 = high, rate the practical burden of VAT set-up* of your customers on your daily reverse logistics operations.*

<div align="center">

Low   *1*   *2*   *3*   *4*   *5*   *6*   *7*   *High*

</div>

33. *What would you like to improve **within your company** in managing your reverse logistics? Rank from 1 = most important to 5 = least important.*

<div align="right">

N/A

</div>

> Ease of obtaining Return Material Authorisation*
> Handling reconciliation of charge-backs*
> Reduce length of time for credit processing
> Quality of re-work or repair
> Clearness and visibility return policy*
> Financial (cost and revenues) insight
> Track and trace returned products
> Warehouse lay-out design for return handling
> Insight in returned inventory level in warehouse
> Don't think something needs to improve
> If other, please specify

34. *What would you like to improve **within your total supply chain** in managing your reverse logistics? Rank from 1 = most important to 5 = least important.*

<div align="right">

N/A

</div>

> Return Material Authorisation process
> Support and troubleshooting activities
> Share detailed data of product returns
> Reward and risk sharing
> Performance measurement
> Sustainability of suppliers
> Don't think something needs to improve
> If other, please specify

<div align="center">

5. People

</div>

In this section you are interviewed on topics concerning workforce and culture of your reverse logistics. Second part examines topics of extended producer responsibilities*.

35. *Is there a functional unit within your company fully dedicated to reverse logistics management?*
> Yes, please indicate the number FTE* and number of temporary employees

▶ No
▶ Don't know

36. *Does the culture in your company support continuous improvement of the reverse logistics process?*
    ▶ Yes
    ▶ Yes, but might be improved. Please specify…
    ▶ No

37. *Which departments share information for the reverse logistics process? Second, which departments frequently discuss the performance of reverse logistics? Check all that apply.*

	Share information	Frequently discuss
▶ *Supply Chain Management*		
▶ *Logistics*		
▶ *Service*		
▶ *Sales & Marketing*		
▶ *Legal*		
▶ *Human Resources*		
▶ *Finance*		
▶ *Tax (more specific to Finance)*		

38. *On a scale of 1 = low to 7 = high, rate the extent of collaboration between tax and supply chain departments on reverse logistics activities.*

Low	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*High*

Several Extended Producer Responsibility (EPR)* in the Electric and Electronic Equipment industry are in force and other are gradually being enforced. In the following questions EPR Directives imply directives under article 95 (RoHS*, REACH* and ECO Design*) and directives under article 175 (WEEE*, Batteries* and Packaging*) of the European Parliament.

39. *What difficulties you experience in managing EPR compliance?*
    ▶ Marking of a product
    ▶ Testing and certification
    ▶ Registration of management and control of the waste chain
    ▶ Documentation for product disassembly for its end-of-life
    ▶ Documentation of quantities of products 'put on the market'
    ▶ Documentation of 'waste' product collected

In questions 40, 41 and 42 you are interviewed on sustainability topics of reverse logistics.

40. *Has your company undertaken initiatives to increase the volume of product returns in the last two years?*
    ▶ No
    ▶ Don't know
    ▶ Yes, please specify..

41. *Has your company made changes in the design of products in the last two years to enhance reverse logistics?*
    ▶ No
    ▶ Don't know
    ▶ Yes, please specify..

42. *What drives a specific sustainability program within your company? Check all that apply.*
    ▶ Driven by legislation

- Driven by internal governance
- Driven by competitive advantage
- Driven by corporate social responsibility
- No specific sustainability program is in place
- Don't know if a sustainability program is in place

43. *On a scale of 1 = low to 7 = high, rate the practical burden you experience to be in compliance with EPR directives.*

        Low   1   2   3   4   5   6   7   High N/A

44. *On a scale of 1 = low to 7 = high, rate the impact of Waste Electrical and Electronic Equipment (Directive 2002/96/EC)* on your reverse logistics cost.*

        Low   1   2   3   4   5   6   7   High N/A

45. *On a scale of 1 = low to 7 = high, rate the importance for your company of global sustainability reporting and rating systems* (e.g. Dow Jones sustainability index, Global Reporting Initiative, Greenpeace Guide to Greener Electronics)*

        Low   1   2   3   4   5   6   7   High

6. Technology

In this section you are interviewed on topics concerning technology infrastructure, service delivery and business alignment.

46. *What hardware do you have installed, or plan to install, to assist your reverse logistics management? Check all that apply*

                        Installed   Plan to install

- Electronic Data Interchange*
- Radio Frequency Identification*
- Bar code scanning
- Serial number identification
- If other, please specify..

47. *What software technologies do you have installed, or plan to install, to support your reverse logistics management? Check all that apply*

                        Installed Plan to install

- Enterprise Resource Planning
- Warehouse Management System
- Customer Relationship Management
- Best-of-breed packages
- Warranty claims processing system
- If other, please specify..

48. *On a scale 1 = low to 7 = high, rate the importance of your IT systems to support reverse logistics processes.*

          Low   1   2   3   4   5   6   7   High

49. *On a scale 1 = low to 7 = high, rate your satisfaction level of the support of IT systems to reverse logistics processes.*

          Low   1   2   3   4   5   6   7   High

50. On a scale of 1 = low to 7 = high, rate your company's ability to integrate the IT systems with supply chain partners.

Low   *1*   *2*   *3*   *4*   *5*   *6*   *7*   *High*

7. Performance Indicators

In this section you are interviewed on performance indicators of subjects earlier discussed. Within the boundaries of information availability in your company, you are asked to answer as precise as possible. In some cases you are asked to indicate whether the indicator is exact or estimated.

Reverse logistics cost is referred to as the cost occurring prior to delivery to the consumer (e.g. re-boxing, re-testing, down grading) and after delivery to the consumer (e.g. cost of processing customer complaints, customer returns, warranty claims, product recalls and discarding costs).

51. *Please indicate the total reverse logistics cost as percentage of your total sales revenues(%)*
    - Exact
    - Estimated
    - %

52. *Please indicate the number of product returns within the initial warranty period as percentage of the total sales volume (%)*
    - Exact
    - Estimated
    - %

The initial value of a product is defined as the total product cost when the product was sold for the fist time. If a product is returned, value can be reclaimed by different reverse logistics activities (e.g. reuse, refurbishing, remanufacturing).

53. *Please indicate the average percentage of initial value reclaimed by reverse logistics.*
    - Exact
    - Estimated
    - %

A part of products that are returned by consumers are not defect.

54. *Please indicate the product returns that have no functional or cosmetic defect as percentage of the total number of product returns*
    - Exact
    - Estimated
    - ..%

The recovery rate is defined as the number of units scrapped divided by total of products inducted in the reverse logistics process in a period of time.

55. *Please indicate the average recovery rate?*
    - Exact
    - Estimated
    - ..%

Market prices of Consumer Electronics are decreasing relatively fast. As we realise that this strongly differs per product, you are asked to answer the following question roughly.

56. *Please estimate the average percentage your products lose value per month:*
    - Exact

- Estimated
- ..%

It is our intention to get a general idea about the type of product returns. Therefore you are asked to answer the following questions with round figures.

57. *Please estimate the percentage of returned goods represented by each of the following:*
    - Stock adjustments   %
    - Wrong deliveries   %
    - Product returned within contractual take back period* for consumers   %
    - Products returned within warranty period   %
    - Products returned after warranty   %
    - Product recalls   %
    - Return after use   %
    - No reason specified   %
    - If other, please specify……

58. *Of the products that are returned by your customers, please estimate the percentage of goods that are*:
    - Repackaged and sold as new   %
    - Repaired   %
    - Refurbished   %
    - Remanufactured   %
    - Recycled (materials reclaimed)   %
    - Landfill   %
    - Resold as is   %
    - Sold to broker   %
    - Donated   %
    - If other, please specify………………………….   %

The return cycle time is defined as the time from when a customer returns a product until it is available again to be put back into the market.

59. *Please estimate the average return cycle time of your company.*

    - Days:

The customer cycle time is defined as the time from when a customer ships a package until the customer receives the repair, refund or exchange.

60. *Please estimate the average customer cycle time of your company.*

    - Days:

The invoicing cycle time is defined as the time from when a Return Material Authorisation is given until the payment of all invoices of that authorisation is completed.

61. *Please estimate the average invoicing cycle time of your company.*

    -

62. *What other key performance measures your company currently use for reverse logistics management? Indicate the target level as well as the actual delivery level for each measure.*

                                                                    Target level   Actual level
    - …

Closing questions

This is the closing section of the survey. You are interviewed on general topics regarding reverse logistics and on topics for the follow-up process of this survey.

63. *Which improvement projects concerning reverse logistics have you planned for the coming two years?*
    ▶

64. *Are you willing to participate in a one-to-one follow-up meeting to discuss your individual results?*
    ▶ Yes
    ▶ No
    ▶ Maybe

65. *In order to send you an official invitation for the closing seminar, please indicate your mail address.*
    ▶ Post Address

66. *Please indicate if you have any comments or suggestions concerning this survey or our further research.*
    ▶

G.3   Retailer survey

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1. General

In this section you are asked on general topics of your company.

1. *Which company are you representing?*
    ▶ <name>

2. *What is your name and what is your function within the company?*
    ▶ <name> and <function>

3. *What is the scope of your responsibilities concerning reverse logistics management?*
    ▶ National
    ▶ Regional, please specify (e.g. Benelux, Nordics, UK and Ireland): …
    ▶ Europe

4. *For what scope of your company are you filling in this survey?*
    ▶ National
    ▶ Regional, please specify (e.g. Benelux, Nordics, UK and Ireland): …
    ▶ Europe

Please answer all following questions according to the scope indicated in question 4.

5. *What is the total number of employees?*
    ▶

6. *What were the annual gross sales in euros of your business during the most recent fiscal year?*
    ▶

In questions 7 and 8 you are asked to estimate indicators. It is our intention to get a general idea, so you are asked to answer in round figures.

7. *Please estimate the percentage of total sales volume that your company procures via the following sales channel:*
   - ► Direct from producer   %
   - ► Via importers   %
   - ► Via distributors   %
   - ► Via wholesalers   %
   - ► Other, please specify

8. *Please indicate the proportion of total sales revenues per sales channel.*
   - ► Via retail stores   %
   - ► Via online channels   %
   - ► Via catalogues   %
   - ► Other, please specify   %

9. *Please indicate the proportion of total that will be sold via the internet.*
   - ►   %

2. Strategy

In this section you are interviewed on topics concerning the strategic environment of your business as well as strategic aspects of reverse logistics.

10. *What is the leading differentiator concerning your business strategy?*
    - ► Price
    - ► Quality
    - ► Innovation

11. *What is the leading differentiator concerning your supply chain strategy?*
    - ► Responsive *
    - ► Lean *
    - ► Hybrid (mixed) *

12. *What is the leading differentiator concerning your warranty strategy?*
    - ► Cost control
    - ► Customer satisfaction
    - ► Hybrid (mixed)
    - ► No warranty strategy in place

13. *Does your company have a specific reverse logistics strategy?*
    - ► Yes, please indicate the leading differentiator:
    - ► No
    - ► Don't know

14. *What is the leading differentiator for your reverse supply chain*?*
    - ► Control *
    - ► Efficiency *
    - ► Responsiveness *
    - ► No clear differentiator

15. *How does your company manage reverse logistics?*
    - As a cost centre
    - As a profit centre

16. *On a scale of 1 = low to 7 = high, rate the importance of reverse logistics to your company.*

    Low   1   2   3   4   5   6   7   *High*

17. *On a scale of 1 = low to 7 = high, rate the level of satisfaction of your current reverse logistics management.*

    Low   1   2   3   4   5   6   7   *High*

18. *On a scale of 1 = low to 7 = high, rate the level of satisfaction of reverse logistics management in your total supply chain.*

    Low   1   2   3   4   5   6   7   *High*

Preliminary research of PricewaterhouseCoopers has identified several developments in the Consumer Electronics Industry (Datamonitor 2007*, Mayers 2007*, PricewaterhouseCoopers sources).

19. *Which five developments are most important to your reverse logistics management? Rank from 1= most important to 5 = least important.*

    - More outsourcing* and off shoring* of production activities
    - Increase of number of competitors
    - Changing environmental legislations
    - Consumers are becoming more powerful
    - Shortening product development cycles
    - Increased focus on selling services
    - Growing pressure for corporate social responsibility*
    - The demand and supply markets become more global
    - Growing importance of internet selling
    - If other, please specify ...

Preliminary research of PricewaterhouseCoopers has identified several developments in reverse logistics (De Brito 2003*, Flapper 2005*, Srivastava 2006*, Yellepeddi 2006, Li 2007*, PricewaterhouseCoopers sources).

20. *Which five developments do you perceive as most important? Rank from 1= most important to 5 = least important.*

    - Intensifying collaboration between supply chain partners in reverse logistics
    - More use of swapping* in the repair process
    - More availability of companies offering reverse logistics activities
    - More use of Design for Environment*
    - Development of best-of-breed packages*
    - More strategic focus on reverse logistics
    - Growing knowledge base on reverse logistics management
    - IT maturation for product tracking and tracing
    - Increasing impact of reverse logistics on corporate image
    - If other, please specify…

Preliminary research has identified several barriers to successfully manage reverse logistics (Aberdeen 2006, Yellepeddi 2006, Li 2007, PricewaterhouseCoopers sources).

21. *What are the most important barriers you experience in managing your reverse logistics? Rank from 1= most important to 5 = least important.*

   ▶ Lack of awareness concerning environmental legislations
   ▶ Limited forecasting and planning of reverse logistics activities
   ▶ Lack of clear return policies
   ▶ Lack of appropriate performance management system
   ▶ Little collaboration between departments (e.g. design, manufacturing, marketing and sales).
   ▶ Little recognition of reverse logistics as a factor in creating competitive advantage.
   ▶ Differences in Extended Producer Responsibility* between countries
   ▶ Tax issues (e.g. Customs, accounting, Value Added Tax)
   ▶ Few senior management attention
   ▶ If other, please specify…

Preliminary research of PwC has identified several success factors for reverse logistics management (Aberdeen 2006*, Yellepeddi 2006*, Mollenkopf 2005*, PricewaterhouseCoopers sources).

22. *What are the most important success factors in managing your reverse logistics? Rank from 1= most important to 5 = least important.*
   ▶ Track and trace capabilities
   ▶ Top management awareness
   ▶ Strategic partnerships with supply chain partners
   ▶ Strategic partnerships with other producers
   ▶ Reclaiming value* from returned products
   ▶ Strategy focus on avoiding products to be returned
   ▶ Efficient gate keeping*
   ▶ Detailed insight in cost and performance of reverse logistics activities
   ▶ Automating returns processes
   ▶ Capability to put returned products rapidly back in the market
   ▶ Visibility of the quality and value of a product throughout its life cycle

   ▶ If other, please specify…

3. Structure

In this section you are interviewed on topics concerning organisational logic and control principles of your reverse logistics.

23. *How is the management of reverse logistics activities organised within your company? Check all that apply.*

	Centralised	Decentralised	N/A
National			
Regional (e.g. Benelux, Nordics, UK and Ireland)			
European			

In questions 23 and 24 you are interviewed on outsourcing and relocating of reverse logistics activities.

24. *Indicate which of the following activities your company performs by order of a producer. Secondly, indicate if these are performed in-house or by a third party.?*

	Performed	In-house	Third party	N/A
Collection from the end-consumer				
Testing* activities				
Reuse* activities				
Repair* activities				
Disassembly* activities				

- Refurbishing* activities
- Remanufacturing* activities
- Recycling* activities
- Waste management activities
- Call centre activities
- Logistics activities
- Financial activities

4. Process

In this section you are interviewed on topics concerning operational processes and management processes of reverse logistics.

25. *Which of the following, if at all, management systems has your company in place for reverse logistics management?*

    - Balanced Scorecard*
    - KPI dashboard*
    - Structure for continuous improvement
    - If other, please specify…

26. *Is there a decision support system to determine the disposition* (e.g. refurbish, recycle or scrap) of a malfunctioning product?*
    - Yes
    - No
    - Don't know

27. *Indicate what main difficulties you experience concerning Return Material Authorisation. Check all that apply.*
    - Unclear warranty conditions
    - Timely financial settlement
    - Unclear warranty responsibilities
    - Lack of visibility product ownership
    - No clear disposition rules
    - Ever changing conditions for authorisation
    - Other, please specify..

