Reverse Logistics – a review of case studies

Marisa P. de Brito, Rommert Dekker, Simme D.P. Flapper
Abstract
Products, components, materials and other equipment stream forward and back wards and back in their supply chains. Reverse Logistics deals with the processes associated with the reverse stream from users/owners to re-users. This paper provides a review and content analysis of scientific literature on reverse logistics case studies. Over sixty case studies are included. In addition, we give an overview of particular issues, which we link with propositions, unanswered questions and thus directions for future research.

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|                                        | 5201-5982 | Business Science |
|                                        | HD9975   | Recycling industry |

| Journal of Economic Literature (JEL) | M | Business Administration and Business Economics |
|                                       | M 11 | Production Management |
|                                       | R 4  | Transportation Systems |
|                                       | E 29 | Consumption, ..., Production, ..., Other |

| European Business Schools Library Group (EBSLG) | 85 A | Business General |
|                                               | 260 K | Logistics |
|                                               | 240 B | Information Systems Management |
|                                               | 10 C  | Business and environmental issues |

**Gemeenschappelijke Onderwerpsontsluiting (GOO)**

**Classification GOO**
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85.34  Logistiek management
85.20  Bestuurlijke informatie, informatieverzorging
58.53  Recycling

**Keywords GOO**
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Bedrijfssprocessen, logistiek, management informatiesystemen
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Reverse Logistics – a review of case studies

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Abstract: Products, components, materials and other equipment stream forward and backwards and back in their supply chains. Reverse Logistics deals with the processes associated with the reverse stream from users/owners to re-users. This paper provides a review and content analysis of scientific literature on reverse logistics case studies. Over sixty case studies are included. In addition, we give an overview of particular issues, which we link with propositions, unanswered questions and thus directions for future research.

Key words: Reverse Logistics, Case studies, and Content Analysis.

1. Introduction

Products, components, materials and other equipment stream forward and backwards in their supply chains. Reverse logistics has been the increasingly growing academic field and practice that deals with the processes associated with the reverse stream from users/owners to re-users. During the early nineties, the Council of Logistics Management started publishing studies where reverse logistics was recognized as being relevant both for business and society (Stock, 1992). Other studies followed stressing the opportunities on reuse and recycling (Kopicki et al., 1993) In the late nineties, Kostecki (1998) discussed the marketing aspects of reuse and extended product life. Stock (1998) reported in detail how to set up and to carry out reverse logistics programs. Rogers and Tibben-Lembke (1999) presented a broad collection of reverse logistics business practices, giving special attention to the US experience (see also Lund, 2001). Recent reviews and literature compilation either on models to support reverse logistics or on the business perspective can be found at Fleischmann et al., 1997, Guide et al.,
2000, Guide and van Wassenhove, 2003, and Dekker et al., 2003. Furthermore, during the last years, many articles dedicated to the analysis of the practice of reverse logistics have appeared, including Canon (Meijer, 1998), Philip Morris (Andriesse, 1999), Esté Lauder (Meyer, 1999), Kodak (Toktay et al., 2000) and Nortel Networks (Linton and Jonhson, 2000). One can not provide proper insights into reverse logistics without being familiar with how firms are dealing with it in practice, which are the trade-offs, how decisions are being supported and so on. Case study literature can be extremely helpful in getting this knowledge.

Quite some case studies on reverse logistics have been described in the literature dealing with different industries, recovery options and drivers. This literature is however scattered over journals for very different research communities. Besides this, in countries in the forefront of reverse logistics a substantial number of case studies have been published in the local language and therefore not accessible for the majority of the research community.

In this paper we provide a content analysis of more than sixty articles portraying how firms and other organizations deal with reverse logistics. We cover the whole range of recovery options and driving forces with cases from several continents. We report eye-catching elements and we link it to propositions, unanswered questions and research directions.

The remainder of the paper is organized as follows. First we describe the methodology used for finding and classifying the case studies presented in this paper. Next we provide overall statistics regarding type of industry, product and the geographic area of the cases. After that, we discuss the case studies, and present observations, propositions and research opportunities. We end with some final remarks and research directions.

2. Methodology

By case study we mean an in-depth description of the practice, the circumstances and its characteristics leading to an understanding of the situation within its own context (see Stake, 1995). Note that this definition rules out mere examples short on details.

The search procedure was as follows. We inspected the Science Citation, and the ABI/Inform online libraries, using the combination of key words listed in Appendix A. We also surveyed literature that is especially dedicated to the topic, like the Handbook of reverse logistics and proceedings of renowned conferences, namely the APICS Reman and IEEE on Electronics and the Environment (see electronic libraries). The main search took place in early 2001 but continued till end 2002.

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To give the reader the overall reverse logistics context, we gathered the following documentation for each case study:

- Product-in (entering the chain), foremost recovery activity and product-out (leaving the chain);
- Actors with their function in the chain (sender, collector, processor, customer and initiator);
- Return reason for sender and driving force for initiator of the recovery process;

The previous information is summarized in Tables in Appendix B. A cell is left empty when the correspondent information is not available. The type of information, as described above it was not randomly selected. Former studies have argued that the processes, actors, types of reuse and actors are relevant to characterize reverse logistics (Fleischmann et al., 1997). De Brito and Dekker (2002) provide typologies of the what, whom and how of reverse logistics, which we adapted to fill out the tables in Appendix B. In short,

Return reason typology:

- Manufacturing returns (raw material surplus, quality-control returns and production leftovers);
- Distribution returns (product recalls, B2B commercial returns, stock adjustments and distribution items/functional returns);
- (Pos-)Market returns (B2C commercial/reimbursement returns, warranties, service returns/repairs and spare parts, end-of-use, end-of-life returns.

Driving force typology:

- Economics (direct profit and indirect –competition, green image, legislation’s anticipation, etc.)
- Legislation
- (Extended) Responsibility (public, social, environmental, etc.)

Recovery option typology:

- Direct recovery (re-sale/re-use/re-distribution
- Process recovery (repair, refurbishing, remanufacturing, (parts) retrieval, recycling, incineration and (proper) disposal.

We present the case studies according to the following decision-making focus: Reverse Logistics Network Structure, Relationships, Inventory Management, and Planning and Control (see Ganeshan et all, 1999; Fleischmann et al, 1997). Furthermore, we give an
overview of Information and Technology (IT) for reverse logistics. By IT we denote technological means to process and transmit information (see IT definitions by OECD and NAICS, electronic references). If a case focuses on multiple decisions, we discuss it in more than one section.

3. Statistics

We have found more than sixty cases involving reverse logistics. Using the United Nations classifications for Industry (see http://esa.un.org), 60% of the cases are in the manufacturing category; about 20% are within wholesale and retail trade and about 10% in construction. We have also found cases in the following categories: transport and communication, public administration and defense, and other community services. Grouping with respect to products (see http://esa.un.org), we observe that almost half of the cases deal with metal products, machinery and equipment. Around 30% of the products being processed are transportable goods like wood, paper and plastic products. Around 20% concern food, beverages, tobaccos, textiles and apparel. Less than 10% fell in the category ores and minerals. Not surprisingly, these numbers show that the majority of the cases are on products with high value. The majority of the cases are from Europe. In fact, we report on 1 case from South America, 2 cases from Asia, 14 cases from North America and more than 50 cases from Europe (note that some cases relate to more than one geographic area). The unequal distribution of cases over geographic areas corresponds to the unequal past development of reverse logistics research in the different continents.

