



CHALMERS

Overcoming barriers for functional reverse logistics in e-commerce

A systematic literature review

Bachelor's thesis in International Logistics

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PREFACE

We finalize our studies at the Chalmers University of Technology by writing this bachelor thesis. The last three years at the International Logistics Program have gone by fast, and it has truly been a pleasure. At the program, we have gained knowledge and insights in subjects ranging from the shipping business and all it incorporates to supply chain logistics and the transport economy. At times, the studies have been very stressful and demanding, but most of the time, the journey has been a delight, and we have learnt a lot. Therefore, we would like to express our appreciation and gratitude towards all teachers, lecturers, and staff for providing us with excellent knowledge and understanding of each subject.

The subject of this bachelor thesis, i.e., reverse logistics in e-commerce, was unfamiliar to both of us. Consequently, the start-up phase of the thesis-writing was mainly concerned with understanding the subject at its core. The writing and gathering of scientific knowledge have often been challenging, but conclusively it has been worth it. It has also been a pleasure to contribute to such a new and upcoming research field as reverse logistics, which we are sure will have a significant impact in the future. Additionally, we both have a passion for logistics and reviewing and evaluating a logistics concept of “tomorrow” has been a great joy.

Finally, we would like to express our sincerest appreciation to our supervisor Violeta Roso at Chalmers University of Technology, who has provided us with support, knowledge, and guidance throughout the writing process. This insight has been instrumental to us delivering and finalizing this bachelor thesis.

Alexander Ahlén and Eric Johansson, Gothenburg, June 2023

Gothenburg, Sweden 2023

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ABSTRACT

Traditionally, the flow of goods has been allocated forwardly in the supply chain, where used products consequently have been discarded and destroyed by the end consumer. In light of globalization, and environmental and economic concerns, the circular economy and its principles have gained considerable attention from supply chain stakeholders. A vital element of the circular economy is reverse logistics. In e-commerce, the reverse logistics process enables the management of returns in the form of products and materials from the end customer travelling backwards in the supply chain, often to the source. However, the topic of reverse logistics in e-commerce is fairly new. This study aims to summarize the current scientific knowledge on e-commerce reverse logistics from the perspective of identifying present barriers, and possible solutions for overcoming the identified barriers by conducting a systematic literature review (SLR). SLR is a comprehensive and precise methodology which synthesizes a large body of knowledge, in a specific scientific area, in a factual and unbiased way that ensures reproducibility and reliability. From the SLR, we found five major barrier categories and six major solution categories, both with belonging sub-categories. The findings show that the significant barriers are lack of knowledge and awareness from top management, limited forecasting, lack of infrastructure, and lack of supply chain coordination. Furthermore, solutions for overcoming these barriers include commitment, awareness, and support from top management, efficient technological infrastructure, and sufficient information exchange in the supply chain. The study is limited to scientific knowledge on reverse logistics in B2C e-commerce.

Keywords: Reverse logistics, e-commerce, reverse logistics barriers, reverse logistics solutions, systematic literature review

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ACRONYMS AND TERMINOLOGY

RL	Reverse logistics
B2C	Business to costumer
3PLP	Third-logistics providers
CLSC	Closed-loop supply chain
RQ	Research Question

1. INTRODUCTION

In the first chapter below, an introduction to the thesis's subject and scope is presented along with what is intended to be investigated. Following the background to the issue is the aim of the thesis, its delimitations and research questions, and a description of the methodology.

1.1 Background

In recent decades, the scope of logistics has expanded from only using linear supply chain methods to incorporating Reverse Logistics (RL) systems in a product's life cycle. Dowlatshahi, (2000) defines RL as "...a process in which a manufacturer systematically accepts previously shipped products or parts from the point of consumption for possible recycling, remanufacturing, or disposal". Primarily, RL handles the specific circular flow of materials and products (Fleischmann et al., 1997). Additionally, refurbishment of returned products can be included as an operation within RL (Krikke et al., 2004). In light of ever-changing global development, (Dekker et al., 2004) have conceptualized the term into two underlying factors: "*driving forces behind reverse logistics*", and "*reasons for returning products*". The driving forces are ever changing global economies, corporate citizenship, and environmental- and trade legislation. The reasons for returning products are manufacturing-, distribution-, and customer returns. Therefore, companies and organizations can benefit from incorporating RL in their business models, both environmentally and economically without the expense of one another. For instance, Dowlatshahi (2000) argues that companies could save a vast amount of costs by reclaiming products intended for remanufacturing, all with less effort and resources than manufacturing entirely new products. However, the authors continue by stating that the remanufacturing of reclaimed products will differ between companies and industries depending on their specific remanufacturing capabilities regarding a product's physicality and valuable components, together with the possibility of re-capturing value from the reclaimed product. Subsequently, implementing RL has become more prevalent within specific industries and segments, including e-commerce.

Considering environmental concerns, which have led to both domestic and international legislations (Dekker et al., 2004), and economical interests, an increasing trend towards implementing reverse logistic practices within E-commerce has surfaced (Kokkinaki et al., 2000). They continue by stating that used parts and surplus goods have been given an important stimulus due to their re-capturing and remanufacturing, but with limited usage of E-commerce. Recent research has concluded that markets with strong E-commerce presence, specifically markets with recent surges of e-commerce such as India, have shown demands for reliable, sustainable, and efficiently designed reverse logistic networks (Dutta et al., 2019).

1.2 Purpose of the thesis and research question

The objective of this bachelor's thesis is to investigate RL within the e-commerce domain, through systematic literature review. An important topic today is e-commerce and how a faster commerce impact our societies and the environment. For e-commerce to be sustainable and efficient over more extended periods in the future, RL must be considered. The first two research question aims to identify and analyze critical barriers, solutions, and opportunities for reverse logistic implementation within e-commerce. The motivation for identifying the barriers, and solutions and opportunities for implementation and adoption of RL practices within e-commerce is to assist knowledge that provides improved reverse supply chain networks in accordance with circular economy principles. This can consequently provide future sustainable customer experiences. This is also important as the barriers to the

implementation of RL practices differ between markets, actors, and researchers, and the aim is to provide a comprehensive overview of both barriers and solutions. Furthermore, the first two research questions facilitate a context for the third research question.

1. *Which barriers hinder the implementation and adoption of reverse logistics within e-commerce?*
2. *Which solutions and opportunities can facilitate reverse logistics implementation and adoption within e-commerce operations?*

The third research question focuses on how the appliance of identified solutions can overcome the identified barriers. Consequently, e-commerce enterprises can precisely identify challenges and develop effective tailor-made solutions towards said barriers.

3. *How can e-commerce enterprises overcome identified barriers to reverse logistics by applying identified solutions?*

1.3 Delimitations

This thesis will be limited to reverse logistics within B2C e-commerce. Other aspects of the terms in the conceptualization of reverse logistics will not be reviewed. Hence, reverse logistics within business-to-business relations will not be discussed and analysed. Furthermore, e-commerce will be limited to business-to-customer (B2C) relations, and operations within customer-to-customer electronic marketplaces, such as eBay, will not be included in this thesis. Finally, the used literature from the analysis and forward will only be collected from the Scopus database.

2. FRAME OF REFERENCE

The following chapter provides an insight into the concepts of circular economy, closed-loop supply chain, and reverse logistics and its activities, which is necessary to understand the purpose and meaning of the thesis. Additionally, e-commerce and its fundamental logistical operations and functions are presented.

2.1 Circular economy

Historically, the dominant economic model has been designed to support a linear flow of resources where resources are efficiently allocated forwardly but fails to consider the finite amount of earth's natural resources (Ghisellini et al., 2016). However, the authors state that growing attention has recently been paid to Circular Economy (CE) as an alternative to the predominant linear economic model. Although CE is trending as a new emerging economic and sustainable model, a definite definition is hard to find as diverging approaches exist within the field, which in return lead to conceptually different concepts of CE (Geisendorf & Pietrulla, 2017). Nevertheless, a commonly used definition has been provided by the Ellen MacArthur Foundation (2012, p.7):

“A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the ‘end-of-life’ concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models.”

Often, the concept of CE is seen through the lens of the 3R principle, namely reduction, reuse, and recycle (Ghisellini et al., 2016). Additionally, recovery will sometimes be added as a fourth action to the principle (Kalmykova et al., 2018). In addition to the principles above, Ellen MacArthur Foundation (n.d.) describe CE as being based on three additional principles: design out waste and pollution, keep products and materials in use, and regenerate natural systems. Furthermore, they continue stating that CE strives to retain already created value in the economic system, while erasing activities which causes harm to both humans and the surrounding nature, and which enhances the usage of renewable resources. Such damageable activities include traffic congestion and air, land, and sea pollution.

2.2 Closed-loop supply chain

Closed-loop supply chains (CLSC) can be said to encompass both a reverse supply chain (*see Figure 1.*), in which RL plays a significant role, and a forward supply chain. In CLSC's, the focus lies on designing closed-loop intervals for products in a marketplace, where the target is for recovered products to be reintroduced into the consumer market at a later stage (Krikke et al., 2004). One of the most common definitions conclude that CLSC management is ultimately about designing and operating a system that can maximize the re-creation of value for a product's entire life span over time. To achieve such an efficient system, value needs to dynamically be recovered for different volumes and different types of product return over an extended timeframe (Govindan et al., 2015). On an elementary level, the encircling loops are either physical closed loops where the recovered product is returned to its original user, or in the form of functional closed loops where the recovered item is restored to its original functionality (Dekker et al., 2004).