28. *What does your company use for process control of product returns?*
    - Forecasting of future arrival of product returns
    - Planning of required capacity (equipment and people) to deal with product returns
    - Inventory management of returned products
    - Quantitative cost analysis*
    - Incorporation of forecasting and planning of product returns in information technology
    - Shared planning and forecasting of product returns with supply chain partners

Reverse logistics cost is referred to as the cost occurring prior to delivery to the consumer (e.g. re-boxing, re-testing, down grading) and after delivery to the consumer (e.g. cost of processing customer complaints, customer returns, warranty claims, product recalls and discarding costs).

29. *Does your company have real-time insight into cost related to reverse logistics management? Second, is cost information used in managing daily operations?*

	Yes	*No*	*Don't know*

    - Real-time available
    - Real-time use

30. *On a scale of 1 = low to 7 = high, rate the importance of forecasting and planning of product returns to successfully manage reverse logistics.*

> Low   1   2   3   4   5   6   7   High

31. *On a scale of 1 = low to 7 = high, rate the impact of tax* on reverse logistics.*

> Low   1   2   3   4   5   6   7   High

32. *On a scale of 1 = low to 7 = high, rate the practical burden of customs formalities* on your daily reverse logistics operations.*

> Low   1   2   3   4   5   6   7   High

33. *On a scale of 1 = low to 7 = high, rate the practical burden of VAT set-up* of your customers on your daily reverse logistics operations.*

> Low   1   2   3   4   5   6   7   High

34. *What would you like to improve **within your company** in managing your reverse logistics? Rank from 1 = most important to 5 = least important.*

N/A

- Handling reconciliation of charge-backs*
- Clearness and visibility return policy*
- Financial (cost and revenues) insight
- Track and trace returned products
- Warehouse lay-out design for return handling
- Insight in returned inventory level in warehouse
- If other, please specify

35. *What would you like to improve **within your total supply chain** in managing your reverse logistics? Rank from 1 = most important to 5 = least important.*

N/A

- Return Material Authorisation process
- Support and troubleshooting activities
- Share detailed data of product returns
- Reward and risk sharing
- Financial settlement
- Quality of rework and repair
- Reward and risk sharing
- Performance measurement
- Sustainability of suppliers
- If other, please specify

5. People

In this section you are interviewed on topics concerning workforce and culture of your reverse logistics. Second part examines topics of extended producer responsibilities*.

36. *Is there a functional unit within your company fully dedicated to reverse logistics management?*
- Yes, please indicate the number FTE* and number of temporary employees
- No
- Don't know

37. *Does the culture in your company support continuous improvement of the reverse logistics process?*
    - Yes
    - Yes, but might be improved. Please specify…
    - No

38. *Which departments share information for the reverse logistics process? Second, which departments frequently discuss the performance of reverse logistics? Check all that apply.*

                                     Share information   Frequently discuss N/A
    - *Supply Chain Management*
    - *Logistics*
    - *Service*
    - *Sales & Marketing*
    - *Legal*
    - *Human Resources*
    - *Finance*
    - *Tax (more specific to Finance)*

39. *On a scale of 1 = low to 7 = high, rate the extent of collaboration between tax and supply chain departments on reverse logistics activities.*

                       Low   *1*   *2*   *3*   *4*   *5*   *6*   *7*   *High*

Several Extended Producer Responsibility (EPR)* in the Electric and Electronic Equipment industry are in force and other are gradually being enforced. In the following questions EPR Directives imply directives under article 95 (RoHS*, REACH* and ECO Design*) and directives under article 175 (WEEE*, Batteries* and Packaging*) of the European Parliament.

40. *What difficulties you experience in managing EPR compliance?*

                             No difficulties   Minor difficulties   Major difficulties
    - Marking of a product
    - Testing and certification
    - Registration of management and control of the waste chain
    - Documentation for product disassembly for its end-of-life
    - Documentation of quantities of products 'put on the market'
    - Documentation of 'waste' product collected

In questions 40, 41 and 42 you are interviewed on sustainability topics of reverse logistics.

41. *Has your company undertaken initiatives to increase the volume of product returns in the last two years?*
    - No
    - Don't know
    - Yes, please specify..

42. *Has your company made changes in the design of products in the last two years to enhance reverse logistics?*
    - No
    - Don't know
    - Yes, please specify..

43. *What drives a specific sustainability program within your company? Check all that apply.*
    - Driven by legislation

- ▶ Driven by internal governance
- ▶ Driven by competitive advantage
- ▶ Driven by corporate social responsibility
- ▶ No specific sustainability program is in place
- ▶ Don't know if a sustainability program is in place

44. *On a scale of 1 = low to 7 = high, rate the importance for your company of global sustainability reporting and rating systems* (e.g. Dow Jones sustainability index, Global Reporting Initiative, Greenpeace Guide to Greener Electronics)*

          Low   1   2   3   4   5   6   7   High

6. Technology

In this section you are interviewed on topics concerning technology infrastructure, service delivery and business alignment.

45. *What hardware do you have installed, or plan to install, to assist your reverse logistics management? Check all that apply*

                             Installed   Plan to install

- ▶ Electronic Data Interchange*
- ▶ Radio Frequency Identification*
- ▶ Bar code scanning
- ▶ Serial number identification
- ▶ If other, please specify..

46. *What software technologies do you have installed, or plan to install, to support your reverse logistics management? Check all that apply*

                             Installed Plan to install

- ▶ Enterprise Resource Planning
- ▶ Warehouse Management System
- ▶ Customer Relationship Management
- ▶ Best-of-breed packages
- ▶ Warranty claims processing system
- ▶ If other, please specify..

47. *On a scale 1 = low to 7 = high, rate the importance of your IT systems to support reverse logistics processes.*

             Low   1   2   3   4   5   6   7   High

48. *On a scale 1 = low to 7 = high, rate your satisfaction level of the support of IT systems to reverse logistics processes.*

             Low   1   2   3   4   5   6   7   High

49. *On a scale of 1 = low to 7 = high, rate your company's ability to integrate the IT systems with supply chain partners.*

             Low   1   2   3   4   5   6   7   High

7. Performance Indicators

In this section you are interviewed on performance indicators of subjects earlier discussed. Within the boundaries of information availability in your company, you are asked to answer as precise as possible. In some cases you are asked to indicate whether the indicator is exact or estimated.

Reverse logistics cost is referred to as the cost occurring prior to delivery to the consumer (e.g. re-boxing, re-testing, down grading) and after delivery to the consumer (e.g. cost of processing customer complaints, customer returns, warranty claims, product recalls and discarding costs).

50. *Please indicate the total reverse logistics cost as percentage of your total costs (%)*
    ▶ Exact
    ▶ Estimated
    ▶ %

In the following question you are interviewed on the type of action performed when a product is returned by a customer. It is our intention to get a general idea, so you are asked to answer in round figures.

51. *Of all products that are returned by your customers, please estimate the percentage of goods that will be:*
    ▶ Exchanged for a new product
    ▶ Picked up by the producer itself
    ▶ Shipped / mailed to the producer
    ▶ Returned to a distribution centre
    ▶ Returned to a testing centre
    ▶ Send to repair centre
    ▶ Send to authorised service centre
    ▶ Send into the waste stream
    ▶ Other

The return cycle time is defined as the time from when a customer returns a product until it is available again to be put back into the market.

52. *Please indicate your opinion of best, average and worst average return cycle time of your company.*

    ▶ Best
    ▶ Average
    ▶ Worst

The return rate is defined as the average number of product returned within the initial warranty period as percentage of total sales volume.

53. *Please indicate your opinion of best, average and worst average return rate for a product.*

    ▶ Best
    ▶ Average
    ▶ Worst

The non-fault-found rate is defined as the percentage of total product returns within the initial warranty period that have no functional or cosmetic defect.

54. *Please indicate your opinion of best, average and worst non-fault-found rate.*

    ▶ Best
    ▶ Average
    ▶ Worst

The customer cycle time is defined as the time from when a customer ships a package until the customer receives the repair, refund or exchange.

55. *Please indicate your opinion of best, average and worst performance of the customer cycle time.*

   ▶ Best
   ▶ Average
   ▶ Worst

The repair turn around time (TUT) is defined as the time from when a malfunctioning product is send to an authorised service centre until it is received back from the centre.

56. *Please indicate your opinion of best, average and worst performance of the TUT.*

   ▶ Best
   ▶ Average
   ▶ Worst

The invoicing cycle time is defined as the time from when a Return Material Authorisation is given until the payment of all invoices of that authorisation is completed.

57. *Please indicate your opinion of best, average and worst performance of the invoicing cycle time.*

   ▶ Best
   ▶ Average
   ▶ Worst

<div align="center">Closing questions</div>

This is the closing section of the survey. You are interviewed on general topics regarding reverse logistics and on topics for the follow-up process of this survey.

58. *Which improvement projects concerning reverse logistics have you planned for the coming two years?*
   ▶

59. *In order to send you an official invitation for the closing seminar, please indicate your mail address.*
   ▶ Post Address

60. *Please indicate if you have any comments or suggestions concerning this survey or our further research.*
   ▶

G.4   Service and repair company survey

<div align="center">1. General</div>

In this section you are asked on general topics of your company.

1. *Which company are you representing*?
   ▶ <name>

2. *What is your name and what is your function within the company*?
   ▶ <name> and <function>

3. *What is the scope of your responsibilities concerning reverse logistics management?*

- ► National
- ► Regional, please specify (e.g. Benelux, Nordics, UK and Ireland): …
- ► Europe

4. *For what scope of your company are you filling in this survey?*
   - ► National
   - ► Regional, please specify (e.g. Benelux, Nordics, UK and Ireland): …
   - ► Europe

Please answer all following questions according to the scope indicated in question 4.

5. *What is the total number of employees?*
   - ►

6. *What were the annual gross sales in euros of your business during the most recent fiscal year?*
   - ►

In questions 7 you are asked to estimate indicators. It is our intention to get a general idea, so you are asked to answer in round figures.

7. *Please estimate the proportion of total service revenues that your company services for the following channel:*
   - ► For distributors   %
   - ► For wholesalers   %
   - ► For retailers   %
   - ► For producers   %
   - ► For OEMs   %
   - ► Other, please specify   %

2. Strategy

In this section you are interviewed on topics concerning the strategic environment of your business as well as strategic aspects of reverse logistics.

8. *What is the leading differentiator concerning your business strategy?*
   - ► Price
   - ► Quality
   - ► Innovation

9. *Does your company have a specific reverse logistics strategy?*
   - ► Yes, please indicate the leading differentiator:
   - ► No
   - ► Don't know

10. *What are your customers demanding as leading differentiator concerning reverse logistics?*
    - ► Control *
    - ► Efficiency *
    - ► Responsiveness *
    - ► No clear differentiator

11. *On a scale of 1 = low to 7 = high, rate the importance of reverse logistics to your company.*

Low   *1*   *2*   *3*   *4*   *5*   *6*   *7*   *High*

12. *On a scale of 1 = low to 7 = high, rate the level of satisfaction of your current reverse logistics management.*

Low   1   2   3   4   5   6   7   High

Preliminary research of PricewaterhouseCoopers has identified several developments in the Consumer Electronics Industry (Datamonitor 2007*, Mayer*s* 2007*, PricewaterhouseCoopers sources).

13. *Which five developments are most important to your reverse logistics management? Rank from 1= most important to 5 = least important.*

- ▶ More outsourcing* and off shoring* of production activities
- ▶ Increase of number of competitors
- ▶ Changing environmental legislations
- ▶ Consumers are becoming more powerful
- ▶ Shortening product development cycles
- ▶ Increased focus on selling services
- ▶ Growing pressure for corporate social responsibility*
- ▶ The demand and supply markets become more global
- ▶ Growing importance of internet selling
- ▶ If other, please specify ...

Preliminary research of PricewaterhouseCoopers has identified several developments in reverse logistics (De Brito 2003*, Flapper 2005*, Srivastava 2006*, Yellepeddi 2006, Li 2007*, PricewaterhouseCoopers sources).

14. *Which five developments do you perceive as most important? Rank from 1= most important to 5 = least important.*

- ▶ Intensifying collaboration between supply chain partners in reverse logistics
- ▶ More use of swapping* in the repair process
- ▶ More availability of companies offering reverse logistics activities
- ▶ More use of Design for Environment*
- ▶ Development of best-of-breed packages*
- ▶ More strategic focus on reverse logistics
- ▶ Growing knowledge base on reverse logistics management
- ▶ IT maturation for product tracking and tracing
- ▶ Increasing impact of reverse logistics on corporate image
- ▶ If other, please specify…

Preliminary research has identified several barriers to successfully manage reverse logistics (Aberdeen 2006, Yellepeddi 2006, Li 2007, PricewaterhouseCoopers sources).

15. *What barriers do you perceive as most important in managing reverse logistics? Rank from 1= most important to 5 = least important.*

- ▶ Lack of awareness concerning environmental legislations
- ▶ Limited forecasting and planning of reverse logistics activities
- ▶ Lack of clear return policies
- ▶ Lack of appropriate performance management system
- ▶ Little collaboration between departments (e.g. design, manufacturing, marketing and sales).
- ▶ Little recognition of reverse logistics as a factor in creating competitive advantage.
- ▶ Differences in Extended Producer Responsibility* between countries
- ▶ Tax issues (e.g. Customs, accounting, Value Added Tax)
- ▶ Few senior management attention
- ▶ If other, please specify…

Preliminary research of PwC has identified several success factors for reverse logistics management (Aberdeen 2006*, Yellepeddi 2006*, Mollenkopf 2005*, PricewaterhouseCoopers sources).

16. *What are the most important success factors in managing your reverse logistics? Rank from 1= most important to 5 = least important.*
   - Track and trace capabilities
   - Top management awareness
   - Strategic partnerships with supply chain partners
   - Strategic partnerships with other producers
   - Reclaiming value* from returned products
   - Strategy focus on avoiding products to be returned
   - Efficient gate keeping*
   - Detailed insight in cost and performance of reverse logistics activities
   - Automating returns processes
   - Capability to put returned products rapidly back in the market
   - Visibility of the quality and value of a product throughout its life cycle

   - If other, please specify…

<p style="text-align:center">3. Structure</p>

In this section you are interviewed on topics concerning third party serivices, organisational logic and control principles of your reverse logistics. Some reasons might not be applicable and might stay unanswered.

17. *Why do your customers use third party service for reverse logistics? Rank from 1= most important to 5 = fifth most important*
   - Concentrate on core business
   - Avoid huge capital expenditures in facilities
   - Not having strong geographic distribution network
   - Required customer service
   - Relying on third party technology
   - Risk and control of the reverse logistics chain
   - Legislation compliance
   - Other, please specify..

18. *How is the management of reverse logistics activities organised within your company? Check all that apply.*

	Centralised	Decentralised
National		
Regional (e.g. Benelux, Nordics, UK and Ireland)		
European		

In questions 20 and 21 you are interviewed on outsourcing and relocating of reverse logistics activities.

19. *Which of the following activities does your company offer? Second, which activities your company planned to offer within two years?*

	Offered	Planned to offer	N/A
Testing* activities			
Reuse* activities			
Repair* activities			
Disassembly* activities			
Refurbishing* activities			
Remanufacturing* activities			

- Recycling* activities
- Waste management activities
- Call centre
- Logistics activities
- Financial activities
- Other, please specify

20. *Where does your company perform the following activities? If partly, please check all that apply. Second, indicate if they have been relocated in the last two years.*

<div align="center">Originating country   Other EU Outside EU Relocated</div>

- Testing* activities
- Reuse* activities
- Repair* activities
- Disassembly* activities
- Refurbishing* activities
- Remanufacturing* activities
- Recycling* activities
- Landfill

<div align="center">4. Process</div>

In this section you are interviewed on topics concerning operational processes and management processes of reverse logistics.