4. Case studies on Reverse Logistics Network Structures

Main activities in reverse logistics are the collection of the products to be recovered and the redistribution of the processed goods. We found 24 case studies on this subject (see Appendix, Table B.1). The most often described recovery option was recycling (11 cases), next re-use/redistribution (10 cases of which 7 described in De Koster et al., 2001), two on remanufacturing and one on repairs. The cases on re-use can be split up into the handling of commercial returns at retailers and the ones on distribution items such as bottles, crates and containers.

Observations
Obs. 1: The critical issues for distribution items are the determination of the number of items needed and the efficient redistribution, i.e. making sure that companies receive the right amount of items at the right moments in time with as little transportation as possible (see Kroon and Vrijens, 1995 and Duhaime et al., 2001).

Obs. 2: Critical issues for remanufacturing are the location of the remanufacturing facility, how to ensure a sustainable volume of products to be remanufactured and finally, how to reduce the uncertainty in the supply of cores (products to be remanufactured). (See also Fleischmann et al., 2001; Guide, 2000; Guide et al., 2000 and Guide and van Wassenhove, 2001)

Obs. 3: – Recycling:
- Both private and public networks exist, although several private ones were not successful (see e.g. the initiatives on carpet recycling, Louwers et al., 1999; Realff et al., 2000 and the ending in AFX-NL 30 Aug 2001). The public networks were created out of government interference in order to reduce waste.
- Environmental objectives are prime reason and costs are second in public networks and the other way around in private networks. The first is often financed through a upfront fee on new products for recycling.
- Recycling often requires expensive facilities and therefore is likely to be centralized. In order to be economically viable, sufficient volumes should be realized (Spengler, 1997; van Burik, 1998; van Notten, 2000). Accordingly, much transportation is needed (see Anderson et al., 1999)

Propositions and Research opportunities

Prop.: Product acquisition and collection network efficiency are major bottlenecks in the economics for private recycling networks, which are therefore more likely to fail than public networks.

Res. Opp. 1: Time, quantity and quality uncertainty in acquisition are known critical factors for reverse logistics (see Fleischmann et al., 1997). We believe that these uncertainties are the explaining factor for public recycling networks subsisting while private ones do not. We suggest an extensive comparative analysis of cases or a survey analysis to test the proposition.

Res. Opp. 2 Economies of scale are needed for successful recycling, inevitably increasing transportation. The trade-off between the environmental benefits of recycling versus the extra
transportation has not been established yet. To do so it is preferable to bring together both economic and ecological (eco-eco) aspects. Some eco-eco models are available (see Bloemhof-Ruwaard et al., 2003).

5. Case Studies on Reverse Logistics Relationships
Typical for reverse logistics is that several parties are involved like the sender of the product, the collector, the processor and the initiator. To stimulate/enforce a certain behavior of their partners, parties in the reverse chain may make use of varied incentive tools. In this subsection we will discuss our findings with respect to the tools that are used in practice to stimulate/enforce a desired behavior of partners in the context of product recovery. A summary of all cases found is provided in Table B.2.

Observations

Obs. 1: There are quite a lot of different tools in the literature: 1) Refund options (Tsay, 2001); 2) Buy back options (www.ford.nl); 3) Fees (Faria deAlmeida and Robertson, 1995; Bartel, 1995); 4) Take back (Wijshof, 1997); 5) Trade-in (Driesch et al, 1998); 6) Lease or rent contracts (Sterman, 2000); 7) Bring-pick up systems (Bartel,1995; McGavis, 1994; Yender, 1998; Guide and van Wassenhove, 2000); 8) Timely and clear information (Faria deAlmeida and Robertson, 1995); 9) Power (Farrow and Johnson, 2000); 10) Environmental responsibility (McGavis,1994); 11) Social responsibility (McGavis, 1994). and 12) Acquisition price (Guide and van Wassenhove, 2001).

Obs. 2: Almost all the case studies that we have found describe tools for stimulating acquisition of goods for recovery. Only one example (Farrow and Johnson, 2000) deals with the enforcement of take back.

Obs. 3: Some tools make up part of sales contracts, like the buy back option offered by Ford (www.ford.nl). Other tools like trade-ins require the customer to buy another product in exchange, like is the case of the engine trade-in option offered by Daimler Chrysler (Driesch et al, 1998). There are also tools that are not directly coupled to a selling activity like a gift to a non-profit organization as used by Hewlett Packard for getting back toner cartridges (McGavis, 1994), or as recently used by TESCO to get back mobile phones (see www.tesco.com).

Obs. 4: We did not find cases on deposit fees (fees paid upfront fully reimbursed upon return, e.g. on beer crates).
Obs. 5: Most case studies describe the tools that are used, without explaining why that tool has been chosen and how the values of parameters related to that tool have been determined.

**Propositions and Research opportunities**

**Prop.:** Only deposit fees and buy back options for used products are specific for product recovery. The other mentioned tools are also used to attract customers in general.

**Res. Opp.:** When to use which (combination of) tool(s) to achieve desired collection goals (quantity, time, quality)?

There is literature available dealing with one or more aspects of those mentioned above. For instance, 1) literature on sales contracts with return options for unused products (see Tsay, 2001; Anupindi and Bassok, 1999; Corbett and Tang, 1999; Lariviere, 1999; Tsay et al., 1999); 2) research on the optimal acquisition price (fee) to realize a certain flow of products (e.g. Klausner and Hendrickson, 2000; Guide et al, 2001; Guide and van Wassenhove, 2001); 3) optimal picking frequencies to achieve a certain collected quantity (Tucker et al., 2000). This literature can be used as a starting point for deriving models to answer the above general question.

6. **Case studies on Inventory Management**

Fourteen cases on inventory management within reverse logistics were found (see Appendix, Table B.3). We found cases related to commercial returns, distribution items, service returns (repairs), end-of-use, and end-of-life returns (see De Brito and Dekker, 2002 for a discussion of the return reasons typology).

**Observations**

**Obs. 1:** Commercial returns (reimbursement)

From the cases it appears that the inventory issues are twofold, first what should happen with the returned item and secondly how is the reordering influenced by the returns. In case of commercial returns, the items are usually of almost as good as new quality; hence in Europe they can often be included into inventory after a simple inspection (see De Brito and Dekker, 2003). In the US laws prohibit selling sold products as new and other recovery actions need to be taken. If the products that are returned can be resold it is important to know the return rate and the return time lag. These aspects are especially important in case of seasonal or non-stationary demands where the determination of the amount needed in a certain period is the crucial issue.
Obs. 2: Service returns (repairs)

The cases have the following characteristics: the repair chain is considered as a closed loop often with multiple echelons. It is important to determine how many parts are needed at each stocking location and how much repair capacity there should be in order to guarantee availability. Time is critical. This area has been studied for long without making the connections with reverse logistics. For an overview we refer to Guide and Srivastava, 1997b.

