



Improving the Reverse Material Logistics Operations for Company Y

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Abstract

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<p>Company Y is constantly building new telecommunication networks while simultaneously dismantling the old technology-based networks. The rapid technological advances cause network products to reach the end of use shortly after few years of usage. However, Company Y is committed to achieve zero waste in its operations by shifting the operations to more circular economy. Thus, selected dismantled network materials are returned to the stock for reuse purposes. Company Y utilizes reverse logistics to return the dismantled material to the warehouse.</p> <p>This research-based thesis focuses on finding points of development for current dismantled telecommunications material reverse logistics operations at Company Y by analyzing the existing reverse logistics operations and the current dismantled material inventory. By identifying the areas of development in the current operations, this thesis finds recommendations on how to improve the reverse logistics to become lean.</p> <p>This thesis utilizes mixed methods as research methods. Qualitative research methods includes semi-structured interviews and five months of observation. Twelve interviews were conducted with eight internal stakeholders and four external stakeholders. Quantitative research methods relied on three numerical data reports produced by the author from Company Y's enterprise resource planning tool. Desktop research was utilized as secondary data. The theoretical framework used published books and peer-reviewed research to gain proper understanding on reverse logistics and value recovery, inventory management for returned goods and finally, improving reverse logistics with lean methods.</p> <p>The results of analyzing of the current reverse logistics operations delivers a three-phase process overview of how the reverse logistics operations currently operate between stakeholders while also receiving an honest interpretation of the current reverse logistics operations issues.</p> <p>Twenty-four points of development were found which can significantly improve the current reverse logistics and three points to improve the current inventory. The current dismantled material inventory poses major concerns with the current inventory management for dismantled materials as twenty-four percent of the inventory has not had any material movement for over five years.</p> <p>The current reverse logistics operations can be significantly improved using lean methods. This thesis recommends a systematic approach of standardizing the reverse logistics process. Additionally, clear guidelines minimize repetitive mistakes and remove uncertainties associated with accountability. Lastly, a proper feedback platform is required to maintain a constant communication between stakeholders to continuously improve the reverse logistics process.</p>
Key words Reverse Logistics, Inventory Management, Lean Operations

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1 Introduction

Telecommunications networks are constantly improving and changing, with a new generation of products and materials being introduced to the market. The rapid technological advances cause network products to reach the end of life shortly after a few years of use. A linear supply chain of “take, make, and dispose” leads to a large amount of functioning network equipment being discarded as waste. (GSM Association 2022, 19.)

To decrease waste caused by fast-paced technological advances, a circular economy is considered as an emerging trend in the telecommunications industry. Buying and reselling refurbished second-hand equipment creates a new market worldwide to avoid surplus equipment ending up as wasted products, components, and materials. (GSM Association 2022, 20.)

Company Y is building new telecommunication networks every year with around two hundred million euros, while at the same time dismantling the old technology-based networks. New networks are replacing old networks which then are returned to the stock for reuse purposes. However, some of the stored materials remain in the warehouse for a long time while losing their value. Storing these non-circulating materials causes additional costs, thus the materials should be circular to avoid unnecessary costs and loss of value.

Company Y recycles parts of the dismantled network materials with the help of different stakeholders. Some of the dismantled materials are stored in warehouses for spare part usage, some are reused in network construction, some are sold to third parties, and lastly, some are disposed of as waste electrical and electronic equipment (WEEE).

This thesis is about analyzing the current reverse logistics process of Company Y’s used telecommunications network materials and finding recommendations on how to improve the reverse logistics operations.

This is a research-based thesis with a goal to describe in detail how the dismantled materials return from the contractor Company A to the warehouse D and E. While describing the material flow, an additional focus is on finding the common issues for points of development from the current reverse logistics process as well as from the current dismantled material inventory. With these focuses, this thesis aims to find recommendations for improving the current reverse logistics process from the current operating model.

1.1 Background

Company Y discovered over the years that a high amount of dismantled material is accumulating in the warehouses which are no longer used in the network. As technology changes rapidly, the dismantled network materials become obsolete within years in network construction. This causes old technology-based dismantled materials to accumulate in the warehouse without proper inventory management.

Warehousing old technology-based dismantled material or exceeding overstock causes unnecessary work, costs, and time loss for multiple stakeholders. By managing efficiently the reverse logistics, the case company can cut costs while improving the quality within the operations. Therefore, Company Y aims to find points of development to improve the reverse logistics operations.

In addition, unnecessary, broken, and wrongly processed returns cause extra costs and loss of time for several stakeholders. Analyzing the reverse logistics operations allows to challenge multiple stakeholders to question how much euros could be saved if there were no unnecessary returns. Thus, the company version of the thesis focuses on finding how much one dismantled material return for reuse purposes costs in various stages.

1.2 Company Y

Company Y is a leading telecommunication company in Nordic and Baltic countries offering telecommunication, IT, and digital services to consumers and business customers. Company Y serves consumers, businesses, and public sector customers with essential digital infrastructure, ICT services, devices, and entertainment. (Company Y 2023, 6.)

Company Y is a large provider of fixed communications and TV, offering communication services and broadband access to businesses and consumers across the operating countries. Company Y also provides wholesale services in mobile and fixed communications. Lastly, Company Y offers ICT and data center services to companies, providing data center and infrastructure services. (Company Y s.a.)

In 2023, network construction and maintenance, network equipment, and other purchased goods and services generated almost 90% of Company Y's total value chain emissions. Thus, Company Y is committed to achieving net zero by 2040 (Company Y 2023, 81-82). Net zero refers to a target that negates the amount of greenhouse gases produced by reducing emissions and implementing methods to remove them from the atmosphere (United Nations 2023).

Before achieving net-zero, Company Y is committed to achieving zero waste in its operations by 2030, including network construction and maintenance. This is executed by shifting the operations to a more circular economy. To achieve zero waste, Company Y targets to reuse and recycle 84% of waste materials from Company Y's operations as well as from network construction and maintenance by 2025. In 2023, the reuse and recycle rate was 72%. (Company Y 2023, 83-85.)

1.3 Research Problem

The goal of this thesis is to study Company Y's reverse logistics process and find solutions on how to improve the reverse logistics of dismantled network materials. The research question is divided into investigative questions that provide a strong analysis of the current reverse logistics operations.

These investigative questions explore the case company's current reverse logistics operations, the current inventory of dismantled materials, and the current issues of the reverse logistics of dismantled materials which can be improved.

By answering these investigative questions, the author finds potential bottlenecks, challenges, and issues in the case company's reverse logistics process which can be solved with proper recommendations. Thus, the main research question is finding recommendations on how to improve the case company's reverse material logistics.

Research Question: How to improve the reverse logistics operations at Company Y?

IQ 1. What are the current process steps in reverse logistics of dismantled materials at Company Y?

IQ 2. What is the current material movement of dismantled materials in the warehouse?

IQ 3. What are the points of development in the current reverse logistics operations of Company Y?

In addition to these investigative questions, the author included an additional fourth investigative question in the company version to find the current costs of the reverse logistics of dismantled materials to provide a financial point of view for the need to improve the operations. By identifying the costs of reverse logistics at various stages, the analysis of the cost of reverse logistics provided a financial validation for the need for improvements in both process development and cost savings. Thus, the company version included a fourth investigative question:

IQ 4. What are the costs of Company Y's reverse logistics operations for dismantling network materials?

This investigative question was left out of the public version of the thesis as it is not in the scope of the thesis. However, it contains valuable evidence for the company to justify the need for the improvements. By secluding the fourth investigative question only to the company version, the author was able to analyze price-sensitive data and find an answer to how much it costs to return one piece of dismantled material at various stages of the reverse logistics process.

1.4 Demarcation

The research is limited to the case company and its reverse logistics operations in Finland. This thesis focuses only on the dismantled telecommunications network materials owned by the case company. Thus, this thesis does not cover business-to-consumer types of goods in reverse logistics.

Dismantled material in this thesis refers to the materials and components that are used in telecom networks and mobile networks. These materials are such as radios, cables, repeaters, baseband equipment, other electrical devices, brackets, and other installation structures.

This thesis does not cover dismantled building elements used in construction such as cement, wood, or aggregates. It also does not cover fasteners, such as screws or nuts, which are used in the installation of network components.

This thesis focuses on the stages and actors involved in returning dismantled network material back into stock for reuse purposes. However, this thesis does not cover the use of dismantled materials in spare parts due to different storage methods.

This thesis has two versions: public and private company versions. This is the public version of the thesis; thus, this version does not include the theoretical framework of costs of reverse logistics, and cost justification of reverse logistics. Additionally, this version of the thesis does not contain the results of the analysis which included costs of the dismantled material retrieval process, costs of warehousing and costs of value-added services, and finally, the cost impact of current reverse logistics at Company Y.

1.5 Benefits and International Aspect

The thesis is highly relevant to the author's current work as it helps the author to understand the commissioner company's operations in-depth. The thesis project is useful for the author's career currently as well as in the future since the author considers the in-depth knowledge of reverse

logistics and circular economy highly relevant in supply chain operations. Additionally, the author benefits from the thesis by improving academic writing, data collection methods, and critical thinking abilities.

The commissioning company benefits from this thesis by receiving an in-depth description of the dismantled material flows with suggestions on how to improve their reverse logistics. The recommendations are the crucial part of the thesis that helps the company to find points of development to improve the reverse logistics operations.

The commissioning company can save money by utilizing the thesis findings as one of the focuses is to find the highest costs in the current process. By finding the costs of reverse logistics, the commissioner can justify the need for reverse logistics development. Additionally, the thesis helps the company to reach their sustainability goal.

Although the thesis focuses on Company Y's reverse logistic operations in Finland, the international aspect of the thesis is already evident in the company's international operations. The thesis findings can be utilized in the commission company's other operational countries. This thesis can be used for developing their supply chain or improving their reverse logistics for dismantled network materials.

In addition to the commission company, other companies in Finland or abroad can utilize the thesis findings. While this thesis focuses only on the reverse logistics of dismantled network materials, the framework of reverse logistics, the findings and the recommendations can help other companies to develop and improve their own reverse logistics operations.

1.6 Key Concepts

Circular Economy is a model which focuses on creating, conserving, and circulating value. The circular economy focuses on creating loops with the resources in use with an aim to maintain the value of products, materials, and resources for as long as possible by returning them into the product cycle at the end of life. (Weetman 2021, 13-14.)

Closed Loop refers to products or materials recovered for reuse either as the same product or for use in a different product. The goal is to reduce waste as the product or material stays in use rather than discarding it after first use. (Weetman 2021, 38-40.)

Inventory is a term to describe accumulations of materials as they flow through processes. Physical inventory, or in other words, stock is the accumulation of physical materials such as

components, parts, and finished goods. **Inventory Management** refers to managing these accumulations. (Slack, Brandon-Jones, & Burgess 2022, 443.)

Lean Operations refers to a continuous improvement philosophy and strategy to achieve a smooth flow of materials or information while delivering exact quality value, in exact quantity, at an exact time and place, while having the lowest possible cost. Initially, the focus is on planning and controlling operations to deliver products or services without waste. Waste in this case means any activity that does not add value from the customers' perspective. (Slack et al. 2022, 552-554.)

Reverse Logistics refers to logistics or management activities that plan, implement, and control the backward flow of finished goods, raw materials, and other resources from a point of consumption to the origin of the supply chain or different point of recovery efficiently and cost-effectively to recapture value or ensure proper disposal. (Bloomberg, LeMay & Hanna 2002, 200; Cherret, Maynard, McLeod & Hickford 2010, 243.)

Telecommunications Network is an infrastructure of electronic devices and communication equipment that exchanges information in different formats. Typical telecommunications networks are mobile networks, telephone landline networks, cable TV networks, or the Internet. (Traficom 2023.)

Third-party Logistics (3PL) refers to a logistics provider or partner that offers outsourcing the logistics services that involve transportation, warehousing, inventory management, or other supply chain activities (Slack et al. 2022, 426).

WEEE refers to Waste Electrical and Electronic Equipment. It is electrical waste, which can be a plug, a battery, or any electrical device such as smartphones and laptops. WEEE may contain metals, minerals, and hazardous substances. Electronic products may contain more than 1000 different substances, making material recovery extremely complex (World Economic Forum 2019, 7.)

2 Efficient Reverse Logistics Practices

Reverse logistics has the aim to support a closed-loop supply chain while affecting product design, supply chain design, and product recovery. It is a broader concept for overall supply chain optimization which focuses on minimizing cost and retrieving value from reverse flows while fulfilling legislative and environmental requirements. (Grant, Trautrim, & Wong 2023, 190-191.)

According to Longshore and Cheatham (2022, 220-225), speed is considered critical in efficient reverse logistics. A cost-efficient supply chain is slow; thus, the short life cycle products rely on a fast efficient supply chain. The more efficient the return process, the more product returns are returned to the life cycle of use instead of disposing. According to Richards (2022, 230), reverse logistics can account for about 5% of turnover. Returning a product back into the supply chain can cost double the cost of buying it as new. Effective product returns increase revenues, lower costs, improve profitability and enhance customer service levels.

Traditional goals and methods of inventory management can be used for non-valued circular goods. However, reverse logistics and circular economy cause inventory management to increase its complexity. Therefore, reverse logistics require inventory management with the objective of controlling external component orders and the internal component recovery process while ensuring a required service level. (Fleischmann et a. 1997, 7-11.)

This chapter studies different points of development in reverse logistics, material flow and value recovery in reverse logistics as well as inventory management for returned goods. With a sound base knowledge of reverse logistics, lean methods are studied to find out how to improve reverse logistics operations.

2.1 Material Flow and Value Recovery

A general reverse logistics process involves three stages: gatekeeping, collection, and sortation. Gatekeeping refers to activities that determine how the goods are collected and select a proper value recovery activity. It is essentially the planning and designing of the reverse logistics for the goods. Collection refers to picking up the materials ready for return whereas sorting separates the materials into product groups which are sent to appropriate processors. (Sarkis & Dou 2018, 116-117.)

Reverse logistics includes retailers, original manufacturers, third-party collectors, sorters, transportation, and waste management. Due to the variety of stakeholders and variance with products and waste, the stages in material flow vary from one stakeholder to another. (Sarkis & Dou 2018, 116-118.)

A warehouse third-party logistics provider (3PL) stores on behalf of several different customers and serves activities based on the agreements. These activities are for example unloading and checking incoming goods, moving incoming goods to the right stock locations, picking, packing, labeling, and loading outgoing goods. Additionally, 3PL warehouse can provide value-added services. The value-added services include reconfiguration, repair and refurbishment, and sub-assembly. This means that the 3PL includes some form of production that modifies a product based on the order. (Richards 2022, 217-218, 371-388).

The reverse logistics process of electrical products and materials consists additional stage of inspection, testing, or disassembling before sorting the product to a correct recovery method (Frei, Bines, Lothian & Jack 2016, 252-253). According to Banihashemi, Fei, and Chen (2019, 5), the quality and condition of returned products may differ greatly, thus inspection is necessary for sorting the products. Additionally, electrical products and WEEE contain valuable materials and metals, thus the additional inspection stage is needed for efficient value recovery (Mokkhamakul 2022, 1-2).

After the product inspection, the product can be sorted into five different recovery categories: Refurbish, repair, resell, recycle, or recover. The general assumption is to recover as much value of the original product or material as possible while extending the lifespan of the products and its parts. (Potting, Hekkert, Worrell, & Hanemaaijer, 2017, 14-16.)

Another way to describe the goal of reverse logistics is to recover value while minimizing costs, with fast processing to return the goods back into the supply chain in any format as soon as possible, whether it is a finished product, disassembled materials, or spare parts, or it is disposed of efficiently (Richards 2022, 228-230). Figure 1 illustrates how different categories recover different amounts of value of the product or material.

First, a value recovery method without additional steps is to simply reuse the returned product. Reuse refers to using a returned product for the same purpose as it was designed and produced earlier. Thus, the returned product is not modified or repaired in any way as it does not need any repairing or other value recovery methods. These products are usually low-value products as more complex products require inspection or testing. (Belvedere & Grando 2017, chapter 7.6.)

According to Frei et al. (2016, 252-253), the most desirable and the highest value retention recovery comes from refurbishing as it means adjusting the used product or material to a specified quality. It can involve disassembly of the products into modules or materials and inspection of the goods, fixing and replacing some modules.

After the quality check, the approved modules are reassembled into refurbished products. The difference between a refurbished product and a remanufactured product is how much of the original product has been replaced. Remanufacturing focuses on remaking the used product back to quality standards which are accepted as new products. The process is overall similar to refurbishing; however, the difference comes from extensive inspection and evaluation of the remanufactured product. (Grant et al. 2023, 181-183.)

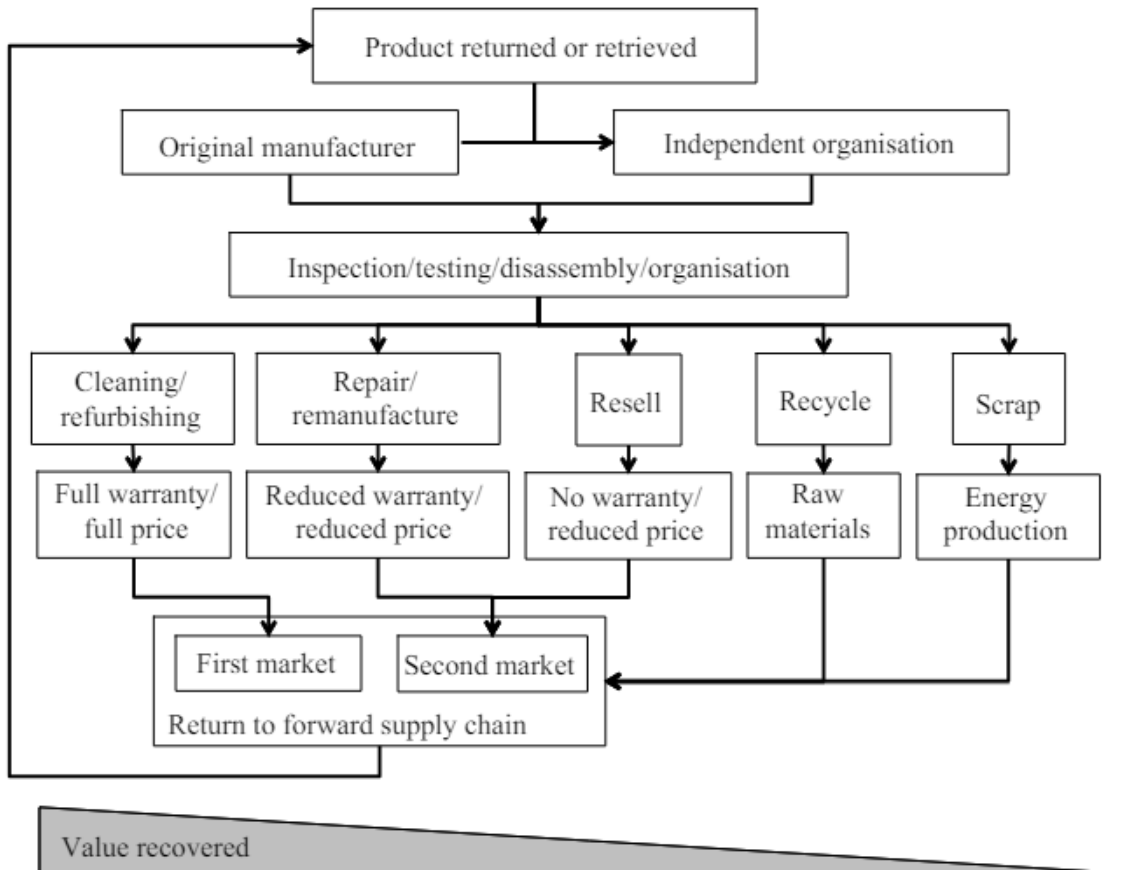


Figure 1. Reverse supply chain types (Frei et al. 2016, 253)

The next highest value recovery comes from repair, as it is quite similar to refurbishing a product. Repair has the aim of returning used products back into working condition. The products are usually not disassembled but some parts may be replaced to fix the product. The quality is usually inferior to a new one. (Grant et al. 2023, 181-183.)