21. *Which of the following, if at all, management systems has your company in place for reverse logistics management?*

- Balanced Scorecard*
- KPI dashboard*
- Structure for continuous improvement
- If other, please specify…

22. *What does your company use for process control of product returns?*
- Forecasting of future arrival of product returns
- Planning of required capacity (equipment and people) to deal with product returns
- Inventory management of returned products
- Quantitative cost analysis*
- Incorporation of forecasting and planning of product returns in information technology
- Shared planning and forecasting of product returns with supply chain partners

Reverse logistics cost is referred to as the cost occurring prior to delivery to the consumer (e.g. re-boxing, re-testing, down grading) and after delivery to the consumer (e.g. cost of processing customer complaints, customer returns, warranty claims, product recalls and discarding costs).

23. *Does your company have real-time insight into cost related to reverse logistics management? Second, Second, is this cost information used by your customers in managing daily operations?*

<div align="center">Yes   No   Don't know</div>

- Real-time available
- Real-time use

24. *On a scale of 1 = low to 7 = high, rate the importance of forecasting and planning of product returns to successfully manage reverse logistics.*

<div align="center">Low   1   2   3   4   5   6   7   High</div>

25. *On a scale of 1 = low to 7 = high, rate the impact of tax* on reverse logistics.*

Low   1   2   3   4   5   6   7   High

26. *On a scale of 1 = low to 7 = high, rate the practical burden of customs formalities* on your daily reverse logistics operations.*

Low   1   2   3   4   5   6   7   High

27. *On a scale of 1 = low to 7 = high, rate the practical burden of VAT set-up* of your customers on your daily reverse logistics operations.*

Low   1   2   3   4   5   6   7   High

5. People

In this section you are interviewed on topics concerning workforce and culture of your reverse logistics. Second part examines topics of extended producer responsibilities*.

28. *Is there a functional unit within your company fully dedicated to reverse logistics management?*
    ▶ Yes, please indicate the number FTE* and number of temporary employees
    ▶ No
    ▶ Don't know

29. *Does the culture in your company support continuous improvement of the reverse logistics process?*
    ▶ Yes, fully supported
    ▶ Yes, but might be improved. Please specify…
    ▶ No

Several Extended Producer Responsibility (EPR)* in the Electric and Electronic Equipment industry are in force and other are gradually being enforced. In the following questions EPR Directives imply directives under article 95 (RoHS*, REACH* and ECO Design*) and directives under article 175 (WEEE*, Batteries* and Packaging*) of the European Parliament.

30. *What difficulties you experience in managing EPR compliance?*

	No difficulties	Minor difficulties	Major difficulties
Marking of a product			
Testing and certification			
Registration of management and control of the waste chain			
Documentation for product disassembly for its end-of-life			
Documentation of quantities of products 'put on the market'			
Documentation of 'waste' product collected			

31. *Has your company undertaken initiatives to increase the volume of product returns in the last two years?*
    ▶ No
    ▶ Don't know
    ▶ Yes, please specify

32. *What drives a specific sustainability program within your company? Check all that apply.*
    ▶ Driven by legislation
    ▶ Driven by internal governance
    ▶ Driven by competitive advantage

- ▶ Driven by corporate social responsibility
- ▶ No specific sustainability program is in place
- ▶ Don't know if a sustainability program is in place

33. *On a scale of 1 = low to 7 = high, rate the importance for your company of global sustainability reporting and rating systems* (e.g. Dow Jones sustainability index, Global Reporting Initiative, Greenpeace Guide to Greener Electronics)*

Low	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*High*

6. Technology

In this section you are interviewed on topics concerning technology infrastructure, service delivery and business alignment.

34. *What hardware do you have installed, or plan to install, to assist your reverse logistics management? Check all that apply*

Installed   Plan to install

- ▶ Electronic Data Interchange*
- ▶ Radio Frequency Identification*
- ▶ Bar code scanning
- ▶ Serial number identification
- ▶ If other, please specify..

35. *What software technologies do you have installed, or plan to install, to support your reverse logistics management? Check all that apply*

Installed Plan to install

- ▶ Enterprise Resource Planning
- ▶ Warehouse Management System
- ▶ Customer Relationship Management
- ▶ Best-of-breed packages
- ▶ Warranty claims processing system
- ▶ If other, please specify..

36. *On a scale 1 = low to 7 = high, rate the importance of your IT systems to support reverse logistics processes.*

Low	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*High*

37. *On a scale 1 = low to 7 = high, rate your satisfaction level of the support of IT systems to reverse logistics processes.*

Low	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*High*

38. *On a scale of 1 = low to 7 = high, rate the ability of your customers to integrate IT with third parties to manage reverse logistics.*

Low	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*High*

7. Performance Indicators

In this section you are interviewed on performance indicators of subjects earlier discussed. Within the boundaries of information availability in your company, you are asked to answer as precise as possible. In some cases you are asked to indicate whether the indicator is exact or estimated.

39. *Please indicate the total sales revenues that is represented by reverse logistics (%)*
   - ▶ Exact
   - ▶ Estimated

40. *Please estimate the expected increase of reverse logistics revenues in the coming two years (%).*
   ▶ Estimated

41. *Of all products you that you service, please estimate the percentage of goods that will be:*

   ▶ Repacked and sold as new   %
   ▶ Repaired   %
   ▶ Refurbished   %
   ▶ Remanufactured   %
   ▶ Recycled   %
   ▶ Send into the waste stream   %

The initial value of a product is defined as the total product cost when the product was sold for the fist time. If a product is returned, value can be reclaimed by different reverse logistics activities (e.g. reuse, refurbishing, remanufacturing).

42. *Please indicate your opinion of best, average and worst performance of the average percentage of initial value reclaimed by reverse logistics.*
   ▶ Best
   ▶ Average
   ▶ Worst

The non-fault-found rate is defined as the percentage of total product returns within the initial warranty period that have no functional or cosmetic defect.

43. *Please indicate your opinion of best, average and worst performance of a non-fault-found rate.*

   ▶ Best
   ▶ Average
   ▶ Worst

The recovery rate is defined as the number of units scrapped divided by total of products inducted in the reverse logistics process in a period of time.

44. *Please indicate your opinion of best, average and worst performance of a recovery rate.*

   ▶ Best
   ▶ Average
   ▶ Worst

The invoicing cycle time is defined as the time from when a Return Material Authorisation is given until the payment of all invoices of that authorisation is completed.

45. *Please indicate your opinion of best, average and worst performance of the invoicing cycle time.*

   ▶ Best
   ▶ Average
   ▶ Worst

The customer cycle time is defined as the time from when a customer ships a package until the customer receives the repair, refund or exchange.

46. *Please indicate your opinion of best, average and worst performance of the customer cycle time.*

   ▶ Best
   ▶ Average
   ▶ Worst

Closing questions

This is the closing section of the survey. You are interviewed on general topics regarding reverse logistics and on topics for the follow-up process of this survey.

47. *Which improvement projects concerning reverse logistics have you planned for the coming two years?*
   ▶

48. *Are you willing to participate in a one-to-one follow-up meeting to discuss your individual results?*
   ▶ Yes
   ▶ No
   ▶ Maybe

49. *In order to send you an official invitation for the closing seminar, please indicate your mail address.*
   ▶ Post Address

50. *Please indicate if you have any comments or suggestions concerning this survey or our further research.*
   ▶

G.5   LSP provider survey

1. General

In this section you are asked on general topics of your company.

1. *Which company are you representing?*
   ▶ <name>

2. *What is your name and what is your function within the company?*
   ▶ <name> and <function>

3. *What is the scope of your responsibilities concerning reverse logistics management?*
   ▶ National
   ▶ Regional, please specify (e.g. Benelux, Nordics, UK and Ireland): …
   ▶ Europe

4. *For what scope of your company are you filling in this survey?*
   ▶ National
   ▶ Regional, please specify (e.g. Benelux, Nordics, UK and Ireland): …
   ▶ Europe

Please answer all following questions according to the scope indicated in question 4.

5. *What is the total number of employees?*
   ▶

6. *What were the annual gross sales in euros of your business during the most recent fiscal year?*
   ▶

In questions 7 you are asked to estimate indicators. It is our intention to get a general idea, so you are asked to answer in round figures.

7. *Please estimate the proportion of total service revenues that your company services for the following channel (in percentages %):*

▶ Via OEMs   %
▶ Via producers   %
▶ Via wholesalers   %
▶ Importers   %
▶ Retailers   (including on-line retailers)   %
▶ Other, please specify   %

2. Strategy

In this section you are interviewed on topics concerning the strategic environment of your business as well as strategic aspects of reverse logistics.

8. *What is the leading differentiator concerning your business strategy?*
    ▶ Price
    ▶ Quality
    ▶ Innovation

9. *Does your company have a specific reverse logistics strategy?*
    ▶ Yes, please indicate the leading differentiator:
    ▶ No
    ▶ Don't know

10. *Is reverse logistics a leading differentiator for your company?*
    ▶ Yes, please indicate the leading differentiator:
    ▶ No
    ▶ Don't know

11. *What are your customers demanding as leading differentiator concerning reverse logistics?*
    ▶ Control
    ▶ Efficiency
    ▶ Responsiveness
    ▶ No clear differentiator

12. *On a scale of 1 = low to 7 = high, rate the importance of reverse logistics to your company.*
    | | Low | 1 | 2 | 3 | 4 | 5 | 6 | 7 | High |

13. *On a scale of 1 = low to 7 = high, rate the level of satisfaction of your current reverse logistics management.*
    | | Low | 1 | 2 | 3 | 4 | 5 | 6 | 7 | High |

Preliminary research of PricewaterhouseCoopers has identified several developments in the Consumer Electronics Industry (Datamonitor 2007*, Mayer*s* 2007*, PricewaterhouseCoopers sources).

14. *Which five developments are most important to your reverse logistics management? Rank from 1= most important to 5 = least important.*

    ▶ More outsourcing* and off shoring* of production activities
    ▶ Increase of number of competitors
    ▶ Changing environmental legislations
    ▶ Consumers are becoming more powerful
    ▶ Shortening product development cycles
    ▶ Increased focus on selling services
    ▶ Growing pressure for corporate social responsibility*
    ▶ The demand and supply markets become more global
    ▶ Growing importance of internet selling
    ▶ If other, please specify ...

Preliminary research of PricewaterhouseCoopers has identified several developments in reverse logistics (De Brito 2003*, Flapper 2005*, Srivastava 2006*, Yellepeddi 2006, Li 2007*, PricewaterhouseCoopers sources).

15. *Which five developments do you perceive as most important? Rank from 1= most important to 5 = least important.*

   ▶ Intensifying collaboration between supply chain partners in reverse logistics
   ▶ More use of swapping* in the repair process
   ▶ More availability of companies offering reverse logistics activities
   ▶ More use of Design for Environment*
   ▶ Development of best-of-breed packages*
   ▶ More strategic focus on reverse logistics
   ▶ Growing knowledge base on reverse logistics management
   ▶ IT maturation for product tracking and tracing
   ▶ Increasing impact of reverse logistics on corporate image
   ▶ If other, please specify…

Preliminary research has identified several barriers to successfully manage reverse logistics (Aberdeen 2006, Yellepeddi 2006, Li 2007, PricewaterhouseCoopers sources).

16. *What are the most important barriers your customers are dealing with in managing your reverse logistics? Rank from 1= most important to 5 = least important.*

   ▶ Lack of awareness concerning environmental legislations
   ▶ Limited forecasting and planning of reverse logistics activities
   ▶ Lack of clear return policies
   ▶ Lack of appropriate performance management system
   ▶ Little collaboration between departments (e.g. design, manufacturing, marketing and sales).
   ▶ Little recognition of reverse logistics as a factor in creating competitive advantage.
   ▶ Differences in Extended Producer Responsibility* between countries
   ▶ Tax issues (e.g. Customs, accounting, Value Added Tax)
   ▶ Few senior management attention
   ▶ If other, please specify…

Preliminary research of PwC has identified several success factors for reverse logistics management (Aberdeen 2006*, Yellepeddi 2006*, Mollenkopf 2005*, PricewaterhouseCoopers sources).

17. *What are the most important success factors in managing your reverse logistics? Rank from 1= most important to 5 = least important.*
   ▶ Track and trace capabilities
   ▶ Top management awareness
   ▶ Strategic partnerships with supply chain partners
   ▶ Strategic partnerships with other producers
   ▶ Reclaiming value* from returned products
   ▶ Strategy focus on avoiding products to be returned
   ▶ Efficient gate keeping*
   ▶ Detailed insight in cost and performance of reverse logistics activities
   ▶ Automating returns processes
   ▶ Capability to put returned products rapidly back in the market
   ▶ Visibility of the quality and value of a product throughout its life cycle

   ▶ If other, please specify…

3. Structure

In this section you are interviewed on topics concerning third party serivices, organisational logic and control principles of your reverse logistics. Some reasons might not be applicable and might stay unanswered.

18. *Why do your customers use third party service for reverse logistics? Rank from 1= most important to 5 = fifth most important*
    - ▶ Concentrate on core business
    - ▶ Avoid huge capital expenditures in facilities
    - ▶ Not having strong geographic distribution network
    - ▶ Required customer service
    - ▶ Relying on third party technology
    - ▶ Risk and control of the reverse logistics chain
    - ▶ Legislation compliance
    - ▶ Other, please specify..

19. *How is the management of reverse logistics activities organised within your company? Check all that apply.*

                                                    Centralised   Decentralised
    - ▶ *National*
    - ▶ *Regional (e.g. Benelux, Nordics, UK and Ireland)*
    - ▶ *European*

In questions 22 and 23 you are interviewed on outsourcing and relocating of reverse logistics activities.

20. *Which of the following activities does your company offer? Second, which activities your company planned to offer within two years?*

                                Offered Planned to offer   N/A
    - ▶ Logistics from/to the customer
    - ▶ Logistics from/to supply chain partners
    - ▶ Testing* activities
    - ▶ Reuse* activities
    - ▶ Repair* activities
    - ▶ Disassembly* activities
    - ▶ Refurbishing* activities
    - ▶ Remanufacturing* activities
    - ▶ Recycling* activities
    - ▶ Waste management activities
    - ▶ Landfill
    - ▶ Inventory management
    - ▶ Warranty management
    - ▶ Other, please specify

21. *Where does your company perform the following activities? If partly, please check all that apply. Second, indicate if they have been relocated in the last two years.*

                    Originating country   Other EU country Outside EU   Relocated   N/A
    - ▶ Testing activities
    - ▶ Reuse activities
    - ▶ Repair activities
    - ▶ Disassembly activities
    - ▶ Refurbishing activities
    - ▶ Remanufacturing activities
    - ▶ Recycling activities
    - ▶ Landfill

4. Process

In this section you are interviewed on topics concerning operational processes and management processes of reverse logistics.

22. *Which of the following, if at all, management systems has your company in place for reverse logistics management?*

   ▶ Balanced Scorecard*
   ▶ KPI dashboard*
   ▶ Structure for continuous improvement
   ▶ If other, please specify…

23. *What does your company use for process control of product returns?*
   ▶ Forecasting of future arrival of product returns
   ▶ Planning of required capacity (equipment and people) to deal with product returns
   ▶ Inventory management of returned products
   ▶ Quantitative cost analysis*
   ▶ Incorporation of forecasting and planning of product returns in information technology
   ▶ Shared planning and forecasting of product returns with supply chain partners

Reverse logistics cost is referred to as the cost occurring prior to delivery to the consumer (e.g. re-boxing, re-testing, down grading) and after delivery to the consumer (e.g. cost of processing customer complaints, customer returns, warranty claims, product recalls and discarding costs).