Obs. 3: Distribution items

Distribution items like containers, bottles, pallets, crates are used in the distribution of other items. From the cases it appears that the main issue is the match between returns and demands in time and place. How much are needed at which location and how much should be relocated within a certain time interval. Most items issued come back, but it is not always known when.

Obs. 4 End-of-use/life returns

End-of-use / life items can be used for spare parts recovery as described in two cases (Fleischmann (2000) and Klausner and Hendrickson (2000). Essential is to know the exact composition and state of returns, as well as their moment of return.

Propositions and Research Opportunities

Prop. 1: To improve the knowledge on what can be recovered from returns is the critical factor for an efficient and effective recovery at part or product level.

Res. Opp.: To determine quality, ease of disassembly and demand from parts / products as function of their state in the product life cycle. To do so, the existent forecasting techniques have to be enriched with broader explanatory variables. For instance, it is increasingly common that retailers and others collect considerable amounts of data on their customers. Thus, a categorization of customers is conceivable and to include that variable in forecasting models should be the next step. We refer to Toktay (2003) for a discussion of other factors influencing returns, which are potential explanatory variables in wise forecasting models.

7. Case studies on Planning & control of recovery activities

This subsection deals with the planning and control of the recovery activities, i.e. the actual execution of recovery activities. The cases are succinctly presented in Table B.4.

Observations
Observation 1: The case studies on planning and control of product recovery activities that we found in literature can be subdivided into case studies dealing with: 1) the separate collection of (parts of) products for recovery (Andriesse, 1999; Del Castillo and Cochran, 1996; Duhaime et al., 2001; Klausner and Hendrickson, 2000; Bartels, 1998; Van Donk, 1999; Van Notten, 2000; Schinkel, 2000; ‘t Slot and Ploos van Amstel, 1999; Ubbens, 2000 and Wijshof, 1997; 2) the separate processing of (parts of) products for reuse or disposal (Bentley et al., 1986; Robison, 1992; Guide and Spencer, 1997; Guide and Srivastava, 1997a; Guide et al., 1997; Guide and Srivastava, 1998; Thomas Jr, 1997; Spengler et al., 1997); 3) the combined planning and control of collection of products for recovery and distribution of new products: (Simons, 1998; Bakkers and Ploos van Amstel Jr, 2000); and 4) the combined planning and control of processing products for recovery and production of new products (Gupta and Chakraborty, 1984; Teunter et al., 2000).

Observation 2: In many of the case studies that we found, one or more planning and control issues are very globally described. The descriptions of the planning and control concept or the (quantitative) motivation behind it are hardly ever given.

Observation 3: The case studies offer practically no insight into the problems companies have with the planning and control of their product recovery activities, nor in the results obtained with their planning and control concept.

Observation 4: All cases concern the recovery of autonomously supplied products.

**Propositions and Research Opportunities**

Proposition 1: The planning and control concepts for product recovery do not differ from the planning and control concepts used in other areas.

Proposition 2: The planning and control of product recovery is more complex than the planning and control of forward production and distribution.

Research Opportunity 1: To test the above hypotheses, first one has to identify, analyse and evaluate the performance of the planning and control concepts that are being used in practice. This can be achieved through comparative case study research. We suggest multiple case studies per type of planning and control systems (Observation 1), among which cases dealing with commercial returns (Observation 4). The research can be carried out in three phases: 1) to identify the planning and control concept that the company uses; 2) to assess how the values of parameters are calculated; 3) to develop performance measures and to assess performance. Another possible approach is survey analysis. Specific studies are already available. Nasr et al. (1998) and
Guide (2000) and investigated the industry practice concerning the production planning and control for remanufacturing in the United States.

**Res. Opp.2:** To rate the practicability of theoretical planning and control concepts.

Quite a number of planning and control concepts for product recovery have been presented in academic literature. However, the supply of recoverables is often assumed to be autonomous, except for some literature on repair (for an overview see e.g. Guide and Srivastava, 1997b) and remanufacturing (see Guide, 2000; Guide et al., 2001; Guide and van Wassenhove, 2001; Minner and Kiesmuller, 2002). No direct relation between sold/leased and recovered products is assumed. Besides this, uncertainty has been incorporated only as far as the arrival of products for recovery and the duration of repair related activities are concerned. Uncertainty with respect to the result of the processing activities has hardly been taken into account (for an exception, see Souza et al, 2002)

### 8. Case studies on IT for Reverse Logistics

We have found various cases concentrating on applications of IT for reverse logistics activities (see Table B.5). IT is used to support reverse logistics during different stages of the life cycle of a product, namely product development, (re-)distribution and market (see Kokkinaki et al., 2003 and Hendrickson et al, 2003). Table I presents the IT tools, requirements and benefits for reverse logistics identified in the case studies that we found.

<table>
<thead>
<tr>
<th>IT Tool</th>
<th>Information’s requirements</th>
<th>Type of support</th>
<th>Life cycle phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDL for electric motors reuse (Klausner et al., 1998), (Klausner and Hendrickson, 2000)</td>
<td>(Info. on potential cost savings)</td>
<td>Reuse decisions through information on usage patterns</td>
<td>Product development; Market</td>
</tr>
<tr>
<td>DSS for end-of-use; (Nagel and Meyer, 1999)</td>
<td>Info. on operations' costs &amp; recycling revenues</td>
<td>Cost optimization, facilities location, vehicle routing, etc.</td>
<td>(Re-)distribution</td>
</tr>
<tr>
<td>Computer's configuration reader (Nagel and Meyer, 1999)</td>
<td>Info. on operations' costs &amp; recycling revenues</td>
<td>Setting buy-back price;</td>
<td>Market</td>
</tr>
<tr>
<td>Software specialized on return handling (Meyer, 1999)</td>
<td>Product's expiration data, damage check</td>
<td>Recovery-related decisions</td>
<td>(Re-)distribution</td>
</tr>
<tr>
<td>DSS for remanufacturing (Linton and Jonhson, 2000)</td>
<td>In-depth information on processes</td>
<td>Remanufacturing-related decisions</td>
<td>(Re-)distribution</td>
</tr>
<tr>
<td>DfX, remote maintenance, etc. (Maslennikova &amp; Foley, 2000)</td>
<td>Extensive data-base on products</td>
<td>Recovery options, environment's sustainability, and so forth.</td>
<td>All phases</td>
</tr>
<tr>
<td>DfX (X=Recyclability) (Farrow and Jonhson, 2000)</td>
<td>Further separation of resins; Technological innovation;</td>
<td>Developing a 100% recycled ( &amp; recyclable) Kayak.</td>
<td>(Re-)distribution</td>
</tr>
</tbody>
</table>

Table I. IT tools, requirements and benefits for reverse logistics, per case study.