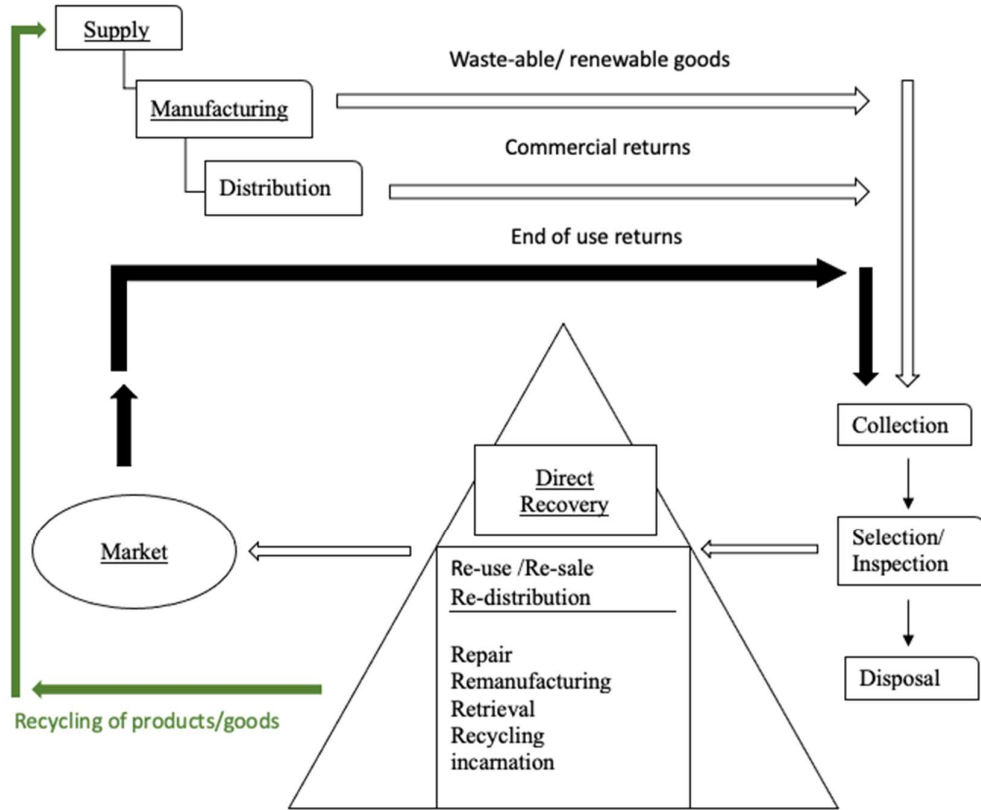


Figure 1: Describing reverse logistics processes and individual positions within the reverse supply chain. The figure has been created and designed by the authors but is based on Figure 1 from Kokkinaki et al., (2000), and Figure 1.3 from R. L. K. Dekker et al., (2004).

According to Guide Jr. & Van Wassenhove, (2009b), different types of product returns exist, which in turn are connected to specifically designed product recovery activities. The three product return types are: 1) Commercial returns, when the bought item generally is returned within 90 days after the purchase, 2) End-of-use returns when the product’s functionality is upgraded, e.g., a technological upgrade, and 3) End-of-life returns when the product usually has become technically unusable. Commercial returns are typically connected with slight repair activities to reintroduce the product as quickly as possible to the market. End-of-use returns are connected to remanufacturing activities where different products have different remanufacturing requirements. Lastly, end-of-life returns are often technically obsolete, hence recycling valuable components from the product is the most feasible option.

In CLSC’s, it is important to note that decisions made in either the forward or the reverse supply chain influence the other one, e.g., with regard to manufacturing and product design, and product modularity (Schenkel et al., 2015). According to Krikke et al., (2004), product design significantly impacts the product’s entire life cycle with several key issues arising, such as how well the product can be recovered and re-manufactured. As stated before, decisions made in the forward supply chain affect the reverse supply chain. Bocken et al., (2016) argue that once product specifications are complete, only smaller adjustments to the product can be made, which in turn affects the handling and management of the product once recovered from the end-user. Furthermore, the authors mean that depending on the product’s

purpose with regard to its complete life cycle, different strategies and aims determine the product design. Such strategies are, for example design for reducing the usage of resources, design for long-life products, design for product-life extension through additional services, and design for disassembly and reassembly.

2.3 Reverse logistics

According to (Dekker et al., 2004), terms like “*reverse channels*” or “*reverse flow*” has been presented in scientific literature since the 1970’s. However, these terms have been related with recycling. One decade later, the view on the topic was related to the movement of goods going against the traditional flows of the supply chain. The standard term Reverse Logistics was presented by the Council of Logistic Management (de Brito & Dekker, 2004).

Throughout the 1990’s, the conceptualization advanced to a standardized topic which covered a broader meaning. At the end of the century, The European Working Group on Reverse Logistics (1998, as cited in R. L. K. Dekker et al., 2004), published the following definition of the term reverse logistics:

The process of planning, implementing, and controlling backward flows of raw materials, in processes in inventory packaging and finished goods, from a manufacturing, distribution or use point, to a point, to a point of recovery or proper disposal”.

Due to the definition's broad scope, scientific literature has simplified the term, for instance (Dowlatshahi, 2000) defines reverse logistics as “A process in which a manufacturer systematically accepts previously shipped products or parts from the point for consumption for possible recycling, remanufacturing, or disposal”.

The concept of reverse logistics has gained recognition from both academics and practitioners, due to increased recognition of sustainable development and increased volume of return loads (Wilson & Goffnett, 2022). In recent years, extensions of theoretical concepts and research has been presented. However, companies lack expertise and strategic insights into the topic to fully implement reverse logistics in a cost-efficient manner (Wilson & Goffnett, 2022). According to Christopher (2011), this has often led to very high costs for companies.

2.3.1 Driver for reverse logistics

In order to grasp and understand why reverse logistics have become more apparent in recent years, it is important to understand and know the driving forces behind reverse logistics implementation. The two major motivational forces to reverse logistics are economic drivers and political drivers, which incorporate environmental motivation.

2.3.1.1 Economical drivers

The financial and economic side of reverse logistics can be seen as a hindrance for companies to adopt reverse logistics activities into their businesses. However, companies can also gain economic strength by adopting circular economy principles in their reverse logistics operations. A primary reason for the current relevance of reverse logistics adoption is the notion that recovering used products can create additional economic value for companies (Bouzon et al., 2018). At times, utilizing already used products for the usage of raw materials and various manufacturing parts can offer a cost-efficient alternative to producing entirely new products manufactured by newly produced raw materials. For example, one of the most notable early adopters of reverse logistics, copy machine producer Xerox, showed in 1998 that their strategy

of utilizing product recovery and material reuse saved them several million dollars annually (Akdoğan & Coşkun, 2012). With regards to the recovery and reuse of products and materials, the economic benefits include both direct and indirect gains. The direct economic gains can for companies be found through for example the utilization of valuable spare parts, reducing the use of waste and raw materials, and creating opportunities not otherwise capitalized, such as reselling on the secondhand market. The indirect gains can be anticipation on forthcoming legislations, market protection, improvement in supplier and customer relationships, and environmentally friendly image consequently leading to the attraction of more customers and suppliers (de Brito & Dekker, 2004). Reducing the usage of resources through reverse logistics processes does not only result in potential economic gain for companies, but it is also in compliance with social and environmental development (Qin, 2022).

Due to rising environmental concerns, companies are often required by laws and legislations to recover and reuse products and materials. Therefore, “green” marketing become important to attract customers (de Brito & Dekker, 2004). Companies need to explore reverse logistics activities, such as recovery, to meet the rising environmentally friendly standards of customer expectations. If done well, it can lead to financial gains (Akdoğan & Coşkun, 2012). Strategic planning is also essential for companies as existing and emerging legislations put more pressure on manufacturers to responsibly handle the entire life cycle of products (Fleischmann et al., 1997). Hence, one of the reasons why companies begin to engage in reverse logistics activities is due to economic and financial gains (de Brito & Dekker, 2004).

2.3.1.2 Political and environmental drivers

The lack of efficiently designed laws and the misuse of such legislations may present themselves as barriers for implementing reverse logistics in e-commerce. Nevertheless, laws and regulations have an impact on the increase of reverse logistics. In several countries in Europe, there has been an increase in environmental legislation regulating for example recycling quotas, manufacturers being held responsible to recovering sold products, and packing requirements that reduces waste (de Brito & Dekker, 2004). The European Union have applied several regulations impacting its member states. For example, such regulations are Waste Electrical and Electronic Equipment Directive, End-of-life Vehicle Directive, and packaging and packing waste directives. Such laws require companies to adopt reverse logistics principles in their business strategies and such laws will also have an effect worldwide due to the globalization effect (Akdoğan & Coşkun, 2012). For companies to facilitate environmental legislations strategically and efficiently, they may be needed to reorganize daily activities such as, raw material acquisition, distribution, and remanufacturing of products (Akdoğan & Coşkun, 2012). Customers may also be held accountable for returning ordered products. For instance, such a law exists in the UK. Sometimes, possible future legislations on reverse logistics activities may provide an incentive for companies to adopt such activities, even though no legislation exist at that moment (de Brito & Dekker, 2004).

Manufacturers are hold more responsible for initial products design, methods of production, and waste reduction and disposal due to applicable legislation (Akdoğan & Coşkun, 2012). Companies operating worldwide in various countries and markets must be aware of different types of legislations concerning reverse logistics and circular economy principles and may consequently be subject to adjusting their internal processes. Hence, legislation in one country or market may impact the reverse logistics operations in another country or market (Akdoğan & Coşkun, 2012).