24. *Does your company have real-time insight into cost related to reverse logistics management? Second, is cost information used in managing daily operations?*

	Yes	No	Don't know

   ▶ Real-time available
   ▶ Real-time use

25. *On a scale of 1 = low to 7 = high, rate the importance of forecasting and planning of product returns to successfully manage reverse logistics.*

   Low   1   2   3   4   5   6   7   High

26. *On a scale of 1 = low to 7 = high, rate the impact of tax* on reverse logistics.*

   Low   1   2   3   4   5   6   7   High

27. *On a scale of 1 = low to 7 = high, rate the practical burden of customs formalities* on your daily reverse logistics operations.*

   Low   1   2   3   4   5   6   7   High

28. *On a scale of 1 = low to 7 = high, rate the practical burden of VAT set-up* of your customers on your daily reverse logistics operations.*

   Low   1   2   3   4   5   6   7   High

5. People

In this section you are interviewed on topics concerning workforce and culture of your reverse logistics. Second part examines topics of extended producer responsibilities*.

29. *Is there a functional unit within your company fully dedicated to reverse logistics management?*
   ▶ Yes, please indicate the number FTE* and number of temporary employees
   ▶ No
   ▶ Don't know

30. *Does the culture in your company support continuous improvement of the reverse logistics process?*
    - ▸ Yes, fully supported
    - ▸ Yes, but might be improved. Please specify…
    - ▸ No

31. *On a scale of 1 = low to 7 = high, rate the extent of collaboration between tax and supply chain departments on reverse logistics activities.*

Low	1	2	3	4	5	6	7	High

Several Extended Producer Responsibility (EPR)* in the Electric and Electronic Equipment industry are in force and other are gradually being enforced. In the following questions EPR Directives imply directives under article 95 (RoHS*, REACH* and ECO Design*) and directives under article 175 (WEEE*, Batteries* and Packaging*) of the European Parliament.

32. *What difficulties do you experience in supporting your customers to manage EPR compliance?*

	No difficulties	Minor difficulties	Major difficulties
▸ Marking of a product			
▸ Testing and certification			
▸ Registration of management and control of the waste chain			
▸ Documentation for product disassembly for its end-of-life			
▸ Documentation of quantities of products 'put on the market'			
▸ Documentation of 'waste' product collected			

33. *What drives a specific sustainability program within your company? Check all that apply.*
    - ▸ Driven by legislation
    - ▸ Driven by internal governance
    - ▸ Driven by competitive advantage
    - ▸ Driven by corporate social responsibility
    - ▸ No specific sustainability program is in place
    - ▸ Don't know if a sustainability program is in place

6. Technology

In this section you are interviewed on topics concerning technology infrastructure, service delivery and business alignment.

34. *What hardware do you have installed, or plan to install, to assist your reverse logistics management? Check all that apply*

	Installed	Plan to install
▸ Electronic Data Interchange*		
▸ Radio Frequency Identification*		
▸ Bar code scanning		
▸ Serial number identification		
▸ If other, please specify..		

35. *What software technologies do you have installed, or plan to install, to support your reverse logistics management? Check all that apply*

	Installed	Plan to install
▸ Enterprise Resource Planning		
▸ Warehouse Management System		
▸ Customer Relationship Management		
▸ Best-of-breed packages		
▸ Warranty claims processing system		
▸ If other, please specify..		

36. *On a scale 1 = low to 7 = high, rate the importance of your IT systems to support reverse logistics processes.*

    Low   1   2   3   4   5   6   7   High

37. *On a scale 1 = low to 7 = high, rate your satisfaction level of the support of IT systems to reverse logistics processes.*

    Low   1   2   3   4   5   6   7   High

38. *On a scale of 1 = low to 7 = high, rate the ability of your customers to integrate IT with third parties to manage reverse logistics.*

    Low   1   2   3   4   5   6   7   High

7. Performance Indicators

In this section you are interviewed on performance indicators of subjects earlier discussed. Within the boundaries of information availability in your company, you are asked to answer as precise as possible. In some cases you are asked to indicate whether the indicator is exact or estimated.

39. *Please indicate the total sales revenues that is represented by reverse logistics (%)*
    - Exact
    - Estimated

40. *Please estimate the expected increase of reverse logistics revenues in the coming two years (%).*
    - Estimated

41. *What part of your customers do you provide both the forward logistics as well the reverse logistics*
    - Estimated

The customer cycle time is defined as the time from when a customer ships a package until the customer receives the repair, refund or exchange.

42. *Please indicate your opinion of best, average and worst performance of the customer cycle time.*

    - Best
    - Average
    - Worst

The return cycle time is defined as the time from when a customer returns a product until it is available again to be put back into the market.

43. *Please indicate your opinion of best, average and worst average return cycle time of your company.*

    - Best
    - Average
    - Worst

The invoicing cycle time is defined as the time from when a Return Material Authorisation is given until the payment of all invoices of that authorisation is completed.

44. *Please indicate your opinion of best, average and worst performance of the invoicing cycle time.*

    - Best
    - Average
    - Worst

Closing questions

This is the closing section of the survey. You are interviewed on general topics regarding reverse logistics and on topics for the follow-up process of this survey.

45. *Which improvement projects concerning reverse logistics have you planned for the coming two years?*
   ▶

46. *Are you willing to participate in a one-to-one follow-up meeting to discuss your individual results?*
   ▶   Yes
   ▶   No
   ▶   Maybe

47. *In order to send you an official invitation for the closing seminar, please indicate your mail address.*
   ▶   Post Address

48. *Please indicate if you have any comments or suggestions concerning this survey or our further research.*
   ▶

H Survey critical success factors

H.1 Introduction

CSFs are an explicit representation of the key performance areas and define those sustaining activities that an organisation must perform well to create sustainable value for its stakeholders. We identified end-consumers, customers (e.g. retailers), suppliers, service providers, shareholders, employees, government and Non-governmental organisations as main stakeholders for reverse logistics of consumer electronics. We regard revenue growth, operating margin and asset utilisation as the three value drivers that create value for stakeholders by managing reverse logistics excellently.

In advance we have identified eight CSFs on executive level of management. Obviously, these are aggregated factors and many others exist at lower levels of management. In line with the holistic view of the study we ask you to rate the importance of both supply chain and tax factors. It is not our intention to draw strict conclusions via this survey, so also in case you are less familiar with some terms we ask you to give your opinion.

The terms for the eight factors are:
1. Responsive reverse chain (RRC)
2. Lean returns process (LRP)
3. Sustainable business model (SBM)
4. Tax compliance & control (TCC)
5. Efficient asset recovery (EAR)
6. Collaboration (Col)
7. Avoidance & Gate keeping (AG)
8. Transparency (TR)

H.2 Questions

In the following questions you are asked to pair-wise compare CSFs. For each pair you are asked to indicate if you perceive one CSF more important, equally important, or less important than the other CSF for creating value for stakeholders by managing reverse logistics.

What do you perceive as more important: Responsive reverse chain or Lean returns process?
- Strongly favour RRC over LRP
- Weakly favour RRC over LRP
- Equal importance
- Weakly favour LRP over RRC
- Strongly favour LRP over RRC

This question was used in the same model for all other comparisons of the eight factors. Hence, in total the questionnaire consisted of 28 questions (7 starting with RCC, 6 starting with LRP, 5 starting with SBM, 4 starting with TCC, 3 starting with EAR, 2 starting with COL, and 1 starting with AG).

For Example:

What do you perceive as more important: Responsive reverse chain or Sustainable Business Model?
- Strongly favour RRC over SBM
- Weakly favour RRC over SBM
- Equal importance
- Weakly favour SBM over RRC
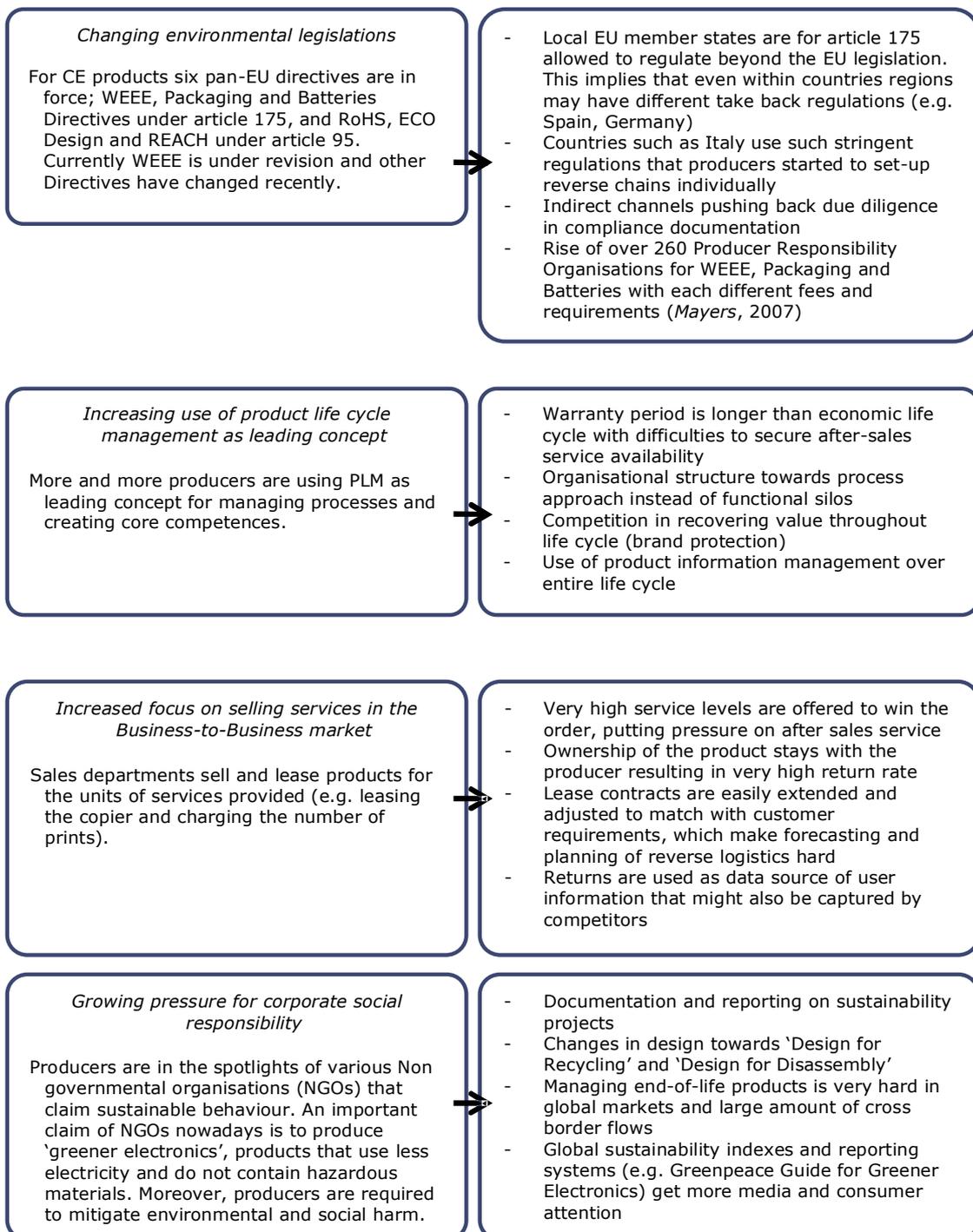- Strongly favour SBM over RRC

H.3 List of respondents

1 academic, 1 Enterprise Resource Planning supplier, 1 Logistics Service Provider manager, 1 Service & Repair manager, 1 logistics platform and 2 PwC consultants. Return Rate: 36.8% (7 out of 19).

I   Field results

This part of the appendix provides more outcomes of our field research.

I.1   Trends and developments in the consumer electronics market

In the left box we present our perception of the trend, and in the right box challenges that managers indicated to experience that relate to the trend.

Changing environmental legislations

For CE products six pan-EU directives are in force; WEEE, Packaging and Batteries Directives under article 175, and RoHS, ECO Design and REACH under article 95. Currently WEEE is under revision and other Directives have changed recently.

- Local EU member states are for article 175 allowed to regulate beyond the EU legislation. This implies that even within countries regions may have different take back regulations (e.g. Spain, Germany)
- Countries such as Italy use such stringent regulations that producers started to set-up reverse chains individually
- Indirect channels pushing back due diligence in compliance documentation
- Rise of over 260 Producer Responsibility Organisations for WEEE, Packaging and Batteries with each different fees and requirements (*Mayers*, 2007)

Increasing use of product life cycle management as leading concept

More and more producers are using PLM as leading concept for managing processes and creating core competences.

- Warranty period is longer than economic life cycle with difficulties to secure after-sales service availability
- Organisational structure towards process approach instead of functional silos
- Competition in recovering value throughout life cycle (brand protection)
- Use of product information management over entire life cycle

Increased focus on selling services in the Business-to-Business market

Sales departments sell and lease products for the units of services provided (e.g. leasing the copier and charging the number of prints).

- Very high service levels are offered to win the order, putting pressure on after sales service
- Ownership of the product stays with the producer resulting in very high return rate
- Lease contracts are easily extended and adjusted to match with customer requirements, which make forecasting and planning of reverse logistics hard
- Returns are used as data source of user information that might also be captured by competitors

Growing pressure for corporate social responsibility

Producers are in the spotlights of various Non governmental organisations (NGOs) that claim sustainable behaviour. An important claim of NGOs nowadays is to produce 'greener electronics', products that use less electricity and do not contain hazardous materials. Moreover, producers are required to mitigate environmental and social harm.

- Documentation and reporting on sustainability projects
- Changes in design towards 'Design for Recycling' and 'Design for Disassembly'
- Managing end-of-life products is very hard in global markets and large amount of cross border flows
- Global sustainability indexes and reporting systems (e.g. Greenpeace Guide for Greener Electronics) get more media and consumer attention

l.2   Trends and developments in managing reverse logistics

Equal to chapter 4, we captured the trend in the left box and describe a number of challenges in managing reverse logistics related to the trend in the right box.
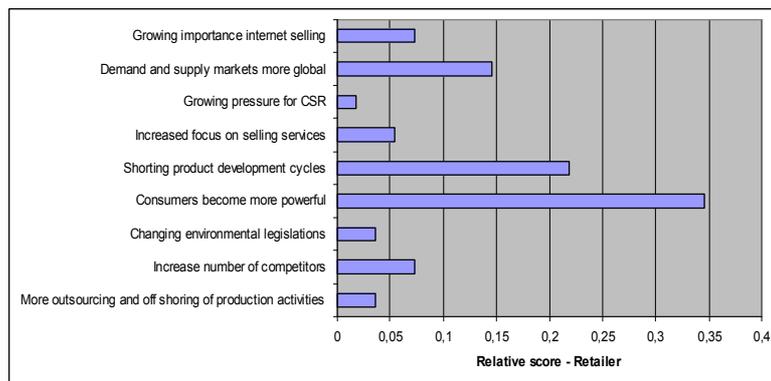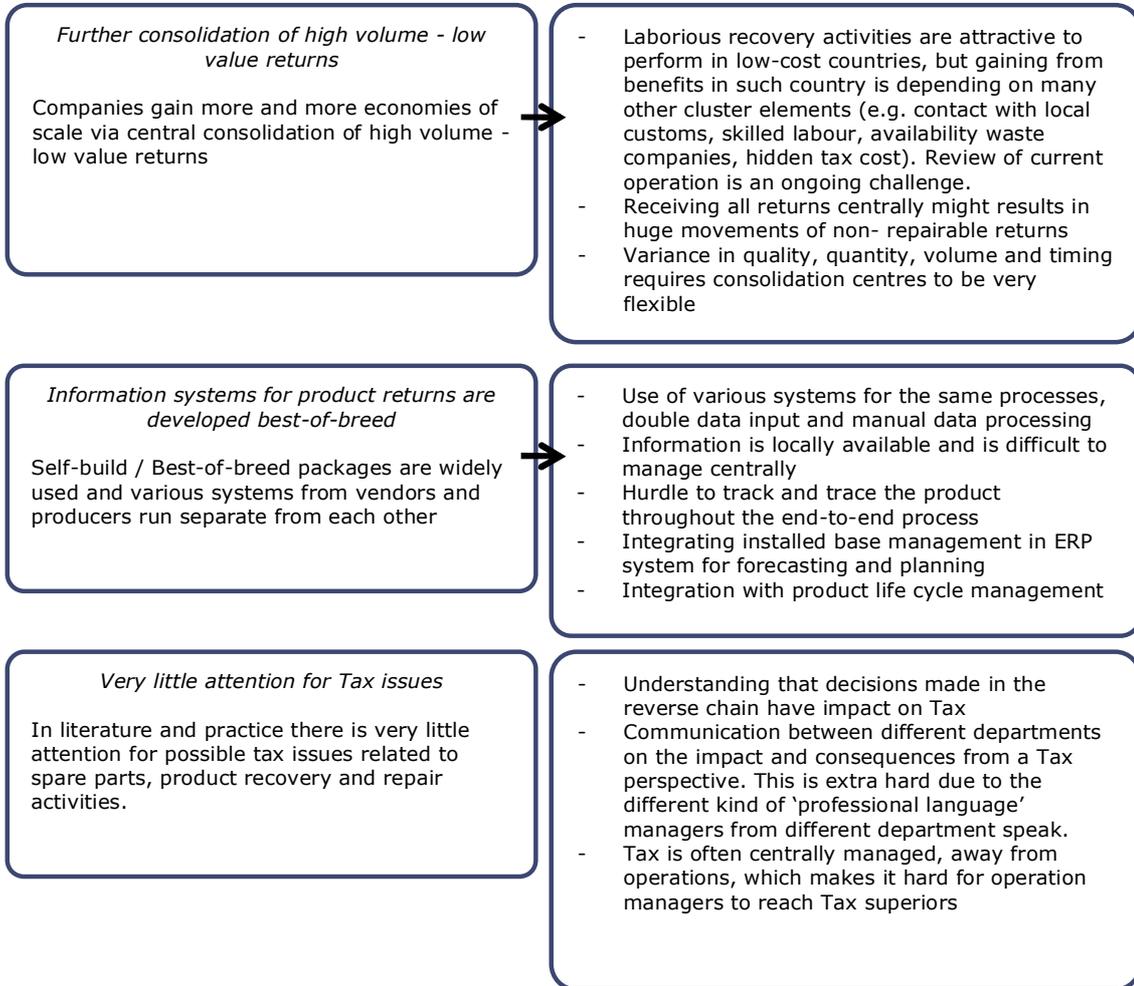
| *Further consolidation of high volume - low value returns*