**Observations**

Page 10
Obs. 1: The case studies illustrate IT applications in all the phases of the life cycle of a product and show improvements for reverse logistics (see Table I). E.g., Xerox (Maslenikova and Foley, 2000) has an integrated solution for reverse logistics from product development to recovery or proper disposal.

Obs. 2: All the case studies provide in one way or another an evaluation on the benefits of IT. However, the investments on such technologies or on the gathering of information are not reported, except for the Estée Lauder case (Meyer, 1999) and partially for Walden Paddlers (Farrow and Jonhson, 2000). Besides this, none of the studies relate to costs associated with the management of information and so on.

Obs. 3: The IT tools to support reverse logistics are very demanding regarding data on the processes, costs and earnings (see Table I).

**Propositions and Research opportunities**

Prop.: Data rather than technology is the limiting factor for the use of IT for Reverse Logistics.

Though the technology is available, IT tools are very demanding regarding data on reverse logistic processes and associated costs and earnings. This data is however often not available. Nagel and Meyer (1999) declare that the lack of information is a bottleneck, which complicates the management of recycling systems. Furthermore, on the Nortel Networks case the DSS could not be designed as desired due to a shortage of data on customer’s returns (see Nagel and Meyer, 1999).

Res. Opp. 1: To test the validity of the previous proposition. To begin with, one has to determine what are the costs and benefits related to reverse logistics processes. The cases indicate that there is no broad knowledge on the costs associated with reverse logistics processes, neither on the worth (see e.g. Nagel and Meyer, 1999). A plausible way of starting is to pursue case studies with the purpose of giving an empirical range of values for cost and profit parameters.

Res. Opp. 2: To identify high impact IT tools for reverse logistics through the whole product life cycle.

As remarked before, the case studies stress the benefits while the investments are neglected. There are some studies investigating the benefit of data logger technology (Klausner et al., 1998; Simon et al., 2001). The same can be done for all the other supportive IT tools. We observe that IT tools employed in a product life phase are individually beneficial. In face of limited investment capacity, it would be helpful to know in which phase the investment
would have most earnings. In addition, if alternative technologies are available, one can investigate which one is the best. To do so, one has to take into account: costs and benefits of collecting and managing data and costs of investing and managing the technology. The following literature is an excellent starting point, as the potential advantages or bottlenecks of some type of information are partially analyzed: Kelle and Silver (1989), Inderfurth et al. (1999), De Brito and Van der Laan (2002), Ferrer (2003), Kiesmuller (2003), and Toktay (2003).

9. Summary and conclusions
We have provided a content analysis of more than 60 cases reported in the literature dealing with reverse logistics aspects. We also have given an overview of particular issues per section, which we have linked to propositions and research opportunities.

In this way, 1) we have given a fair idea of the diversity of real life reverse logistics situations; 2) we have provided a reference guide to researchers searching for case support; 3) besides proposing specific directions for future research, we have handed over a check list tool for researchers willing to conduct (comparative) case studies (e.g. by looking after issues not well investigated yet).

The majority of the case studies deal with one aspect of a real reverse logistics situation but they do not give the overall business environment, what make insights sort of one-dimensional. Thus, there is a need for conducting more integral case study research, by mapping the business context together with more broad information on critical factors, trade-offs and implications.

By comparing North American with European cases, one notices that the prime driver in most North American cases is economics while in Europe legislation is also an important driver. For researchers acquainted with practice, this is a well-known ‘truth.’ However, there is room to investigate to which degree this difference in drivers makes the differences, or not, in network structures, relationships, inventory management and planning and control. Or instead, to directly investigate whether to some businesses similarities are a function of the industry. This could not be established with this content analysis, as the collection of the case studies have been disparately conducted. We suggest sampling groups of cases with different drivers and industry categories and to proceed to an intra- and inter- case study comparative analysis.
Finally we have observed a lack of cases on reimbursement returns. However, with the growth of the catalogue industry (also in the Internet), this is an area with a challenging reverse logistics problematic, which calls for field research.

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Appendix A – Keywords

The search was executed with each of the words from Table A.1 and (a combination of) the words: logistics, planning, control, transport, inventory, capacity, production, information.

<table>
<thead>
<tr>
<th>Asset recovery</th>
<th>Post-consumer</th>
<th>Repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>By-products/byproducts</td>
<td>Producer responsibility</td>
<td>Repairable</td>
</tr>
<tr>
<td>Containers</td>
<td>Product ownership</td>
<td>Resale/re-sell</td>
</tr>
<tr>
<td>Co-products/co-products</td>
<td>Product recovery</td>
<td>Resell/re-sell</td>
</tr>
<tr>
<td>Core</td>
<td>Product stewardship</td>
<td>Return (includes commercial returns)</td>
</tr>
<tr>
<td>Defects</td>
<td>Reassembly</td>
<td>Reuse/re-use</td>
</tr>
<tr>
<td>Defective</td>
<td>Rebuild</td>
<td>Reutilisation</td>
</tr>
<tr>
<td>Disassembly</td>
<td>Reclaim</td>
<td>Reusable</td>
</tr>
<tr>
<td>Dismantling</td>
<td>Reclamation</td>
<td>Reverse logistics</td>
</tr>
<tr>
<td>Disposal</td>
<td>Reconditioning</td>
<td>Rework</td>
</tr>
<tr>
<td>Downgrading</td>
<td>Re-consumption</td>
<td>Salvage</td>
</tr>
<tr>
<td>Energy recovery</td>
<td>Recovery (product, resource, asset)</td>
<td>Secondary (market, materials)</td>
</tr>
<tr>
<td>Environment</td>
<td>Recycling</td>
<td>Separation</td>
</tr>
<tr>
<td>Garbage</td>
<td>Refill</td>
<td>Source reduction</td>
</tr>
<tr>
<td>Gate keeping</td>
<td>Refillable</td>
<td>Take back</td>
</tr>
<tr>
<td>Green logistics</td>
<td>Refurbishing</td>
<td>Upgrading</td>
</tr>
<tr>
<td>Material recovery</td>
<td>Remanufacturing</td>
<td>Value recovery</td>
</tr>
<tr>
<td>Obsolete (stock)</td>
<td>Repack</td>
<td>Warranty</td>
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<tr>
<td>Outlet</td>
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<td>Waste</td>
</tr>
<tr>
<td>Overstock</td>
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<td></td>
</tr>
</tbody>
</table>

Table A.1 Search words.

References

Paper libraries


[79] Stake R.E. (1995), The art of case study, SAGE publications, California, USA.