Reselling the product or material does not bring much value as the ownership changes. Before selling the product, it still needs to be inspected and potentially reset back to factory settings or it requires some other updates. This causes additional costs for the original holder; thus, the value retention is not as high as keeping the product in-house for use. (Frei et al. 2016, 253-254.)

Rapid technological advances cause electronic and technological products to become quickly undesirable and obsolete in developed countries. The resale of products that are no longer acceptable or desirable on the original market extends the short life cycle of technological products by targeting other markets within the country or abroad to those countries that are lacking in technology. (Frei et al. 2016, 253-254.)

However, reselling technological devices contains a risk of brokering dual-use items. Dual-use items refer to goods such as technology and software that can be used both for civil and military purposes. The dual-use materials are listed by the European Union and the EU controls exporting them with regulations. (European Commission 2024.)

A lower value recovery comes from recycling (Frei et al. 2016, 252-253). This can also be described as cannibalization. The aim is to recover specific reusable materials from the returned products. The recovered materials can be used to produce original products and components if the quality is acceptable. Otherwise, the recovered materials can be used in spare parts or in other type of products which require similar materials. The remaining parts of the original returned material are then fully recycled or disposed of. (Grant et al. 2023, 181-183.)

The very last resort to gain value from returned material is to dispose of and send it into landfill, as there is nothing to be gained from the process. Some materials are not easily degradable while some contain toxic substances, which cause environmental problems (Belvedere & Grando 2017, chapter 7.6). However, some of the disposed materials can be used in energy recovery such as incineration, which can be used directly to heat buildings and produce energy. Usually, the waste management partners manage the disposal as it requires investments in waste infrastructure (Frei et al. 2016, 252-254).

Several factors impact the suitable recovery category selection. These factors can be such as product complexity where the product itself may not always be suitable for refurbishing, repairing, remanufacturing, or even reuse due to the technicality of the product. The volume of the returns as well as the timing of the returns can also impact the efficiency of the reverse logistics. Lastly, the returned product quality grade impacts the suitable category sorting selection as the testing and evaluation complexity, or remanufacturing complexity affects the robustness. Choosing the right recovery category for the returned product may lower costs, increase profitability and efficiency, and improve customer service while leading to a better corporate image. (Grant et al. 2023, 183-185.)

2.2 Improving Reverse Logistics

Common challenges in reverse logistics are large returns inventory, unidentified returns, long process times, and unknown total cost of the returns process (Longshore & Cheatham 2022, 228-229). To improve the reverse logistic operations, lean operations should be considered.

Slack et al. (2022, 559-560) claim three wastes should be eliminated or reduced in the operations to become lean operations. In short, if a process is inconsistent, it may overburden people or equipment, which will cause unnecessary non-value-adding activities.

The first cause of waste is likely from poor communication, inefficient use of resources, or failure to adopt a systematic approach. Communication and proper recording of processes are required to solve this issue. Additionally, standardization and visual management are effective tools for ensuring efficient use of resources and communication. (Slack et al. 2022, 559-560.)

The second cause of waste is the lack of consistency and unpredictability. Sarkis and Dou (2018, 123-126) claim that the uncertainty of quantity in returns and timing causes management risk in reverse logistics which differentiates reverse logistics from traditional forward logistics. The uncertainties are usually caused by variations in demand, diversity in a range of products, or variations in how the process is managed. Often these causes lead to overburdening resources while others are having downtime. (Slack et al. 2022, 559-561; Kanikula & Koch 2009.) The changes in quantity, quality, variability, and timing cause unnecessary long processing and waiting times, which then affect the operations scheduling and recovery activities (Kurilova, Sundin & Poksinska 2018).

Lastly, the third cause of waste is unnecessary or unreasonable requirements on processes and resources which result in poor outcomes. This means failing on basic operations, such as failing to plan operative activities due lack of prioritizing, scheduling, and resources. (Slack et al. 2022, 559-561.) The planning is difficult especially on the value recovery activities, as not every product needs all recovery activities while the quality of the returned goods varies (Kanikula & Koch 2009).

Lean considers accumulations of inventory as an obstruction which prevents operational problems from being noticed. These operational problems can be for example inaccurate quantities, downtime, defective deliveries, untrained employees, or off standards. (Slack et al. 2022, 552-558.) High inventory levels solve these problems temporarily as compensation for insufficient core quality, however lean operations aim to solve these problems permanently (Kurilova, Sundin & Poksinska 2018, 17).

As lean objectives are ideals, no operations can improve to perfection. Thus, the concept of continuous improvement is important in lean philosophy. The continuous improvement allows operations to constantly improve the activities as a long-term commitment. (Slack et al. 2022, 571.)

2.3 Inventory Management for Returned Goods

Implementing circular business models in operations causes new types of inventories to occur due to quality differences in products. These inventories will have a separate stock for only that purpose, for example, a separate stock for used products to remanufacture or disassemble, stock for disassembled parts or components, and remanufactured products. These new types of inventories additionally impact bookkeeping as the inventory may have a different way of calculating value than originally. (Kossila 2022, 253-255.)

Ponte, Naim, and Syntetos (2019, 630-631) refer to a combined effect on uncertainty of demand and returns as dual-source uncertainty. This hybrid uncertainty impacts the coordination of both manufacturing and remanufacturing operations toward customer-satisfying demand.

Inventory planning is determining the optimal levels of inventory. Planning and forecasting a hybrid inventory require different methods (Ponte et al. 2019, 630-631). As seen in figure 2, the hybrid system consists of two different inventories, serviceable stock which is the forward material flow, and recoverable stock from reverse logistics.

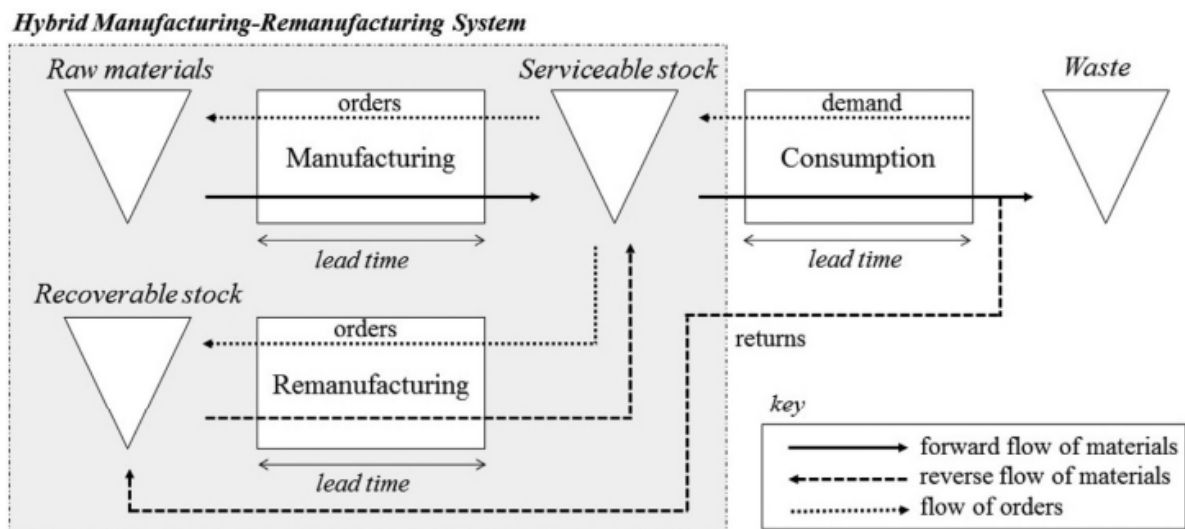


Figure 2. Structure of hybrid manufacturing - remanufacturing system (Ponte et al. 2019, 630-631)

Commonly pull-based method is used in inventories. Pull system refers to a lean management method of eliminating overproduction as the material is not issued until an actual need (Kerber &

Dreckshage 2011, 11). The pace of the inventory flow is set by the customer and need; thus, the customer's demand triggers the inventory movement. (Slack et al. 2022, 344-345.)

However, in hybrid operations, Ponte et al. (2019, 630-631) recommend return flows as push-based. In contrast to the pull method, the push-based method refers to scheduled activities with demand forecasting (Slack et al. 2022, 344-345.). This means that the material is pushed into inventory based on forecasts and not on the actual need.

By using the push method for returned materials, it guarantees value recovery operations proceed in time and secures a constant inventory for the selected returned items. The value recovery and remanufacturing of used products hold risk in the pull method, as the flow of the material returns is not the same as the demand in use. Additionally, the value recovery process requires time to manage the material returns which slows the product delivery in the pull method. (Kossila 2022, 256-258.)

According to Kossila (2022, 256-259), level production is a long-term strategy that utilizes the push method. Level production refers to a long-term strategy of production that guarantees the planned quantity of products or materials produced within time. This ensures a constant inventory availability as the unpredictability of the returns causes uncertainties. As seen in figure 3 below, the inventory quantity follows the required level and stocks up with new and remanufactured goods with forecasts.

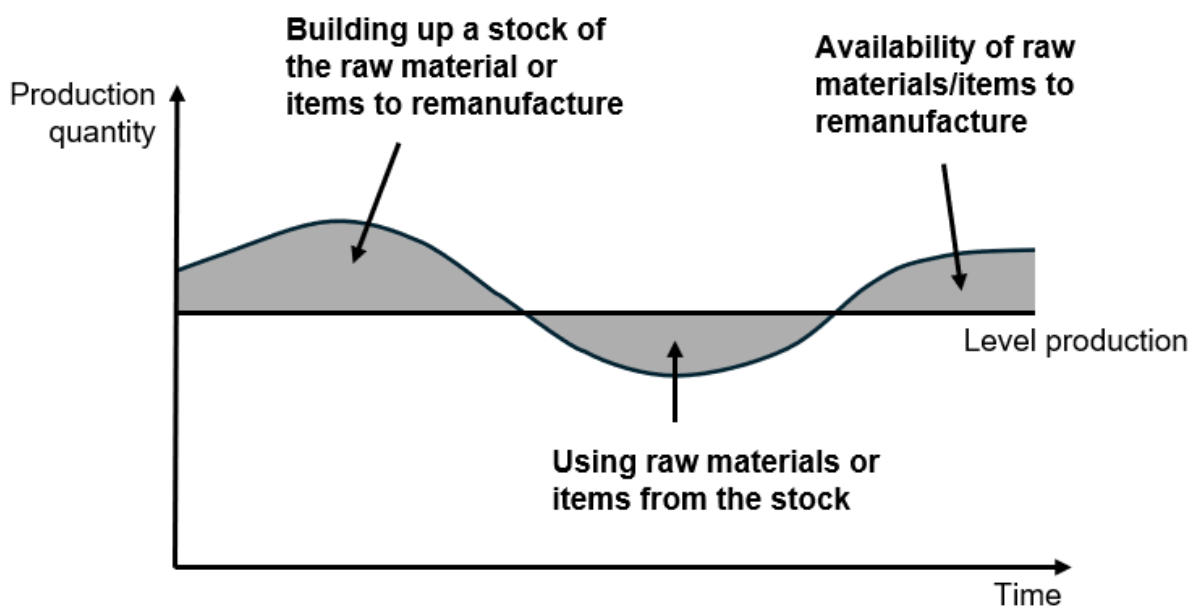


Figure 3. Level production strategy (adapted from Kossila 2022, 258)

Richards (2022, 228-230) claims that returned goods should not remain in the warehouse for a long period. It is important to note that stored products may lose value over time since the technology is aging, and the product has been replaced by a newer model on the market. Additionally, some products may deteriorate from exposure to humidity, dust, or sun over time causing value loss (Frei et al. 2016, 253-256.) Slack et al. (2022, 451) add that obsolete products also cause obsolescence costs, as obsolete products should be disposed of, causing waste management costs.

While not doing anything about the returns in reverse logistics costs money but also keeping them in the warehouse costs money. Returns are difficult to value, as well as they take up space and they potentially lose an opportunity to get back to a circle of use if they are not added back into inventory fast enough. Without returning the goods back into stock, the procurement bears a risk of ordering further stock as new (Richards (2022, 228-230.) Therefore, efficient inventory management is needed to optimize the reverse logistics process.

Identifying the most financially important inventory goods allows one to realize the highest spend or costs in the inventory. This is done by the ABC classification tool or in other words, Pareto classification. Pareto refers to a rule of roughly 80% of effects come from 20% of causes. In other words, 20% of the cause is considered the "vital few" which affects 80% of the result. (Richards 2022, 120-121.)

However, Richards (2022, 120-121) adds, that this 80/20 Pareto rule is not universal, but it can be easily applied to find relations in different causes. The 80/20 split is not always the case which highlights the frequently used products as well as the least used products. Using the Pareto rule allows to find potential products for disposal.

The tool ABC categorizes stock inventory into three groups, A, B, and C according to the value and usage rate. Class A includes inventory items which are 20% of high-value items that account for 80% of total usage value. Class B is the medium value which means that 30% of the inventory items account for 10% of total usage value. Lastly, Class C is the low usage value items that comprise 50% of total inventory items, yet only account for 10% of the total usage value. Figure 4 illustrates the ABC tool after ranking the items by usage value. (Slack et al. 2022, 467-469.)

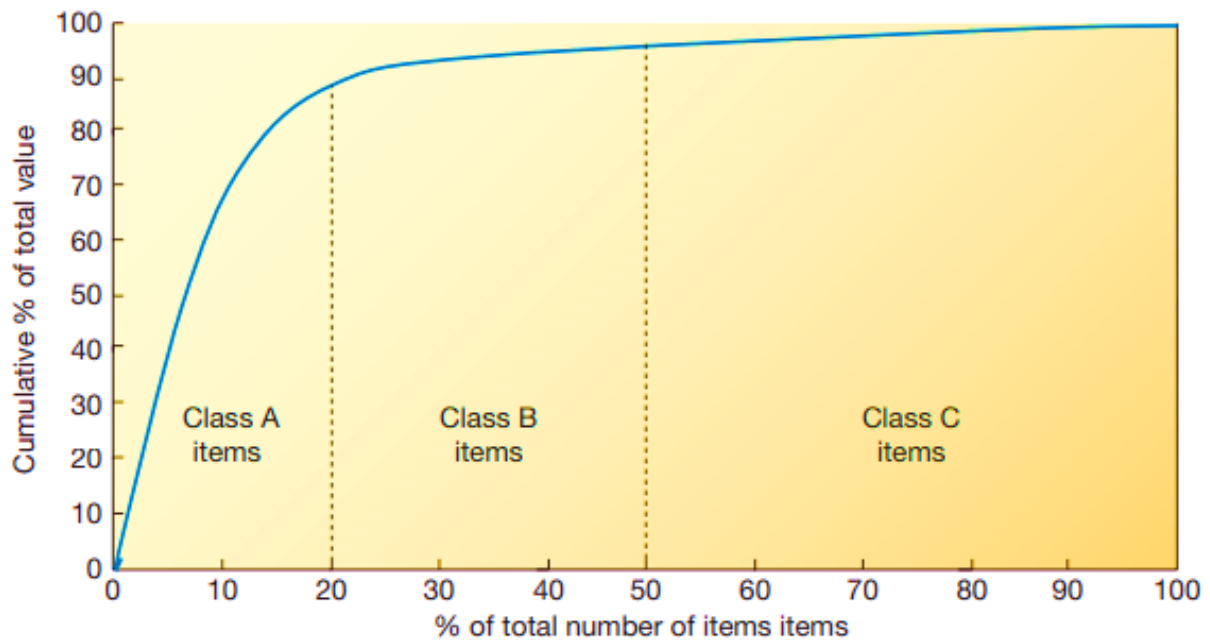


Figure 4. ABC classification tool as Pareto curve (Slack et al. 2022, 468.)

Due to the unpredictable stock, disposal of returned products is considered as an option (Fleischmann et al. 1997, 7-11). Thus, by categorizing inventory by ABC tool, the excess inventory with high costs can be found. Relph and Milner (2019, 261-265) suggest following the logic of managing inventory by storing a low amount of high-value inventory at a frequently received rate and a large number of low-value items received infrequently.

3 Research Methods

This thesis is mainly based on qualitative research methods. Qualitative research relies on non-numerical data such as words, images, videos, and other similar materials. Usually, qualitative research uses questionnaires, structured interviews, or observation as a data collection tool. (Saunders, Lewis & Thornhill 2012, 161-163.)

In addition to qualitative research, this thesis requires quantitative research. This is because different IQs require different types of data for adequate validity. Quantitative research relies on statistical and numerical data which can be measured. Statistics and data analysis procedures such as data categorizing are part of quantitative research. (Saunders et al. 2012, 161-163.) Table 1 illustrates how different IQs utilize the theoretical framework and research methods to gain the wanted results.

The application of both data collection methods, quantitative and qualitative, is defined as mixed methods (Saunders et al. 2012, 164). Mixed methods design should be used when either a quantitative or qualitative approach is insufficient to answer the research problem (Creswell 2009, 35).

Table 1. Overlay Matrix

Investigative Question (IQ)	Theoretical Framework	Research Methods	Results
IQ 1. What are the current process steps in reverse logistics of dismantled materials at Company Y?	Efficient reverse logistics practices	Expert interview Desktop study Observation	Analysis of the current reverse logistics process
IQ 2. What is the current material movement of dismantled materials in the warehouse?	Inventory management for dismantled materials	Expert interview Quantitative data	Analysis of the current dismantled material stock
IQ 3. What are the points of development in the current reverse logistics operations of Company Y?	Improving reverse logistics	Expert interview Observation	Points of development in the current reverse logistics operations

3.1 Research Design

Figure 6 illustrates a research design that is specifically made to outline and organize the research process of this thesis. It is a tool that guides the author through each phase of the research.

First, the author received a research study that is connected to the topic of the thesis from the commissioning company. The author studied the preliminary research and obtained a base knowledge of the topic. During this phase, the author began working as a logistics trainee at the

company which gave the author the opportunity to start observing at the workplace. With this preliminary information, the author was able to define the research problem as well as the risks and benefits of the research.

The first phase included the literature review which is focused on the desktop research. After the literature review, research methods were carefully planned and justified. The literature review provided an understanding of the reverse logistics process and the costs of reverse logistics as well as inventory management. The base knowledge helped the author to compose interview questions to investigate the current reverse logistics process and find the potential challenges or bottlenecks in the operations. In addition to preparing interview questions, this phase included the preparations of finding the correct quantitative reports what are needed for the analysis part, and how to read the data correctly.

The second phase focused on the empirical part of the research. The data was collected with qualitative interviews and quantitative reports. After receiving the data, the data was sorted, processed, and analyzed to address the three investigative questions. IQ1 involved multiple different stakeholders as it required a large amount of data to learn how the process is done step-by-step in different process stages. After receiving the data, the author drew a flowchart of all the stakeholder activities included in the different stages. Next, IQ2 required analyzing multiple SAP reports that were connected. The IQ3 included observation findings, interview findings as well as findings from IQ1 and IQ2.

Lastly, IQ4 required data from invoices as well as from SAP reports and interviews. However, as this thesis is the public version, this step is not included in this thesis.