2.4 E-Commerce

Since the launch of internet for commercial use in the 1990's, retailers and online marketplaces has transitioned their operations towards online sales directly towards customer. The rapid growth of e-commerce can be attributed to a vast range of options available to customers, the increased pricing transparency from retailers, the prevalence of discounts, and the increase of internet usage worldwide (Nanayakkara et al., 2022). Commonly known e-commerce enterprises such as Amazon, Zalando and Ali Express have been on the revolution's frontier. The total global e-commerce sales were estimated in 2020 to 4,280 billion US dollars, with an annual growth of 22% during the last 5 years. (Risberg, 2022). In 2022, the estimation has increased to 6,310 billion US dollars and predicting to steadily increase to 8,148 billion US dollars in 2026, which is a 228% increase in worldwide retail sales since 2014 (Statista, n.d.).

2.4.1 E-commerce logistics

Xiao et al., (2012, as cited by Risberg, 2022) explains e-commerce as several processes in which information, capital, business, and logistic flows re integrated. E-commerce logistics is concisely described as the physical supply chain from the supply source to customer, including reverse logistics operations (Risberg, 2022). Throughout the growth of global sales in e-commerce, the complexity of the supply chain has consequently followed the growing trend (Nanayakkara et al., 2022). According to Nanayakkara et al., (2022), the efficiency of material flows, information sharing, and transaction pace are central components to reach successful deliveries in terms of capacity utilization. The logistical framework is hence the critical component to build and monitor the supply chain when complexity is added to the reverse logistics equation. Reverse logistics operations mirror some of the same aspects of a forward supply chain, such as that raw materials, in-process inventory, finished goods and information flows needs corresponding framework as a linear e-commerce supply chain. Furthermore, the processes should maintain efficiency and cost effectiveness regarding linear and reverse supply chains (Nanayakkara et al., 2022).

Within B2C e-commerce, the reverse logistics side of the field refers to the return of bought products and items, which the customer has returned due to dissatisfaction with the product, deficiencies, or poor quality (Xiaoyan et al., 2012). In comparison, Pinkman (2020) states that, on average, 30% of online purchases will be returned while only 8% of purchases made in physical stores are returned. E-commerce consequently relies heavily on reverse logistics functions. As stated above, reverse logistics operations mirrors some of the aspects that exists in a forward supply chain. However, there are some significant differences between forward logistics and reverse logistics within e-commerce. According to Lindsey (2016), in the forward supply chain, the relatively easily forecasted demand leads to economies of scale, as well as being able to precisely predict product ranges and volumes more accurately than in the reverse set-up. When looking at online returns, i.e., the reverse logistics leg, there is a much greater unpredictability to its operations which leads to difficulties in forecasting online returns in a multichannel system such as e-commerce. Lindsey (2016) continues by stating that more complex technology and analytics techniques are necessary for companies to predict online returns in such an erratic market. Furthermore, to improve efficiency and decrease logistics related costs, outsourcing the reverse e-commerce logistics operations to third party logistics providers has been preferred, beneficially as it allows companies to improve on customer service and costs, and they can focus more on their core business (Xiaoyan et al., 2012).

3. METHOD

The following chapter presents an overview of the methodology used to answer previously mentioned research questions. This section will outline the research strategy, research design, data collection, and analysis techniques used to conduct the purpose of the thesis.

3.1 Research strategy

In academic research, such as the present thesis, it is essential to articulate the specific methodology employed for the retrieval and analysis of the literature. This bachelor thesis intends to employ a Systematic Literature Review (SLR) to investigate the topic Reverse logistics comprehensively. SLR is used because it provides a reliable and objective overview of the knowledge and evidence present in the field of reverse logistics. This approach is recommended by scientific literature for drawing conclusions based on evidence proven in qualitative research (Denscombe, 2018, p. 201). Denscombe further asserts that an SLR is an effective approach to gain an extensive understanding of a particular field by meticulously examining the current knowledge and research. Consequently, SLR is employed to provide an unbiased compilation of the present research and knowledge of reverse logistics within e-commerce. The study will in turn cover topics such as barriers, drivers, challenges, and implementation possibilities. It is crucial to note that a traditional SLR will not be conducted. However, a revised version of SLR suited for supply chain research will be used which have been drafted by Durach et al., (2017). A detailed explanation of this type of SLR will further be presented in the chapter *Research design*.

The frame of reference was based on relevant literature gathered through mainly Scopus, and in a few cases Science Direct. The inclusion and exclusion of articles was based on certain criteria, which is further explained in the chapter *Retrieving relevant literature*. The literature for the results part were gathered and analyzed through the usage of Nvivo, which were not used in the frame of reference, which is a software designed to perform qualitative data analysis. It provides tools for organizing, analyzing, and visualizing data. Nvivo allows users to code data, annotate, and tag data sets for easier location of data. It supports various research methodologies, such as SLR.

3.1.1 Bias

Durach et al., (2017) argues that a systematic literature review aims to provide a comprehensive and objective overview of the existing literature on a particular topic. However, SLR's is also vulnerable to bias due to various factors such as research strategy, inclusion criteria, and data extraction methods. Durach et al., (2017) defines bias in supply chain related SLRs as systematic errors, in the selection, identification, or analysis of data that can lead to distorted or inaccurate solutions. Bias can occur at different stages of the of the SLR process. Furthermore, there can occur different types of bias. The authors present Selection bias and Publication bias. Selection bias refers to potential errors in the identification and selection process of studies for inclusion in the study. Bias can arise from several different factors, such as incomplete or inadequate research strategy exclusion of certain studies and fail to include studies that may be relevant to answering research questions (Durach et al., 2017). Publication bias refers to potential errors in the availability and inclusion of published studies. Bias can emerge from factors such as the selective reporting of results, the preference of select positive findings only in the result and diminishing negative

findings. (Durach et al., 2017). Durach et al., (2017) emphasize that both selection bias and publication bias can significantly impact validity and reliability of the preformed SLR study.

3.1.2 Snowballing

Snowballing is a technique used in systematic literature reviews to identify relevant studies that may have been missed in the initial search process. The technique involves using a set of initial studies, typically found through a systematic search, and then iteratively expanding the dataset by following references and citations that studies, articles, and books provides.

According to Wohlin, (2014) there is two main types of snowballing methods: Backward and Forwarding snowballing processes. Backward snowballing, also known as citation tracking, which refers to using a data set of primary literature that were identified through a systematic search and examining the reference list for furthered relevant literature that provides information that strengthen the thesis. The intention is to identify literature that were published prior the primary study (Wohlin, 2014). Forwards snowballing, also known as reference tracking, refers to examining the studies that have been cited in the primary literature, then determining if the citation is relevant for the thesis, an analysis of the literature is then carried out. Forwards snowballing have the same intentions as backwards, but the difference is in which method the author prefers (Wohlin, 2014). Both backwards snowball methods can be useful in identifying studies that were missed in the initial systematic search. However, it's important to note that snowballing should not be used as a supplement to the systematic search to identify additional relevant studies. Additionally, it is also important to implement a standardized method when conducting gathering of snowball literature.

3.2 Research design

A literature review can provide extensive assessment of relevant literature, along with further evaluation of the data in the field. Durach et al., (2017) strongly propose that performing SLRs can contribute substantially to advancing knowledge in certain fields. Historically, medicine is one such field. However, the authors continue by stating that SLRs may only contribute with limited amounts of new knowledge in the field of supply chain management due to its "...ontological and epistemological idiosyncrasies of research in supply chain management". Therefore, the authors have proposed a new SLR model designed to fit research in supply chain management more precisely that focuses on distinct features of supply chain management as well as best practice methods within the field. SLR's are performed following a series of steps, which are: (1) defining the research question(s), (2) determining the required characteristics of primary studies, (3) retrieving a sample of potentially relevant literature, (4) selecting the pertinent literature, (5) synthesizing the literature, and (6) reporting the results. Durach et al., (2017) have brought forward SLRs guidelines, which are based on the aforementioned steps, with slight modifications in order to fit research into supply chain management more precisely. These guidelines have been followed and used when writing the report. The thesis follows the steps formulated by (Durach et al., 2017), which is shown in Table 1. As mentioned above, Durach et al., (2017) suggest a new paradigm shift in supply chain research. Therefore, the description, purpose, and aim of each step has been redefined for easier and more efficient adaption to the field when considering the idiosyncrasies of supply chain research.