**Electronic libraries**

[100] ABI/Inform, ABI/Inform Global
http://www.proquest.umi.com


[104] OECD, Organization for Economic Co-operation and Development,
http://www.oecd.org/

[105] RevLog, the European Working group on Reverse Logistics
http://www.fbk.eur.nl/OZ/REVLOG/

[106] ScienceCitation, Science Citation Index Expanded, Elsevier Science B.V.
http://www.sciencedirect.com/
Appendix B – The case studies: supply chain and recovery overview

Network structure

<table>
<thead>
<tr>
<th>Reference</th>
<th>Product (in)</th>
<th>Process</th>
<th>Product (out)</th>
<th>Sender</th>
<th>Collector</th>
<th>Processor</th>
<th>Customer</th>
<th>Initiator</th>
<th>Return reason and/or Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barros et al.</td>
<td>construction waste</td>
<td>recycling</td>
<td>Sand</td>
<td>waste processors</td>
<td>consortium</td>
<td>consortium</td>
<td>construction industry</td>
<td>consortium</td>
<td>end-of-life (waste disposal) legislative</td>
</tr>
<tr>
<td>Bartels (1998)</td>
<td>batteries</td>
<td>recycling</td>
<td>Materials</td>
<td>households, Companies</td>
<td>municipalities, Retailer chains, Schools</td>
<td>specialized companies</td>
<td>Dutch master organization of importers of batteries</td>
<td>end-of-use (environmental responsibility, small presents)</td>
<td>legislation</td>
</tr>
<tr>
<td>Chang et al.</td>
<td>household waste</td>
<td>recycling</td>
<td>households</td>
<td>public authority: environmental protection bureau</td>
<td>public authority: environmental protection bureau</td>
<td>Kaohsiung’s city government</td>
<td>Kaohsiung’s city government</td>
<td>end-of-life (waste disposal) (public) responsibility</td>
<td></td>
</tr>
<tr>
<td>DeCastillo &amp; Cochran (1996)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>See Table on Inventory Management (B.3)</td>
</tr>
<tr>
<td>De Koster et al. (2000)</td>
<td>large white goods</td>
<td>recycling</td>
<td>Materials</td>
<td>households</td>
<td>municipalities, retailers, 3rd party logistics service providers</td>
<td>recycling companies (CoolRec, HKS)</td>
<td>materials processing companies</td>
<td>Dutch organizations of electronics supply chain</td>
<td>end-of-life (no disposal costs) legislative</td>
</tr>
<tr>
<td>De Koster et al.</td>
<td>products, packaging</td>
<td>re-distribution</td>
<td>same product</td>
<td>Supermarket chain / Distribution Centers</td>
<td>Supermarket A</td>
<td>supermarkets, materials collectors, processors, suppliers</td>
<td>Supermarket A</td>
<td>functional, commercial &amp; end-of-life (less disposal costs)</td>
<td>economics</td>
</tr>
<tr>
<td></td>
<td>materials, distribution items</td>
<td>(sorting, re- stocking)</td>
<td>packaging and distribution items, and waste</td>
<td>individual supermarkets</td>
<td>chain / Distribution Centers</td>
<td>chain store A</td>
<td>same &amp; other market (special outlets)</td>
<td>chain store A reimbursement economics</td>
<td></td>
</tr>
<tr>
<td>De Koster et al. (2001)</td>
<td>shoes, sports</td>
<td>re-distribution</td>
<td>same product</td>
<td>customers / chain stores</td>
<td>chain stores / Distribution Centers</td>
<td>chain store A</td>
<td>same &amp; other market (special outlets)</td>
<td>chain store A</td>
<td>reimbursement economics</td>
</tr>
<tr>
<td></td>
<td>attributes, waste, advertisement materials</td>
<td>(sorting, re- stocking)</td>
<td>packaging and distribution items, and waste</td>
<td>customers / chain stores</td>
<td>chain stores / Distribution Centers</td>
<td>chain store B</td>
<td>same &amp; other market (special outlets)</td>
<td>chain store B</td>
<td>reimbursement economics</td>
</tr>
<tr>
<td>De Koster et al. (2001)</td>
<td>shoes, sports</td>
<td>re-distribution</td>
<td>same product</td>
<td>Customers / chain stores</td>
<td>chain stores / DC</td>
<td>chain store C</td>
<td>same &amp; other market (special outlets)</td>
<td>chain store C</td>
<td>reimbursement economics</td>
</tr>
<tr>
<td></td>
<td>hangers and racks</td>
<td>(sorting, re- stocking)</td>
<td>waste, reusable containers, coat hangers</td>
<td>customers / chain stores</td>
<td>chain stores / DCs</td>
<td>chain store C</td>
<td>same &amp; other market (special outlets)</td>
<td>chain store C</td>
<td>reimbursement economics</td>
</tr>
<tr>
<td>De Koster et al. (2001)</td>
<td>products / advertisement materials / containers</td>
<td>re-distribution</td>
<td>same product</td>
<td>customers / chain stores</td>
<td>chain stores / DCs</td>
<td>chain store C</td>
<td>same &amp; other market (special outlets)</td>
<td>chain store C</td>
<td>reimbursement economics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(sorting, re- stocking)</td>
<td>waste, reusable containers, coat hangers</td>
<td>customers / chain stores</td>
<td>chain stores / DCs</td>
<td>chain store C</td>
<td>same &amp; other market (special outlets)</td>
<td>chain store C</td>
<td>reimbursement economics</td>
</tr>
<tr>
<td>De Koster et al. (2001)</td>
<td>consumer goods</td>
<td>re-distribution</td>
<td>same product</td>
<td>customers</td>
<td>mail order company A</td>
<td>mail order company A</td>
<td>same market</td>
<td>mail order company A</td>
<td>reimbursement economics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(sorting, re- stocking)</td>
<td></td>
<td>distribution centers</td>
<td>mail order company B</td>
<td>mail order company B</td>
<td>same market</td>
<td>mail order company B</td>
<td>reimbursement economics</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Reference</th>
<th>Product</th>
<th>Distribution (sorting, re-stocking)</th>
<th>Same Product</th>
<th>Customers</th>
<th>Distribution Center</th>
<th>Mail Order Company C</th>
<th>Same Market</th>
<th>Mail Order Company C</th>
<th>Reimbursement Economics, Legislation (Business Requirement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>De Koster et al. (2001)</td>
<td>cloths, small appliances</td>
<td>re-distribution</td>
<td>same product</td>
<td>customers</td>
<td>distribution center</td>
<td>mail order company C</td>
<td>same market</td>
<td>mail order company C</td>
<td>reimbursement economics, legislation (business requirement)</td>
</tr>
<tr>
<td>Dijkhuizen (1997)</td>
<td>defective parts</td>
<td>remanufacturing</td>
<td>remanufactured parts</td>
<td>Customer</td>
<td>regional or national center</td>
<td>regional or national center</td>
<td>same customer</td>
<td>IBM</td>
<td>service returns economics (market protection, feedback on quality) Legislation</td>
</tr>
<tr>
<td>Duhaim et al. (2001)</td>
<td>Distribution items</td>
<td>re-distribution (cleaning)</td>
<td>same product</td>
<td>Canada Post</td>
<td>Canada Post</td>
<td>Canada Post</td>
<td>Canada Post</td>
<td>Canada Post</td>
<td>functional returns economics</td>
</tr>
<tr>
<td>Kleinland et al. (2000)</td>
<td>wastepaper</td>
<td>recycling vs. incineration</td>
<td>Paper material or energy</td>
<td>households, businesses</td>
<td>mainly non-profit organisations</td>
<td>wastepaper processor vs. collector</td>
<td>pulp industry</td>
<td>end-of-life (waste disposal) economics</td>
<td></td>
</tr>
<tr>
<td>Kroon and Vrijens (1995)</td>
<td>Distribution items</td>
<td>re-distribution (cleaning)</td>
<td>same product</td>
<td>business customers</td>
<td>Nedloyd</td>
<td>Nedloyd</td>
<td>business customers</td>
<td>functional (incentive: deposit fee) economics (rental income)</td>
<td></td>
</tr>
<tr>
<td>Krikke (1999a)</td>
<td>used photocopiers</td>
<td>remanufacturing</td>
<td>remanufactured photocopiers</td>
<td>Local operating company</td>
<td>Oce, a copier firm in NL or (Czech Rep.)</td>
<td>Oce</td>
<td>Same &amp; New Market</td>
<td>Oce</td>
<td>end-of-use (incentive: fee) economics</td>
</tr>
<tr>
<td>Louwers et al. (1999)</td>
<td>carpets</td>
<td>recycling</td>
<td>fibers, filling materials for roads and dams etc</td>
<td>households, companies (e.g. involved in floor covering)</td>
<td>companies involved in floor covering, municipalities, special organization</td>
<td>organization for sorting, fiber producers, cement industry</td>
<td>customers for fibers, cement, road and dam builders</td>
<td>carpet industry, including their fiber suppliers</td>
<td>end-of-life/ end-of-life economics (image); legislation, (expected)</td>
</tr>
<tr>
<td>Mejer (1998)</td>
<td>scanners, faxes, printers, copiers, tonercartridges packaging</td>
<td>remanufacturing recycling</td>
<td>remanufactured machines, materials</td>
<td>dealers, Third party logistics service providers</td>
<td>Canon France (Toner Cartdr.), Canon Scotland (Copiers)</td>
<td>Canon</td>
<td>Canon</td>
<td>end-of-use/ end-of-life (incentive: no disposal costs) economics (green image)</td>
<td></td>
</tr>
<tr>
<td>Reaff et al. (2000)</td>
<td>Carpeting Mat.</td>
<td>recycling</td>
<td>nylon fibres</td>
<td>business customers</td>
<td>carpet dealers</td>
<td>DuPont</td>
<td>DuPont</td>
<td>end-of-life (waste disposal) economics (market value)</td>
<td></td>
</tr>
<tr>
<td>Spengler (1997)</td>
<td>steel by-products</td>
<td>recycling</td>
<td>materials</td>
<td>steel industry</td>
<td>steel industry</td>
<td>steel industry</td>
<td>steel and other industry</td>
<td>industry, government</td>
<td>manufacturing (leftovers); disposal cost savings public responsibility</td>
</tr>
<tr>
<td>Idem</td>
<td>domestic buildings</td>
<td>recycling</td>
<td>materials</td>
<td>households</td>
<td>demolition companies</td>
<td>recycler</td>
<td>industry</td>
<td>government</td>
<td>end-of-life (disposal cost savings) public responsibility</td>
</tr>
<tr>
<td>Van Burken (1998)</td>
<td>car wrecks</td>
<td>recycling</td>
<td>materials, waste</td>
<td>car owner</td>
<td>certified disassembly companies</td>
<td>selected recycle companies</td>
<td>car importers in The Netherlands</td>
<td>end-of-life (incentive: no disposal costs) legislation, economics</td>
<td></td>
</tr>
<tr>
<td>Van Notten (2000)</td>
<td>glass from bottles, pots</td>
<td>recycling</td>
<td>materials (input for glass industry)</td>
<td>households, companies</td>
<td>specialized companies</td>
<td>glass recycling companies</td>
<td>glass industry</td>
<td>glass collectors, glass recyclers, glass producers</td>
<td>end-of-life (incentive: no disposal costs) legislation</td>
</tr>
</tbody>
</table>