The third phase combined the findings from the literature review and the empirical part. With all the gathered information, the author was able to draw conclusions from the current reverse logistics operations of the case company and give proper recommendations to improve the operations. After that, the observation ended as there was no more data that could affect the recommendations.

Lastly, the author presented the findings to the commissioner and received feedback on the research. The author adjusted the final thesis based on the feedback of the commissioner. Then, the author adjusted the thesis for the public version by removing identifications of the company as well as removing the fourth investigative question to make the thesis more compact and easier for anyone to read. After the final adjustments, the research is finished and published.

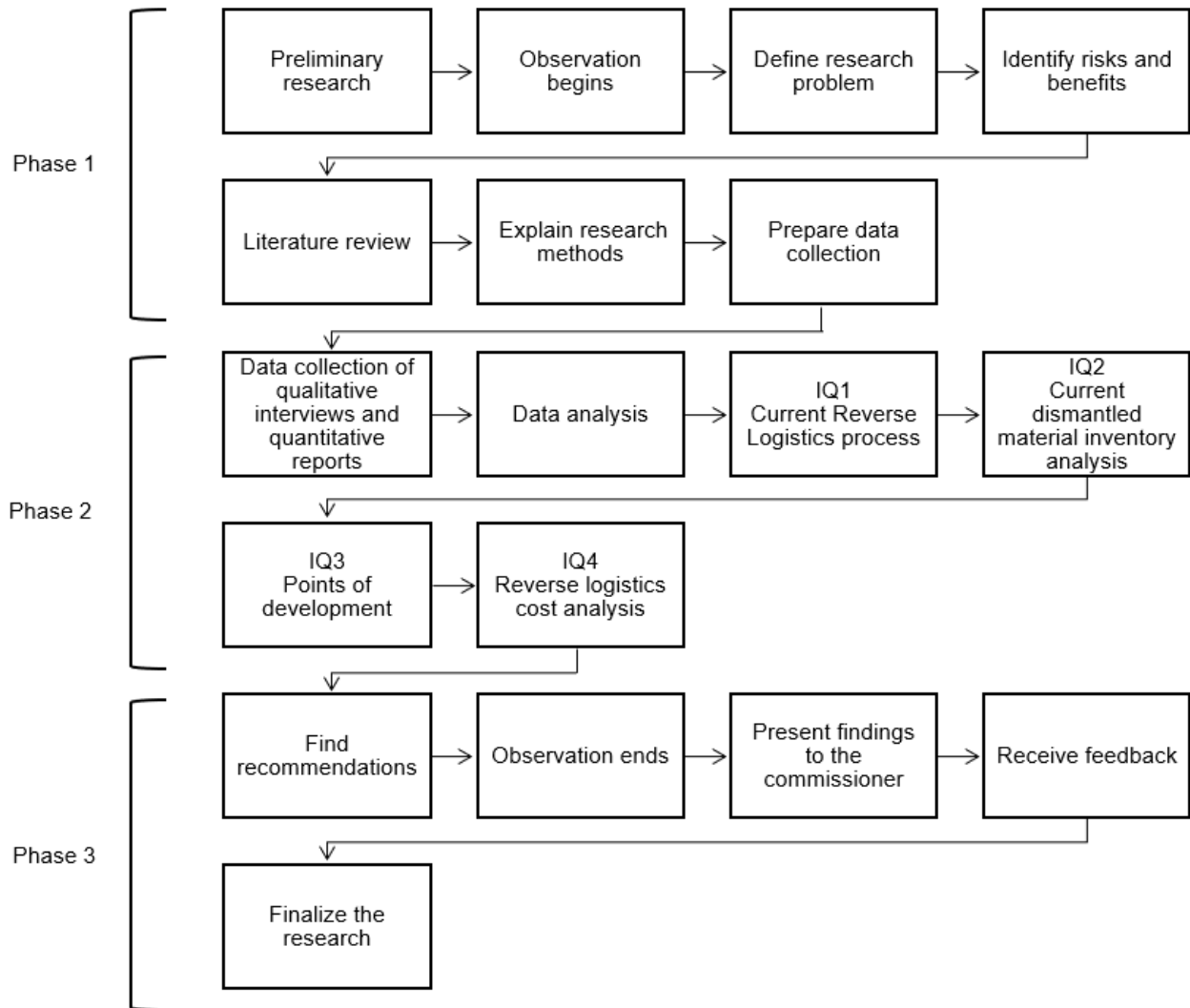


Figure 5. Research design

3.2 Data Collection

As the thesis relied on mixed research methods, the data collection also required mixed methods. Interviews were selected as the primary data for the thesis. The interview results were used in all investigative questions. Primary data is information that is collected directly from the source with a specific purpose in the research. For example, interviews, questionnaires, observations, and document collection is considered primary data. (Saunders et al. 2012, 304-306.)

The observation was utilized in IQ1 and IQ3 as primary data. Additionally, according to Saunders et al. (2012, 308-309), observation provides an additional secondary data source. Thus, this thesis utilized minutes of meetings and other meeting records as well as reports to stakeholders. This type of data was not produced specifically for this research, therefore the data functioned as secondary data.

Finally, due to the methods of the thesis, IQ2 and IQ4 required additional quantitative data from reports that provided information on reverse logistics costs and inventory data. These reports were collected specifically from the company database by the author, making them primary data.

The thesis used desktop research as secondary data to provide a base for the theoretical framework. Secondary data refers to data that has been published earlier (Saunders et al. 2012, 304-306.). Published books and e-books, company reports, invoices, and peer-reviewed research were used in this thesis as secondary data. The most crucial secondary data for this thesis was the invoices from transportation, warehouse suppliers, and waste management, which revealed all the necessary costs and prices for cost analysis.

3.2.1 Expert Interview

The primary data were collected by using semi-structured expert interviews. The list of conducted interview questions is found in Appendix 1. Semi-structured interview refers to a qualitative interview with a list of themes and key questions that provide an opportunity for a discussion over the topics. In short, it means that the interviewer and interviewee may discuss something related to the topic as a follow-up question. This allows the interviewer to be more flexible during the interview and obtain deeper information on the topics. (Saunders et al. 2012, 374-378).

Expert interview in this thesis refers to the specialized expertise and knowledge that the interviewees hold on the topic of the thesis. All interviewees were employees or stakeholders of Company Y. The employees are from the same organization which manages infrastructure strategy and operations as well as logistics and partner management.

The interviews were conducted between June and September 2024 mainly on Microsoft Teams. Most of the interviews were conducted one-on-one with the interviewer and the interviewee. However, some interviews required specific information from others, and they were invited to the interview with others, making them group interviews.

The author conducted a total of twelve interviews. The interviews included sessions where the author was instructed on how to find proper data as they were opportunities to ask questions regarding the process flow, inventory, costs, or reports overall. A detailed list of interviewees is found in Appendix 2 table 10.

The internal employee interviewees were the Supply Chain Manager, Senior Development Manager, Senior Network Specialist, Chief Network Specialist, Project Manager A, Contingent Worker, Special Expert A and Special Expert B.

The external interviewees were two employees from Company D or in other words, FIBV Warehouse: Team Leader A and IT-assistant, and two employees from contractor company A: Project Manager B and Team Leader B.

Additionally, the author held a total of four progress review meetings during the research where the author presented the progress to the Logistics Team and the commissioner. This provided additional feedback during the thesis progress which allowed the author to adjust the thesis according to the feedback. A detailed list of the participants is found in Appendix 2 table 11.

3.2.2 Observation

Observation is a lesser-known data collection method in research. In short, observation involves systematic observation, recording, description, analysis, and interpretation of people's behavior and actions. It can be either quantitative with structured observation, or qualitative as participant observation. (Saunders et al. 2012, 340-343.)

As the thesis was taken place in the real-world work environment, the author had a unique opportunity in observation while working. The observation began in May 2024 and ended in September 2024. The author did observations at work during fieldwork such as warehouse visits, business meetings, stakeholder meetings, e-mails, and other conversations at the workplace. Observation provides additional information about the topics while deepening the author's knowledge (Yin 2018, 122-125).

This thesis used participant observation with the author's identity being revealed. This means that the informants were informed of the thesis which the author was conducting. By having the identity revealed in observation, the author is involved in participation. The author used two different participation roles in observation. First, the author used the observer-as-participant role, which primarily involved the author just observing. By only observing, the author focused on the research and did not interact with participants too much. However, in the work environment, this can be difficult. Therefore, the author used a more active role of being participant-as-observer. This is a crucial role in this thesis, as the author was not only a passive observer but also a participant in the actions that were studied. (Saunders et al. 2012, 344-345.).

3.2.3 Quantitative Reports

Quantitative data is usually produced in such raw form that needs to be processed first before it can be analyzed and interpreted (Saunders et al. 2012, 472). The quantitative data for this thesis was produced from Company Y's Enterprise Resource Planning tool, SAP S4HANA, using different transactions.

Transactions refer to navigation codes used in SAP to perform tasks such as creating purchase orders, managing inventory, and generating reports. These codes are commonly used in SAP. Using these codes, the author produced SAP reports specifically for this research.

Before producing the data, the author was instructed by several colleagues on how to responsibly manage the SAP data. After producing SAP reports, the data was processed in Excel to produce useful and readable data that was analyzed further. Table 2 below lists the report types and SAP transactions used to produce the data.

Table 2. Produced SAP reports

Report number	Report type	Transaction Code	Transaction description	Date and time
1	Materials by last goods movement	MC.9	Material Analysis	19.7.2024 11:00
2	Material groups by last goods movement	MC.9	Material Analysis	19.7.2024 11:30
3	Number of material movements filtered by plant	MC.9	Material Analysis	21.8.2024 14:00

Quantitative reports were produced by the author whenever the author needed them. The main data was produced with MC.9 transaction in SAP. This transaction was first filtered by the FIBB plant and the period from no data to the current period of 07.2024. After executing, the key figures were selected. These reports utilized valuated stock, last goods movement, and average consumption key figures.

A second MC.9 SAP report was produced to obtain the last goods movement data by material groups. This report produced simpler data that shows which material groups are the most used and whether there is material in some material groups that should no longer be used. Material groups of zero stock were removed from the analysis as there was no inventory to analyze.

Lastly, the third MC.9 report was produced to receive data on a number of material movements in FIBB stock. This report was filtered by the FIBB plant and period of 01.2023 to 12.2023. Thus, the report only analyzed the year 2023 of material movements. This report allowed the author to produce an ABC analysis.

To properly understand data from MC.9 SAP transaction, some data was examined with other SAP transactions such as MB51 and MM03 which produced more specific data on the material. This allowed the author to see the material movement history and provided an additional understanding of the material. As these SAP transactions are used to search materials one by one when needed for

further analysis, no actual report was produced while using them. Table 3 lists the SAP transactions that supported the analysis.

Table 3. Description of supportive SAP transactions

Transaction Purpose of Support	Transaction Code	Transaction description
View material documents and track movements while investigating inventory discrepancies	MB51	Material Document List
Display existing material master data of a specific material	MM03	Display Material

3.3 Data Analysis

Observation was a constant data collection method during the thesis process. The author kept writing notes of all the findings or follow-up questions that were relevant to the thesis while working. The follow-up questions allowed the author critically to think about the process analyses and ask further questions during later interviews or via Teams.

The notes of the observation allowed the author to independently analyze the company's reverse logistics processes. After independent analysis, the findings were presented to relevant stakeholders and adjusted according to the feedback. This allowed the author to critically analyze each step of the process and produce critical questions which helped the author to find recommendations.

The interviews were conducted either one-on-one or as a smaller group online or at the office. The interviews were not voice-recorded; however, notes were taken during the interview to ensure the validity of the interview. Additionally, the same interview questions were asked from multiple interviewees to confirm the reliability of the data. This also provided an opportunity to deepen the understanding of the question and allowed the interviewee to add more information if something was missing previously.

During the inventory data analysis, the author discovered that the cables have slightly different storage method as most of the cables are purchased directly from the supplier, and the cables in stock can be new and not dismantled. Due to the different processes, it was decided that the author would not focus on the cables during the analysis. This removes material groups 340 and 301 from the analysis as these material groups contain only cable materials.

During the analysis, some material stock that was supposed to be disposed of earlier was found in the inventory reports. These materials were found due to the data collection method of selecting all FIBB stock locations instead of using the currently used X001 stock location. This finding did not affect the analysis of the data, as it was found immediately when analyzing the data. The physical

material in the warehouses has been disposed of accordingly, therefore the stock of these materials does not cause additional warehousing costs. Neither did it affect stock orders as the stock for these materials was in a warehouse location that is no longer used. However, it proves the need to monitor the stock updates to ensure that the stock data is correct.

3.4 Risks and Limitations

The highest risks are related to the availability of resources. As most of the internal data is managed as interviews, it requires efficient time management. When improving internal processes, each stakeholder must validate the development to ensure that the recommendations are possible.

Using observation as a data collection method provides access to information that is not public. This grants an unusual opportunity but also a major risk. As the information is inaccessible to the public, the data has no other collection way. The data has the risk of manipulation, especially in the participant-as-observer role, as the observer can have control of the use of documents, interviews, and archive records. (Yin 2018, 122-125.) However, this risk has been minimized by having informant verification through the interviews.

According to Saunders et al. (2012, 352) using participant observation as data collection may cause threats to reliability and validity. The setting can be unknown to the observer and lacks details that are needed to interpret the observation data, causing an observer error. To avoid this threat, the author had to understand the setting before interpreting it. Thus, the base knowledge was provided from the preliminary research and work instructions and guidance at work.

Additionally, as the observer is an employee of the company, which makes the observer an insider, the observer may take some things for granted. This can also lead to observer bias, where the observer uses their own point of view to interpret the information (Saunders et al. 2012, 352). However, as an employee of the company, the author verified the information with the team, the commissioner, and the supervisor. This allowed the observation to have informant verification.

The author considers confidentiality as one of the highest risks. As the author processed confidential and sensitive company data, the author had to ensure that during or after the thesis process, there would not be any confidential information leakages. The author followed the commissioning company's instructions on how to store and dispose of the data properly.

The risk of confidential information leakage is reduced by publishing two versions of the thesis. The first version is the company version, which is only available for company use. Therefore, it contains all the information in detail. The company version includes additional investigative question which

the public version lacks. The cost analysis is not included in the public version due to sensible financial data.

The second version is the public version for publishing and grading. The public version lacks sensitive information such as material, supplier, or other stakeholder names as well as any numerical data on prices and costs. By publishing two versions of the thesis, the company received useful thesis research without the fear of information leakage.

4 Analysis of the Current Reverse Logistics Process of Company Y

The dismantled materials are materials that have been used in mobile and telecom networks such as radios, cables, repeaters, baseband equipment, other electrical devices, brackets, and other installation structures. As the materials are not only electronic goods, but also metal structures and several types of cables, the analysis focuses on the whole reverse logistics process to acquire an overall picture and avoid listing individual case practices.

The current process of reverse logistics at Company Y requires multiple stakeholders and communication between them. Thus, Company Y's reverse logistics splits into distinct phases that communicate between different stakeholders. The stakeholders are divided into inner and external stakeholders.

The inner stakeholders are employees of Company Y, mainly from the Logistics Team, but also Network Specialists and other management. The external stakeholders are the constructors and subcontractors from companies A, B, and C, the warehouse stakeholders from companies D and E, the transportation, and the waste management.

To have a clear understanding of the current reverse logistics processes, each subchapter includes a process flowchart of the phase. These flowcharts illustrate the process flow from the start of dismantling the material to the warehouse or final disposal. The flowcharts are split into three phases. The first phase is material retrieval or disposal during the dismantling of the network, while the second phase is about warehousing the dismantled material, and lastly, the third phase is about the value-added services of the dismantled materials.

4.1 Dismantled Material Retrieval Process

The reverse logistics process begins with the constructors receiving an order to dismantle an old network site. With the proper order, the constructors begin dismantling the network site according to the instructions.

The constructors are responsible for the first-hand inspection according to the instructions. During the inspection, the constructors select which materials will be disposed of as WEEE and which materials will be sent to the warehouse for reuse purposes. This inspection aims to discard old, broken, or undesirable materials.

According to Project Manager B of constructor company A, the inspection is performed either at the dismantled network site or at the constructor's warehouse. This depends on the constructor's technical knowledge about the dismantled materials as well as the reverse logistics process. If the

dismantling is done by a subcontractor, the inspection is done at the main constructor's warehouse. This means that potential WEEE is transported from the dismantled site to the contractor's warehouse before actual WEEE collection.

According to Project Manager B, old, broken, or undesirable dismantled materials are collected by the constructor in a WEEE collection container. The container is rented by a waste management supplier to the constructor. After the collection bin is full, the constructor orders transportation to the waste management supplier. The waste management supplier replaces the full WEEE container and transports the WEEE to the waste treatment facility. In the facility, the waste management supplier then sorts the dismantled material to correct waste recycling processes and obtains raw materials from the waste.

Team Leader B of the constructor company A adds that dismantled material may receive a double inspection, first at the dismantled site and the second at the constructor's warehouse. The second inspection is the more critical inspection which is done by employees with proper technical knowledge of the materials. This inspection is done while listing the dismantled materials for reuse purposes on a return form.

The return form is a list of approved materials that are accepted for reuse purposes for network construction. The return form additionally includes instructions if certain bundle products need to be disassembled into product types (e.g. Mini repeater should be disassembled into a power supply, two different modem kits, and a jumper cable). These disassembled bundle parts can be later reused separately as they have different material codes for identification. In addition to the return form, according to Special Expert B, the constructors have access to an information bank that contains instructions for their reverse logistics process in more detail.

If the dismantled material is on the approval list, the constructors begin packing the materials based on the instructions they have received for the materials. In addition to packing the dismantled materials, marking the packages, and the return form, the constructor is also responsible for obtaining the packaging material. According to Project Manager A, the constructors are instructed to reuse existing packaging material to avoid waste. However, according to the return form instructions, certain materials require additional packaging material to protect the components. This means that the constructors handle the supply of packaging material by themselves unless it is a certain type of protective packing material which then will be ordered by a warehouse stakeholder.

The constructors fill the return form which includes a list of dismantled materials the constructor is going to return to the warehouse for reuse purposes. The form is sent to the warehouse stakeholder who continues processing the form. The warehouse stakeholder selects the correct

warehouse for storing the dismantled materials as well as orders appropriate transportation. The transportation depends on the size of the return. Finally, the warehouse stakeholder generates an identification for the return. According to IT-assistant of warehousing company D, this identification code can be used to track improper returns to its' original dismantler.

According to Project Manager B, proper documentation is required to finish the project of dismantling a network. This requires a transport tracking code, the return identification code, and an overall photo of the whole set of dismantled materials packed. After receiving the information, the constructor submits it to a network construction database.

After the form has been processed, the form is sent back to the contractors with transportation information with a copy to the Logistics Team. Depending on the size of the dismantled material, the constructors pack the dismantled materials in postal packages, pallets, or roller cages. Lastly, the transportation service picks up the delivery from an agreed place and delivers it to the selected warehouse.

Figure 7 illustrates phase one of the reverse logistics process, the process flow of dismantled material retrieval. As the reverse logistics process requires multiple stakeholders and steps, the flowcharts illustrate these steps to recognize the process more clearly. As the reverse logistics process continues, phase one ends when the dismantled material is taken by the transportation.