Table 1 Research design

Steps (based on Durach et al., 2017)	Execution
i) Define research questions	<p>RQ1: <i>Which barriers hinder the implementation and adoption of reverse logistics within e-commerce?</i></p> <p>RQ2: <i>Which solutions and opportunities can facilitate reverse logistics implementation and adoption within e-commerce operations?</i></p> <p>RQ3: <i>How can e-commerce enterprises overcome identified barriers to reverse logistics by applying identified solutions?</i></p>
ii) Determine required characteristics of primary studies	Peer-reviewed academic publications, articles, and books
iii) Retrieve sample of potentially relevant literature	Search in academic databases, i.e., Scopus and ScienceDirect. Additionally, literature will be retrieved through relevant suggestions in academic databases
iv) Select pertinent literature	<p>Literature included based on the following exclusion criteria for primary studies:</p> <ul style="list-style-type: none"> Irrelevant subject Wrong publication type Background article Full publication not available through Chalmers Foreign language Unsignificant citations compared to publishing year
v) Synthesize literature	<p>Bibliometric analysis: organizing the included data set/literature into distinct categories, related to the RQ's, which in turn forms distinct thematic areas. Knowledge is then extracted from each thematic area</p>
vi) Report the results	Reporting the finding to the research questions

3.3 Retrieving literature

According to Adams et al., (2017), the critical feature of a systematic review is comprehensive information gathering, compositing relevant evidence, identification of relevant perception of identified review questions and initiating keywords in electronic databases containing scholarly publications. The data for the chapter “frame of reference” will be collected via various databases, primarily Scopus, Science Direct, and Chalmers library. According to (Adams et al., 2017), including numerous sources in the data collection process will provide validity and credibility for the chosen literature. Furthermore, the analysis and discussion will only contain peer reviewed articles from the Scopus data base. It is important to note that only collecting data from one data base might result in a knowledge bias in

comparison to using all existing literature within the field of reverse logistics across all data bases (Durach et al., 2017). The gathered literature will later be analyzed and reviewed in a software program called NVivo. To ensure the scientific accuracy and objectivity of this thesis, the extensive collection of literature will be systematically analyzed for relevance to the subject matter. Only the most relevant and trustworthy sources will therefore be selected for inclusion regarding the chapter “frame of reference”. The selection of literature will be based on a set of predetermined inclusion criteria to ensure accuracy and relevance is used correctly. The criteria follow:

- *Peer reviewed articles*
- *High citation score in data scientific data bases*
- *Books and academic material*

3.5 Data collection

The literature search for the analysis was conducted in March 2023 in the Scopus database. The search string used was “e-commerce” AND “reverse logistics”. Additionally search strings, “e-commerce” AND “reverse-logistics”, “e commerce” AND “reverse logistics”, and “e commerce” AND “reverse-logistics” were tried, however with no additional significance to the literature gathering. Initially, a list of 135 papers were collected by said search string. To find papers with significant relevance to the thesis, all abstracts to each paper was reviewed regarding relevance. For some papers, an abstract screening was not sufficient, hence a full-text screening was done. Additionally, if a paper did not meet the inclusion criteria, for example if it was written in a foreign language, it was excluded. Most of the excluded items were removed from the literature list because of its irrelevancy. For example, a paper mentioned “reverse logistics” and “e-commerce” in its abstract but did not in fact focus on the topic. Some articles were of the wrong publication type (conference, not peer-reviewed articles). Additionally, a few articles were not available either through Chalmers or through other publications. Finally, through synthesizing the literature, seven snowballing articles were added as they showed significance in providing relevant and noteworthy material for the analysis. In Table 2, a complete overview of the screening process is presented.

Table 2 Retrieving data set

Inclusion/Exclusion process	Parameter	Result
	Total number of retrieved items from Scopus	135
	Included after abstract analysis	135 – 45 = 90
		Excluded: Irrelevant (32) Wrong publication type (6) Foreign language (5) Not available (2)
	Included after full-text analysis	90 – 9 = 81
	Snowballing articles added	81 + 7 = 88
	Final/Total	88

3.4 Research process

At the commencement of the thesis, a discourse was conducted with the supervisor from Chalmers in order to deliberate the topic of reverse logistics and the appropriate approach to carry out the SLR. Collaboratively with the supervisor, relevant research questions were formulated, and an appropriate software was identified for conduction of the analysis. As previously mentioned, the analysis was executed by using Nvivo Software. At the outset of the thesis, an extensive investigation of pertinent literature was carried out to acquire comprehensive knowledge about reverse logistics.

The research mythology involved using multiple databases and the resources available through the Chalmers Library. The selection of appropriate literature was determined through discussions with the supervisor, and peer reviewed articles found in SCOPUS were deemed to be most suitable for the analysis. However, to provide a comprehensive background understanding of the subject matter, various peer reviewed articles were collected. The aim was to acquire knowledge and insight into the challenges faced in the field of reverse logistics in e-commerce, while also establishing a framework for performing a SLR in a correct and objective manner.

Upon completion of the assembly of relevant background knowledge, the writing process was initiated, encompassing an explanation of crucial concepts of reverse logistics practices and e-commerce environments. Subsequently, a midterm seminar was conducted with students enrolled in the international logistics program, which included a presentation of the thesis and a feedback session. Following the seminar, guidance consultation was held with the supervisor to identify and correct any flaws and improve the overall quality of the thesis contents. Thereafter, the analysis process commenced, culminating in the finalization of code selection and coding, an ultimately resulting in the presentation of the thesis outcomes.

3.6 Structure of analysis and discussion

The final 88 articles were later assembled in the NVivo software program, and an extensive coding process was executed. This refers to collecting and structuring relevant data aimed for the analysis, referring to the thesis research questions. To answer each research question (RQ), a search within the gathered literature was to by using one keyword for each RQ, and additionally, synonyms to the selected keyword was searched for. The Nvivo tool “search for stemmed words” were also used when the literature was synthesized. For example, if the keyword is “talk”, Nvivo also searches for “talking” etc. For RQ1, the keyword “barrier” was used, and synonyms “obstacle” and “hinder” was used. For RQ2, the keyword “solutions” were used as the keyword and the synonyms were “opportunity” and “facilitate”. RQ3 acts as the basis for the discussion and is grounded as a comparison of RQ1 and RQ2. Hence, RQ3 is not directly grounded upon any literature synthesizing.

Despite, the collection of 81 articles, it was determined that certain articles did not contribute with answers of presented research, due to reasons such as lack of relevance to the research questions or insufficient quality of contents. As a result, these articles were not included in the final analysis and the study findings were based on snowball articles together with articles form the data set answering the thesis. This approach ensured that the results of the SLR study were based on a rigorous selection of relevant high-quality articles, thus enhancing validly and reliability of the study outcomes.

Table 3: Step by step in Nvivo	Keywords:	Additional information
1. Retrieving Dataset from literature data base		Data base: <i>SCOPUS</i>
2. Abstract analysis		
3. Assemble and import data set into NVivo		
4. Search query using keywords	<i>Barriers</i> <i>Drivers</i> <i>Solutions</i> <i>Opportunity</i>	Synonyms to keywords have been used, resulting in same output as keywords.
5. Full-text analysis		Analysis was performed regarding: <i>RQ1</i> <i>RQ2</i> <i>RQ3</i>
5.1 Structure Code selection		Code selection is based on:
5.2 Code relevant data		<i>Structure</i> <i>Findings</i>
6. Review code selection		

4. FINDINGS AND ANALYSIS

This chapter will present the findings of the preformed SLR in accordance with the RQ's. Major barriers to reverse logistics implementation and adoption within the e-commerce business environment are presented. Additionally, several possible solutions and opportunities towards advancing reverse logistics practices in the e-commerce market have been found through the literature research which consequently has been presented.

4.1 Barriers to reverse logistics

This section will present several major barriers to RL implementation in the e-commerce realm. Within these major barriers, several sub-barriers have been examined. The results presented on barriers have been found through analyzing the sampled literature. In table 4, a summarization of all barriers is presented along with an informative description

Table 4: Summary of barriers

Main barrier category and sub-barriers	Description	Reference
<i>Management and organizational barriers</i>		
Lack of commitment from top management	Top management not acknowledging the importance of RL	[7, 30, 36, 46]
Poor organizational structure	Insufficiently designed organizational structure which hinders RL practices	[10, 36]
More concerned on forward logistics/internal neglect	Top management only focusing the forward leg of the supply chain. Hence, internally neglecting RL	[7, 24, 30, 36, 46]
Lack of knowledge/awareness/education on reverse logistics	Top management neither informed and educated on RL, nor the knowledge	[7, 30]
Lack of performance measurement systems	Not measuring supply chain performance.	[30]

Company policies against reverse logistics	Companies more focused on forward logistics and primary market. May fear cannibalization of new products	[7, 46]
<i>Infrastructure barriers</i>		
Lack of physical internal infrastructure (storage, transportation, etc.)	RL require certain facilities and so forth. Having no such infrastructure hinders implementation	[30, 36, 37]
Lack of external infrastructure (poor road conditions, etc.)	Hinders reverse logistics practices	[7, 35]
Lack of technological infrastructure	Technology is needed for sufficient RL practices and neglect hinders implementation	[7, 29, 35, 36, 37, 39, 46]
Lack of information technology	Poor information sharing, both internally and with collaborators	[24, 29, 46]
<i>Political and governmental barriers</i>		
Lack of specific laws	Lack of laws explicitly targeting RL	[7, 30]
Lack of motivational laws	Lack of incentives for companies to adopt RL practices	[7, 47, 53]
Lack of governmental policies on returned products	Lack of regulations on how to handle returned products correctly.	[7, 30, 36, 47]
Lack of regulations of return policies	Lack of incentives on the design of return policies	[7, 30, 36]
Loopholes in legislation	Possible to work around legislation	[7, 30]
Misuse of laws and regulations	Companies not using laws to what they were designed for	[7]

Table 4: (continued) Summary of barriers

Main barrier category and sub-barriers	Description	References
<i>Financial and economic barriers</i>		
Limited forecasting and demand	Refers to the uncertainty's retailers, manufacturers, etc., face when predicting product returns. Effect volumes, i.e., economies of scale	[7, 30, 36, 46]
Lack of capital and investments for reverse logistics	Reverse logistics may not be considered as profitable, which in turn might result in the lack of investment that is required in order to function efficiently	[7, 9, 30, 36, 37, 46]
Lack of economy of scale	The volumes of returned products are often smaller than in forward logistics. Additionally, the demand is often erratic which can lead to less economy of scale	[9, 30, 37]
High costs in reverse logistics practices	Operating reverse logistics practices is expensive, especially if not operated efficiently	[7, 9, 24, 30, 36, 37, 52]
<i>Supply chain and coordination barriers</i>		
Lack of coordination with customer	Refers lack of information exchange with customer, which effect consumer behavior and supply chain management.	[7, 30, 36]
Poor service quality/lack of integration	Lack of coordination with supply chain stakeholders which can result in poor service quality	[7, 10, 30, 36, 37]
Lack of coordination with 3PLP's	Insufficient information exchange and planning with 3PLP's	[36]
Lack of support from supply chain partners	Supply chain stakeholders unwilling to cooperate to the proficient extent	[7, 30]

In order to understand the different barriers to RL implementation, one must know that they are comprised of internal and external barriers. According to Bouzon et al., (2018) internal barriers are the challenges that occur in the company structure, which can impede the adoption of environmental aspects, frameworks of goods flow, or communication between branches within the organization. External barriers involve challenges which hinder the adoption of RL practices, such as governmental laws, the global economy, or customer behaviour.