Companies gain more and more economies of scale via central consolidation of high volume - low value returns | - Laborious recovery activities are attractive to perform in low-cost countries, but gaining from benefits in such country is depending on many other cluster elements (e.g. contact with local customs, skilled labour, availability waste companies, hidden tax cost). Review of current operation is an ongoing challenge.
- Receiving all returns centrally might results in huge movements of non- repairable returns
- Variance in quality, quantity, volume and timing requires consolidation centres to be very flexible |

| *Information systems for product returns are developed best-of-breed*

Self-build / Best-of-breed packages are widely used and various systems from vendors and producers run separate from each other | - Use of various systems for the same processes, double data input and manual data processing
- Information is locally available and is difficult to manage centrally
- Hurdle to track and trace the product throughout the end-to-end process
- Integrating installed base management in ERP system for forecasting and planning
- Integration with product life cycle management |

| *Very little attention for Tax issues*

In literature and practice there is very little attention for possible tax issues related to spare parts, product recovery and repair activities. | - Understanding that decisions made in the reverse chain have impact on Tax
- Communication between different departments on the impact and consequences from a Tax perspective. This is extra hard due to the different kind of 'professional language' managers from different department speak.
- Tax is often centrally managed, away from operations, which makes it hard for operation managers to reach Tax superiors |

Figure I.1: Perceived importance trends in the consumer electronics market - retailer

Figure I.2: Perceived importance trends in the consumer electronics market - LSP

Figure I.3: Perceived importance trends in the consumer electronics market - SR

I.3 Additional results web-based surveys

Answers to the surveys we categorise over dimensions of the Guide (PwC): strategy, process, structure, people and technology.

I.3.1 Strategy

Goal of the strategic part is to gain insight in leading differentiators used for the whole supply chain, and particular strategies directly related to reverse logistics.

Leading differentiators
Leading differentiators that respondents indicate for their reverse logistics strategy are customer satisfaction, avoiding returns for commercial reasons and sustainable/environmental business models. For the warranty strategy majority of managers (91%) is able to indicate what the leading differentiator for the reverse chain is. Efficiency scores highest, with responsiveness and control almost equal scores.
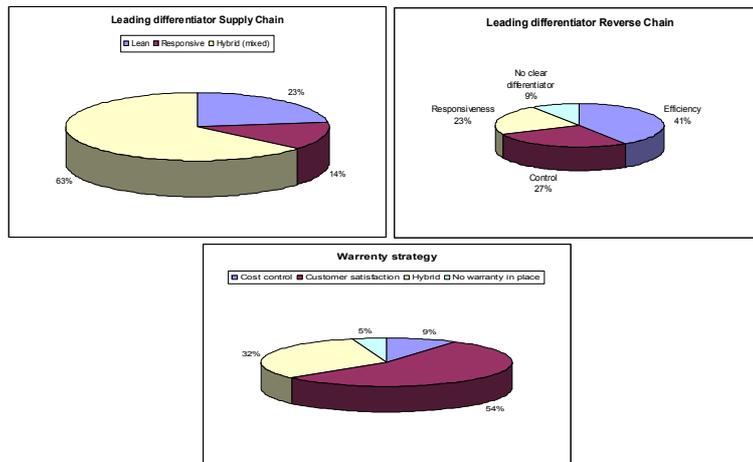
Figure I.4: Differentiators in the supply chain

Retailer

Retail respondents indicated to have either a responsive or a hybrid (mixed) differentiator for the supply chain and 60% indicated to have a reverse logistics strategy, either focussed on cost control or customer satisfaction. 80% of respondents rated customer satisfaction as differentiator for the warranty strategy, and other 20% a hybrid (mixed) approach. 20% of retailer respondents indicated to manage reverse logistics as a profit centre, and 80% as a cost centre.

LSP

30% of LSP respondents indicated not to have or not be aware of a specific reverse logistics, and not to perceive reverse logistics as a leading differentiator. Those who did have a strategy, indicated that leading differentiators are sustainability, drop-off strategies, offering end to end service in full compliance with security and environmental directives and Pan-European offerings. Only 10% of respondent rated reverse logistics as not profitable for the company and 10% indicated to treat reverse logistics not as a profit centre but as a cost centre.

SR

All SR respondents indicated to have a reverse logistics strategy, with answers of customer service, service in the shop and one stop shopping, RMA process, flexibility, meeting customer requirements and niche positioning.

Barriers
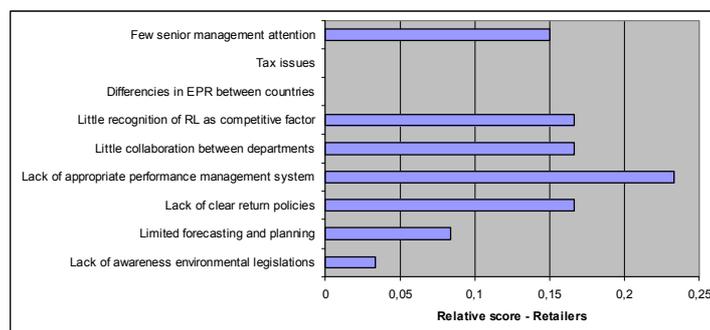
Figure I.5: Barriers for successful reverse logistics management – retailer
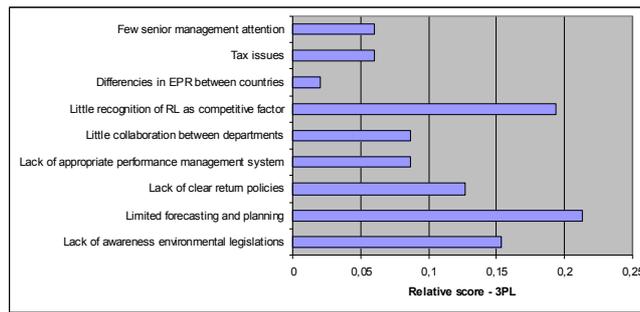
Figure I.6: Barriers for successful reverse logistics management – LSP
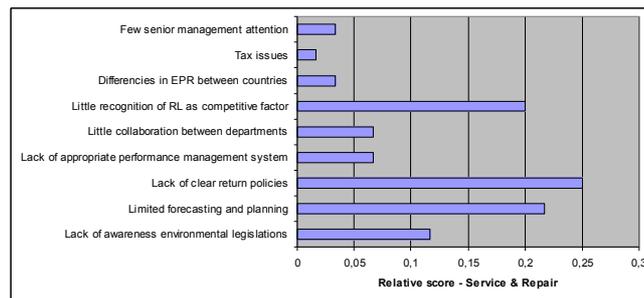
Figure I.7: Barriers for successful reverse logistics management – SR

Critical success factors
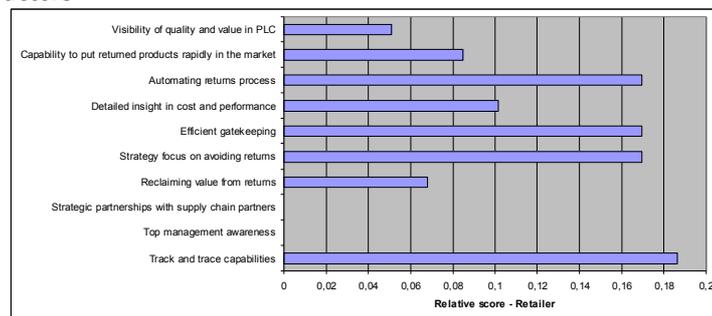
Figure I.8: Critical success factors for reverse logistics management – Retailer
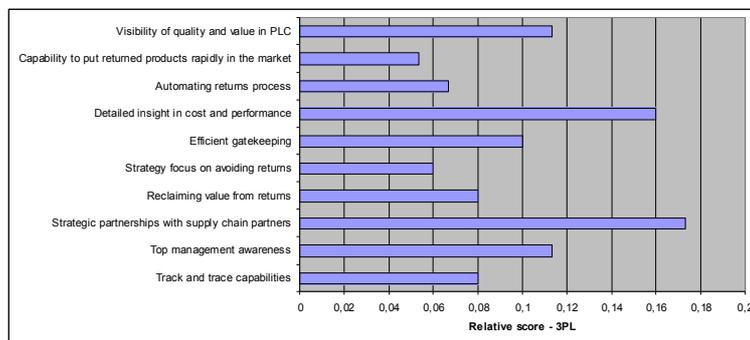
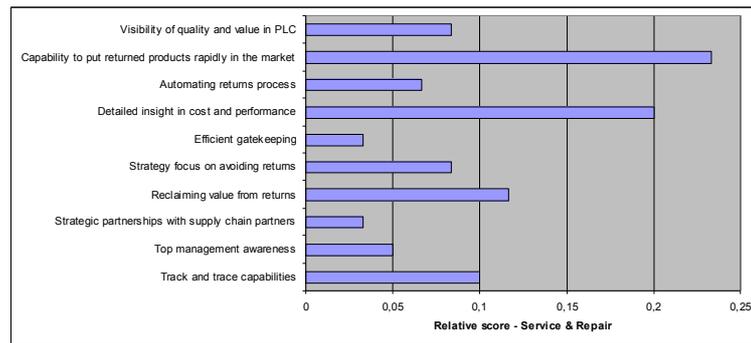**Figure I.9**: Critical success factors for reverse logistics management –LSP

Figure I.10: Critical success factors for reverse logistics management –LSP

I.3.2   Structure

Vast majority of European management for reverse logistics activities has been centralised.
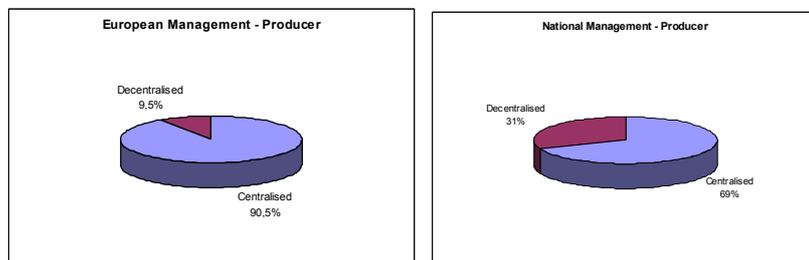
Figure I.11: Centralised management of reverse logistics - producer

80% of retailer respondents had for the national scope central management, and 20% of retailer respondents decentralised. This retailer indicated not to have a reverse logistics strategy and rated the importance of reverse logistics as very low for the company.

10% of LSP respondents indicating to have decentralised management also indicated not to have a reverse logistics strategy and no clear differentiator for the reverse supply chain. Obviously this cannot be statistically proven, but at least it can be perceived as remarkable.
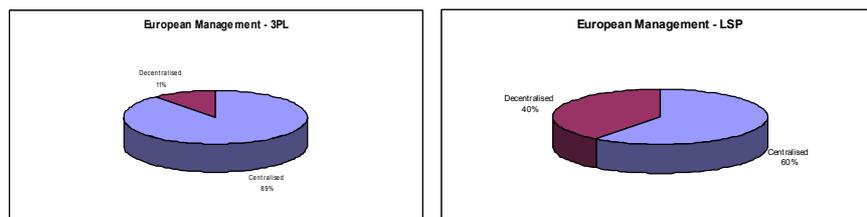
Figure I.12: Centralised management of reverse logistics - LSP
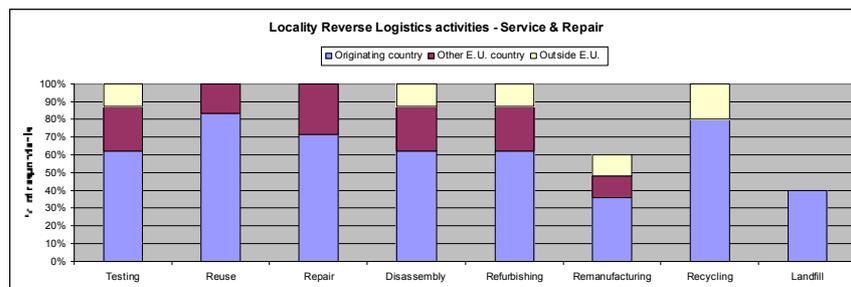
Figure I.13: Locality Reverse Logistics activities – SR

Majority of the products returned are tested and value recovery takes place in an EU country. With only 9.1% of responding beyond EU scope it is interesting to see that several activities have higher rate of outside EU locality.
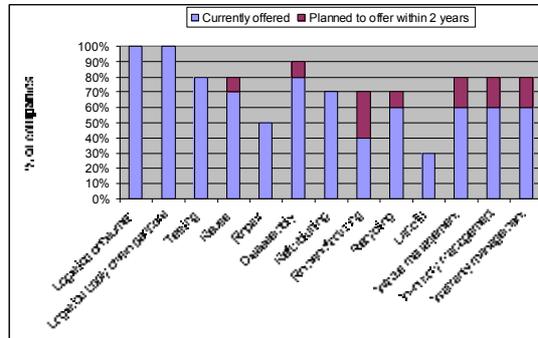

Figure I.14: Service offerings LSP companies

Some of the LSP participants indicated to start to offer also more laborious activities such as remanufacturing in order to provide a full solution for management of reverse logistics. Some logistic service providers position themselves mainly as a 4PL, offering purely logistics activities with drop-off solutions for e.g. empty cartridges or returns that easily can be shipped via the postal network.
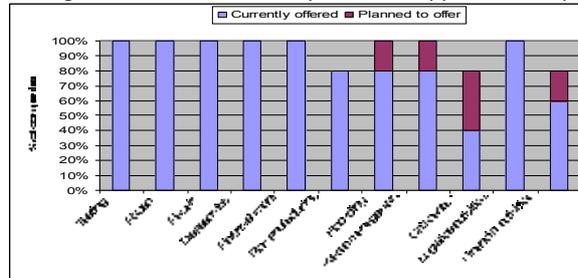
Figure I.15: Service offerings service & repair companies