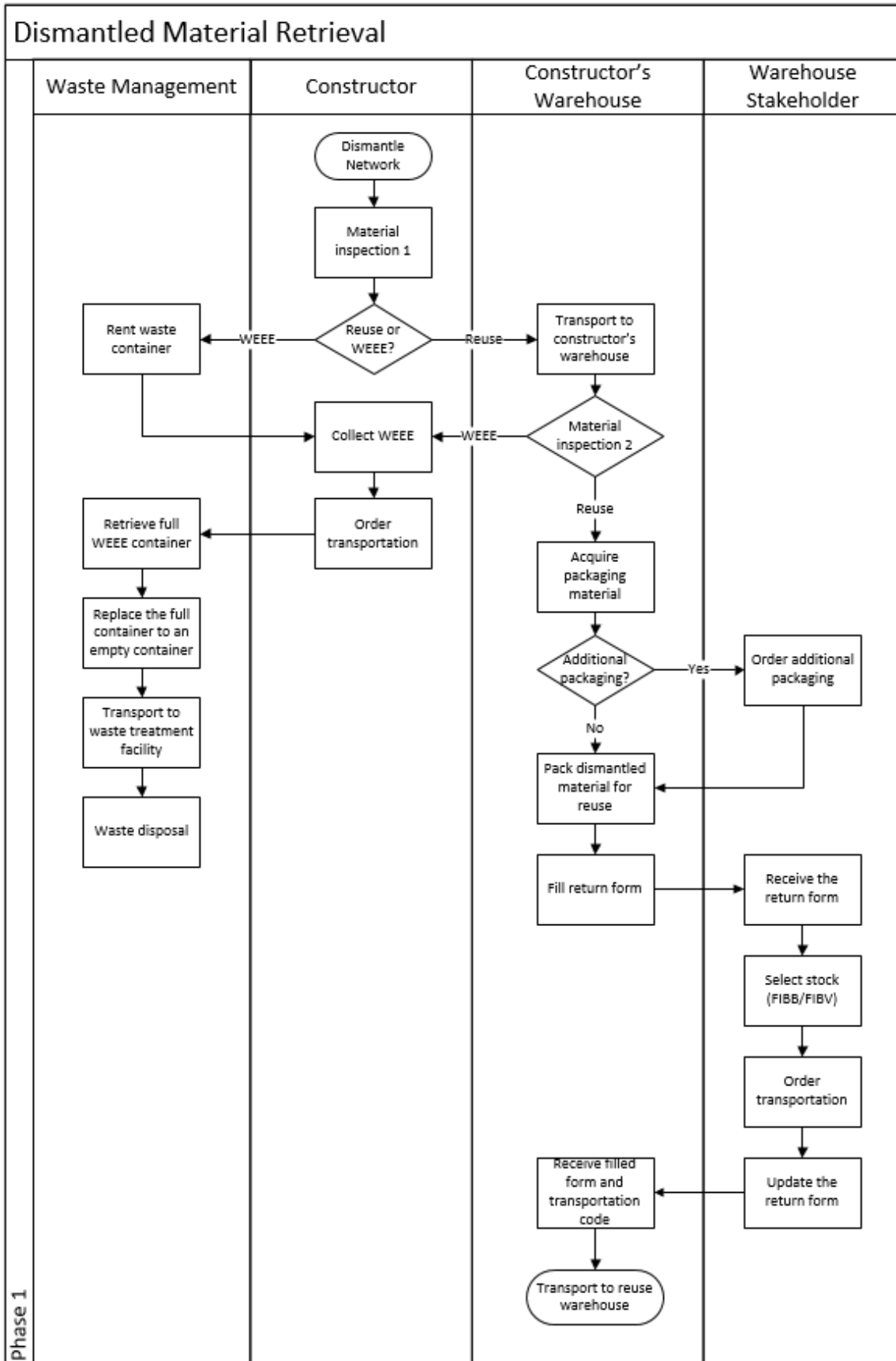


Figure 6. Flowchart of dismantled material retrieval process (Author's own)

4.2 Dismantled Material Warehousing Process

According to the Senior Development Manager, the dismantled materials are stored in two warehouse locations depending on the quality and the state of the material. If the dismantled material does not require further inspection or update, it is stored in the FIBB location. If the dismantled material requires inspection, it is stored in the FIBV location. This is the stock where certain materials are directed which require inspection or software update before reusing. Thus, the remanufacturing and repairing value recovery is done in FIBV stock. The stock destination has been selected by the warehouse stakeholder in phase one of dismantled material retrieval. Table 4 illustrates the properties of different warehouse locations.

Table 4. Company Y's warehouse types

Location	Warehouse company	Warehouse name	Description
FIBB	Company E	BB 0%	Unbroken dismantled material
FIBV	Company D	Mobility Dismantled	Dismantled material for evaluation or update
FIBK	Company E	Valuated	Valuated new material

FIBB is the primary location for dismantled materials that fulfill material orders for reuse purposes in network building. The constructors send dismantled materials which are inspected only by the constructor to the FIBB warehouse location. These materials should be marked correctly on the packages, with the correct components while being in working condition. Thus, these materials require no later inspection at the warehouse as they should be functioning materials and ready for reuse.

According to Special Expert A, the materials in FIBB and FIBV are considered as financially zero value, or in other words, non-valuated materials. Although the value is zero in inventory, the materials hold value for reuse purposes as reusing material decreases the need to buy the material as new.

Some returns can be stored in FIBK with an exception. FIBK is the warehouse that stores valuated materials. According to Special Expert A, these materials are new and have not been used in network construction. Thus, the value of the material is the same as new and it can be stored in FIBK. These returns are possible if the network construction receives additional materials, or the construction has been canceled or postponed.

The selected warehouse receives the packed dismantled materials with the filled return form. Without the form, the warehouse cannot recognize the materials or the warehouse location. If the

dismantled material is sent to the warehouse without a proper form, the warehouse employees need to ask the Logistics Team by e-mail for material recognition or find an e-mail copy of the form.

After processing and placing the materials into stock, the warehouse updates their warehousing system to correct the stock quantity. Depending on the warehouse, this stock update is also automatically updated to Company Y's enterprise resource planning system. If it is not automatically updated, the warehouse employees must inform the logistics team by e-mail about the stock change. After that, the logistics team updates manually the stock in their system.

The warehouse records the spent time on returned materials, which allows the Logistics Team to measure the efficiency of the warehouse processing times. The Logistics Team and the warehouse hold meetings regarding material returns weekly and biweekly which promotes good communication between the stakeholders and an opportunity to inform potential bottleneck situations.

Figure 8 illustrates the flowchart of the dismantled material warehousing process. This allows to understand phase two better on how the warehousing is done with two different warehouses. As seen at the end of the flowchart, the dismantled material stored in the FIBB warehouse is already ready for reuse purposes. This means, that if the dismantled material is processed according to the flowchart, the dismantled material can be ordered for reuse purposes from the warehouse for new network construction. However, the reverse logistics process does not end in this phase, thus the phase two process ends with the logistics team monitoring the stock. This is due to the final phase three process which will be explained in the phase three more in detail.

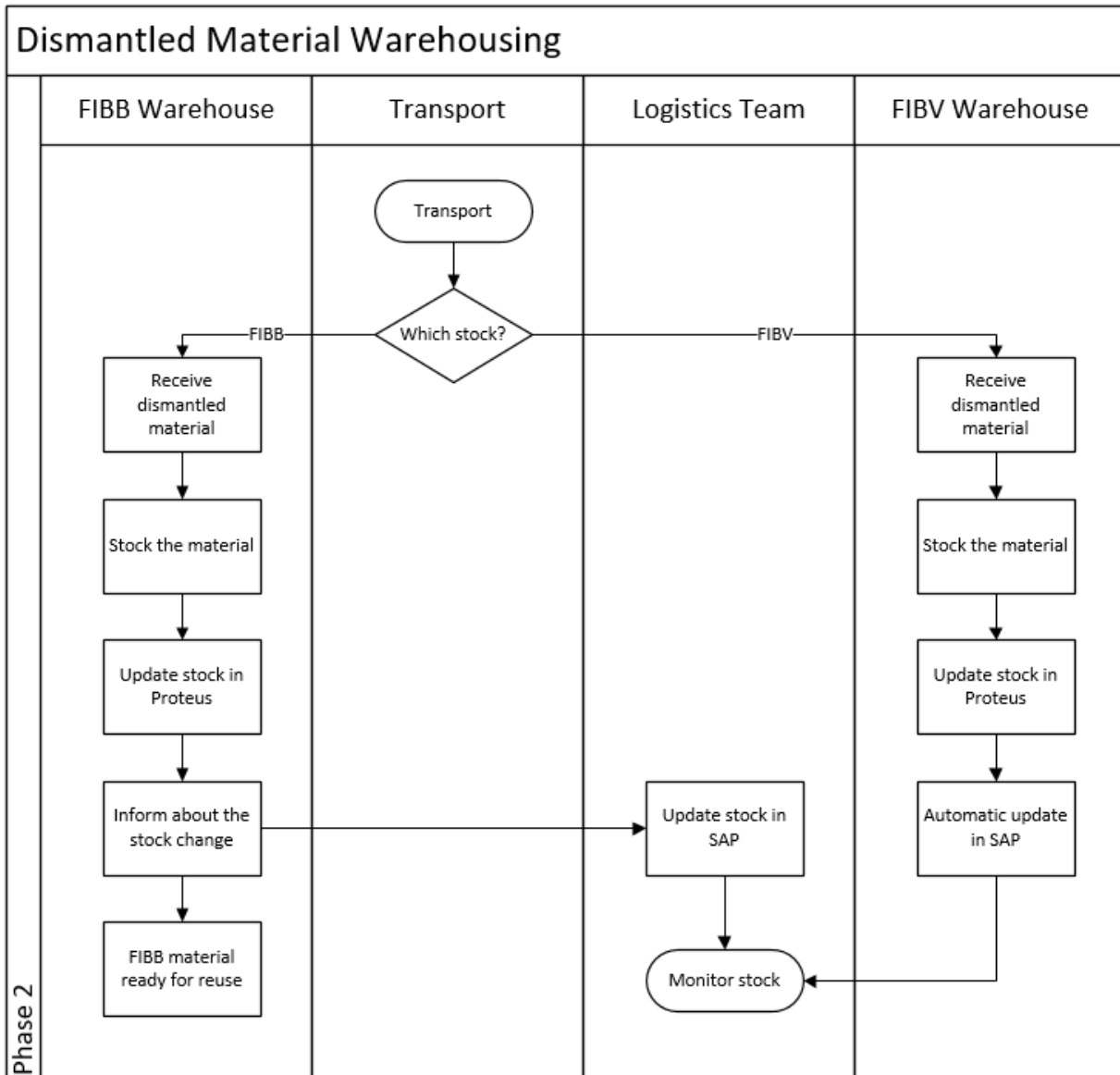


Figure 7. Flowchart of dismantled material warehousing process (Author's own)

4.3 Dismantled Material Value-Added Services

During the analysis, the author found three main value recovery activities for reuse purposes: refurbishing, remanufacturing, and repairing. Additionally, the author found two main value recovery activities for material disposal purposes: resell and scrap. As they were described in Chapter 2.1, refurbishing refers to adjusting the used material to a specified quality, remanufacturing refers to re-making the product to fit the quality standards, repairing refers to returning the used product into working condition, reselling refers to an exchange of ownership for money, and finally, scrapping refers to final disposal as waste.

As it was discussed in Chapter 4.1, the constructors are responsible for the first-hand inspection and disassembling of the dismantled material according to the instructions. This means that the constructors do the main refurbishing value recovery. The constructors inspect, disassemble, and pack the material for reuse purposes.

If dismantled material is listed as WEEE in the return form, or the material is in such condition that it cannot be reused, the material is scrapped as WEEE already at phase one as described earlier. Scrapping materials as WEEE provides the least amount of value recovery and it should be considered as the last resort.

The Logistics Team ensures the stock rate for each warehouse. Thus, the Logistics Team monitors the FIBB stock frequently. If FIBB stock is running low and it is considered as a needed material for network construction, the Logistics Team orders a stock transfer which includes inspection, update, or repair of FIBV materials which then can be transferred to FIBB stock. The stock transfer includes the same stock updates that are required to keep up the stock data. However, the dismantled FIBV material list is limited, thus not all dismantled material can be found in both warehouses.

According to Special Expert B, the material orders are aimed to be packed in a single warehouse instead of dispatching multiple packages from different warehouses to reduce the number of deliveries. Thus, FIBB stores dismantled material that has been updated or repaired from the FIBV warehouse. This makes the warehousing company E as the main warehouse for material deliveries.

Not all dismantled material should be repaired or remanufactured as it becomes too expensive when it may require remanufacturing by the original manufacturer. However, according to Senior Network Specialist, some material is no longer produced which means that those materials must be remanufactured no matter the higher costs. Thus, only selected dismantled materials are repaired, refurbished, or updated.

In general, the Logistics Team monitors the stock rates. By monitoring the rate, the Logistics Team finds non-circulating material that is no longer used in networks, has accumulated too much in storage, or the repair and refurbishing costs too much compared to the original purchasing price. Such dismantled material is then sold to third parties or scrapped as WEEE.

According to the Senior Development Manager, the dismantled material for resale is processed in reverse logistics as the same as usual dismantled material. This means that the dismantled material is inspected, refurbished, and repaired before selling the material. Additionally, if the reselling action is triggered by the surplus of inventory, it means that the excess dismantled material has accumulated inventory and warehouse costs.

Special Expert A and Senior Network Specialist add that due to the technological properties of the disposed material, some materials are dual-use goods. This restricts selling certain materials to third parties, as it holds a risk of exporting dual-use goods to countries that can weaponize the material. Thus, dual-use material can only be disposed of as waste, and it is forbidden to sell to third parties.

The Logistics Team sends an inquiry to a third-party buyer of their excess dismantled materials. The third-party buyer sends a list of agreed materials and their current need and stock availability. The Logistics Team selects what materials and how many can be sold based on the list. After agreeing on the materials, the Logistics Team arranges a stock order which lets the warehouse pick up the sold goods and begin the delivery process.

Potential disposable dismantled material requires approval from Life Cycle Management (LCM) or other Company Y's inner stakeholders. The Logistics Team or Network Specialists enquires LCMs when inventory accumulation has been noticed. Senior Network Specialist adds that the LCM team is not actively analyzing the inventories; thus, the request must come from the stakeholders who are actively monitoring the inventory activities.

Finally, the surplus dismantled materials from warehouses receive approval for disposal. The logistics team orders a stock update for the warehouse. The warehouses collect the approved material for disposal in WEEE collection containers similarly to how constructors collect disposed material. After the collection is full, the warehouse similarly orders transportation to the waste management supplier for waste processing.

Figure 9 illustrates the last phase of the reverse logistics, phase three or in other words, dismantled material value-added services. This flowchart illustrates the decision point after monitoring the stock and how the dismantled material is ready for reuse purposes after value-added service from repair or update activities.

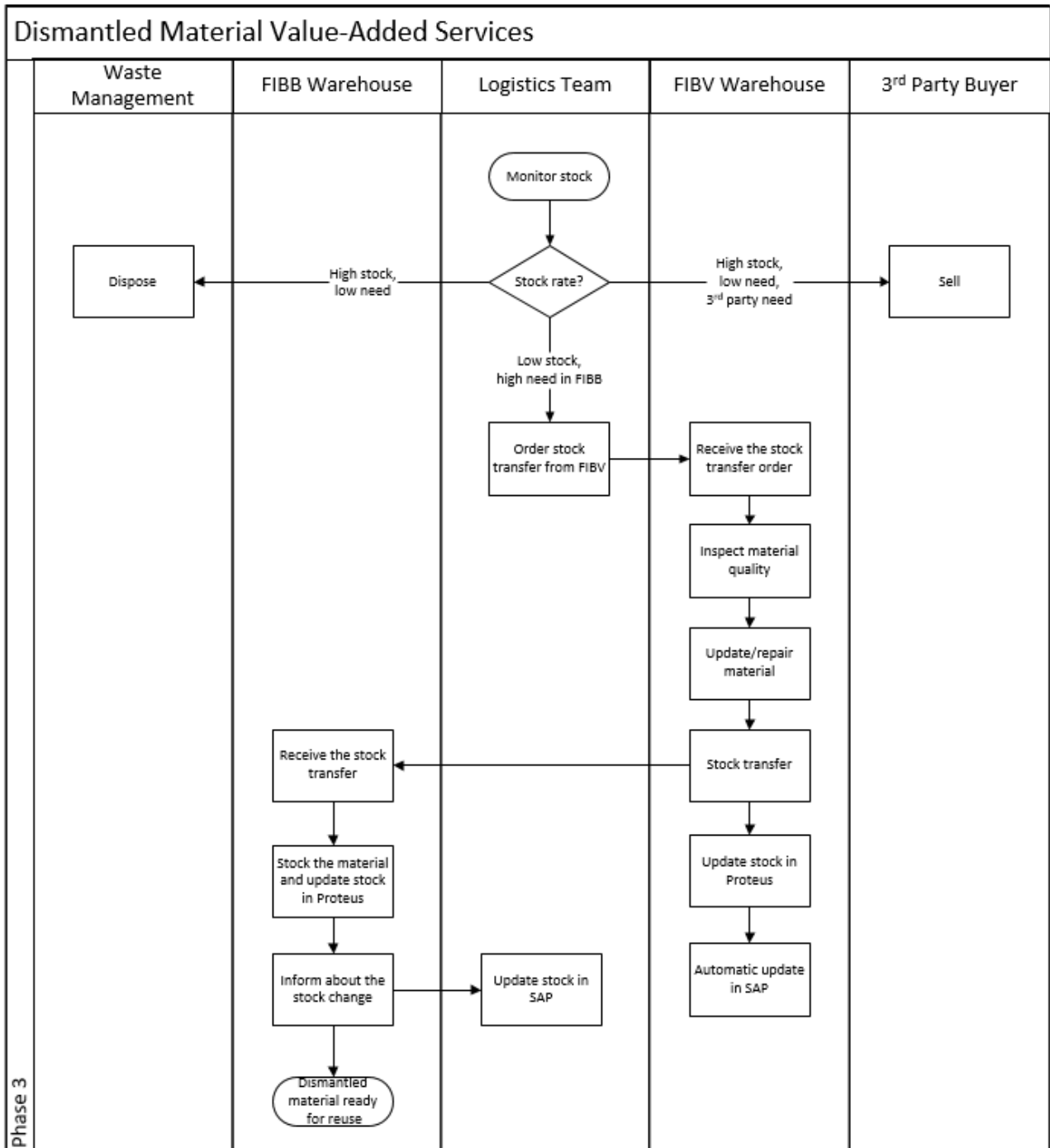


Figure 8. Flowchart of dismantled material value-added services process (Author's own)

5 Analysis of The Current FIBB Dismantled Material Stock

As reverse logistics require different types of inventories due to quality differences, it is possible to unintentionally neglect the impact of inventory due to non-valued stock. Therefore, to find points of development to improve the reverse logistics operations, the non-valued inventory is analyzed.

This analysis focuses on FIBB stock, as it is the primary warehouse location for dismantled materials. However, FIBB stock contains two different types of material: non-valued dismantled material and non-valued write-offs. According to Special Expert A, write-off refers to material that has been originally stored in valuated storage as new material and later recognized as reduced or zero value of an asset. Due to this storage method, it is not possible to only analyze dismantled materials in the inventory.

Special Expert A adds that write-off materials in FIBB stock are materials that may not be produced anymore. This means that a supplier is no longer offering the materials and the material in Company Y's stock is the only available stock. Thus, Company Y cannot dispose of the material before ensuring the reserve buffer for old materials that are still in use in networks.

The current FIBB stock is first analyzed by the last goods movement and the material groups to find materials with long stock ages as well as materials that have no material movement data. After this, the inventory is categorized by the ABC categorization method. With these analyses, it is possible to find potential non-circulating dismantled materials.

5.1 Last Goods Movement

Using last goods movement data allows to see an overview of the inventory movement. This filter gives a general idea of the age of the stock. By grouping materials into stock age groups, the material can be investigated further as to why the material is still in stock or if the stock data is correct.