4.1.1 Management and organizational barriers

For companies to implement RL within its e-commerce operations, there needs to be a will from the top management to adopt RL operations. There exist various management related barriers. Naseem et al., (2021) conceptualize the management related barriers into three distinct categories: 'lack of commitment from top management', 'poor organizational structure', and 'management and organization more concerned about core business and forward logistics'. When focusing on the e-commerce market in a developing economy, in this case Pakistan, for management barriers, lack of commitment from top management was suggested to have highest prioritization to solve, followed by management more concerned about forward logistics in second, and poor organizational structure in third. Companies may be unconcerned by RL operations as the top management will put their main effort into their core business and forward logistics, especially in the startup phase of the company (Hao, 2014). Internal neglect from online retailers often happen for this reason. Such neglect can often result in insufficient investments into supply chain technology and software with sufficient facilitation capabilities in terms of the increased volume of online product returns (W. Wang et al., 2013).

Additionally, the top management across different departments in a company might not have the knowledge or awareness of reverse logistics, which consequently might result in an inefficient RL setup or a complete lack thereof (Bouzon et al., 2018). The top management and the broader organization might also show a resistance to change, i.e., unwillingness to adopt RL (Davidavičienė & Al Majzoub, 2021). Continuing, they argue that the managers in a company also have an important role in adopting as well as improving their RL operations, as poor management in strategic planning and support of the RL functions will result in a decline of supply chain performance.

A poor organizational structure is considered as a barrier to adopting, improving, and running RL operations within e-commerce. Davidavičienė & Al Majzoub (2021) states that a poor organizational culture, which is mainly influenced by bad management, will result in poor RL performances and that non-supportive cultures does not have a strong desire to perform well in their RL operations.

Among major barrier categories, Lamba et al., (2020) concluded that management related barriers were the third most important major barriers category after economic barriers and coordination (supply chain) barriers. Furthermore, their findings on specific managerial related barriers were ranked chronologically as follows in terms of importance: 'more concern on forward logistics', 'lack of commitment on the part of top management', 'lack of training and education about reverse logistics', 'lack of performance measurement systems'. Naseem

et al., (2021), found that from the perspective of academic experts, management-related barriers were ranked the least important major barrier category in developing countries, and more specifically in the Pakistan e-commerce market. Bouzon et al., (2018) analyzed and ranked the importance level of different RL related barriers, where the five most important barriers in each analyzed category were considered the most relevant barriers in the presented analysis. 'Company policies against reverse logistics' were ranked as the barriers with the most importance from an organizational perspective. From the asked expert in the survey, companies do not want to endanger the value of their newly manufactured products by reselling already used and recovered products. Additionally, 'low involvement of top management and strategic planning' ranked fifth. From the customer perspective, no management related barriers were ranked as one of the five most significant barriers. From the governmental perspective, 'Low importance of RL relative to other issues (within companies)' ranked first and 'low involvement from top management and strategic planning' ranked as second. When the results were aggregated, i.e., the different stakeholders' perspectives were combined, low importance of RL relative to other issues ranked third and company policies against RL ranked fifth. Additionally, company policies against RL were considered to be the seventh most causally effective barriers in the aggregated results.

4.1.2 Infrastructure barriers

E-commerce enterprises encounter various internal and external obstacles, especially with the infrastructure and technologies required to implement the RL concept being the most prominent. Infrastructure concerns are related to both internal infrastructure, such as technological infrastructure, warehouses, and transportation, and external infrastructure factors, such as roads, and areas to assemble warehouses, etc., which can establish circular economy principles. Additionally, investing in sufficient infrastructure which can handle the RL operations is challenging to companies due to several reasons such as the limited forecasting ability of online returns (Nel & Badenhorst, 2020). Continuing, they argue that such problems are due to and will lead to a lack of logistics knowledge in how to develop the surrounding logistical infrastructure. Additionally, the lack of sufficient technological and physical infrastructure might negatively impact both the ability to handle economies of scale and sporadic volumes in product returns (Nel & Badenhorst, 2020). Deficient transport infrastructure also present challenges to implement and operating RL operations. In Brazil, for example, the insufficiently designed and operated highways lead to high transport costs and cargo loss (Bouzon et al., 2018). The transition towards RL practices in e-commerce cannot be achieved with a single party's efforts alone (Nanayakkara et al., 2022). Critical elements for implementation include specific activities, resource technologies, and partner networks, commonly known as infrastructure enablers. According to Nanayakkara et al., (2022), there is a research gap in understanding the importance and how to establish circular economy networks with RL principles in the e-commerce industry.

The improvement of technological advancements has been proven to significantly enhance RL performance by reducing reaction times and increasing knowledge in managing several processes of the concept. (Nanayakkara et al., 2022). However, the expressed lack of IT systems, technology and infrastructure prohibits further implementation. The authors continue with other aspects of hindrance, such as the financial aspects of these technologies, which have a high price point that minor e-commerce enterprises will tamper with to implement and see ROI results. Nanaykkara et al., (2022) underline that a lack of external infrastructure, such as in developing countries, can lead to high operating costs, which in turn lead to business closures. A topic that Bouzon et al (2018) displayed in their research on barriers. The absence

of strong and updated infrastructure poses one of the most visual barriers regarding B2C e-commerce enterprises.

From a manufacturing standpoint, manufacturers often encounter difficulties in managing the quantity and timing of returned products. As noted by Lai et al., (2022), information technology such as big data, cloud logistics, and other IT tools, has been demonstrated to effectively facilitate RL operations of manufacturing e-commerce products. Nonetheless, there remain challenges such as latency, server overload, and system follow-up procedures (Lai et al., 2022). It is noteworthy that these tools can potentially cause severe operational issues for e-commerce businesses. Without a stable flow of information, it will disturb the synergy between the supply and demand units both upstream and downstream in the supply chain, due to the “bull whip” effect resulting in greater risk of operational backlog and staggering financial costs. (Hao, 2014). Another noteworthy remark is what Wang et al., (2013) claims concerning financial aspects of the current use of informational systems, i.e., such systems results in large financial investments for implementation and maintenance costs.

When analyzed by (Naseem et al., 2021), infrastructure barriers were ranked as the most important major barrier category out of the five analyzed major barrier categories. The sub-categorized barriers ranked in descending order: ‘lack of technological infrastructure’, and ‘lack of infrastructure (storage and transportation)’. This indicates that a lack of technological infrastructure is a more present a greater challenge to the implementation of reverse logistics practices than a lack of physical infrastructure. Whilst the physical infrastructure is critical for the facilitation of goods, the technology surrounding is vital for its implementation. Lamba et al., (2020), concluded that infrastructure barriers were the fourth most important major barriers category, only followed by policy and political barriers. The analyzed infrastructure barriers were ‘lack of infrastructure facility (storage and transportation)’, and ‘lack of technological infrastructure to adopt reverse logistics’, and they ranked fourth respectively sixth in importance out of all sixteen sub-categorized barriers. This implied that inadequate designed physical infrastructure needs to be resolved for RL to be implemented successfully.

The infrastructure barriers analyzed by Bouzon et al., (2018), were more concerned with the technical infrastructure surrounding the implementation of RL rather than the physical infrastructure, such as storage and transportation. The barriers were ‘lack of IT systems standards’, ‘lack of latest technologies for recovering products’, ‘technology and the Research and Development issues related to product recovery’, and ‘inconsistent quality of returned products’. From the organizational perspective, none of the infrastructure barriers was considered significant, and the highest-ranked infrastructure barrier was technology and the Research and Development issues related to product recovery, which ranked 11th. In contrast, when analyzed from the customer perspective, infrastructural barriers showed larger significance. Each of the four barriers ranked in the top eight out of the twenty analyzed barriers, were ‘technology and the Research and Development issues related to product recovery’, ‘inconsistent quality of returned products’, and ‘lack of IT systems standards’ ranked fourth, fifth, and sixth in a chronological order. Additionally, in both the organizational- and customer analysis, neither infrastructure barrier showed any significant causality towards any other barriers, which indicates a small effect on the entire network. From the governmental perspective, ‘technology and the Research and Development issues related to product recovery’, and ‘inconsistent quality of returned products’ showed a relative significance as they ranked sixth respectively eight in terms of importance, whilst the other two showed a significant smaller amount of importance. Additionally, inconsistent quality of returned products was the second most significant barrier in terms of causal effects of other barriers. When the results

from the different perspectives were aggregated, 'technology and the Research and Development issues related to product recovery' ranked fourth, 'inconsistent quality of returned products' ranked eight, 'lack of IT systems standards' ranked 11th, and 'lack of latest technologies for recovering products' ranked 13th. In terms of the aggregated causality, only 'inconsistent quality of returned products' showed significant causality as it ranked as the fourth most causally effective barrier.