I.3.3   Process

Management systems we found in place were reverse supply chain visibility systems, tracking & tracing, action trackers and customer satisfaction measurement.
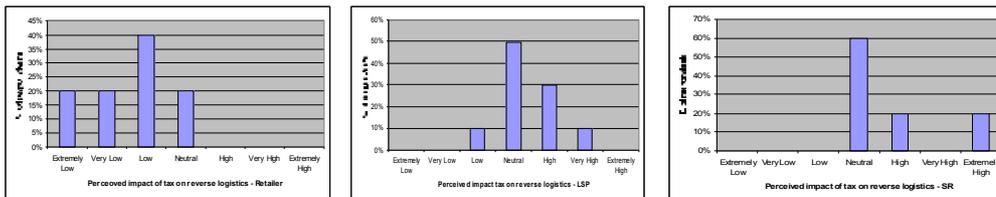

Figure I.16: Perceived impact of tax on reverse logistics – Retailer, LSP and SR
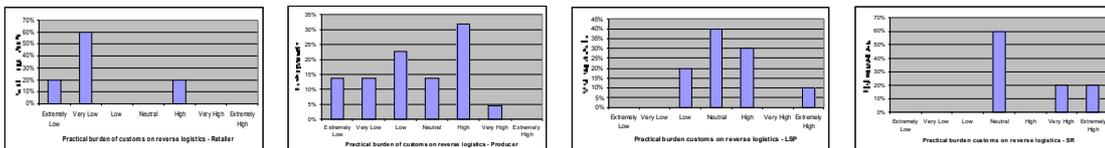

Figure I.17: Practical burden customs on daily reverse logistics operations

Obviously play customs mainly a role in case of cross-border movement of goods (PricewaterhouseCoopers, 2008).
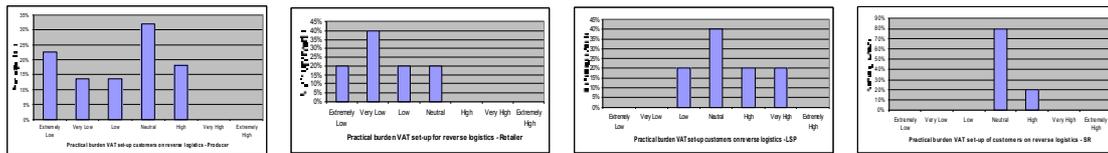
Figure I.18: Practical burden VAT set-up of customers for reverse logistics

Figure I.19: Extent of collaboration between tax and supply chain departments

100% of retail respondents indicated the aspiration to improve management of reverse logistics.
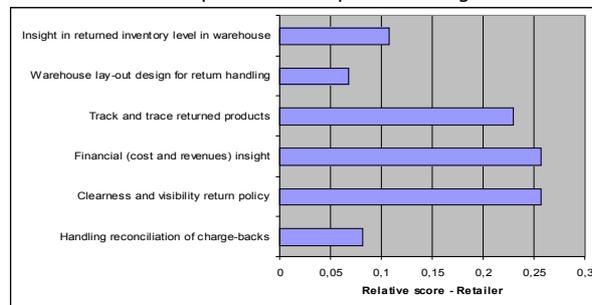

Figure I.20: Improvement potential within company – Retailer

For the own company the return policy to both consumers and suppliers scores highest, with aspiration for financial insight and track and trace of returned products.

Answers for improvements within the supply chain were provided by 36% of the producer respondents.
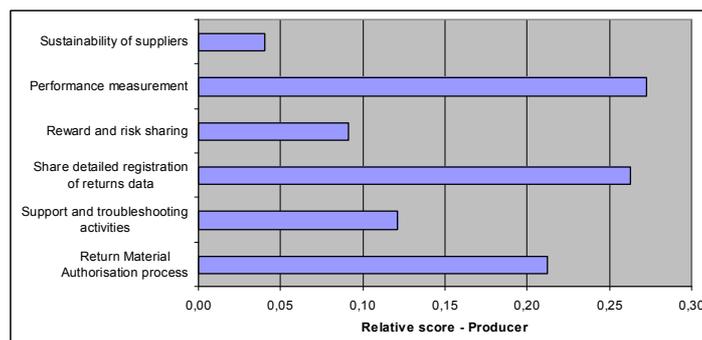

Figure I.21: Improvement potential within supply chain - Producer

The RMA process, sharing returns data and performance measurement score high and we observe that these are in line with improvement potential within the company.
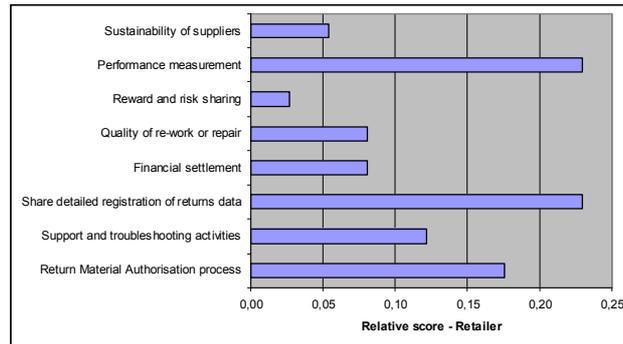
Figure I.22: Improvement potential within supply chain – Retailer

Performance measurement, sharing detailed registration of returns data and the RMA process are given highest score. It seems that the participants would like to increase visibility and collaboration with other actors in the reverse chain.

The three improvement initiatives with highest scores from producers and retailers respondents are again the same. This could be in indication of pain points that in practice are hard to improve, while the aspiration from both side exists.

I.3.4   People

Majority of respondents indicate to have a functional unit that is fully dedicated to the management of reverse logistics.

	Producer	Retailer	LSP	Service
Fully dedicated functional unit	68,18%	60,00%	80,00%	100,00%
Range in FTE	[2 - 200]	[10 - 40]	[1 - 450]	[5 - 150]

Table I.1: Range in full time employment for reverse logistics

The number of FTE ranges for producers mainly between 2 and 15, with two respondents indicating to have 100 and 200 FTE. The high numbers can be explained by in-house involvement in laborious activities such as disassembling, refurbishment and waste management.
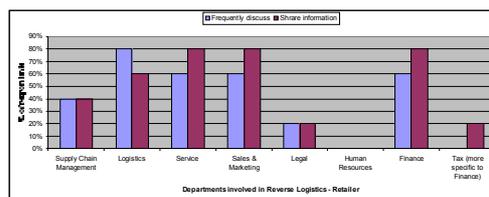

Figure I.23: Departments involved in the Reverse Logistics Process - Retailer

Among the respondents improvements mentioned are: overall understanding but reduction in complexity is needed, no structural process developed yet, investments in IT and operations would be needed and continuous improvement did not have always highest priority within the company.

From various activities that are required by EPR Directives respondents seem to struggle most with the registration of management and control of the waste stream.
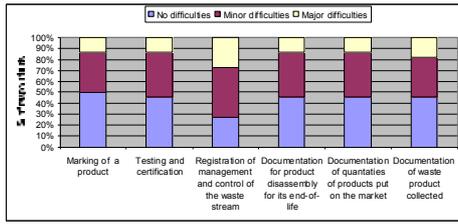
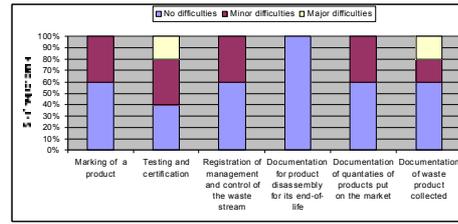**Figure I.24**: Experienced difficulties in managing EPR compliance - Producer

Figure I.25: Experienced difficulties in managing EPR compliance - Retailer
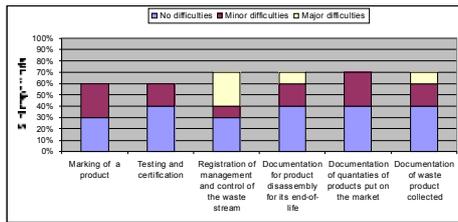

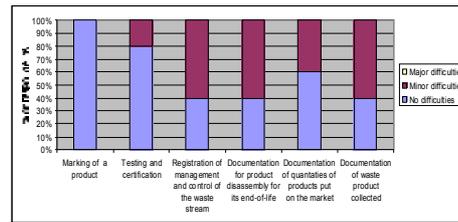**Figure I.26**: Experienced difficulties in managing EPR compliance - LSP

Figure I.27: Experienced difficulties in managing EPR compliance - SR

Remarkable to see that the especially for LSP the registration and documentation is rated to cause difficulties. This underlines the perception of this respondent group of importance of changing environmental legislations as a key trend.

The SR respondents seem to experience minor difficulties to support their customers to be compliant with legal obligations of EPR directives. Depending on the activities performed actors in the reverse chain experience for some extent difficulties with managing EPR compliancy.
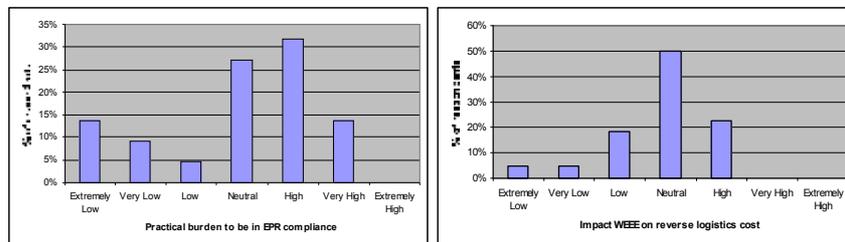
Figure I.28: Impact of EPR in reverse logistics - Producer

Part of the respondent indicated to have undertaken initiatives to increase the volume of product returns. We observe initiatives as closed loop formation, encouraging end-user to take direct contact with producer, offer new users to return used products, refurbishment and remanufacturing initiatives, collection programs and continuous focus on return rate improvement under respondents.

Managing reverse logistics and yield of reverse logistics can be enhanced by various design changes (*Krikke et al.* 2003). Half of the producer respondents reported actual product design changes in the last two years.

Figure I.29: Product design changes to enhance reverse logistics in last two years – Producer

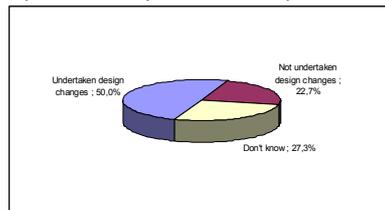Across the respondents several product improvements are reported; change of packaging so it can be re-used, change towards RoHS compliance, design for repair, design for service and self service tools, increased quality to have lower percentage in repair, brainstorming between design and service departments, move to more generic products, implementing of chips for easy scanning, more use of recyclable parts, and use of feedback information from repair process to improve product designs.
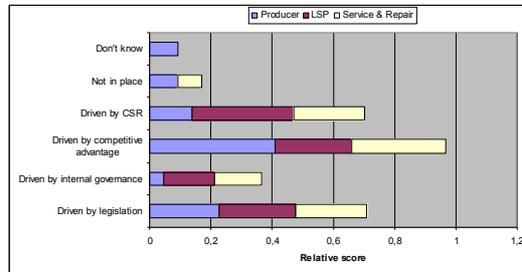

Figure I.30: Availability sustainability programs – Producers, LSP and Service & Repair

Interesting to see is that all respondents of LSP companies and Service & Repair companies were aware of a specific program in place, while for producers some were not aware. Competitive advantage, legislation and CSR are the main drivers of a sustainability program.
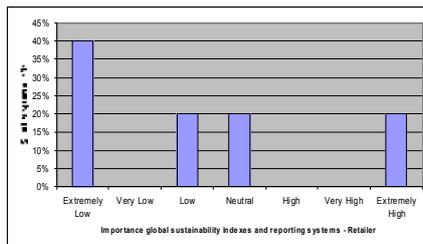
Figure I.31: Importance of global sustainability rating and reporting systems of suppliers - Retailer
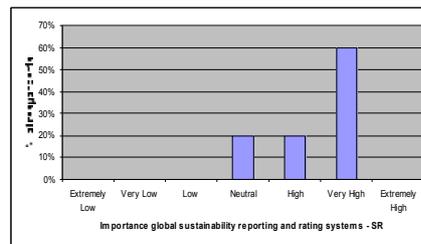
Figure I.32: Importance sustainability reporting and rating systems for customers - SR

When asked the importance of sustainability reporting and rating systems (e.g. Greenpeace guide for greener electronics, Dow Jones sustainability index, Global reporting initiative) to the company the lower rates have higher frequencies. However, service & repair respondents indicate that for their customers such rankings are important.

I.3.5 Technology

The role and importance of information technology and systems is often addresses in previous surveys concerning reverse logistics (e.g. *Rogers and Tibben-lembke*, 1998; *Dhandi and Hill*, 2001).
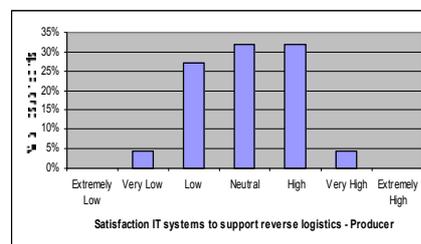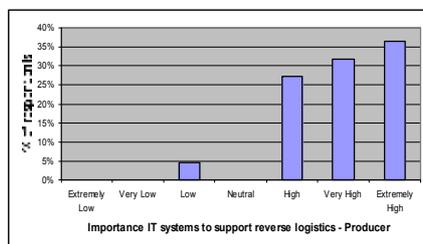
Figure I.33: Importance and satisfaction IT systems to support reverse logistics – Producer
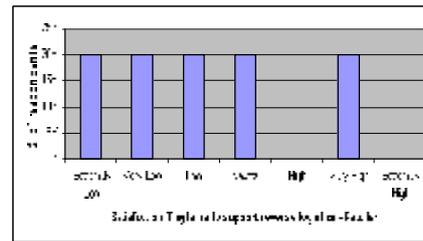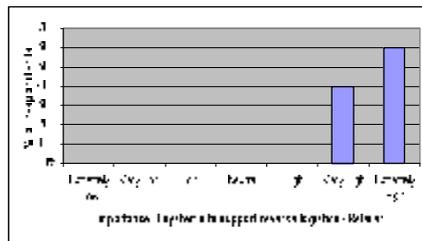
Figure I.34: Importance and satisfaction IT systems to support reverse logistics — Retailer
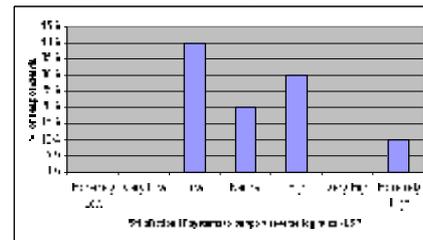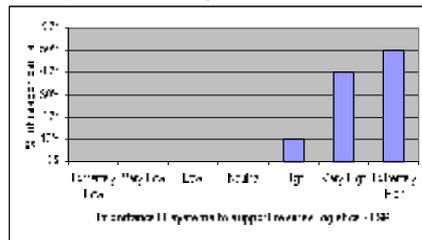
Figure I.35: Importance and satisfaction IT systems to support reverse logistics — LSP
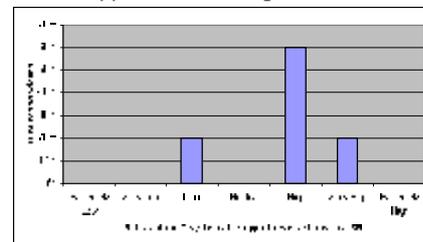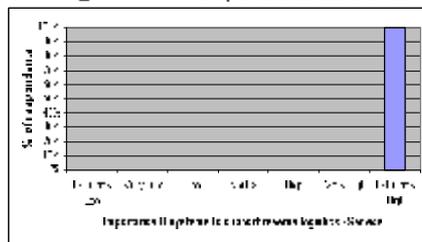
Figure I.36: Importance and satisfaction IT systems to support reverse logistics — SR

Across all respondent groups we observe a gap between importance and satisfaction of IT systems to support reverse logistics. Satisfaction is lowest among retailer and producer respondents, and is highest amongst SR respondents.