However, the last goods movement data in MC.9 only shows the last time the material received an update in their stock data. Further information on the stock update data can be searched by using MB51 transaction in SAP. This updated data can mean for example a stock-taking when the warehouse has done an inventory check for the stocked items and updated the stock-corrections, or stock transfer for write-offs by using goods movement transaction.

Using product 9041842 as an example, the MC.9 report reveals that product 9041842 has four pieces in stock with the last goods movement in 2024. Figure 10 illustrates how the MB51 transaction in SAP shows the material movement data for one material. By investigating further with MB51 transaction, the data reveals that nineteen pieces of the material were received in stock last time in

2017 and the last consumption of the material was in 2014. The most recent post in 2024 refers to 221 material movement type, which is a stock correction. This proves that the last goods movement data may have been done in recent years even though the material has not been used from the stock for ten years.

Material		Material Description			
Location	MvT	S Mat.	Doc.	Item Pstng Date	Quantity in UnE EUn
9041842		EMP-Ylijännitesuojakotelo			
X001	221	4923081407	2	05.06.2024	15- PCE
X001	202	4911012616	1	28.12.2017	19 PCE
X001	647	4906630350	1	07.08.2014	2- PCE
X001	647	4906610773	1	01.08.2014	1- PCE
X001	647	4906208851	1	24.03.2014	1- PCE

Figure 9. Screenshot of material movement list (Obtained using MB51 in SAP)

FIBB includes two different types of stock. Materials stocked by pieces (PCE) and metered goods. The total stock of PCE inventory is 23 629. The last goods movement from 2008 to 2020 totaled 2 267 materials while materials from 2021 to 2024 totaled 21 362 materials. This means, that the materials that have been kept in the warehouse longer than five years consist of 10% of the whole stock in FIBB.

Though, the major amount of inventory, 19 586 PCE, has a last goods movement date between 2023 and 2024. This is 83% of the whole FIBB PCE stock. Thus, it is possible to say that nearly 85% of the current FIBB PCE stock has a last goods movement date between 2023 and 2024.

Figure 11 illustrates the total material PCE count based on the last goods movement year. This reveals that total 541 material has not moved from the warehouse since 2008 according to SAP data. Based on the age of the material, it is possible to say that these materials have not been used in network construction since they were received in the stock.

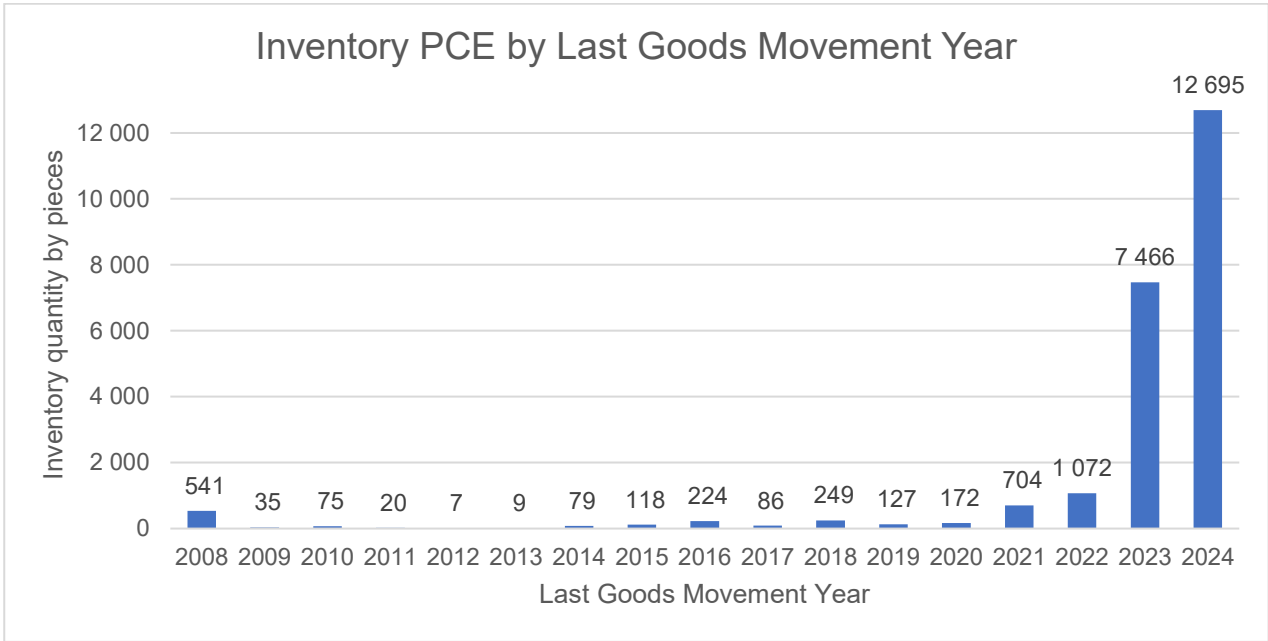


Figure 10. The current PCE inventory quantities sorted by last goods movement year

In addition to PCE materials, materials stored by meters were analyzed separately as the numerical data would change the result of the analysis drastically. Therefore figure 12 illustrates the material stocked by meters and its' last goods movement by years.

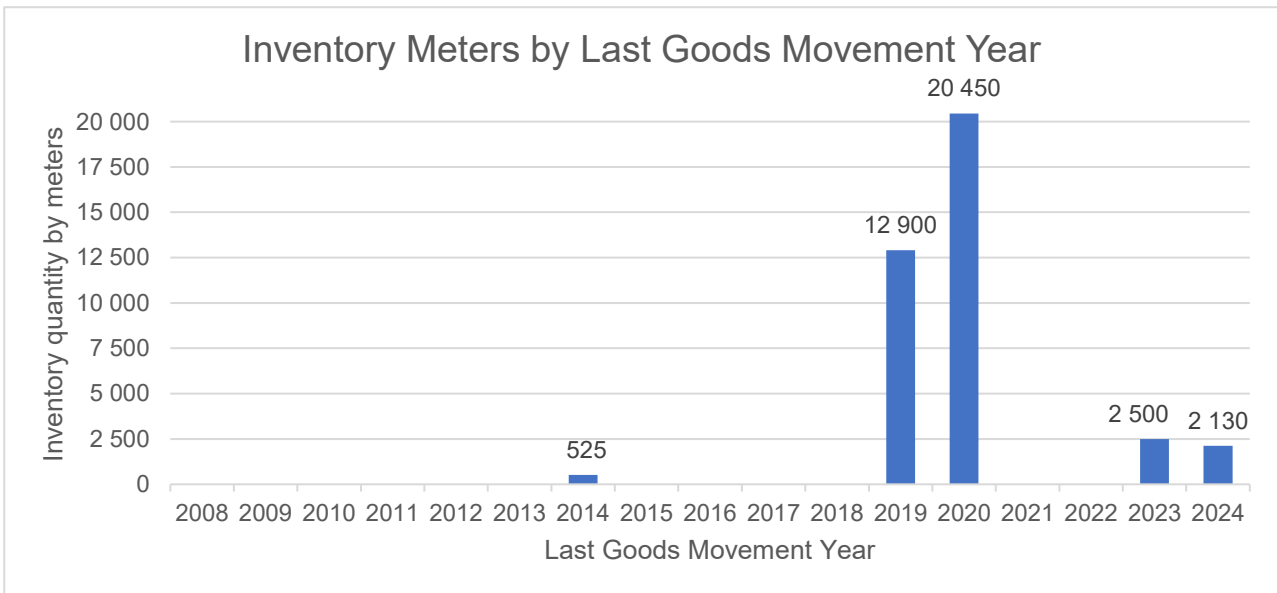


Figure 11. The current metered inventory quantities sorted by the last goods movement year

A total 38 505 meters of materials are stocked in FIBB. Out of 38 505 meters, only 4 630 meters have had a recent last goods movement in 2023 and 2024. This means only 12% of the stock has been in recent use in 2023 and 2024, while 88% of the stock has no movement data since 2020.

By combining the PCE stock and metered stock allows to analyze the total material movement of the stock. The total stock combined PCE and meter inventory in FIBB is 62 184. Figure 13 illustrates the total stock distribution by the years of goods movements.

Last goods movement from 2008 to 2019 totals 14 995 materials, which means that 24% of the inventory has not had any material movement history since 2019. In other words, 24% of the total stock has been stored in the warehouse for at least five years or more.

16% of the inventory has material movement history in 2023 and 24% in 2024, totaling 24 761 materials. This is 40% of the inventory having a last goods movement during recent years 2024 and 2023. The remaining inventory from 2020 to 2022 contains 22 398 materials, making up 36% of the inventory.

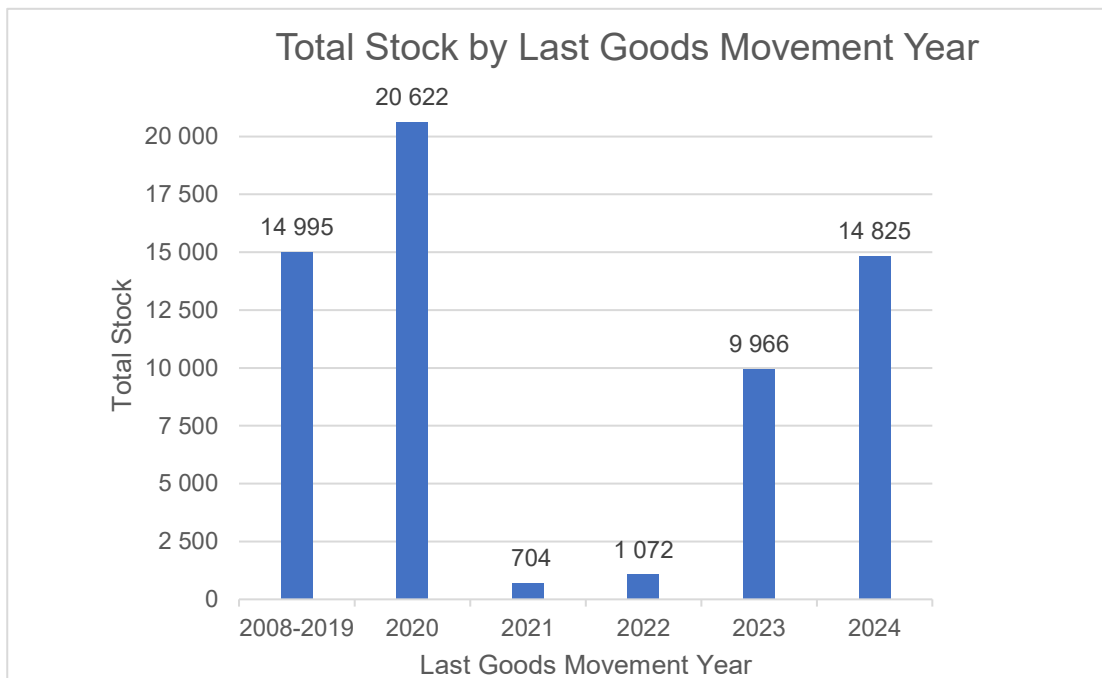


Figure 12. The percentage distribution of the total stock by the years of goods movements

Thus, with the last goods movement data, it is possible to say that 76% of the total stock has the latest movement between 2020 and 2024, while the remaining 24% of the total stock has not moved for at least five years. This means that 14 995 pieces of material have been in stock for at least five years.

These 24% of the stock should be investigated further to see if they should remain in stock in such quantity or if can they be disposed of. When investigating further on the material movement by using supporting SAP transaction, MB51, the author finds 687 pieces of material with no data on the material movement history. This means that the material has been in the stock since they have

been added in stock with no movement after storing. Figure 14 shows a screenshot of the SAP using MB51 transaction while searching for material with no material history data.

Material	Material Description						
Location	MvT	S	Mat. Doc.	Item	Pstng Date	Quantity in UnE	EUn
List does not contain any data							

Figure 13. Screenshot of material movement list with no available data (Obtained using MB51 in SAP)

By investigating further the material with no data availability, the author picked randomly two materials with no material movement history. Figure 15 lists two materials with the last goods movement data of 2008 but no data on material movement. This means that the material has been in stock since 2008 and has not moved from stock since then. This triggers a need for confirmation from the warehouse if their stock matches the data produced by SAP. During the analysis, Special Expert A confirmed with warehouse E that the stock report matches with their system data.

Thus, the finding reveals that some materials have in fact been in stock since 2008. More of such material could be still found in the stock as this was only a random pick from the author. This highlights the importance and need of maintaining the inventory regularly.

Material	ValStockValue	Valuated stock	Last gds mvmt.
Total	0,00 EUR	27 PCE	
9018855	0,00 EUR	17 PCE	02.01.2008
9030516	0,00 EUR	10 PCE	02.01.2008

Figure 14. Screenshot of last goods movement data (Obtained using MC.9 in SAP)

By analyzing the current stock with the last goods movement data, the author confirms that the stock contains a significant amount of non-circulating goods. These materials should be examined for their true need and disposed of appropriately.

5.2 Material Groups

Another way of analyzing the current stock is by material groups. As mentioned in Chapter 4.1, the Network Specialists are responsible for their material groups, and some expect the Logistics Team to inform them about non-circulating materials.

MC.9 report allows an investigation of material groups with the quantity of the inventory sorted by date when using the last goods movement filter. This report produces sixty-four material groups and filtering out the material groups with no stock, it provides fifty material groups to be analyzed.

Filtering the data by year of last goods movement in Pivot, figure 16 sums the total material quantities within the material groups by material movement year. With this filter, it is possible to investigate further the material groups which have no recent material movement data.

Although it was discovered earlier that there are materials stored in the warehouse since 2008, there are no material groups with material movements no later than 2012. This means that the last goods movement of the material group refers to the latest material movement in that material group.

3	Sum of Valuated stock	Year							
4	Material Group	2012	2013	2014	2016	2022	2023	2024	Grand Total
38	783							267	267
39	784						38		38
40	800							8	8
41	801							2	2
42	810							284	284
43	820							26	26
44	823							2157	2157
45	824							96	96
46	825				18				18
47	999			70					70
48	1098							2	2
49	1207							5	5
50	1266					3			3
51	1351							1468	1468
52	9999							81	81
53	Grand Total	31	2	70	205	23	464	61347	62142

Figure 15. Screenshot of pivot table total material quantities in material groups by last goods movement year

Pivot reveals seven material groups with a total of 308 pieces of material that had a last goods movement before 2019. This means that these seven material groups have had no material activity for five years or longer.

Figure 17 illustrates the sum of the material quantities in material groups with the latest material movement year between 2012 and 2016. With this chart, it is possible to see material group 741 has the most materials, containing 186 pieces of material.

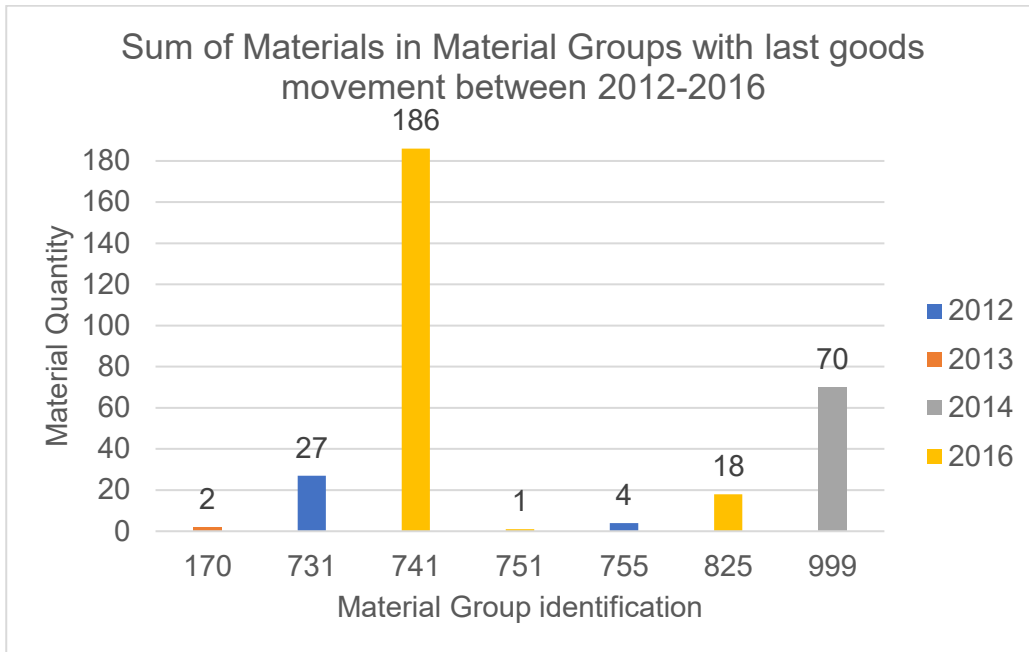


Figure 16. The sum of materials in material groups with the last goods movement between 2012-2016

However, as it was earlier discussed, the material movement contains all activities from receipt, usage, stock correction, and disposal. This means that the material group's last goods movement may include dates of material that is no longer in stock. Thus, using the MC.9 SAP transaction, a more detailed report per material group can be produced.

Using Material Group 741 as an example, MC.9 shows the last goods material movement for the remaining stock in 2008 and 2009. Figure 18 lists the remaining material in material group 741.

Material	Valuated stock	Last gds mvmt.
Total	186,000 ***	
9019773	180 PCE	02.01.2008
9019789	5 PAC	04.12.2009
9020241	1 PCE	16.07.2009

Figure 17. Screenshot of material group 741 last goods movement (Obtained using MC.9 in SAP)

This reveals a major concern for the materials groups. Some material groups are not up to date with the materials in the network. This confirms the suspicion that there is no coherent approach to who is responsible for updating the material group and the materials within the material group.

Additionally, the material group analysis provided an insight into potentially unnecessary material group. Material group 9999 was found with the name “Deleted/obsolete” which contains eighty-one pieces of materials. According to Special Expert A, this material group was originally made by a different team at Company Y’s international operations, and it is not used the same as the name would assume.

A general assumption of this material group would be, that the materials would be disposed of soon. Figure 19 lists the materials inside this “deleted/obsolete” material group and the last goods movement date. As seen from the last goods movement column, some of the materials have not been moved from stock since 2015.

Material	ValStockValue		Valuated stock		Last gds mvmt.
Total	0,00	EUR	81,000	***	
9026876	0,00	EUR	27	PCE	31.10.2022
9069463	0,00	EUR	24	PCE	08.12.2021
9026878	0,00	EUR	12	PCE	31.10.2022
9027033	0,00	EUR	6	PCE	24.11.2016
9030543	0,00	EUR	3	PCE	24.11.2016
9027443	0,00	EUR	3	PCE	22.02.2016
9028457	0,00	EUR	2	PCE	24.11.2016
9027441	0,00	EUR	2	PCE	10.11.2015
9028559	0,00	EUR	1	PCE	03.01.2020
9028455	0,00	EUR	1	PCE	10.11.2015

Figure 18. Material group 9999 stock (Obtained using MC.9 in SAP)

Using material 9026876 as an example, figure 20 reveals several goods movement data on material between 2016 and 2022. This means, that these materials in the 9999 material group are not restricted in use in SAP. In other words, it is possible to add such materials in stock. As the materials in the 9999 material group are not restricted in use, they keep being active materials while being in the warehouse and causing unnecessary warehousing costs.