4.1.3 Political and governmental barriers

The environmental barrier concerning RL in the e-commerce industry is intricately related to local, regional, and global governance and politics. The United Nations' sustainable development goals, as presented in the "Agenda 2030" apply pressure on member states to decrease global emissions and promote responsible consumption and production. Despite this, governmental experts, as highlighted in the study by Bouzon et al., (2018) which evaluated RL barriers, argue that governmental bodies lack the legislation or incentives necessary to encourage manufacturers to engage in reverse logistic operations and lack the requisite knowledge regarding taxation to implement laws regarding returned products. Moreover, they lack supportive policies related to the principles of the circular economy. The need for regulated return policies for companies is also deemed necessary. Especially in the e-commerce industry, where the environmental impact is generated by insufficient use of resources and the increased amount of misuse from returned products. The need for regulated return policies for companies is also deemed necessary according to Bouzon et.al (2018), and the low priority of RL activates is viewed as inconsistent from a company perspective. Bouzon et al., (2018) go on to emphasize that companies consider RL to be of low priority compared to other internal operational issues.

Implementing policies on reward and punishment can guide manufacturers, e-commerce enterprises, and consumers to actively participate in closed-looped supply chains, explicitly adopting reverse logistic practices. Adopting such principles can significantly impact e-commerce regarding return prices and enhance consumer's awareness of their pivotal role in the RL supply chain (Y. Wang & Zhang, 2020). In e-commerce, governmental institutions must promote the adoption of RL by providing technical support and policies that encourage its implementation (Yao & Ran, 2019). Yao & Ran highlights the need for more government supervision of the behaviour of reverse logistic in e-commerce to reach a successful implementation of the concept within the industry. Furthermore, they argue for implementing rewarding treatment to enterprises that use reverse logistics, and to penalize non-compliance otherwise (Yao & Ran, 2019). Additionally, they propose a model that illustrates the interdependence between e-commerce, the consumer, and governmental instances. Finally, they conclude the need for creating policies that prioritise consumer rights and the protection of the ecological environment, simultaneously considering the regulatory cost of governmental regulation (Yao & Ran, 2019). In developing nations, economies, and markets, such as the Indian market, the problems surrounding the implementation of RL practices are larger compared to developed nations, largely due to the lack and shortage of laws and policies concerning these issues (Lamba et al., 2020).

Naseem M et al., (2021) confirm a shortfall of government policies related to RL related to the automotive industry in Iran. Naseem M et al., (2021) continue by indicating that the e-commerce industry in Pakistan is progressing towards adopting reverse logistic practices. However, only a few enterprises could successfully adopt RL practices due to several governmental and environmental barriers (Naseem et al., 2021). Lamba et al., (2020) express "loopholes" in the Indian regulation policy on e-commerce. The regulation in terms of extended producer responsibility (EPR) is non-existent. EPR refers to the manufacturer's responsibility

for the product's end-of-life disposal after its intended use by regional consumers (Lamba et al., 2020). There exists no major driving force from the Indian government in relation to implementing RL, i.e., there are no existing incentives for RL implementation. In contrast, policymakers have established a sensible policy framework for waste/disposable items but not for RL (Lamba et al., 2020).

When studied by Lamba et al., (2020), policy and politically related barriers were shown to be the major barrier category with the least importance for companies in and the market overall out of five analysed major categories. The sub-barriers in this major category were identified and ranked chronologically as follows: 'poor return policies', 'lack of government supportive policies on reverse logistics', and 'loopholes in regulation on e-commerce'. In this study, poor return policies were therefore considered to be the main barrier for RL adoption in the market and for companies. Noteworthy is that each of the three mentioned barriers was concluded to be ranked outside the ten most important barriers out of sixteen analysed barriers. When barriers to RL in e-commerce got examined by Naseem et al., (2021), policy and politically related barriers were ranked as the fourth most important major barrier category out of five analysed, only followed by management related barriers which showed a lower weightage overall, i.e., lower importance. The sub-categorized barriers within the significant category were ranked in the following descending order: 'lack of government policies for reverse logistics', and 'poor return policies'. Additionally, 'lack of government policies for reverse logistics' was shown to have the second most importance out of all fourteen sub-categorized barriers and was only preceded by 'lack of infrastructure (storage and transportation).

When analysed by Bouzon et al., (2018), the policy and politically related barriers were 'lack of specific laws', 'lack of waste management practices (poor return policies)', 'lack of inter-ministerial communication', 'lack of motivational laws', and 'misuse of environmental regulations'. From the analysed organizational perspective, none of the policy and political barriers ranked in the top five most significant barriers in terms of importance and prominence out of twenty analysed barriers, with lack of waste management practices and lack of specific laws ranking seventh respectively eighth. However, in contrast to the above, the findings concluded that the two most causal barriers were lack of specific laws and lack of motivational laws, i.e., the barriers with an effect on the most amount of other barriers. From the customer perspective, there are similarities in the ranking of barriers. Lack of waste management practices is the highest ranked policy and political barrier, rated as the 11th most important while the rest is placed lower on the scale. When looking at the causality of each barrier, lack of waste management practices was determined to be the second most causal barrier, whilst lack of specific laws ranked relatively high as well, namely fourth. From the governmental perspective, the highest ranked policy and political barrier were lack of motivational laws, whilst the rest of the barriers ranked lower on the list.

On the other hand, three out of the five policy and political barriers were ranked in the top five in terms of causality. Lack of motivational laws was concluded to be the most causal barrier of all. In contrast, lack of specific laws and lack of waste management practices ranked fourth and fifth in chronological order. In the aggregate result, where the three stakeholder perspectives were combined, the highest ranked barrier was lack of waste management practices which placed 10th. However, and similar to the different stakeholders' perspectives, the policy and political barriers showed significant causality. Three of the five barriers were ranked in the top five, with lack of specific laws and lack of waste management practices (poor return policies) placing first and second, whilst lack of motivational laws ranked fifth. Bouzon et al., (2018) argue that lack of specific laws and lack of waste management practices (poor return policies)

have a significant relationship between each other as efficient return policies and transparent waste management practices are not usually implemented correctly or at all due to the lack of efficiently designed laws, regulations, and governmental policies on the subject.

4.1.4 Financial and economic barriers

In general terms, RL in e-commerce have been found to be dictated by both high initial investments and high accumulated operating costs. An attributing factor to the high costs related to RL is the lack of economies of scale, which results in not capturing scale benefits such as utilization in transportation and storage (Nel & Badenhorst, 2020). For a company to develop a framework for how to handle their RL operations efficiently, large investments into transportation are required which in turn will lead to higher transportation costs and companies may consequently be restrictive towards adopting RL within their businesses (Daultani et al., 2022;Lamba et al., 2020). To develop a framework for how to operate a RL system, it also requires large volumes of financial and material resources, and a large amount of highly skilled workers (Hao, 2014).

As RL is not based seasons and trends to the same extent as forward logistics, it is hard for companies to predict when the products will be returned, who the returnee is, which quantities that will be returned, and from where the returns will happen. This uncertainty in predicting product returns makes forecasting and profits forecasting difficult in RL (W. Wang et al., 2013). The limited forecasting and planning of the returned products in the reverse supply chain leads to cost increases and it may hinder the motivation for supply chain collaborators to efficiently invest in RL operations and activities (Bouzon et al., 2018). Not investing sufficiently into RL can sometimes be due to internal neglect from top management, due to the fact that the return rate of goods is difficult to predict and require a proper analysis through different technologies, which in turn requires more significant investments (W. Wang et al., 2013). Additionally, the uncertainty of product returns facilitates the need for optimal storage space with optimal utilization within it. This is due to both safeguarding tactics against diverging volume rates across time, and the readiness to ship products to customers due to the increasing amount of e-commerce transactions. The usage of optimally utilized storage space will consequently bear high costs (Nel & Badenhorst, 2020).

Insufficient investments into RL operations and activities present barriers to effectively implementing and managing RL in general (Nel & Badenhorst, 2020). Both inexperience and internal neglect from the top management within companies are seen as attributing factors to the insufficient investments. Supply chains, in particular, have also frequently overlooked the importance of adequate investing into information systems capable of handling the growing reverse supply chain (W. Wang et al., 2013). One consequence of not investing in and utilizing well-designed information systems is not optimizing trucking and transportation capacity. A low utilization rate consequently leads to difficulties in the supply chain network and increased transportation costs (Daultani et al., 2022). In addition, such information systems and related technology requires a workforce who can handle such advanced technology processing and there is a dire competition between companies to hire such individuals (Hao, 2014).

Environmental laws and regulation may stand in conflict financially with companies. Some environmental laws, which require the usage of various RL activities, may result in increased costs for companies, for example amounts of recycled and reclaimed products (Hao, 2014). The overreaching positive environmental and societal effects of environmental laws and regulations might have a negative economic impact on companies. For example, costs might increase due to regulations on mandatory reclaiming of sold products (Yang et al., 2017).

When analysing RL barriers in e-commerce, Naseem et al., (2021) found evidence which suggested that the economic barriers should be the second most prioritized major barrier category by companies after infrastructure related barriers. In addition, the different economic barriers were ranked chronologically as follows: 'lack of funds for product return management', 'higher cost of adopting reverse logistics', 'expenditure of collecting used products', and 'limited forecasting and planning reverse logistics'. This analysis was conducted concerning developing markets and especially the emerging e-commerce RL market in Pakistan. Lamba et al., (2020) analysed major RL barriers in e-commerce markets and concluded that economic barriers are the most important major barrier category which should be prioritized the highest by companies. Within the financial and economic barriers, the descending order of the barriers is 'lack of investment in reverse logistics', 'uncertain demand/limited forecasting', and 'lack of economy of scale'. Each of the three economic barriers was shown to be three of the five most important barriers among sixteen individual barriers, with lack of investment in RL shown to have the largest significance and importance.