J Diagnostic model

Audit scheme managing reverse logistics

| Factor	Aspect	Maturity				Source
		1	2	3	4	
Business strategy	*Clearly stated supply chain strategy*	The supply chain strategy is hazy and not clearly defined	A clearly stated supply chain strategy exists	The clearly stated supply chain strategy is customer focused	Clearly stated supply chain strategy is customer focused and aligned with company's strategy, mission and vision	Verstrepen et al (2007)
	Integrate returns management in supply chain strategy	Returns management is the appendix of the supply chain strategy	Returns management is secondary part of the supply chain strategy	Returns management is semi-integrated in supply chain strategy	Returns management is integral part of the supply chain strategy	Bemon, 2007
Related strategies	*Top management awareness and commitment*	Managing reverse logistics is not part of the corporate agenda	Managing reverse logistics is part of the corporate agenda but there is limited attention from senior management	Managing reverse logistics is part of the corporate agenda and is translated into senior management attention	Managing reverse logistics is perceived as key differentiator and treated as such	
	Efficient end-of-life strategies	End-of-life strategies are not incorporated in product design	Impact of upstream design choices or effectiveness of end-of-life strategies is considered	End-of-life strategies are incorporated in the early phase of product design	The effectiveness of design initiatives to support end-of-life strategies is used for ongoing improvements	
	Design for Environment	Design for environmentally friendlier products is limited considered	Environmental impact of products is identified and quantified	Environmental policy is in place providing designers with a cradle-to-the-grave approach	Environmental aspects are considered into all aspects of designers tasks	
	Environmental management programs	No environmental management program in place	Cross functional management is part of environmental program	Stakeholder integration and cross functional management are part of environmental program	Higher order learning processes by stakeholder integration and incorporating functional management in environmental program	Toffel, 2004
Reverse supply chain management strategy and goals	*Managing reverse logistics as core business process*	Product returns are perceived as irrelevant and managed as purely cost driver	Importance of product returns is recognised but no awareness about how to handle	Strategic focus on product returns a.o. manage both as cost and value driver	The reverse supply chain is a strategic, profit generating core business process	
	Holistic supply chain approach	Isolated approach to manage returns in each part of the reverse chain	Cross-functional approach to manage product returns	An integral approach to supply chain is taken to manage returns	A comprehensive supply chain approach is adopted to manage product returns	Bemon, 2007
	Clear reverse logistics goals for end to end process	Reverse logistics management goals are not in place	Reverse logistics management goals are in place for parts of returns processes	Reverse logistics management goals are in place for all processes	Reverse logistics management goals are in place for all end to end processes	
	Alignment with business objectives	Reverse chain operations are not adapted to business objectives	Reverse chain processes are adapted to business objectives	Reverse chain processes and operations are aligned with business objectives	Reverse processes and operations are aligned with business objectives and market developments	

Category	Sub-item	Level 1	Level 2	Level 3	Level 4	Source
Voice of stakeholders	*Sustainable reverse supply chain*	Environmental and social issues are considered irrelevant for reverse chain strategy	Company strive to consider environmental and social expectations during reverse strategy development	Social expectations from all stakeholders are integrated in the reverse chain strategy	Chain partners are stimulated to integrate social and environmental requirements in business models	
	Environmental consciousness	Environmental norms are seldom used to reconsider processes	Environmental norms (e.g. ISO 14000) integrate environment into company's processes and the way people work	Channel partners are actively encouraged to comply with environmental norms by environmental audits and assessments	Anticipating future legislation is actively aimed for in the company	Bemor, 2007
	Full chain sustainability reporting	Limited reporting on sustainability impact of managing reverse logistics	Internal reporting on sustainability impact of managing reverse logistics	External reporting on individual impact on sustainability of managing reverse logistics	External reporting on full chain impact on sustainability of managing reverse logistics	
	Support for producer responsibility	Producer responsibility is not part of the corporate agenda	Support for collective producer responsibility	Support for individual producer responsibility in some countries and in other collective producer responsibility	Pan-European support for individual producer responsibility	Greenpeace guide for greener electronics
	Individual customer support on take back	No information is provided on possibilities for product take back	Customers are redirected to local representatives for information on product take backs	Accessible information to consumers what to do with their discarded products	Provide Pan European take back information for both customers and consumers	Greenpeace guide for greener electronics
	Reporting on recycling rate	No reporting on recycling collection and rate	Recycling collection and rate reporting based on short term historic sales data	Recycling collection and rate reporting based on long term historic sales data	Recycling collection and rate reporting are and fed by independent parties	Greenpeace guide for greener electronics
Product life cycle management	*Balanced return related resources*	Unclear integration of returns into business model	Returns are integrated into business model through life cycle approach	Return related resources are balanced with return requirements in each stage of the product life cycle	Return related resources are synchronised and standardised in each stage of the product life cycle	Hebben lemke (2002?)
Forecasting	*Synchronisation*	Spare part planning and forecasts do not incorporate product returns	Short term return forecasts are used in spare part planning and forecasts	Return forecasting is integral part of spare part planning	Synchronised planning of spare part demand and return forecasting	Interview Xerox
Supplier Relationship Management	*Consistency across suppliers*	Varying return policies and processes complicate control	Communication policies are aligned across suppliers to ensure consistent expectations and messages for returns management	Return processes are consistent across various suppliers	Return metrics, processes and policies are aligned between suppliers	
	Supplier value	Warranty cost are recovered from suppliers	Supplier performance is used to reward or push performance on returns management	Asset recovery initiatives are encouraged through supplier partnerships	Value of reverse logistics is identified for suppliers, and supplier interests are incorporated in returns management goals	RL magazine aug / sep 2007
	Outsourcing	Returns processes are (partly) outsourced to get in control of returns processes	Service providers are monitored for performance and commitment to operational efficiencies	Activities are synchronised, and process visibility & control is increased with third party vendors	Added value of returns processes is maximised by use of specialised skills and capabilities of vendors	

					Interview FRS
Network planning					
Comprehensive product return networks are developed	Limited use of shared services for reverse logistics management	Single legal entity work together on shared services on returns management	Group companies work together on shared services on returns management	Partnerships with competitors to make use of shared services on returns management	
External integration	Information systems have difficulties to communicate resulting in laborious processes	Information systems are able to communicate with customers and share information automatically	Integral systems provide full control over chain partners and visibility over returns processes	Systems are fully integrated with key chain partners, systems to support returns processes	Netland, 2007
Back and risk sharing	Reverse chain partners share limited risk, costs and rewards for the performance of the reverse process	Reverse chain partners share risk, costs and rewards for the current process	Reverse chain partners share risk, costs and rewards when improving performance of specific parts of the returns process	Reverse chain partners share risk, costs and rewards when improving end to end process performance	
Optimised network	Repair and recovery centres are linked enabling proper disposal and write off of returns	Network of repair and recovery centres that mainly enables down-selling	Integrated network of repair and recovery centres that enables upselling	Optimised network of repair and recovery centres that enables up selling and cross selling across the entire value chain	
Tax (Vat & Customs) planning					
Continuous review	Network and return flows are merely evaluated on alternatives	Network redesign studies and flow alternatives are available	Network redesign studies and flow alternatives in collaboration with reverse chain partners	Continuous review for optimal return flows and network configuration in collaboration with suppliers, service providers and customers	Netland, 2007
Tax compliance and control	Compliance to Tax obligations are taking into account in calculations of financial aspect of returns management	Tax compliance in respect of returned goods forms a aspect of a tax risk policy	Tax rulings are in place with respect to transfer pricing and/or VAT specifically for the financial management of returned goods	Full tax compliance and control issues are taken into account in modelling the management of reverse flows	
Tax agreements	Incomplete inter- and intra-group tax agreements in respect of returned goods flow	Comprehensive tax agreements between group companies	Comprehensive inter and intra-group agreements	Comprehensive intra-group and inter company contracts concluded in respect to all tax aspects of returned goods flow	
Aligned reward structure	Reward structure does not support take back strategy	Differentiated reward structure that is aligned with take back strategy	Standardised reward structure that is aligned with take back strategy	Standardised reward structure that is aligned with take back strategy throughout entire network	
Visibility return drivers	Return policy is based on limited understanding of drivers (e.g. market value of used products) of product returns	Return policy is based on full understanding of drivers of product returns	Customer and category specific return policy is developed based on full understanding of return drivers	Customer and category specific return policies are used to influence product returns	
Quality dependent reward structure for recoverable products	No reward structure for recoverable products is in place	Reward structure is in place with flat prices for a product quantity and quality	Reward structure is in place with flat prices for a product quality and flexible for product quantity	Rewards structure is in place that has different incentives for different quality and quantity of reverse flows	Ioffel, 2004

Avoidance guidelines	*Integral avoidance policy*	Avoidance guidelines are unclear defined	Clear and easily understandable avoidance guidelines exists and communicated	Clear stated avoidance guidelines are aligned with marketing and post-sale support strategy	Avoidance guidelines are integral part of the marketing and post-sale support strategy	
	Aligned avoidance reward structure	Reward structure does not support avoidance policy	Differentiated reward structure that is aligned with avoidance policy	Standardised reward structure that is aligned with avoidance policy	Standardised reward structure that is aligned with avoidance policy throughout entire network	MCA 2007 / Verstrepen et al (2007)
	Monitoring	Limited registration of sources and motivation of products being returned	High level registration of sources and motivation of return s used for internal management	Careful registration of sources and motivation of return is used by sales, marketing and procurement for customer & supplier feedback	Careful registration of sources and motivation of return is used to actively manage front end partners and suppliers	
Acquisition guidelines	*Integrated take-back strategy*	Acquisition guidelines are unclear defined	Clearly stated take back guidelines	Take back guidelines are aligned with post-sale support and asset recovery strategy	Take-back guidelines are an integral part of the post-sale support and asset recovery strategy	Fleischmann, 2004
Disposition guidelines	*Clear disposition guidelines*	No clear disposition guidelines exist	Clearly stated disposition guidelines are defined	Clearly stated disposition guidelines are aligned with reverse supply chain, supply chain and business strategy	Clearly stated disposition guidelines are aligned with reverse supply chain, supply chain and business strategy, and communicated and available throughout the entire reverse chain	
Swap / spare part management	*Inventory control*	Due to many stock outs, high number of orders has to be cancelled and products can not be recovered	Target order fulfilment rates are achieved mainly from internal stock resulting in high buffer stocks, low turnover of stock and high risk of obsolescence	Fulfilment rate are achieved by optimising internal inventory levels of high turnover stock and use of consolidation parties to source low turnover stock	Aimed fulfilment rates are fully met by optimal inventory control	
	Synchronisation	Limited visibility of (consigned) buffer stock levels	Information and physical visibility throughout entire service network	Central control and visibility over (consigned) buffer stocks in entire service network	Demand, inventory and movement of is synchronised across the reverse supply chain	
	Inventory optimisation	Inventories are managed locally	Inventory level and forecasts are managed within the reverse supply chain	Demand and supply variance is reduced for inventory cost savings	Multi-echelon inventory models and tools are applied for optimisation of the reverse supply chain	
Secondary markets & remarketing	*Control over recovery*	Recovery is done by unauthorised organisations with risk of brand damage due to low quality products	Setting of low quality recovered assets is prevented by use of authorised recovery and disposal network	Control over quality of recovered asset	Control over quality of recovered assets and reselling in secondary channels	
	Knowledge secondary markets	Knowledge about secondary markets for recovered assets is considered as irrelevant	Knowledge about secondary markets for recovered products is available	Knowledge about demand markets for recovered asset is used during the returns processes	Advanced knowledge of demand markets for recovered assets is integrated in management decisions for reverse flows	Interview Xerox

		(Level 1)	(Level 2)	(Level 3)	(Level 4)	Reference
Customer Relationship Management	*Re-marketing*	Non-fault found and excess products are written-off at faulty products	Non-fault found and excess products are used to retrieve spare parts	Secondary markets are identified for non-fault found and excess returns	Primary markets are identified for non-fault found and excess products	Harrison et al. (2002)
	Align with customer needs	Returns processes are designed and executed in isolation of voice of the customer	Returns processes are connected to voice of the customer	Returns process are aligned with voice of the customer	All returns process are fully aligned with customer needs and integrated in customer relationship management	
	Efficient consumer response	Difficulties to achieve service goals due to complex returns processes	Customer service policy is supported by returns processes	Customer requirements are anticipated and service is delivered against their expectations (Customer focus)	Efficient consumer response and increasing customer confidence are achieved by excellent returns processes	
	Customer experience	Reverse chain process has stiff interfaces with customers	Returns process is hassle-free designed for customers	Reverse chain process is customer friendly and followed-up throughout the process	In collaboration with customers is the negative impact of returns on their operational and financial performance managed	
Installed Base Management	*Tracking and tracing*	Tracking and tracing process is developed	Transportation, customer and provider turn around times are monitored	Tracking and tracing process enables alert/exception management for planning and forecasting	Tracking and tracing capabilities enable customers and end-users to track and trace reverse flows	
Commercial returns	*Active control sales agreements*	Limited visibility of reverse sales transactions from excess / unsold products	Reverse sales transactions are measured and reported to senior management	Sales departments are actively measured on reverse sales transactions	Joint initiatives from sales and supply chain to reduce excess products	
Repairables	*Predictable service*	Service offerings and warranty conditions vary widely across commercial agreements	Standardised return policies and service offerings	Cross country standardisation and harmonisation of service offerings and return policies	Service demand is highly predictable	
	Efficient repair support	Repair strategies are not incorporated in product design	Impact of upstream design choices or effectiveness of repair strategies is considered	Repair strategies are incorporated in the early phase of product design	Effectiveness design initiatives to support repair strategies is used for ongoing improvements	
End-of-use	*Control over end of use volume*	Little effort is made to control the volume of returns	Incentives for chain partners are in place to increase understanding of drivers that cause return flow variations	Incentives for chain partners are in place to increase control over volume of returns	Active control over volume of returns by incentives for chain partners	
Gate keeping guidelines	*Integral gate keeping policy*	Avoidance guidelines are unclear defined	Clear and easily understandable gate keeping guidelines exist and are communicated	Clear stated gate keeping guidelines are aligned with marketing and post sale support strategy	Gate keeping guidelines are integral part of the marketing and post-sale support strategy	
	Aligned gate keeping reward structure	Reward structure does not support gate keeping policy	Differentiated reward structure that is aligned with gate keeping policy	Standardised reward structure that is aligned with gate keeping policy	Standardised reward structure that is aligned with gate keeping policy throughout entire network	

Returns network flow options	*Integrated preventive measures*	Ad hoc preventive measures are in place for avoiding and preventing product returns	Preventive measures are aligned with avoidance and gate keeping guidelines	Preventive measures are integrated into avoidance and gate keeping guidelines	Preventive measures are standardised in all avoidance and gate keeping guidelines	Toffel, 2004
	Full understanding management capabilities	No clear understanding of current capabilities return's management	Understanding of current capabilities returns management	Understanding of current capabilities returns management and required capabilities to manage returns processes	Full alignment of current capabilities with required capabilities to manage returns processes	
	Completeness forecasting	Forecasting and planning data for returns are based on high-level overview of sales	Detailed forecasting and planning data are available from sales departments and from service departments	Initiatives to increase accuracy and availability of forecasting and planning data of returns	Forecasting and planning data is complete, accurate, and available	
	Financial impact integration	Financial impact of network flows is poorly managed	Financial impact of the entire reverse supply chain is managed	Financial impact and tangible cost impact are applied to decision rules	Financial impact and tangible cost impact are applied to decision rules and integrated in managing network flows	
Receive / Inspect & sort	*Early return differentiation*	Limited use of categorisation of returns during returns processes	Returns are categorised at central test centres	Multi-level categories are used at regional consolidation centres to make decision on disposition of return	Multi-level categories are used to make decentralised quick decisions on disposition of return at entry point of reverse supply chain	Souza (2004)
	Time value modelling	Level of grading and sorting is determined independent from time value of products	Level of grading and sorting is modelled on time value of product categories	Level of grading and sorting is modelled and evaluated on time value of products	Level of grading and sorting is modelled and evaluated on time value of components	Heischmann, 2004
Process recovery	*Aligned asset recovery strategy*	No clear asset recovery strategy exists	Clearly stated recovery strategy exists based on economic and technical viability of recovery options	Clearly stated asset recovery strategy is aligned with reverse chain strategy and business strategy	Fully aligned recovery strategy exists based on economic, technical and environmental viability of recovery options	Heischmann, 2004
	Sharing tacit disassembly know-how	Disassembly know-how is shared with all reverse chain partners, free of cost	Disassembly know-how is not shared with own recovery centres	Disassembly know how is shared within own recovery centres	Disassembly know how is shared between and within own recovery centres	
Direct recovery	*Lean and seamless process*	Returns processes vary across functions and are highly complex	Cross-functional standardisation of returns processes and reduction of complexity	Focus on can returns processes and simplification	Direct recovery processes are heavily standardised, adaptive to market changes and seamless	
Credit rules	*Seamless return material authorisation process*	The RMA process causes delays and conflicts in returns processes	Automated RMA process smoothens financial management of returns processes	RMA process is smooth, quick and accurate	RMA process is seamless and facilitates short turn around times	
	Standardised credit rules	Credit rules are unclear causing much communication in the reverse channel	Credit rules are clearly communicated and easy accessible	Credit rules are clear and universal for all channel partners	Credit rules are standardised for all returns processes	