Material		Material Description							
Location	MvT	S	Mat. Doc.	Item	Pstng Date	Quantity	in UnE	EUn	
9026876		NI-2-155SM-155SM							
X001	202		4919986089	31	31.10.2022	2	PCE		
X001	202		4917154858	5	24.08.2021	4	PCE		
X001	202		4916206159	2	30.03.2021	4	PCE		
X001	202		4916206294	2	30.03.2021	1	PCE		
X001	202		4916081166	4	11.03.2021	16	PCE		
X001	647		4912414530	1	19.02.2019	5-	PCE		
X001	647		4909433878	7	13.10.2016	5-	PCE		
X001	647		4909179595	1	08.08.2016	2-	PCE		

Figure 19. Screenshot of 9026876 material movement list (Obtained using MB51 in SAP)

As previously found, 9026876 belongs to the 9999 obsolete material group. Using the MM03 transaction in SAP allows to investigate the historical date when this material was moved into the 9999 material group. Figure 21 shows that the material received a material change update in 2015 which made the material move into the 9999 material group.

Material 9026876 Changed by FHU9585 Date 20.05.2015 Time 20:29:37					
Action	Org. Unit	Field Desc.	Old Value	New Value	Additional
Entry		Material descr. in language			DA
Entry		Material descr. in language			NO
Entry		Material descr. in language			SV
Change		Material Group	172	9999	

Figure 20. Screenshot of material change history of material 9026876 using MM03 in SAP

This proves that using the 9999 obsolete material group does not restrict the material movement although the material might no longer be used in network construction, nor it has other activity in stock than warehousing.

5.3 Number of Material Movements in ABC Categorization

Due to non-valued stock items, a general ABC analysis cannot be done to find the highest value of materials. However, it is possible to analyze the number of material movements to find the most frequently used materials. The purpose of this ABC categorization is to find proof for the frequency of use.

However, using the number of material movements as the ABC categorization can have several risks and limitations. The number of material movements does not account for the value of the materials. This means that a low-cost material may contain high material movement that causes the material to be categorized in segment A. Though, even with the risk and limitations of using the number of material movements as criteria, it is useful in this case when analyzing the frequency of the material movement.

It is important to note that the material movements contain all activities done to the material, whether it is material return, stock transfer order, or stock count update. Therefore, using the count of material movements may distort the result if the data is only used to evaluate the material usage.

The ABC categorization criteria were assigned as following: A segment contains 70% of the number of material movements, B segment contains 20% of the number of material movements, and C segment contains 10% of the number of material movements.

Table 5 illustrates the ABC categorization of 3104 unique material descriptions. The analysis was done for the year 2023 FIBB materials. During 2023, the total material movement of FIBB stock was 5384.

Table 5. ABC Categorization by number of material movements

Category Segment	Unique material descriptions	Percentage of Materials	Number of material movements	Percentage of Movements
A	62	2,00 %	3776	70 %
B	190	6 %	1071	20 %
C	2852	92 %	537	10 %
Total	3104	100 %	5384	100 %

Segment A holds 62 materials with a total of 3 886 material movement which is 70 % of the total FIBB material movement. This is 2% of the unique material descriptions in the FIBB inventory. Materials with high movement rates spend less time in the stock, thus inventory levels can be optimized by focusing on these materials.

Thus, the materials in segment A are used frequently in network construction, which means that these materials should be readily available in stock to avoid buying them as new. This means that these materials should be focused on returning faster from the dismantled site or having them refurbished or repaired instead of waiting for a stock transfer order.

Segment B holds 190 materials with 1 071 material movement which makes 20 % of the FIBB material movement. This is 6 % of the unique material descriptions in the FIBB inventory. The movement is relatively high for such a small segment of materials.

As the material description count in segment B is rather small, it could be moved into the A segment to prioritize these materials to return in time and refurbish or repair them instead of waiting for stock orders.

Lastly, segment C holds 2 852 materials with 537 material movements, making 10 % of the FIBB material movement. This category includes 92 % of the unique material descriptions in the FIBB inventory. Segment C contains all the materials with less than two material movements within a year. This is why the segment is massive compared to other segments.

Thus, with this data, it is possible to draw a Pareto chart of the ABC Analysis. Figure 22 illustrates the Pareto chart while showing how the cumulative percentage of material movement corresponds with the cumulative percentage of material descriptions.

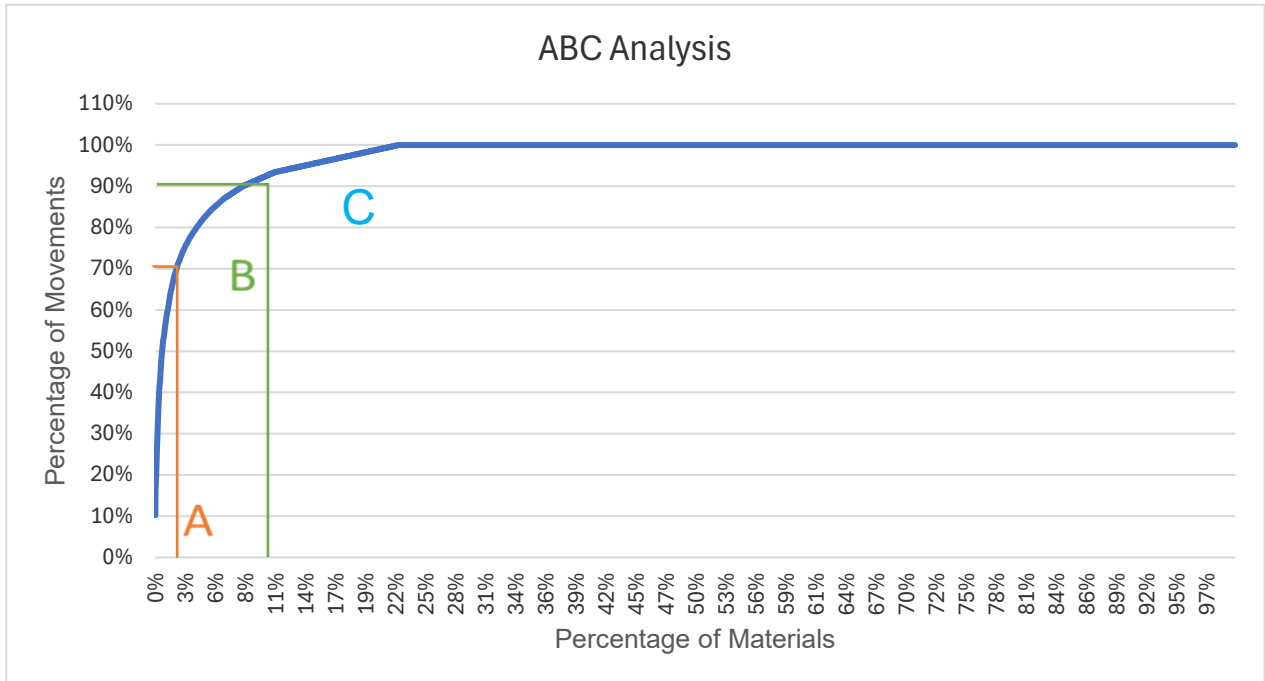


Figure 21. Pareto Chart of ABC Analysis

With the Pareto Chart, it is possible to conclude that the small percentage of materials in segment A accounts for most of the material movements. This illustrates the typical 80/20 Pareto rule in ABC categorization although it is not an exact 80/20 split.

As mentioned in Chapter 2.3, the Pareto rule allows for finding potential products for disposal. In this case, segment C should be carefully analyzed whether they are truly needed for network construction. Although ABC classification has a greater impact when the stock is up to date. By clearing the non-valued and non-circulating materials, the ABC classification can be utilized better.

6 The Points of Development in the Current Reverse Logistics Operations

Common issues should be identified to improve existing reverse logistics operations. Thus, this chapter focuses on finding the points of development in the current reverse logistics process to improve operations.

The points of development are based on the base knowledge of the current reverse logistics process from the previous analysis as well as the findings from conducted interviews. Additionally, the analysis of dismantled material inventory provided another focus on how to improve the non-circulating inventory, or in other words, how to avoid accumulating non-circulating inventory. Thus, this chapter is divided into more specific focuses on the parts of the process that should be improved in the current reverse logistics operations.

6.1 Dismantled Material Retrieval and Material Receiving Process

Although the constructors are responsible for inspecting, packing, and marking the dismantled materials as well as the return form correctly, IT-assistant admits that the warehouse cannot trust the current process. According to Team Leader A, the dismantled material is no longer supposed to be inspected at the warehouse. However, according to IT-assistant, the warehouse does frequently inspect suspicious dismantled returns due to trust issues.

The lack of trust reflects to other stakeholders if responsibilities have not clearly established. The author noticed during observation that some stakeholders frequently corrected mistakes caused by stakeholders or overall did additional work which is not part of their responsibilities. For example, the warehouse stakeholder does extra investigation for uncertain dismantled material returns. However, this poses a high risk if the warehouse stakeholder stops doing the additional work because the correct responsible stakeholder will continue to make mistakes. Thus, the faulty and mislabeled material returns are still processed in the supply chain.

IT-assistant and Chief Network Specialist claims that reusing package materials causes a risk of having wrong material descriptions and markings showing on the packaging. If the old markings on the packaging have not been erased, the warehouse may receive the material by the wrong material code. The mistake will be realized during the reuse phase when the wrongly marked material has been ordered to a new network construction site.

The constructors reuse protective packaging from other materials if such protective packaging is not available to order according to Project Manager B. This means that not all dismantled material has specific protections although they are required to have. Project Manager B adds that this

causes the contractors to question whether the instructions are correct or availability issues on certain protective packaging.

However, during the observations constructors from company A suggested the possibility of collecting these smaller dismantled material returns to avoid the repetitive work done by filling forms separately per dismantled network site and to decrease packaging waste as well as transport costs. This suggestion was brought up during weekly construction meetings and it was not denied either.

The constructors as well as the Head of Mobile & Fixed Roll Out Manager suggested that these smaller returns should be considered case by case and obtain a confirmation from the Logistics Team. However, as this was only briefly discussed in a weekly meeting, it does not have an official guideline or agreed method of how it should be done. This highlights the need for clear guidelines that all construction companies should follow.

According to Chief Network Specialist, some constructors may pack the container in a way that slows the receipt process at the warehouse. IT-assistant confirms that the way of packing affects the warehouse receipt process. The constructors may split the same products in multiple different packages which means that the warehouse must keep track of the product count while receiving and possibly trying to find them between other items.

The warehouse may store received dismantled material for 48 hours before processing and placing them into stock according to Special Expert A. The author noticed during the observation that if the warehouse lacks employees or resources, the returned dismantled materials may stay untouched for a longer period. During the observation period, a few dismantled materials returns received the return form on 30.7.2024 while the warehouse processed them almost a month later on 21.8.2024. However, these cases are informed to the Logistics Team in weekly meetings to stay on track with the workload in the warehouse, thus this is not considered as an issue.

Team Leader A from warehouse company D adds, that if the warehouse informs the Logistics Team about a faulty, unknown, or other way unusual material return that requires more investigation, the return process is considered finished. This means that these uncertain returns take longer processing time due to their unusual or unique cases.

The dismantled material may lack some components, screws, bolts, mounting brackets, cables, or plastic casings after disassembly according to Chief Network Specialist. Screws, bolts, and other mounting attachments are general goods which can be bought later from hardware stores. However, some plastic casings are specifically made for the unit (e.g. Power units). These casings

cannot be reordered; thus, during the reuse process, the constructor must adapt the lack of plastic casing by modifying it if possible.

During the observation, the author noticed a recurring issue of missing components in dismantled materials. Receiving a component lacking a dismantled material unit during the re-use phase causes additional work for the next network construction, as the constructor needs to inspect the material and file a reclamation if some component is missing. At the worst case, the dismantled material is unusable, and it needs to be replaced either by another dismantled material or a brand-new one. This slows the new network construction as the constructors must wait for the missing component arrival.

Large quantity returns are considered an issue during the receipt process in the warehouse according to IT-assistant. At worst, the returns may come in eight separate roller cages while having multiple materials scattered in every cage. This requires long processing to calculate and confirm all the materials as well as shelving the materials for reuse.

However, on the contrary, IT-assistant adds that smaller or singular returns are wasteful. If the dismantled network site only returns one or a few smaller components, the return process is still managed by the network site. This means that by following the guidelines, the constructors may send smaller dismantled materials individually in their own packages. This causes wasteful packaging as well as transportation costs.

Project Manager B confirms that by managing the dismantled returns by the dismantled network site, the documentation process is faster. If the constructors collect dismantled materials for a bigger return, the documentation process is halted until the appropriate information has been acquired. Thus, by following the guidelines and faster documentation process, the dismantled materials are sent to the warehouse without an excess wait.

IT-assistant adds that although constructors have been instructed to remove certain materials from a bundle, it is not always followed. A bundle refers to a final product that contains multiple different materials and products. This means that the warehouse receives the dismantled bundle in its original condition. The warehouse stocks the bundle in a bundle material code instead of disassembling the bundle into different materials. A dismantled bundle holds a risk of having unnecessary materials or missing materials for reuse purposes.

Based on the findings, the dismantled material retrieval and material receiving processes cause the most issues in the current reverse logistics operations. Table 6 contains a list of points of development regarding the constructor's material retrieval and the warehouse's receiving processes.

Table 6. List of material retrieval and material receiving process points of development

Issue	Reason	Risk
Wrong markings and material codes on the packaging	Reusing old packaging material Lack of removing the old material information from the packaging	Wrong material stored in the warehouse. Next reuse receives the wrong material
Dismantled materials missing during warehouse receipt	Multiple transportation units Transportation schedule	Receiving the wrong amount of material in stock
Warehouse receiving unknown materials	Constructors sending additional dismantled material. Wrongly filled return form	Wrong material stored in the warehouse. Additional work for the warehouse
Returns in the wrong warehouse	The delivery unit contains materials for both warehouses	Storing materials in the wrong warehouse Additional transportation costs
Constructors sending general waste to the warehouse	Not following the guidelines	Unnecessary waste transport
Large bulk returns	Collecting dismantled material at the constructor's warehouse	Miscalculations during receipt Wrong material stored in the warehouse
Case-based guidelines and instructions	Lack of standardization	Constructors follow different guidelines
Small or single-dismantled material returns	Small dismantled network site Following the guidelines	Unnecessary delivery and packing costs
Additional work by taking responsibility for others	Lack of trust Misconception of responsibilities Correcting mistakes in advance	Distorting the outcomes Misrepresent the liability holder
Warehouse doing additional inspections	Lack of trust	Additional work and expenses
Returns missing components or units are broken	Fail of inspection	Faulty material in reuse
"Bundles" as returns	Materials have not been disassembled into their material units	Usable materials stuck in the bundle Bundle lacking components
Warehouse exceeding 48h processing time	Lack of employees Prioritizing work	Material availability Buying material as new

6.2 Dismantled Material Return Form

The return form is the main tool for the constructors to recognize materials for reuse purposes. The form should be updated frequently if new material is introduced. However, according to Project Manager B, some dismantled material or excess new material is not always listed on the return form. This causes additional investigation at the constructor's warehouse to find the material code for such material.

The return form is Excel based and it is updated by the Logistics Team or Network Specialists. The form notifies relevant stakeholders if the form has been updated. However, according to Special Expert B, this notification can be turned off and causes a high risk of the constructor not noticing an updated version if the constructor has saved the form on their device.

Project Manager B adds that although it is usually the constructor Project Manager's responsibility to inform the constructors on site and subcontractors about the return form changes, the procedure may differ in different operative locations. Therefore, the constructor may use the outdated version of the return form and process unnecessary dismantled materials forward to the warehouses.

As the process may differ in different operative locations, the constructor companies A, B, and C may have differences in how they process the dismantled material. During the observation, the author noticed that some constructors may have additional instructions or recommendations on how to process the return form or overall, how to process the dismantled materials. Although all constructors receive the same guidelines and instructions, some dismantled material processes are proceeded case-based with exceptions. This poses a high risk of having multiple different ways how to handle the dismantled materials and causes a high potential for mistakes.

The constructors consider the return form processing time as a bottleneck for their dismantling process according to Project Manager B. Processing the form may take up one to two days, depending on the time when the form has been submitted. IT-assistant confirms the processing time is twenty-four hours. However, if the return form has been submitted in the late afternoon, the processed return form may be sent back to the constructors the next day afternoon.

According to the IT-assistant, missing return forms is a current trend across all construction partners. This means that the dismantled materials have been packed and returned to the warehouse without the list of goods. As it was earlier in chapter 4.2 described, a missing return form causes additional work for the warehouse employees. The return form acts as a packing list as well as a confirmation of the return.

IT-assistant adds that it is a common occurrence that the returns contain more dismantled material than the constructor originally listed. Quantities may differ and different materials have been added to the return package. This causes additional work to investigate the products as well as reluctance to trust the marked materials on the return form list.

An additional issue was found during the observation that the constructors may work for Company Y subsidiaries with similar dismantled material return processes. This means that the constructor processes the subsidiary's dismantled materials as Company Y's dismantled material by mistake. The Supply Chain Manager adds that this can be considered as a company loss of assets if materials are sent to the wrong warehouse and treated under the assumption that they belong to another company.

Due to wrongly filled return forms and recurring mistakes, the filled return form cannot always be trusted as the error is found later during the receiving process at the warehouse. This causes unnecessary work for the warehouse and the logistics team as they need to find the correct owner of the material.

Finally, some returns may contain dismantled materials from two different warehouses according to the IT-assistant. This means that the dismantled network site produces returnable materials for two different warehouses and the constructor packs the dismantled materials in one packaging instead of splitting them to correct warehouse destinations. If these materials are missing from the return form, the warehouse must investigate the correct material codes and warehouse destination. The author also noticed this as a common issue during the observation.

Therefore, based on the analysis, some of the common issues were a result of incorrect use of the return form. The issues were caused by using outdated return forms, filling the form incorrectly or the form was lacking newly launched materials. Thus, by focusing on improving the return form, the issues during dismantled material retrieval and warehouse receiving will decrease. Table 7 below lists the points of development regarding the dismantled material return form.

Table 7. List of dismantled material return form points of development

Issue	Reason	Risk
Using an outdated return form	Turning off the notifications from return form updates Saving the return form to a device	Following wrong guidelines Returning wrong materials Risk of disposing of new or valuable material
Return form missing from the package to the warehouse	Not following the guidelines	Additional work for the warehouse
Company Y subsidiary dismantled materials returned by mistake	Wrongly filled return form	Loss of company asset
Return form lacking newly launched materials	Lack of updates on the return form	Uncertainty of approved dismantled materials for reuse purposes Risk of disposing of new or valuable material
Return form processing time	Following the guidelines Submission time of the form	Constructor waiting time
Listing the wrong material or wrong quantity in the return form	Not following the guidelines Negligence during filling out the form	Warehouse receiving unknown materials. Miscalculations during receipt Wrong material stored in the warehouse

6.3 Feedback Platform

According to Project Manager B, the constructors are not given immediate feedback on their mistakes during reverse logistics operations. In other words, the constructors rarely receive any feedback regarding mistakes in reverse logistics. This is due to a lack of feedback platform or agreed guidelines on who takes the responsibility to give or share the feedback.

Project Manager B adds that currently the feedback is given by severity of the mistake or by individual employees of Company Y. These mistakes are considered as instances that are not generalized for all related constructor stakeholders in different operative locations. This means that the mistakes may continue to occur by a different constructor stakeholder.

Previously, general trash was sent with the dismantled materials to the warehouse by the constructor according to the Chief Network Specialist. This caused unnecessary work and waste management for the warehouse. Special Expert A confirms that this has happened, but the issue has

decreased after giving feedback to the constructors. This proves the importance of receiving feedback from all stakeholders as well as adapting the process based on the feedback.