Table B.1: Case studies with focus on Network Structures.
## Relationships

<table>
<thead>
<tr>
<th>Reference</th>
<th>Product (in)</th>
<th>Process</th>
<th>Product (out)</th>
<th>Supplier/Giver</th>
<th>Collector</th>
<th>Processor</th>
<th>Customer</th>
<th>Initiator</th>
<th>Sender</th>
<th>Initiator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bartel (1995)</td>
<td>toner cartridge</td>
<td>remanufacturing (parts) retrieval</td>
<td>remanufactured toner cartridges, or parts</td>
<td>customers of Unisys</td>
<td>US postal services</td>
<td>Customers of Unisys</td>
<td>Unisys</td>
<td>end-of-use (fee as an extra incentive)</td>
<td>economics (to offer recovered toner cartridges)</td>
<td></td>
</tr>
<tr>
<td>Driesch et al. (1998)</td>
<td>car engines</td>
<td>remanufacturing refurbishing</td>
<td>same product</td>
<td>owners of a Mercedes Benz (MB) car with an MB engine</td>
<td>MB dealers</td>
<td>DR MTR</td>
<td>owner of a MB car</td>
<td>Daimler-Chrysler (Mercedes-Benz)</td>
<td>service</td>
<td>economics (customer’s relations)</td>
</tr>
<tr>
<td>Faria de Almeida and Robertson (1995)</td>
<td>batteries</td>
<td>recycling</td>
<td>materials</td>
<td>user batteries</td>
<td>shopping malls, stores, mobile collection units, recycling points</td>
<td>different processors</td>
<td>customers raw materials</td>
<td>City of Leicester (UK)</td>
<td>end-of-use</td>
<td></td>
</tr>
<tr>
<td>Farrow and Jonsson (2000)</td>
<td>See Table on Information Technology (B.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guide and van Wassenhove (2000)</td>
<td>toner cartridge</td>
<td>remanufacturing</td>
<td>remanufactured or recycled toner cartridges</td>
<td>customers of Xerox</td>
<td>US Postal Services</td>
<td>same chain (customers of Xerox)</td>
<td>Xerox</td>
<td>end-of-use returns (fee as an extra incentive)</td>
<td>economics</td>
<td></td>
</tr>
<tr>
<td>Guide and van Wassenhove (2001)</td>
<td>cellular phones</td>
<td>remanufacturing (testing, sorting)</td>
<td>same product</td>
<td>cellular airline providers</td>
<td>Recellular, 3rd party remanufacturer</td>
<td>Recellular</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>McGavis (1994)</td>
<td>used toner cartridges</td>
<td>recycling</td>
<td>materials</td>
<td>user cartridge</td>
<td>UPS</td>
<td>several processors for different parts</td>
<td>HP</td>
<td>HP</td>
<td>end-of-use returns (donation by HP to WWF as an incentive)</td>
<td>economics (energy savings, bad image by bad quality 3P remanufacturer)</td>
</tr>
<tr>
<td>Vroom et al. (2001)</td>
<td>PC bottles; distribution items (crates, pallets)</td>
<td>re-distribution (cleaning, sorting)</td>
<td>same product</td>
<td>households, supermarket; DCs; supermarket chains; Campina; Campina;</td>
<td>Campina</td>
<td>Campina</td>
<td>Campina</td>
<td>end-of-use returns (deposit fees as an incentive) functional returns</td>
<td>economics</td>
<td></td>
</tr>
<tr>
<td>Wijkhof (1997)</td>
<td>Rock wool from building or demolishing locations</td>
<td>recycling (also cleaning)</td>
<td>material (secondary input production rock wool)</td>
<td>building companies, demolishers, rock wool sellers</td>
<td>third party logistics service provider (BFI, Sovabo)</td>
<td>sorting by BFI or Sovabo; recycling by Rockwood</td>
<td>building industry</td>
<td>Rockwool</td>
<td>end-of-life (less disposal costs as a natural incentive)</td>
<td>economics (green image)</td>
</tr>
<tr>
<td>Yender (98)</td>
<td>batteries</td>
<td>recycling, (also recharging)</td>
<td>raw materials, batteries</td>
<td>households, companies</td>
<td>UPS, retailers, municipalities</td>
<td>different processors including INMETCO</td>
<td>raw materials users</td>
<td>rechargeable battery recycling corporation</td>
<td>end-of-use</td>
<td></td>
</tr>
</tbody>
</table>