When RL barriers were examined by Bouzon et al., (2018), the economical related barriers were 'limited forecasting and planning', 'lack of initial capital', and 'lack of taxation knowledge on returned products'. Limited forecasting and planning were concluded to have the second highest importance level from an organizational point of view, whilst neither of the other two economic barriers showed a significant importance level. From a customer perspective, limited forecasting and planning were shown to have the highest importance level whilst also being primary causal barrier among the twenty analysed. Neither of the other economic barriers showed any relative significance. In contrast, limited forecasting and planning, and lack of initial capital ranked fourth respectively fifth in terms of importance from a governmental perspective, whilst lack of taxation knowledge on returned products showed low importance. When aggregating the results, i.e., combing the three perspective, limited forecasting and planning showed the greatest significance level overall. Additionally, limited forecasting and planning were also found to be the barriers with the highest prominence-causal effect, i.e., the barrier having a causal effect on the highest number of other barriers.

4.1.5 Supply chain and coordination barriers

In a reverse supply chain, companies must efficiently deal with a complex network of returns, locations, and customers, which will bring difficulties to the company. For returned products, a system of pick-ups, classification, inspection, reprocessing, storage, and repacking need to be organized in order to handle the RL operations of returned products efficiently. Furthermore, in such a complex system as reverse logistics, the backwards operations must be organized well as inefficiency in the operations may lead to increased costs, due to for example inefficient handling of returned products (Nel & Badenhorst, 2020). A significant part of the network complexity stems from the having a large number of unpredictable return channels having a diverse product mixture. If not handled well, this will increase the uncertainty and reliability of the RL operations which in turn will increase costs (Bouzon et al., 2018). As these kinds of operations are at such complexity, many companies will lack the required supply chain knowledge to handle the operations efficiently (Davidavičienė & Al Majzoub, 2021).

When analysing barriers from different academical expert's perspective, Naseem et al., (2021) found that in terms of supply chain and coordination barriers, lack of coordination with customer should be the highest prioritized coordination barrier for companies, specifically in the Pakistan e-commerce market. Chronologically, 'lack of coordination with 3PL's' and 'poor service quality/lack of integration' followed. Additionally, among five major barrier categories,

coordination barriers were identified as the third most important. Lamba et al., (2020) found that coordination barriers should be the second most prioritized barrier category after economic barriers. They identified that the coordination barriers should in the following descending order in terms of importance: 'lack of understanding about best practices', 'lack of support from logistics partner', 'poor service quality', and 'customers are not informed to take back (product recalls)'. Bouzon et al., (2018) analysed and ranked twenty types of barriers within e-commerce RL from an organizational, customer centred, and governmental perspective. From the organizational point of view, difficulties with supply chain members ranked fourth in terms of relevance and prioritization. In parallel, difficulties with supply chain members were ranked as second from the customer perspective and respectively third from the governmental perspective. In the aggregated results from the study, difficulties with supply chain members ranked as the second most significant barrier to overcome among the twenty analysed barriers.

4.2 Solutions for implementing reverse logistics in e-commerce

This section presents solutions and opportunities found in the literature for overcoming and mitigating barriers to RL implementation and operation. The solutions and opportunities are categorized into broader thematic areas where sub-categories are also presented. Table 5 summarizes the leading solutions and its sub-categories.

Table 5: Solutions and opportunities

Main solutions and sub-categories	Description	References
<i>Clear internal and external policies</i>		
Internal policies	Refers at large to different return policy strategies	[4, 5, 36, 54]
External policies	Governmental policies on reverse logistics practices	[31, 40]
<i>Standardized reverse logistic processes and various models for enhancing reverse logistics practices</i>		
Develop standardized reverse logistics processes	Developing standardized procedures for RL in day-to-day operations	[30, 36, 40]
Different standardized reverse logistics models	Refers to models and practices that can optimize RL operations	[32, 36, 38]
<i>Relationship with supply chain members</i>		
Collaboration with supply chain members	Coordination in supply chains among stakeholders are crucial. Hence, efficient collaboration is required	[2, 36, 48]
Cooperative policies	Cooperative policies can lead to better collaboration with supply chain members	[40]
Information exchange	Information exchange among stakeholder is required for efficient supply chain operations, such as RL	[36, 48]
<i>Improvement of consumer awareness and collaboration</i>		
Relationship with customers	Good relationships with customers can make them aware	[34, 40]

Information provided to customers	of RL practices and have an effect on customer behavior Sufficiently provided information to customers can affect their behavior and collaboration level	[34, 40]
<i>Infrastructure solutions</i>		
Internal infrastructure	Qualitative technology, warehouses, storage, etc., can mitigate barriers	[4, 10, 44]
External infrastructure	Qualitative external infrastructure, such as roads, can ease RL operations	[10]
<i>Top management support, awareness, and knowledge</i>		
Support	Support from top management on reverse logistics is required for efficient RL operations	[2, 36, 44]
Awareness	Top management must have an awareness of RL as they otherwise might neglect RL	[2, 36, 44]
Knowledge	Efficient RL operations require good knowledge from top management, or the insight of smart delegation to people with knowledge	[2, 40]

4.2.1 Clear internal and external policies

To successfully implement reverse logistics, clear internal policies are important and play a key role. Naseem et al., (2021) found that 'clear policies and processes' should be the second most prioritized solution. Five distinct return policies have been identified by Zennaro et al., (2022) and they are: remanufacturing, refurbishing, repacking, recycling, and destroying. Implementing generous return policies towards customers, for example certain refunds for returned products, have financial benefits as they increase demand, both in the primary and secondary market (Batarfi et al., 2017). Increasing customer's awareness of companies return policies are important as it can result in higher profits, and it can be done by for example advertising. The quality of returned products is also important for efficient utilization (Batarfi et al., 2017).

Companies must consider the price sensitivity of the customer base. High-price sensitivity gain from free-return policies, and low-price sensitivity on return policies can result in extra fees. However, a very low price, combined with a high price sensitivity and generous free return policies, can result in constraints for companies as the amount of returns increases (Beranek, 2020).

Concerning external policies, Li et al., (2018) and (Prajapati et al., 2022) states that governmental policies on reclamation/return of products which can help companies to adopt reverse logistics, and governments can support companies in their implementation through for example allocated funds and tax incentives.

4.2.2 Standardized reverse logistic processes and various models for enhancing reverse logistics practices

For companies to overcome barriers to RL implementation, standardization of RL practices and the development of infrastructure are essential (Lamba et al., 2020). For full RL

integration and implementation, standardization of such practices is to be considered a very significant solution to overcome the faced obstacles according to Naseem et al., (2021) and Prajapati et al., (2022). Several technical solutions have been provided by Naseem et al., (2021), and they include automation of grading and sorting products return, centralized RL networks, integrating management systems for online returns, RFID technology, and applications for tracking products. For example, RFID technology decreases the handling time of products and increases tracking ability, and automation increases accuracy and efficiency of logistics operations (Naseem et al., 2021).

The literature also suggests solutions such as Closed-loop location inventory problem (CLLIP), which can optimize inventory-, transportation-, and facility-location management. Such a model allows management to proficiently decide on good return strategies and improving operational ability cost-efficiently (Li et al., 2014).

Pan et al., (2015) have proposed an innovative crowdsourcing model for product return collection in metropolitan areas, which utilizes taxi drivers and centrally located shops for product recollection and distribution. The model promotes environmental friendliness, and operational- and economic efficiency. Additionally, Pan et al., (2015) advocates for intelligent modular containers for enhancing traceability of product returns.

4.2.3 Relationship with supply chain members

In the literature, several studies have advocated for the importance of collaboration among supply chain members for overcoming RL barriers. Naseem et al., (2021) evaluated general solutions for RL implementation and identified 'developing a good relationship with third-party logistics providers' and 'developing e-collaboration with supply chain members' as the third and respectively seventh most important solutions. For productive relationships and collaboration, cooperative policies are needed for successful RL implementation (Prajapati et al., 2022). Agarwal et al., (2016) have developed an optimization model for RL and concluded that it heavily depended on collaboration among supply chain members to implement optimization strategies sufficiently.

To facilitate collaboration and relationship development among supply chain stakeholders, such as manufacturers, retailers, third- and fourth party logistics providers, and costumers, Wei et al., (2021) have proposed a B2C e-commerce RL information and collaboration exchange system. The system allows for information to travel efficiently and timely among the stakeholders and it provides increased operational ability as well as decreased costs. This system offers support at various stages of the supply chain, such as forecast prediction, warehouse demand elasticity, and facilitation of order placement and acceptance, as well as optimizing several factors such as transportation capacity, product allocation, and pricing and costs.

4.2.4. Improvement of consumer awareness and collaboration

The literature has emphasized the importance of customer behavior and its effects on product returns in e-commerce. Lv & Liu, (2022) highlights the importance of collaboration and communication with customers as it enables customers to make informed and rational purchasing decisions, and a good relationship can help in reducing product return volumes. Lv & Liu, (2022) also states that companies engaged in RL activities must understand how their strategies effect customer behavior. For example, impulsive and irrational purchasing decisions can be triggered by information overload or heavy price reductions. Lv & Liu,

(2022) have additionally proposed three approaches for addressing such behaviors: (1) comprehensive and concise information provided to customers, (2) utilizing optimized recommendation algorithms for custom-tailored information and in-depth product description to customers, and (3) provide precise explanations of terms and agreements of product discounts to decrease the excitement factors of online purchasing.

To increase customer awareness of RL practices, companies can provide awareness campaigns to customers which additionally can inform them on the environmental impact of RL (Prajapati et al., 2022).