According to Special Expert B, the warehouse stakeholders collect a list of inaccurate, wrongly marked, or wrongly sent dismantled materials from the constructors. IT-assistant confirms listing faulty returns. However, the IT-assistant adds that the warehouse is suspicious if this list of mistakes is discussed in any meeting to improve the operations. This is because the constructors constantly repeat the same mistakes.

Currently, a proper platform for giving or receiving feedback is missing based on the interviews with warehouse stakeholders Team Leader A and IT-assistant as well as Project Manager B and Team Leader B from the constructor company A.

6.4 Non-circulating Inventory

During the observation, the author noticed that if the material is listed as WEEE in the return form, the material still can be active in SAP and warehouse stock. According to Special Expert A, the materials are active in SAP if the material is still used in network building. This means that if the constructor returns such material to the warehouse by mistake, the return process may continue as normal because it is seen as active material in the warehouse. Thus, the warehouse processes the return as normal, accumulating unnecessary non-circulating material in stock.

According to the Chief Network Specialist, Network Specialists are responsible for their materials in their material groups. Material groups refer to the specific materials used in certain network constructions. In other words, material groups contain a set of materials that are used in building a specific network.

However, the frequency of monitoring the materials in the material group depends heavily on the Network Specialists. According to the Chief Network Specialist, some Network Specialists keep track of the materials in their material groups more frequently than others. If the material list is not examined frequently, it causes an issue of storing old and unnecessary items as well as an issue of no one taking responsibility for the old material if the material is not in their group.

Senior Network Specialist and Chief Network Specialist mention that some Network Specialists trust the logistics team to inform about old material accumulations, which means that the Logistics Team is expected to be actively monitoring the stock rate. This causes a potential risk in recognizing the possible disposable dismantled materials. If the material disposal request has not been approved or the material owner has not been recognized, the material is not disposed of. At the worst case, the material will stay in stock as long as someone recognizes the material.

The points of development for dismantled material inventory focus mainly on non-circulating items, as the amount of non-circulating items is significant. The need and the usage should be recognized from the current dismantled inventory before the dismantled inventory could be improved. Table 8 lists these dismantled material inventory points of development which should be investigated and resolved before improving the operations affecting the inventory.

Table 8. List of non-circulating inventory points of development

Issue	Reason	Risk
Lack of taking accountability	Negligence Changing employees	Causing additional work for others
Non-circulating materials stored in the inventory	Need of disposal approval Lack of monitoring	Storing unnecessary material
Network specialists expect the logistics team to inform of old-age stock	Misconception of responsibility	Non-circulating materials staying in storage for an extended period
Materials listed as WEEE in return form still received in stock as returns	Material active in SAP Outdated return form Unknown material returns	Storing unnecessary and unneeded material

7 Conclusion

The goal of this thesis was to find recommendations on how to improve the current reverse logistics operations at Company Y. However, before finding improvements for the reverse logistics operations, the author had to first understand the current reverse logistics process. Thus, the first investigative question focused on describing the current reverse logistics process. The second investigative question focused on analyzing the non-valued inventory to find non-circulating materials, and lastly, the third investigative question analyzed the reverse logistics process more in detail to find points of development.

By following the recommendations, Company Y can significantly reduce the costs of reverse logistics. In addition, the recommendations have a positive impact on the reverse logistics process by following the lean methods of reducing uncertainties and unnecessary practices.

This thesis utilized qualitative and quantitative research methods. Observation, quantitative SAP reports, and expert interviews were used to gain enough data for empirical analysis. Each investigative question required expert interviews, thus the author conducted twelve interviews with eight internal stakeholders and four external stakeholders.

The Logistics Team validated the findings during the research progress. This means that the findings came as no surprise to the team, although the number of points of development was alarming evidence that the current reverse logistics process needs to be improved.

To present the findings, the author made a PowerPoint presentation summarizing the results of the research (Appendix 4). This presentation included the flowcharts of the current reverse logistics, key findings in the dismantled material inventory, and the point of development. With this presentation, the commissioner can easily share the findings within the company.

7.1 Key Findings

The analysis of the current reverse logistics operations produced three flowcharts from the constructors dismantling an old technology-based network to transporting the dismantled material to the selected warehouse and value-added services in the warehouse. The warehouse is responsible for receiving and storing the dismantled materials correctly and updating the stock quantities while informing the Logistics Team.

The constructor is responsible for listing the dismantled materials for reuse purposes on the return form, inspecting the dismantled material quality, packing as well marking the packages according to the guidelines. The warehouses no longer inspect the dismantled material when receiving the

material in stock. Therefore, the mislabeled, component missing, or broken dismantled material will continue the process through transport to the warehouse if the constructor is not following the guidelines correctly. The faulty dismantled material will be stored in the stock for reuse purposes and the error is only realized when the dismantled material has been ordered and transported to a new network construction site for reuse.

Thus, the analysis of the current reverse logistics operations provided an opportunity to receive an honest view of the recurring issues. The discovery of common issues in the existing reverse logistics operations resulted in a total of twenty-four points of development. Multiple interviewees considered the inspection and packing of the dismantled material as the biggest issue of the reverse logistics process. Furthermore, incorrectly filled return form causes additional work for the warehouse which affects even during reuse. Lastly, storing non-circulating dismantled materials causes unnecessary work for all stakeholders.

Recurring issues cause severe trust issues among the warehouse stakeholders. As for now, the warehouse D is performing extra work that has not been formally instructed. This additional non-instructed work decreases the mistakes of returned dismantled materials. However, there is a significant risk of failing reverse logistics if warehouse D stops performing these additional inspections.

As mentioned in Chapter 2.2, the inventory accumulations may obstruct the view of operations. High inventory compensates for insufficient quality, inaccurate quantities, defective deliveries, and lack of employee knowledge or training. Currently, Company Y is able to deliver the correct material for network construction after an initial mistake due to the high inventory. However, the current method is not lean as it causes unnecessary work by failing to plan operative activities.

Company Y utilizes a hybrid manufacturing and remanufacturing inventory system. Instead of the recommended push-based method, Company Y uses the pull-based method. The pull-based method should eliminate overstock in common inventory management. However, the reverse logistics is inconsistent and unpredictable for the returned goods as well as the quality and the need for value-added services, the pull-based method is insufficient.

The dismantled material inventory analysis reveals significant concerns with inventory management. Twenty-four percent of the dismantled material inventory has not had any material movement for over five years. This means that almost fifteen thousand pieces or meters of material have last goods movement between 2008 and 2019. Additionally, almost seven hundred materials lack any material movement data in SAP, indicating they have not moved since being stocked.

While analyzing material groups, it is possible to recognize the most used material groups and the potentially old material groups with no material movement. Material group 9999 named “deleted/obsolete” was found with eighty-one pieces of material in stock. This obsolete material group includes material with recent year material movement although the material has been moved into this “deleted/obsolete” material group in 2016. This indicates that the materials moved into a material group will not restrict the material in receipt or usage.

ABC categorization reveals that seventy percent of the total material movement in one year comes from only two percent of the unique material descriptions. These materials should be readily available and monitored frequently to avoid buying them as new. However, as currently twenty-four percent of the dismantled material in stock has not moved for over five years, the ABC categorization is misleading. Thus, a proper ABC categorization should be done after the inventory has been cleared from non-circulating materials.

7.2 Recommendations

Based on the recurring issues, lean methods are possible to incorporate into the current reverse logistics operations to improve the operations. As discussed in Chapter 2.2, proper recording, communication, and standardization are effective tools to decrease issues that are likely caused by poor communication and failure to adopt a systematic approach.

The mistakes during the material retrieval and the material receiving can already be minimized by following the guidelines on how to fill the return form correctly and include the filled form with the returned materials. In addition, by just inspecting and marking the packages correctly, the improved material retrieval process will have a positive effect on the warehouse and inventory management as well as in the reuse stage.

The case-based guidelines and instructions pose a considerable risk of having multiple different versions of guidelines and methods on how to process the dismantled material. Thus, by following lean methods, and establishing standardized guidelines that are easily communicated to constructors, contractors, and subcontractors, the operations turn leaner while the common issues decrease.

In addition to standardizing guidelines, the stakeholders should take accountability for their responsibilities. Currently, stakeholders are fixing other stakeholders' errors, but the true impact of the mistake is not clear. The responsibilities of each stakeholder should be reviewed to ensure that the division of responsibilities is clear without any ambiguities.

Based on the points of development, the lack of feedback causes recurring issues. Thus, a proper feedback platform should be set up. A platform in this case refers to an opportunity to communicate and provide up-to-date information and feedback on current issues. The platform should be discussed with sourcing and stakeholder management how the feedback is given, who gives it, and whether it can be followed up and monitored.

By ensuring effective quality control at the material retrieval stage, Company Y saves a significant amount of money in costs. To improve the material retrieval stage, Company Y should invest in replacing the current Excel-based return form with a return tool. This tool would give easier access to relevant and up-to-date information and decrease unnecessary steps of using the Excel-based form. Therefore, the return tool would promote lean operations.

Senior Development Manager and Special Expert B suggested developing a tool that operates similarly to already established network construction tools. Developing a tool or app that is connected to SAP and other Logistics Team services would decrease the response time to unknown dismantled material inquiries and provide automatic confirmation for approved dismantled materials. Currently, Company Y has several different apps and services for network building, thus such a tool could be added to an existing network-building tool.

Such a dismantled material service tool could contain all the necessary return information and instructions in one place. Additionally, the constructors could fill in the returnable dismantled material information in the app while automatically updating the return data to SAP and the warehouse management system. This would decrease the response time between stakeholders. Additionally, using the tool would decrease unknown material returns as well as outdated dismantled materials.

With the concentrated tool, constructors can communicate between stakeholders and add pictures of the dismantled materials. The logistics team can update the approved dismantled material list in real time and restrict unwanted returns. Automatic inventory updates decrease the amount of manual work for each stakeholder and save the previous usage in its data. By saving the previous data, the faulty or broken returns are easier to identify and allow to give feedback to correct constructors.

However, developing an operation-specific tool for reverse logistics requires expenses and time to develop. Thus, it is recommended to immediately focus on the recurring issues that can be solved by the lean methods of proper feedback and monitoring of the operations.

Finally, as the dismantled material inventory which has not moved from the inventory in five years totals one-fourth of the whole FIBB stock, it is critical to ensure the true need for the materials. The unneeded material should be sold to third parties, recycled, or disposed of properly to avoid

lingering warehouse costs. However, it is important to note that the disposing activities involve additional costs.

Inventory planning should be utilized better to determine the optimal inventory level for dismantled materials. Instead of the pull-based method, Company Y should consider the push-based method. The push-based method ensures a constant stock of the materials that are used frequently. With the push-based method, Company Y can utilize the long-term strategy of level production that is described in Chapter 2.3.

The metered material is not used in a circular way often due to the unique network needs. Each network requires a different length of cables or other metered material, making the possibility of re-using the metered material small. Company Y should reconsider the reverse logistics operations on metered goods.

Material groups should be analyzed to recognize the need for the material and the materials within the groups. This requires inquiries from internal stakeholders to gain proper approval. By recognizing the material groups and the need for the materials, old material groups with a lack of recent material movement could be disposed of or reduced to save some warehousing costs. Additionally, there should be a clear accountable person for the materials with agreed responsibilities and a timeframe when the materials should be analyzed for the need.

With these recommendations, Company Y reduces the current issues in their dismantled telecommunications material reverse logistics and improves the operations while becoming lean. However, as mentioned in Chapter 2.2, lean operations refer to continuous improvement. This means that the guidelines and established standards should be reviewed regularly to avoid outdated information. It requires taking accountability and responsibility for keeping the data up to date.

7.3 Suggestions for Future Research

The lack of non-valued stock inventory management in academic resources was noticeable. Circular economy and reverse logistics are popular research topics; however, reverse logistics operations are unique in every organization. The returned products and materials can be marked as non-valuable assets to devalue the stock. By storing materials that are considered non-valuable or zero value from a financial point of view, the true value and cost of the returned material are not visible immediately. Thus, the cost justification of reverse logistics operations should be researched more.

In addition to cost justification, the commissioner should calculate the total dismantled material returns in a year to find the amount of faulty dismantled material returns whether it being broken or component lacking return. This would prove the actual cost impact of current operations as well as

how much the company could save money in costs. With these calculations, it is possible to re-search further the possible process development investments.

As the author focused on analyzing the current process and improving the reverse logistics process, the findings of this thesis indicate a lack of monitoring and giving feedback to the stakeholders. Thus, to improve stakeholder relationships, the impact of stakeholder management should be studied further.

7.4 Reliability and Validity

Reliability indicates the author's approach consistent with other researchers by demonstrating research procedures and the data collection well. This means that the research can be repeated with the same results by other researchers. Reliability minimizes the possibility of errors and biases in the research. (Yin 2018, 46-47.) As this thesis focused heavily on internal data, the author made sure that the research methods and the data collection were described in detail so that any other research with the same set of information could repeat the process with the same results.

In addition, the commissioner received the thesis as well as the numerical data used to analyze inventory and cost calculations. Thus, the commissioner can repeat the results using the data the author used.

Validity refers to confirming the accuracy of findings. The validity is ensured by using multiple sources of evidence and having key informants review the research. Internal validity required understanding and ensuring the researchers' interpretations were correct by the key informants. External validity generalizes the findings which means that the insights are possible to transfer to other settings or groups (Yin 2018, 42-46.)

The author validated the results by the commissioner as well as by the Logistics Team which contains internal employees with expertise and knowledge of the topic. In addition, the author used the same interview questions for several interviewees to obtain consistent information on which different stakeholders agree. By doing this, the author ensured consistent information and validation by the stakeholders.

According to Saunders et al. (2012, 352) using participant observation as data collection may cause threats to reliability and validity. The setting can be unknown to the observer and lacks details that are needed to interpret the observation data, causing an observer error. To avoid this threat, the author had to understand the setting before interpreting it. Thus, the base knowledge was provided from the preliminary research and work instructions and guidance at work.

7.5 Learning Reflection

The thesis established great conversations between all stakeholders during the whole thesis progress. The stakeholders were more than happy to help while providing opinions and feedback on the current process. The stakeholder cooperation provided new perspectives which contributed to the development of the thesis. This proves that the thesis topic was needed and provided a great platform for all stakeholders to have their voices heard.

The author considers the cooperation with the commissioner, commissioning company, and all stakeholders to be an extremely unique case. The cooperation motivated the author to produce a useful thesis for all stakeholders which impacts the reverse logistics operations positively.

The progress reviews with the commissioner, as well as the Logistics Team, allowed the author to set different goals and deadlines throughout the thesis process. Thus, the thesis required efficient planning and time management to conduct all the needed interviews between progress reviews. By following the schedule, the author did not have any major setbacks during the thesis progress.

The thesis topic was highly relevant to the author's job as well as the field of interest. The author learnt the reverse logistics process in detail as well as non-valued inventory management and value recovery. Lastly, the author learned SAP reporting as well as using SAP in an investigative way during the thesis progress. The author considers these skills beneficial in work life. Overall, the author is proud of this thesis and considers the thesis beneficial for all stakeholders.

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Appendices

Appendix 1. Interview Questions

Table 9. Structured interview questions

Question	Organization	Theme
1.	What are the key operational procedures involved in reverse logistics at Company Y?	Process flow
2.	Can you describe each step of the reverse logistics process, from initial collection to final disposition?	Process flow
3.	How does Company Y collaborate with suppliers, constructors, and other stakeholders during the reverse logistics process?	Process flow
4.	What is considered the main challenges or issues in the current reverse logistics processes?	Process flow
5.	What are the common bottlenecks encountered in the reverse logistics?	Process flow
6.	How does Company Y track shortages of dismantled materials that require stock transfer?	Process flow
7.	How does Company Y ensure quality control throughout the reverse logistics process?	Process flow
8.	How does Company Y map and document reverse logistics operations?	Process flow
9.	How are the unknown dismantled materials processed? How does it differ from the usual process?	Process flow
10.	Do you give feedback on incorrectly processed dismantled materials?	Process flow
11.	Do you identify the individuals who most often make mistakes?	Process flow
12.	How do you think the reverse logistics process could be improved?	Process flow
13.	Is there any preparation for processing the dismantled materials?	Process flow
14.	How does Company Y track and manage the condition and usability of dismantled materials over time?	Inventory
15.	How are slow-moving or obsolete materials identified and managed?	Inventory
16.	How much dismantled material is accepted in storage if the supplier no longer produces it?	Inventory
17.	How are inventory utilization rates measured?	Inventory

Appendix 2. Data Collection of Conducted Interviews and Progress Reviews

Table 10. Conducted interviews

No.	Title	Organization	Date and time	Topic	Place
1.	Supply Chain Manager, Special Expert A	Company Y	26.2.2024 12:00	Preliminary research	Microsoft Teams
2.	Supply Chain Manager	Company Y	11.6.2024 10:30	Thesis kick- start	Microsoft Teams
3.	Senior Development Manager	Company Y	11.7.2024 8:30	Reports, Process flow	Microsoft Teams
4.	Special Expert A	Company Y	11.7.2024 10:00	Reports	Microsoft Teams
5.	Contingent Worker	Company Y	12.7.2024 10:00	Reports, Process flow	Microsoft Teams
6.	Special Expert A	Company Y	23.7.2024 12:30	Inventory	Microsoft Teams
7.	Senior Network Specialist	Company Y	15.8.2024 14:00	Process flow	Microsoft Teams
8.	Chief Network Specialist	Company Y	19.8.2024 14:00	Inventory, Process flow	Microsoft Teams
9.	Senior Development Manager, Special Expert B, Project Manager A	Company Y	20.8.2024 13:30	Inventory, Process flow	Microsoft Teams
10.	IT-Assistant, Contingent Worker	Company D Company Y	6.9.2024 14:00	Process flow	Microsoft Teams
11.	Team Leader A, IT-Assistant	Company D	12.9.2024 10:00	Process flow	Microsoft Teams
12.	Project Manager B, Team Leader B	Company A	13.9.2024 9:00	Process flow	Microsoft Teams

Table 11. Conducted Progress Reviews

No.	Title	Organization	Date and time	Topic	Place
1.	Supply Chain Manager, Senior Development Manager, Special Expert A	Company Y	5.7.2024 10:00	Progress review 1	Microsoft Teams
2.	Supply Chain Manager, Special Expert A, Contingent Worker, Special Expert B	Company Y	27.8.2024 12:00	Progress review 2	Microsoft Teams
3.	Special Expert A, Contingent Worker, Special Expert B	Company Y	12.9.2024 13:00	Progress review 3	Microsoft Teams
4.	Supply Chain Manager, Special Expert B	Company Y	18.9.2024 12:00	Progress review 4	Helsinki, Microsoft Teams
5.	Supply Chain Manager, Senior Development Manager, Special Expert A, Special Expert B, Contingent Worker, Project Manager A, Senior Service Manager	Company Y	27.9.2024 10:00	Thesis presentation session	Microsoft Teams

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Appendix 4. PowerPoint Presentation

Thesis findings

Improving the Reverse Material Logistics
Operations for Company Y

Anni Viherä
Haaga-Helia
University of Applied Sciences
25.9.2024

Research Problem

Research Question

How to improve the reverse logistics operations?

Investigative question 1

What are the current process steps in reverse logistics of dismantled materials?

Investigative question 2

What is the current material movement of dismantled materials in the warehouse?

Investigative question 3

What are the points of development in the current reverse logistics operations?

Investigative question 4

What are the costs of reverse logistics operations for dismantling network materials?