Table B.2: Case studies with focus on Relationships.
## Inventory Management

<table>
<thead>
<tr>
<th>Reference</th>
<th>Product (in)</th>
<th>Process</th>
<th>Product (out)</th>
<th>Sender</th>
<th>Collector</th>
<th>Processor</th>
<th>Customer</th>
<th>Initiator</th>
<th>Initiator</th>
<th>Return Reason &amp; Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>De Brito and Dekker (2003)</td>
<td>laboratory equipment (15,000 sku)</td>
<td>re-use (refunding and re-stocking)</td>
<td>same product</td>
<td>internal customers</td>
<td>Customer brings it back</td>
<td>CERN</td>
<td>internal customers</td>
<td>CERN</td>
<td>commercial returns (reimbursement) economics</td>
<td></td>
</tr>
<tr>
<td>De Brito and Dekker (2003)</td>
<td>fashion, electronics and furniture</td>
<td>re-distribution (collection, inspection, re-stocking)</td>
<td>same product</td>
<td>customers</td>
<td>mail-order company</td>
<td>mail-order company</td>
<td>customers (same chain)</td>
<td>mail-order company</td>
<td>commercial returns (reimbursement) economics (marketing) legislation</td>
<td></td>
</tr>
<tr>
<td>De Brito and Dekker (2003)</td>
<td>thousands of spare parts</td>
<td>repair and/or re-stocking</td>
<td>same product</td>
<td>maintenance personnel</td>
<td>maintenance brings it back</td>
<td>refinery (as maintenance)</td>
<td>internal customers</td>
<td>CERN</td>
<td>commercial returns (no longer needed) economics</td>
<td></td>
</tr>
<tr>
<td>DelCastillo and Cochran (1996)</td>
<td>softdrink bottles</td>
<td>re-distribution (cleaning)</td>
<td>same product</td>
<td>consumer</td>
<td>retailers</td>
<td>Coca Cola</td>
<td>original chain</td>
<td>Coca Cola</td>
<td>end-of-use (plus deposit) economics (cost savings)</td>
<td></td>
</tr>
<tr>
<td>Diaz and Fu (1997)</td>
<td>railway spare parts</td>
<td>repair</td>
<td>repaired spare parts</td>
<td>Caracas Subway</td>
<td>Caracas Subway</td>
<td>Caracas Subway</td>
<td>Caracas Subway</td>
<td>Caracas Subway</td>
<td>repair economics (cost savings)</td>
<td></td>
</tr>
<tr>
<td>Donker and van der Ploeg (2001)</td>
<td>circuit boards for telephone-exchanges</td>
<td>repair</td>
<td>repaired circuit boards</td>
<td>telephone companies</td>
<td>Lucent Technologies</td>
<td>telephone companies</td>
<td>Lucent Technologies</td>
<td>repair economics (cost savings)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fleischmann (2000)</td>
<td>used/ unused machines</td>
<td>repair/ refurbishment (dismantling)</td>
<td>spare parts</td>
<td>business customers/ retailers</td>
<td>IBM facilities</td>
<td></td>
<td>commercial (overstocks/ no longer needed) economics / legislation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Klausner and Hendrickson (2000)</td>
<td>power tools</td>
<td>remanufacturing recycling</td>
<td>Remanufactured power tools, or materials</td>
<td>customers</td>
<td>dealer, logistics provider</td>
<td>specialized facility</td>
<td>manufacturers of power tools</td>
<td>end-of-use economic</td>
<td>economics (pro-active policy)</td>
<td></td>
</tr>
<tr>
<td>Moffat (1992)</td>
<td>aircraft engine</td>
<td>repair/ refurbishing</td>
<td>re-processed aircraft engine</td>
<td>UK Air force</td>
<td>UK Air force</td>
<td>UK Air force</td>
<td>UK Air force</td>
<td>service returns (repairs) economics (cost savings)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rudi et al. (2000)</td>
<td>wheel chairs, hearing aids, etc</td>
<td>reuse/ refurbish/ recycling/ retrieval, landfill</td>
<td>re-processed wheel chairs, hearing aids, etc</td>
<td>users</td>
<td>Technical Aid Center (TAC)</td>
<td>TAC (in some cases recycling center)</td>
<td>people with handicaps</td>
<td>Norwegian National Insurance Administration</td>
<td>service returns (repairs) economics (cost savings) costs (distribution item)</td>
<td></td>
</tr>
<tr>
<td>Sanders et al. (2000)</td>
<td>complete products retail</td>
<td>re-distribution (collection, sorting)</td>
<td>same product</td>
<td>customer</td>
<td>third party logistics service provider</td>
<td>Mail Order Company, Wehkamp</td>
<td>Same market</td>
<td>Wehkamp</td>
<td>commercial return (reimbursement) economics (to attract and keep customers)</td>
<td></td>
</tr>
<tr>
<td>Swinkels and van Esch (1996)</td>
<td>Beer kegs</td>
<td>re-distribution/ re-use</td>
<td>same product</td>
<td>restaurants, bars, etc</td>
<td>Bavaria, Agents</td>
<td>Bavaria</td>
<td>Bavaria</td>
<td>Bavaria</td>
<td>functional returns (distribution item) economics (cost savings)</td>
<td></td>
</tr>
<tr>
<td>Toklay et al. (2000)</td>
<td>single-use photo cameras</td>
<td>remanufacturing</td>
<td>same product</td>
<td>consumer</td>
<td>Photo Shops / Retailers</td>
<td>Kodak</td>
<td>Same chain</td>
<td>Kodak</td>
<td>end-of-use (or distribution item) economics (cost savings)</td>
<td></td>
</tr>
<tr>
<td>Van der Laan (1997)</td>
<td>used car parts</td>
<td>remanufacturing</td>
<td>same product</td>
<td>National Importer Organization</td>
<td>Volkswagen (Kassel's facility)</td>
<td>Kassel (remanufact.)</td>
<td>NIO which delivers to car sellers</td>
<td>Volkswagen (Kassel's facility)</td>
<td>end-of-use economics (cost savings)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Boldface items indicate cases with a focus on the Inventory Management.
### Planning and Control