Category	Element	Level 1	Level 2	Level 3	Level 4	Source
Tax compliance	Smooth document management	Capturing, collection and storing of supporting documents is a painful process and includes back accuracy and availability	Document accessibility, availability, completeness and accuracy is supporting return flows	Automated collection and storage of documents leads accuracy and completeness	Accuracy, availability and completeness of documentation fully supports reverse flows and enables full tax compliance	Tollef, 2004
	Streamlined customs process	Products are difficult to identify when received	Clarify product early in the supply chain process to facilitate export/import handling	Customs processes are simplified and cleared	All customs processes are simple, aligned and streamlined for reverse logistics	
Cross functional management	Self-learning organisation	Recommendations for improvement activities are rising from functional silos	Recommendations for improvement activities are rising from various functions involved in the process	Recommendations for improvement activities are rising between various legal entities relate to the process	The entire reverse supply chain is self-learning and improvement activities are rising in every part of the chain	
	Active use of return data	Return data is collected but is limited used to improve product and process design	Return data is used to improve and manage internal processes	Return data is used to improve and manage returns inter and intra-group processes	Return data are used to improve and manage reverse flow in all end-to-end processes	
	Collaboration Tax and supply chain	Tax and supply chain share detailed information with respect to returned goods	Silos between Tax and Supply chain department are eliminated on returns related issues	Mutual awareness and understanding of supply chain and tax issues in return's management	Company culture fully supports functional integration of tax and supply chain in respect of returns management	
	Ownership	Ownership of the returns processes is unclear	Responsibilities for management of product returns is clear within functional units	Responsibility for management of product returns is clear for all cross-functional units	Responsibility and roles for management of product returns are clear throughout the entire organisation so that conflict is avoided	
	Management culture	Departmental silos hold back efficient returns management	Functional groups involved in return's process are aligned	Cultural differences are addressed when defining policies and guidelines	Global integration of company cultures for a stimulating management culture for reverse logistics	
	High-level oversight and accountability	Management responsibility is scattered across various functions	Dedicated functional units have oversight and accountability for managing reverse logistics	Cross-functional teams organise returns management	Dedicated reverse supply chain function has aggregated insight and accountability for reverse logistics	
	System integration	Information has to be transferred manually due to lack of system interaction	Separate systems communicate to control different parts of the returns process	Systems provide internal control and link unrelated parts of returns processes creating full visibility	Fully integrated systems support cross-functional control, visibility and information sharing	
Performance Management	SMART defined value drivers	Value drivers for returns processes are hazy or not in place	Clearly stated value drivers for parts of returns processes are in place	Clearly stated value drivers for all processes exist	Clearly stated value drivers for all end to end processes exist	
	Performance measurement	Performance measurement that consolidates metrics from sources into single view	Financial and operational measures are integrated	First tier channel partner are part of performance management system	Integrated performance management system for end-to-end processes	

Full cost control	Reverse logistics costs are reported in dispersed accounting systems	Communication between accounting systems creates high level insight in reverse logistics costs	Systems link unrelated parts creating full insight in total reverse logistics costs	Full cost control over clear and hidden reverse logistics costs, including third party cost control	
Clear differentiators	The differentiators for the reverse supply chain are hazy and not clear defined	Clearly stated differentiators for parts of the reverse supply chain exist	Clearly stated differentiators for the all processes in the reverse supply chain exist	Clearly stated differentiators exist for all processes in the reverse supply chain with specification of long-term plans for managing them	
total cost approach	limited visibility of cost of specific parts of returns processes	Insight in cost of all returns processes	Insight in total costs of all internal and external failure costs of product returns	Insight in total 'clear' and 'hidden' cost for reverse logistics and such total cost approach is taken towards programs and solutions.	Lamb et al (2002)
Use of benchmarking	No structure in place for benchmarking	Structure for continuous improvement is in place for internal benchmarking	Structure for continuous improvement is in place for intra-group benchmarking	Structure for continuous improvement for internal and external benchmarking with comparable returns processes of industry standards, peers and competitors	

K   Eigen vectors

In preparation of the round table session we asked an expert group consisting of 19 managers to indicate their perception of the relative importance of one CSF compared to another CSF. In short we describe our approach to quantify the relative importance. Consider n elements to be compared, C_1 to C_n, and denote the relative weight (or importance) with C_i to C_j and form a matrix $A=(a_{ij})$ of order n with the constraints $a_{ij} = 1/a_{ji}$ and $a_{ii} =1$, all i. For comparison involving human assessment, one should consider that the judgements are inconsistent to a greater or lesser extent. The vector ω satisfies the equation $A\omega = \lambda_{max}\omega$ and $\lambda_{max} \geq n$, where ω is the eigen vector (of order n) and λ is an eigen value. The difference, if any, between λ_{max} and n is an indication for the inconsistency of the judgements. Next, a Consistency Index can be calculated from $(\lambda_{max}-n)/(n-1)$. This result can be assessed against judgements made completely at random (Saaty, 1988). A true Consistency Ratio is calculated by dividing the Consistency Index for a set of judgements by the Index for the corresponding random matrix. In practice, Consistency Ratio higher than 0.1 can be accepted, though literature argues that the ratio should be lower than 0.1 to be consistent enough to be reliable.

There are several methods to calculate the eigenvector. Multiplying together the entries in each row of the matrix and then taking the nth root of that product, gives a very good approximation to the correct answer (*Coyle*, 2004). The nth roots are summed and that that sum is used to normalise the eigenvector elements to add to 1.00.

	Respon-sive reverse chain	Lean returns process	Sustain-able business model	Tax compli-ance & control	Efficient asset recovery	Colla-boration	Avoidan-ce & Gate keeping	Trans-parency	8th root of product of value	Eigen vector
Responsive / adaptable chain	1	3	3	5	3	1/5	3	3	1,987	0,1982
Lean returns process	1/3	1	1/3	5	3	1/3	3	1/3	0,929	0,0927
Sustainable business model	1/3	3	1	5	3	3	5	3	2,258	0,2251
Tax compliance & control	1/5	1/5	1/5	1	1/5	1/5	1/5	1/5	0,245	0,0244
Efficient asset recovery	1/3	1/3	1/3	5	1	1/3	3	1/3	0,706	0,0704
Collaboration	5	3	1/3	5	3	1	3	1/3	1,716	0,1711
Avoidance & Gate keeping	1/3	1/3	1/5	5	1/3	1/3	1	1/5	0,472	0,0471
Transparency	1/3	3	1/3	5	3	3	5	1	1,716	0,1711
SUM										1.00

Table K1: Approximation of eigenvectors (case example)

The eigenvectors for answers of the case example (**table K.1**) indicate that a sustainable business model, responsive reverse chain are most valuable, collaboration and transparency are roughly equal important and other factors are behind.

In order to check the consistency of the answers we multiply each row with the eigenvectors, obtaining a new vector. The calculation of the first row is:

$$1*0.1982 + 3*0.0927 + 3*0.2251 + 5*0.0244 + 3*0.0704 + 1/5*0.1711 +$$
$$3* 0.0471 + 3 * 0.1711 = \mathbf{2.1735}$$

and the other rows give 0.8222, 2.1642, 0.2195, 0.6196, 2.0463, 0.4257 and 1.6720. From these vectors we estimate λ_{max} by dividing each vector by the corresponding eigenvector element (e.g. for first element: $2.1735/0.1982 = 10.9684$). The mean of these values is an estimate of λ_{max} , for this case 9.754. The consistency Index is calculated from this estimation from $(\lambda_{max}-n)/(n-1)$. Since n = 8 for this matrix, the CI is 0.2506. The final step is to calculate the Consitency Ratio using the CI for the corresponding value from large samples of purely random judgements. For eight factors under comparison is the CI 1.41 (*Coyle*, 2004), hence the CR is 0.2506/1.41 = 0.1777. The CR is not below the theoretical 0.1, but for the practical purpose of the model perceived as enough reliable.

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List of abbreviations

AG	Avoidance and Gate keeping
AHP	Analytical Hierarchy Process
CE	Consumer Electronics
COL	Collaboration
CSF	Critical Success Factor
CSR	Corporate Social Responsibility
EAR	Efficient Asset Recovery
EFQM	European Foundation for Quality Management
ERP	Enterprise Resource Planning
EU	European Union
FTE	Full Time Employment
LRP	Lean Returns Process
LSP	Logistics Service Provider
IT	Information Technology
N/A	Not Applicable
OEM	Original Equipment Manufacturer
PLM	Product Life Cycle
PwC	PricewaterhouseCoopers
R&D	Research and Development
REACH	Registration, Evaluation, Authorisation and Restriction of Chemical substances
RL	Reverse Logistics
RMA	Return Material Authorisation
ROHS	Restriction Of Hazardous Substances
RRC	Responsive Reverse supply Chain
SBM	Sustainable Business Model
SMART	Specific, Measurable, Achievable, Relevant and Time-bound
SR	Service and Repair company
TCC	Tax Compliance and Control
TR	Transparency
TU	Technical University
VAT	Value Added Tax
WEEE	Waste of Electrical and Electronic Equipment

Glossary

Agile
Flexible, efficient response to unique customer demand

Avoidance & Gate keeping
Strategic focus on preventing products being returned and the screening & testing of products at the entry point of the reverse flow.

Balanced Scorecard
Concept for measuring whether the activities of a company are meeting its objectives in terms of vision and strategy.

Batteries
Directive 2006/66/EC aiming to minimize the negative impact of batteries and accumulators on the environment.

Best-of-breed package
Specific software program or package for each specific application or requirement.

Charge-backs
Consumer requesting for a refund.

Collaboration
Inter and intra company collaboration in managing reverse logistics; between departments (e.g. design, marketing, sales), between supply chain partners (e.g. producer, retailer, service provider) and between competitors.

Corporate social responsibility
Concept whereby companies consider the interests of society by taking responsibility for the impact of their activities on customers, employees, shareholders, communities and the environment in all aspects of their operations.

Customs formalities
Regulations that are in force for cross-border flow of product, such as import declarations and documentation.

Design for Environment
Approach to product design that examines a product's entire lifecycle and proposes changes to how the product is designed to minimize its environmental impact during its lifetime.

Disassembly
Activities that dismantle a product into separate modules, components or materials.

Disposition
Type of recovery or disposal used for a returned product.

ECO Design
Directive 2005/32/EC that sets standards for the integration of environmental aspects into product design.

Efficiency
Obtain economies of scale of reverse product flows by separating of valuable parts from the returned products in a cost-efficient way.

Efficient asset recovery

The efficient disposition of returned goods, surplus, obsolete, scrap, waste and excess material products, in a way that maximizes returns to the owner, while minimizing costs and liabilities associated with the dispositions.

Electronic Data Interchange
A system for business to business electronic communication.

EU country
European Union Country: a member state of the European Union (Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom).

Extended Producer Responsibility
Producer responsibility is the act of making the producer of a product responsible for the product throughout its entire life cycle, including the disposal at the end of life.

FTE
Full Time Employment.

Gate keeping
The screening of product returns at the entry point of the reverse logistics process.

Global sustainability reports
Global indexes tracking the financial and environmental performance of the leading sustainability-driven companies worldwide.

Hybrid (mixed)
A mix of lean and agile supply chains.

KPI Dashboard
Key Performance Indicator Dashboard: real-time (graphical) reporting tool indicating the status of key performance indicators.

Lean
Elimination of bottlenecks towards "pulling" goods through the system based on demand.

Lean returns process
Streamlining the returns process through simplifying processes, increasing flexibility, (spare part) inventory reductions and reducing sources of waste and delay.

Off shoring
The relocation of business processes from one country to another.

Outsourcing
Delegation of non-core operations from internal production to an external entity specialising in the management of that operation.

Packaging
Directive 2004/12/EC that prescribes recycling targets and collection of all packaging waste.

Radio Frequency Identification
Automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders.

REACH
Registration, Evaluation and Authorisation of Chemicals: Directive 2006/121/EC that will oblige all producers to register all those chemical substances produced or imported above a total quantity of 1 tonne per year.

Reclaiming value
If a product is returned, value can be reclaimed by different reverse logistics activities (e.g. reuse, refurbishing, remanufacturing).

Recycling
Use of material of product returns as raw material.

Refurbishing
Upgrading of a product by repairing/upgrading product modules.

Remanufacturing
Component recovery after products are dismantled in the same products or in different products.

Repair
Implies process recovery when a product is repaired at item level.

Responsive reverse chain
The agility of a supply chain in responding to marketplace changes to gain or maintain competitive advantage and put returned goods speedily back into the market.

Responsiveness
Aim at responsiveness and flexibility in order to keep time between a product being returned from the market and put back into the market low.

Return Material Authorisation
Transaction whereby the recipient of a product arranges to return defective goods to the supplier to have the product repaired or replaced or in order to receive a refund or credit for another product from the same retailer or producer.

Return policy
Deliberate plan of action to guide decisions and achieve rational outcome for product returns

Reuse
Implies direct recovery activities when the quality of the product is 'as-good-as-new', examples are re-distribution, re-sale and re-boxing.

Reverse logistics
The process of planning, implementing and controlling flows of finished goods, from a manufacturing, distribution or use point to a point of recovery or point of proper disposal.

Reverse supply chain
That part of the supply chain that is concerned with product returns.

RoHS
Restiction of Hazardous Substances: Directive 2002/95/EC that bans the use of lead, mercury, cadmium, hexavalent chromium, polybrominated biuphenyls and polybrominated diphenyl ethers in electrical and electronic products.

Sustainable business model

Integrating environmental thinking and considering society interest into supply chain management by taking responsibility for the impact of activities on customers, employees, shareholders, communities and the environment in all aspects of operations.

Swapping
A product is replaced by another product with the same or better specifications.

Take back period
The period in which a consumer is allowed to return the product to the supplier and receive refund or credit back.

Tax
Financial charge or other levy imposed on an individual or a legal entity by a government or a functional equivalent of a government. Transfer pricing, customs, Value Added Tax are main categories.

Tax compliance & control
Ensuring the quality, accuracy and completeness of direct (e.g. VAT) and indirect (e.g. WEEE) tax compliance and the efficient control of this compliance.

Testing
Determining the quality of a product.

Third party
An entity besides the two primarily involved in a relationship (either companies or consumers)

Transparency
Insight in performance, yield and cost of managing reverse logistics and the ability to track and trace products during their life cycle.

VAT set-up
Resources to comply to Value Added Tax regulation, by for example an integrated system to declare and report on Value Added Tax.

WEEE
Waste Electrical and Electronic Equipment: Directive 2002/96/EC that concentrates on recycling and puts responsibility to the producer to finance the collection, treatment and recycling and recovery of all WEEE that the product puts into the market.

Quantitative cost analysis
Planning and forecasting based on quantitative data.