Data Collection

Total 12 interviews conducted between June and September 2024

- 8 internal stakeholders
- 4 external stakeholders
 - 2 warehouse stakeholders
 - 2 constructors

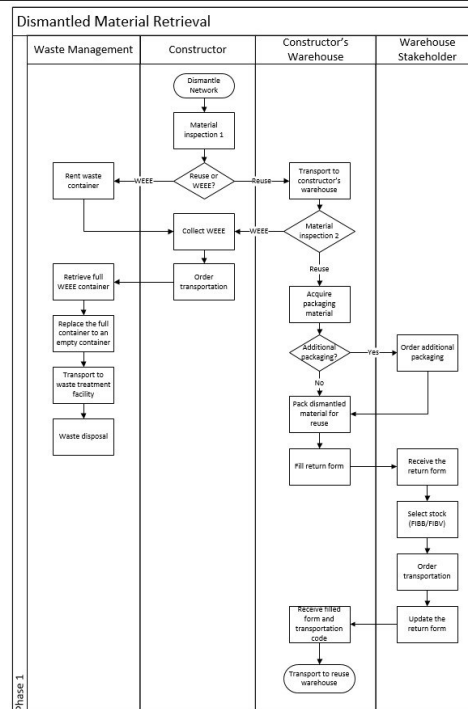
No.	Title	Organization
1.	Supply Chain Manager	Company Y
2.	Senior Development Manager	Company Y
3.	Special Expert A	Company Y
4.	Special Expert B	Company Y
5.	Contingent Worker	Company Y
6.	Senior Network Specialist	Company Y
7.	Chief Network Specialist	Company Y
8.	Project Manager A	Company Y
9.	Team Leader A	Company D
10.	IT-Assistant	Company D
11.	Project Manager B	Company A
12.	Team Leader B	Company A

Current Reverse Logistics Process:

Dismantled Material Retrieval

The main responsibilities for Constructor:

- Main inspection
- Deciding whether the dismantled material is disposed as waste or processed further for reuse
- Packing the dismantled material
- Marking the packages correctly
- Fill the return form correctly
- Sending out the materials for warehouse



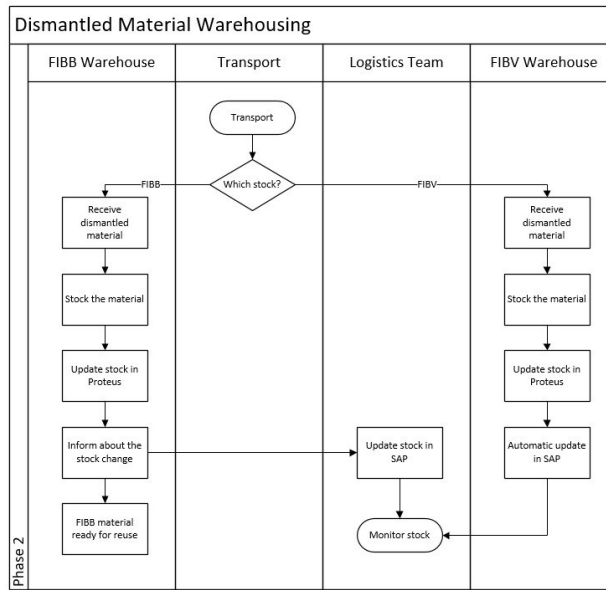
Current Reverse Logistics Process:

Dismantled Material Warehousing

The main responsibilities for Warehouse:

- Receiving the material
- Stock the material
- Update stock quantities
- Inform Logistics Team

NOTE: No inspection!



Current Reverse Logistics Process:

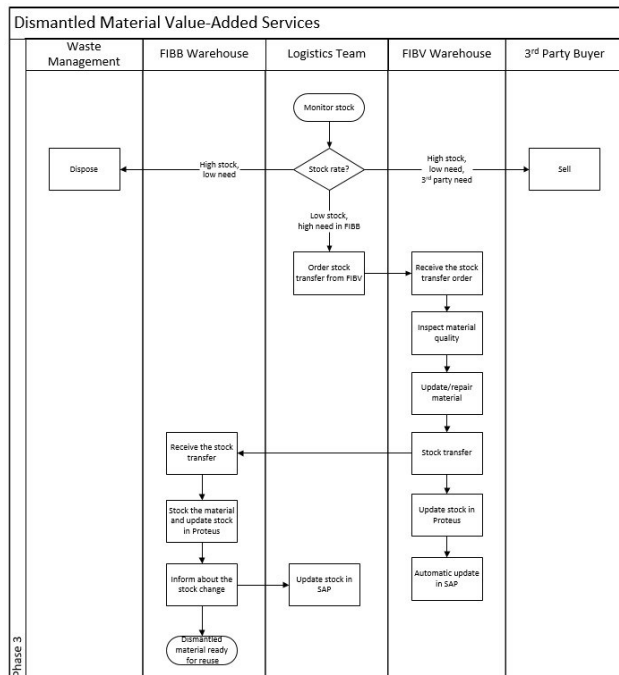
Dismantled Material Value-Added Services

The main responsibilities for Logistics Team:

- Monitor stock
- Stock replenishment orders

The main responsibilities for Warehouse during stock replenishment FIBV-> FIBB:

- Receive stock order
- Material inspection
- Repair/update material
- Stock transfer
- Stock quantity updates

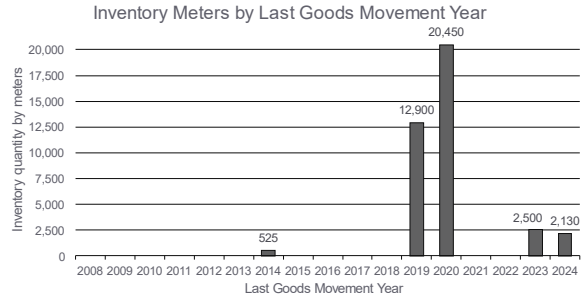
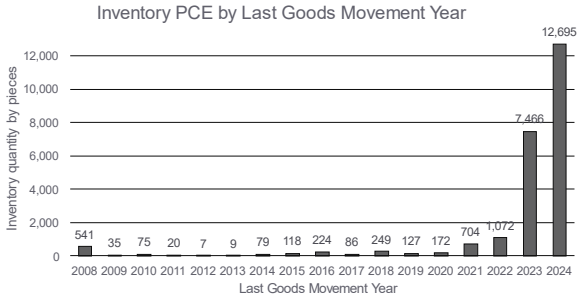


Dismantled Material Inventory FIBB Analysis Last Goods Movement Year

Last Goods Movement:

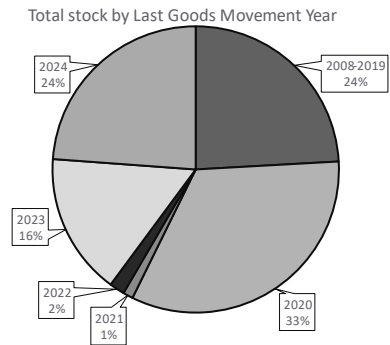
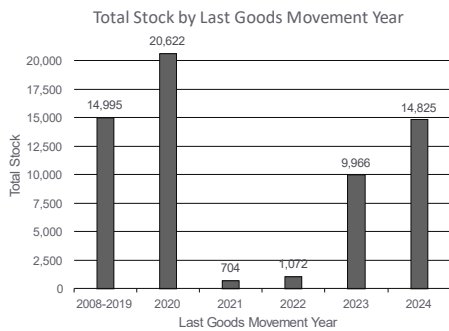
The last time the material received a movement in stock (Stock order, stock return, stock update etc.)

The material has stayed in stock and received no activity since the year of last goods movements
= non-circulating items while accumulating storage costs.



Total FIBB Stock by Last Goods Movement Year

24% of the current total FIBB stock has not received movement activity for 5 years or more.



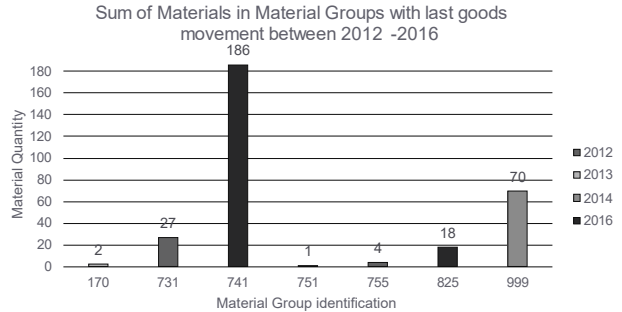
Analyzing Material Groups

- 170 LAN products
- 731 Modem/ISDN/ADSL/VDS
- 741 PDH-equipment
- 751 NIU-Radio link ante
- 755 Point to multipoint
- 825 IPTV equipment
- 999 NIU-Other materials

7 material groups found with a last goods movement before 2019.

These material groups have no material movement since 2019 and may accumulate storage costs for long time.

Lack of taking accountability for materials poses a high risk of materials staying in stock for long period.



Material	Valuated stock	Last gds mvmt.
Total	186,000 ***	
9019773	180 PCE	02.01.2008
9019789	5 PAC	04.12.2009
9020241	1 PCE	16.07.2009

Material Group 9999 "Deleted/Obsolete"

81 materials found in "Deleted/Obsolete" material group

Material	ValStockValue	Valuated stock	Last gds mvmt.
Total	0,00 EUR	81,000 ***	
9026876	0,00 EUR	27 PCE	31.10.2022
9069463	0,00 EUR	24 PCE	08.12.2021
9026878	0,00 EUR	12 PCE	31.10.2022
9027033	0,00 EUR	6 PCE	24.11.2016
9030543	0,00 EUR	3 PCE	24.11.2016
9027443	0,00 EUR	3 PCE	22.02.2016
9028457	0,00 EUR	2 PCE	24.11.2016
9027441	0,00 EUR	2 PCE	10.11.2015
9028559	0,00 EUR	1 PCE	03.01.2020
9028455	0,00 EUR	1 PCE	10.11.2015

Figure 18 Material Group 9999 stock

Example material moved into the group in 2015

Material	9026876				
Changed by	FHU9585				
Date	20.05.2015				
Time	20:29:37				
Action	Org. Unit	Field Desc.	Old Value	New Value	Additional
Entry		Material descr. in language			DA
Entry		Material descr. in language			NO
Entry		Material descr. in language			SV
Change		Material Group	172	9999	

Figure 20 SAP MM03 Screenshot of 9026876

Material activity shows that the material is still active in this material group.

Green = Receiving in stock (Stock return/stock update)

Red = Reducing the stock (Stock order/stock update)

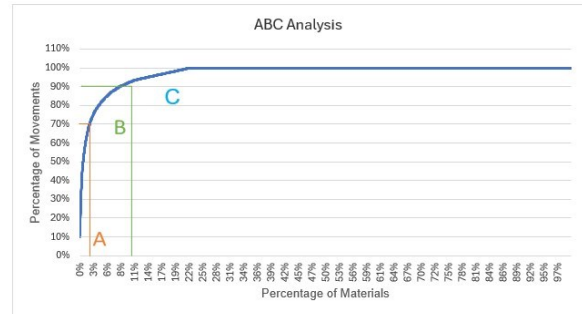
Material	Material Description						
Location	MvT	S	Mat. Doc.	Item	Pstng Date	Quantity in UnE	Elun
9026876					NI-2-155SM-155SM		
X001	202	4919986089	31	31.10.2022		2	PCE
X001	202	4917154858	5	24.08.2021		4	PCE
X001	202	4916206159	2	30.03.2021		4	PCE
X001	202	4916206294	2	30.03.2021		1	PCE
X001	202	4916081166	4	11.03.2021		16	PCE
X001	647	4912414530	1	19.02.2019		5	PCE
X001	647	4900433878	7	13.10.2016		5	PCE
X001	647	4900179505	1	08.08.2016		2	PCE

Figure 19 SAP MB51 Screenshot of 9026876 material movement

Number of Material Movements in 2023 ABC Categorization

62 material descriptions hold 70% of the material movement.
190 material descriptions hold 20% of the material movement.

Category Segment	Unique material descriptions	Percentage of Materials	Number of material movements	Percentage of Movements
A	62	2 %	3776	70 %
B	190	6 %	1071	20 %
C	2852	92 %	537	10 %
Total	3104	100,00 %	5384	100,00 %



Total 252 material descriptions hold 90% of the material movement!
2852 material descriptions received 0-1 material movement within a year.

ABC Categorization should be done again after clearing non-circulating items from stock.

Cost Impact of Reverse Logistics

Cost description	Cost elements	Cost impact
Cost of return	Material dismantling and packing + transport + storage	Medium
Cost of return with value-added service	Material dismantling and packing + transport + storage + value-added service	High
Cost of disposal at constructor	Waste container rent + container swap and transport + waste disposal	Low
Cost of disposal at warehouse	Material dismantling and packing + transport + storage + container rent + container swap and transport + waste disposal	Highest

Assumption if the constructor receives a faulty dismantled material during new network construction :

Cost of disposal at constructor during reuse	Cost of return + new order processing + transport + administration costs (N/A) + cost of disposal at constructor +	Extreme loss of time
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Cost of Reverse Logistics

Cost description	Small (1kg)	Medium (5kg)	Large (20kg)
Cost of return for reuse purposes	REDACTED	REDACTED	REDACTED
Value-added service by time (30min, 1h, 2h)			
Total cost of return with value-added			
Total cost of disposal at constructor			
Total cost of disposal at warehouse			

Costs of Reverse Logistics

Category	Description	Invoice prices	per unit	Small (1kg)	Medium (5kg)	Large (20kg)
Material dismantle and packing	Constructor dismantling old network and packing it	REDACTED	REDACTED	REDACTED	REDACTED	REDACTED
Transportation	Separate collection and distribution, packages					
	Express package					
	Express package big					
	Separate collection and distribution, transport units					
	Cage trolley rent + transport					
	Pallet delivery					
Storage FIBV	Small item (month)					
	Pallet <0,80 (month)					
	Pallet <1,25 (month)					
	Pallet >1,25 (month)					
	Dism. Mat. return. Mobile (h)					
Value-added service	Mobile BS testing (h)					
Waste disposal at Constructor	Container rent for Constructor (1,5m = 125kg)					
	Container change from Constructor					
	WEEE (kg)					
Waste disposal at Warehouse	REDACTED					
	TOTAL					
Cost of return	Dismantl. + transport + storage					REDACTED
Cost of return with value-added service	Dismantl. + transport + storage + value-added					REDACTED
Cost of disposal at constructor	Container rent + change/transport + waste disposal					
Cost of disposal at warehouse after 1 year	Dismantl. + transport + storage + Container rent + change/transport + waste disposal					

Material Retrieval and Receiving Process Points of Development

Issue	Reason	Risk
Wrong markings and material codes on the packaging	<ul style="list-style-type: none"> Reusing old packaging material Lack of removing the old material information from packaging 	<ul style="list-style-type: none"> Wrong material stored in the warehouse. Next reuse receives the wrong material
Dismantled materials missing during warehouse receipt	<ul style="list-style-type: none"> Splitting returned materials into different transportation units Transportation schedule 	<ul style="list-style-type: none"> Receiving wrong amount of material in stock
Warehouse receiving unknown materials	<ul style="list-style-type: none"> Constructors sending additional dismantled material. Wrongly filled return form 	<ul style="list-style-type: none"> Wrong material stored in the warehouse. Additional work for the warehouse Storing materials in wrong warehouse
Returns in the wrong warehouse	<ul style="list-style-type: none"> Delivery unit contains materials for both warehouses 	<ul style="list-style-type: none"> Additional transportation costs
Constructors sending general waste to the warehouse	<ul style="list-style-type: none"> Not following the guidelines 	<ul style="list-style-type: none"> Unnecessary waste transport
Large bulk returns	<ul style="list-style-type: none"> Collecting dismantled material at the constructor's warehouse 	<ul style="list-style-type: none"> Miscalculations during receipt Wrong material stored in the warehouse
Case-based guidelines and instructions	<ul style="list-style-type: none"> Lack of standardization 	<ul style="list-style-type: none"> Constructors follow different guidelines
Small or single dismantled material returns	<ul style="list-style-type: none"> Small dismantled network site Following the guidelines Lack of trust 	<ul style="list-style-type: none"> Unnecessary delivery and packing costs
Additional work by taking responsibility for others	<ul style="list-style-type: none"> Misconception of responsibilities Correcting mistakes in advance 	<ul style="list-style-type: none"> Distorting the outcomes Misrepresent the liability holder
Warehouse doing additional inspections	<ul style="list-style-type: none"> Lack of trust 	<ul style="list-style-type: none"> Additional work and expenses
Returns missing components or units are broken	<ul style="list-style-type: none"> Fail of inspection 	<ul style="list-style-type: none"> Faulty material in reuse
"Bundles" as returns	<ul style="list-style-type: none"> Materials have not been disassembled into their own material units 	<ul style="list-style-type: none"> Usable materials stuck in the bundle Bundle lacking components
Warehouse exceeding 48h processing time	<ul style="list-style-type: none"> Lack of employees Prioritizing work 	<ul style="list-style-type: none"> Material availability Buying material as new
Lack of giving feedback to the contractors	<ul style="list-style-type: none"> Lack of feedback platform 	<ul style="list-style-type: none"> Mistakes and errors continue

Dismantled Material Return Form Points of Development

Issue	Reason	Risk
Using outdated return form	<ul style="list-style-type: none"> Turning off the notifications from return form updates Saving the return form to a device 	<ul style="list-style-type: none"> Following wrong guidelines Returning wrong materials Risk of disposing new or valuable material
Return form missing from the package to the warehouse	<ul style="list-style-type: none"> Not following the guidelines 	<ul style="list-style-type: none"> Additional work for the warehouse
Telia subsidiary dismantled materials returned by mistake	<ul style="list-style-type: none"> Wrongly filled return form 	<ul style="list-style-type: none"> Loss of company asset
Return form lacking newly launched materials	<ul style="list-style-type: none"> Lack of updates on the return form 	<ul style="list-style-type: none"> Uncertainty of approved dismantled materials for reuse purposes Risk of disposing new or valuable material
Return form processing time	<ul style="list-style-type: none"> Following the guidelines Submission time of the form 	<ul style="list-style-type: none"> Constructor waiting time
Listing wrong material or wrong quantity in the return form	<ul style="list-style-type: none"> Not following the guidelines Negligence during filling the form 	<ul style="list-style-type: none"> Warehouse receiving unknown materials. Miscalculations during receipt Wrong material stored in the warehouse

Points of Development for Non-Circulating Inventory

Issue	Reason	Risk
Lack of taking accountability	<ul style="list-style-type: none"> • Changing employees • Negligence 	<ul style="list-style-type: none"> • Causing additional work for others
Non-circulating materials stored in the inventory	<ul style="list-style-type: none"> • Need of disposal approval • Lack of monitoring 	<ul style="list-style-type: none"> • Storing unnecessary material
Network specialists expect the logistics team to inform of old-age stock	<ul style="list-style-type: none"> • Misconception of responsibility 	<ul style="list-style-type: none"> • Non-circulating materials staying in storage for long period
Materials listed as WEEE in return form still received in stock as returns	<ul style="list-style-type: none"> • Material active in SAP • Outdated return form • Unknown material returns 	<ul style="list-style-type: none"> • Storing unnecessary and unneeded material

Recommendations

Lean Methods

- A systematic approach
- Standardization
- Clear guidelines
- Proper communication
- Ensure proper feedback platform
- Immediate feedback
- Review stakeholder responsibilities
- Take accountability
- Monitor the process
- Continuous improvement

Recommendations

Inventory Management

- Sell or dispose non-circulating material
- Monitor the stock frequently
- Reconsideration for the need of metered material in reuse purposes
- Review stakeholder responsibilities
- Take accountability

Recommendations

“E- Palautus” platform

- Replaces the Excel based return form
- Clear information, guidelines and actions in one place
- Along with E-move / E-master
- Communication tool
- Feedback platform
- Links with SAP material management
- Automation possibilities