<table>
<thead>
<tr>
<th>Reference</th>
<th>Product (in)</th>
<th>Process</th>
<th>Product (out)</th>
<th>Sender/Giver</th>
<th>Collector</th>
<th>Processor</th>
<th>Customer</th>
<th>Initiator</th>
<th>Sender</th>
<th>Initiator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andriesse (1999)</td>
<td>pallets, pallet's caps</td>
<td>re-distribution (sorting)</td>
<td>same product</td>
<td>suppliers</td>
<td>Philip Morris</td>
<td>Philip Morris</td>
<td>suppliers</td>
<td>Philip Morris</td>
<td>functional</td>
<td>legislation</td>
</tr>
<tr>
<td>Bakkers and Ploos van Amstel Jr. (2000)</td>
<td>PVC lamellas</td>
<td>recycling</td>
<td>PVC material</td>
<td>Households, companies</td>
<td>Distributors lamellas</td>
<td>Ortes Lecluyse</td>
<td>Ortes Lecluyse</td>
<td>Ortes Lecluyse</td>
<td>end-of-life</td>
<td>economics</td>
</tr>
<tr>
<td>Bartels (1998)</td>
<td>See Network Structure Table (B.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bentley et al. (1986)</td>
<td>subway/transit cars</td>
<td>repair/ refurbishing (overhaul)</td>
<td>re-processed product</td>
<td>NY City, NJ, Chicago, Transit, etc</td>
<td>Morrison-Knudsen Company</td>
<td>NYCity, NJ, Chicago Transit, etc</td>
<td>Morrison-Knudsen Company</td>
<td>economics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Del Castillo and Cochran (96)</td>
<td>See Inventory Management Table (B.3)</td>
<td></td>
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</tr>
<tr>
<td>Duhaime et al. (2001)</td>
<td>See Network Structure Table (B.1)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Driesch et al. (1998)</td>
<td>See Relationships Table (B.2)</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gupta and Chakraborty (1994)</td>
<td>glass scrap</td>
<td>recycling</td>
<td>glass materials</td>
<td>Producer glass</td>
<td>Producer glass</td>
<td>Producer glass</td>
<td>Producer glass</td>
<td>manufacturing leftovers (plus savings)</td>
<td>economics</td>
<td></td>
</tr>
<tr>
<td>Klausner and Hendrickson (2000)</td>
<td>See Inventory Management Table (B.3)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Kokkie et al. (1999b)</td>
<td>PC monitors</td>
<td>(parts) retrieval, recycling</td>
<td>components materials</td>
<td>consumers</td>
<td>Municipal Waste Company</td>
<td>secondary markets</td>
<td>Municipal Waste Company in NL</td>
<td>legislation, economics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Robinson (1992)</td>
<td>Diesel engine components</td>
<td>remanufacturing</td>
<td>remanufactured engine components</td>
<td>Detroit Diesel remanufacturer West</td>
<td>Detroit Diesel remanufacturer West</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schinket (2000)</td>
<td>gypsum (building industry)</td>
<td>recycling (sorting)</td>
<td>gypsum</td>
<td>building companies</td>
<td>third party LSPo producer's of Gypsum products</td>
<td>customers</td>
<td>Producers of Gypsum products (organization)</td>
<td>end-of-life (lower disposal costs as an incentive)</td>
<td>legislation</td>
<td></td>
</tr>
<tr>
<td>Simonis (1998)</td>
<td>wooden sheets, prod. scrap (internal and external)</td>
<td>recycling (sorting)</td>
<td>wood materials</td>
<td>Trespa (prod. scrap)/Scrap from building sites</td>
<td>third party LSP builders, demolishers</td>
<td>Trespa</td>
<td>Builders</td>
<td>Trespa</td>
<td>manufacturing leftovers (plus reduction on disposal costs)</td>
<td>economics</td>
</tr>
</tbody>
</table>

Note: The table above provides information on the planning and control of various product supply chains, including reference, process, product, sender/giver, collector, processor, customer, initiator, sender, and initiator details. The table also includes details on return reasons and drivers, such as functional (plus cost reduction), legislation, economics, and green image.
### Table B.4: Case studies with focus on Planning and Control

#### Information Technology

<table>
<thead>
<tr>
<th>Product</th>
<th>Supply chain</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nagel and Meyer (1999)</strong></td>
<td>refrigerators</td>
<td>remanufacturing recycling</td>
</tr>
<tr>
<td><strong>Idem</strong></td>
<td>computers</td>
<td>(parts) retrieval</td>
</tr>
<tr>
<td><strong>Meyer (1999)</strong></td>
<td>cosmetics</td>
<td>re-sale (re-stocking)</td>
</tr>
<tr>
<td><strong>Linton and Jonhson (2000)</strong></td>
<td>circuit boards</td>
<td>remanufacturing</td>
</tr>
<tr>
<td><strong>Klausner et al. (1998, 2000)</strong></td>
<td>See Inventory Management Table (B.3)</td>
<td></td>
</tr>
</tbody>
</table>

**Table B.5: Case studies with focus on Information and Technology.**
Publications in the Report Series Research* in Management

ERIM Research Program: “Business Processes, Logistics and Information Systems”

2003

Project Selection Directed By Intellectual Capital Scorecards
Hennie Daniels and Bram de Jonge
ERS-2003-001-LIS

Combining expert knowledge and databases for risk management
Hennie Daniels and Han van Dissel
ERS-2003-002-LIS

Recursive Approximation of the High Dimensional max Function
Ş. İl. Birbil, S.-C. Fang, J.B.G. Frenk and S. Zhang
ERS-2003-003-LIS

Auctioning Bulk Mobile Messages
S.Meij, L-F.Pau, E.van Heck
ERS-2003-006-LIS

Induction of Ordinal Decision Trees: An MCDA Approach
Jan C. Bioch, Viara Popova
ERS-2003-008-LIS

A New Dantzig-Wolfe Reformulation And Branch-And-Price Algorithm For The Capacitated Lot Sizing Problem With Set Up Times
Zeger Degraeve, Raf Jans
ERS-2003-010-LIS

Reverse Logistics – a review of case studies
Marisa P. de Brito, Rommert Dekker, Simme D.P. Flapper
ERS-2003-012-LIS

Product Return Handling: decision-making and quantitative support
Marisa P. de Brito, M. (René) B. M. de Koster
ERS-2003-013-LIS

* A complete overview of the ERIM Report Series Research in Management:
http://www.ers.erim.eur.nl

ERIM Research Programs:
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ORG Organizing for Performance
MKT Marketing
F&A Finance and Accounting
STR Strategy and Entrepreneurship