4.2.5 Infrastructure solutions.

For internal infrastructure, the literature most significantly highlights technology improvements as solutions to RL barriers. Sirisawat & Kiatcharoenpol, (2018) states that technological infrastructure can enhance companies' ability to facilitate an efficient RL implementation. Technology can decrease response time and enhance companies' ability how to handle RL operations. Technology can furthermore increasingly help companies to optimize their RL operations as the technology becomes more and more sufficient to use as time passes (Batarfi et al., 2017), and adequate IT systems are imperative when handling product returns (Davidavičienė & Al Majzoub, 2021).

However, even with good internal infrastructure, companies can struggle with RL due to poor external infrastructure. To address this problem, governments can develop and foster robust external infrastructure as it can enhance the possibility and ability of companies to adopt and operate RL operations (Davidavičienė & Al Majzoub, 2021).

4.2.6 Top management awareness, support, and knowledge

Top management awareness, support, and knowledge is beneficial, and sometimes crucial, for adopting RL in e-commerce. Naseem et al., (2021) recognized 'top management support and awareness' as the essential solution for RL implementation among eight significant solutions. For companies to be competitive in the e-commerce market, sufficient supply chain- and logistics management is needed (Prajapati et al., 2022). According to Agarwal et al., (2016), support, awareness, and knowledge is needed from the top management in supply chain stakeholders for sufficient implementation of RL.

When solutions to RL barriers were analyzed by Sirisawat & Kiatcharoenpol, (2018), they concluded that the highest prioritized solution should be top management awareness and support as it has the potential to directly or indirectly effect the greatest number of other barriers, such as 'lack of top management awareness and support', 'policies for RL', 'governmental laws and supportive policies', 'specific environmental and waste management goals', and 'financial constraints'. Additionally, Sirisawat & Kiatcharoenpol, (2018) continue by stating that decision makers cannot focus on all solutions simultaneously. Hence, the ranking and prioritization of solutions provides decision makers with a clear incentive towards which solution that should be prioritized the highest.

5. DISCUSSION

The following chapter will present a discussion on how to facilitate optimization of the reverse supply chain in accordance with RQ3. Consequently, main findings on barriers and solutions will be presented, discussed, coordinated, and paired. This discussion will act as a foundation for answering RQ3 as well as further recommendations for research on the topic.

5.1 Solutions and opportunities for management and organizational barriers

From the literature findings, it is conclusive to state that lack of commitment from top management is the most decisive management and organizational barrier to RL implementation. Lamba et al., (2020), (Naseem et al., 2021), and (Bouzon et al., 2018) all identified lack of commitment from top management as a significant barrier, even though it was not prioritized the highest in all studies. However, it has the possibility to be the most causal management and organizational barrier. Consequently, overcoming management barriers has a great deal to do with top management being aware of and supporting RL practices, as top management support and awareness can ease the hardship of other barriers, such as non-adequately designed policies for RL. This was for example suggested by Sirisawat & Kiatcharoenpol, (2018). Furthermore, Naseem et al., (2021) similarly indicated that top management awareness and support is the essential solutions for RL practices. Again, this can relate to the effect decisions from top management have on whole RL operation, not just related managerial barriers. If top management is aware of RL practices, there is a more remarkable change of good decisions being taken on for example how to design their return policies and what technology the company should invest in to enhance their RL operation.

The possible economic benefits might also have an effect on how to make top management aware and supporting of RL practices in order to optimize the reverse e-commerce supply chain. Solid economic performance is at the heart of companies and top management might become more supportive of RL practices by demonstrating its possible economic upside. Such strategies include the design of return policies with the goal of increasing profits (Batarfi et

al., 2017), or technology which enhances the capabilities of the RL operations which consequently can lead to greater economic performance (Naseem et al., 2021).

5.2 Solutions and opportunities for infrastructure barriers

According to the literature, the significance of infrastructural barriers compared to other major barrier categories is not at a consensus. However, in terms sub-infrastructure barriers, it is clear that internal infrastructure, especially technological barriers, is of the most significance to solve as it presents the most notable obstacles for companies engaged in RL. Therefore, considering the adoption of different technologies is crucial for the efficient use of RL. Collaboration and information exchange between supply chain stakeholders is important for developing good RL procedures (Naseem et al., 2021, Agarwal et al., 2016), hence adopting data analysis and visibility technologies that can facilitate collaboration and information exchange is desirable, such as the model provided by Wei et al., (2021). Such models can offer analyses of return patterns, such as forecast prediction and product condition. Such information makes it easier for companies to for example achieve economies of scale and to precisely decide product volumes connected to each return activity, i.e., refurbishment, repair, remanufacturing, etc. Also, using RFID technology can be desirable as it decreases product handling time and increases traceability. Thus, using such technological tools alleviate the usage of technological models c to optimizing inventory, transportation, etc., for example CLLIP. It is further important to note that these technologies must be implemented in a standardized manner for optimized usage (Naseem et al., 2021, Prajapati et al., 2022).

Even if companies have developed efficient internal infrastructure, optimization of the reverse supply chain is also dependent on external infrastructure. To overcome this, governments can develop a robust infrastructure specifically intended to optimize logistics operations, such as warehouse and terminal areas, but also roads, etc., that benefit the whole society.

5.3 Solutions and opportunities for political and governmental barriers

According to the literature, political and governmental barriers are not shown to have an apparent significance in comparison to other major barriers categories. However, governmental laws and policies on RL practices were shown to have a significant causality towards other barrier categories (Bouzon et al., 2018). This could mean that governmental action on RL might not be that important on its own, but it can create a bull-whip effect on other types of barriers. For example, delinquently designed return policies are a significant solution to RL obstacles (Naseem et al., 2021), and legislation on return policies can force companies to adopt such policies (Prajapati et al., 2022, Li et al., 2018). However, a reason for political and governmental policies having low significance compared to other major barriers might be that forcing companies to adopt governmentally designed practices and strategies might not result in the desired outcome, namely a wider usage of circular economy principles. As RL is quite a new strategy, no singular model has been defined as the most efficient strategy, especially not for all companies as different companies are in different situations in each specific e-commerce market. The solution with the greatest impact for solving political and governmental barriers might then be for governments to provide incentives (Prajapati et al., 2022, Li et al., 2018), rather than providing forcing legislation.

5.4 Solutions and opportunities for financial and economic barriers

RL is an essential aspect that e-commerce enterprises must address due to the rapidly growing volumes of product returns. To achieve cost-effective and efficient RL systems, enterprises

must make significant initial investments that implies accumulated cost over time. The high costs associated with RL operations are primary due to the lack of economy of scale, which results in even larger investments as transport utilization and storage cost increase in line with scale benefits (Nel & Badenhorst, 2020). To make good investment decisions, it is vital that top management actors possess correct knowledge regarding RL practices, as the supply chain will otherwise not be optimized sufficiently. Additionally, good decisions may consequently lead to enhanced profits and cost reductions of RL operations.

Despite the challenges posed by the high costs of RL operations, e-commerce enterprises cannot afford to ignore them, as failure to develop efficient and cost-effective systems can lead to increased costs, reduced profits, and dissatisfactory service levels. Therefore, adopting a sustainable and operationally efficient RL framework is essential. The literature highlights limited forecasting and planning as showing crucial significance, especially according to Bouzon et al., (2018) who ranks the barrier as the one with the highest importance to solve, as well as the barrier with the most causal influence overall on other barriers. Hence, adopting technologies that can predict forecast and demand is important to achieve significant economies of scale which consequently affect the entire network. This consequently relates financially to transportation and warehouse management. One of solutions suggested by Daultani et al., (2022) is to achieve economies of scale by partnering with other e-commerce enterprises to share transportation and warehouse utilization. Additionally, the literature suggests that implementing IT technologies, automation technologies and leveraging data analytics can streamline return processes and improve return management.

Furthermore, to better understand the prediction of product returns and understanding customer behavior is crucial. The literature highlights the significant impact of customer's consumption behavior and the related product returns in the e-commerce domain (Lv & Liu, 2022). Establishing a relationship between B2C e-commerce and customers can mitigate and ease prediction of amount of product returns. Resulting in reductions of associated costs and operational obstacles created by consumers.

Finally, it's important to note that environmental laws and regulation can result in scale benefits for the society. However, such legislation can result in high costs and decreased profits for B2C e-commerce enterprises. (Hao, 2014; Yang et al., 2017). Hence the solution to address this associated high cost, can be to foresee forthcoming legislation, last enterprises developing efficient policies and frameworks beforehand.

5.5 Solutions and opportunities for supply chain and coordination barriers

The literature has identified supply chain and coordination barriers as a significant, but not the most crucial barrier category, especially difficulties with supply chain members (Bouzon et al., 2018), which to some extent encapsulate all sub-barriers into one barrier. As concluded by (Nel & Badenhorst, 2020), companies must operate efficiently in a complex network of stakeholders and operations, which is hard to do. Consequently, overcoming supply chain and coordination obstacles heavily relies on efficient collaboration with supply chain stakeholders which several articles in the literature have argued. It can be important to note that optimization models for RL might be heavily dependent on supply chain collaboration (Agarwal et al., 2016). Consequently, to optimize reverse supply chain, different strategies that can facilitate such collaboration and coordination become important. For example, Prajapati et al., (2022) argues that cooperative policies towards supply chain stakeholders can result in productive relationships. Furthermore, sufficient information exchange between stakeholders is important for collaboration and coordination in the supply chain as it enhances

the operational efficiency, and it can also build trust between collaborators. Hence, methods such as Information and collaboration exchange system (Wei et al., (2021) could be utilized as it provides actors with correct information in a timely manner.

Additionally, it is crucial to have a good communication with customers as customers can be said to have control over the market in a sense. Sufficiently, customers can be included in systems like Information and collaboration exchange systems, where they for example can place orders. It is also important know understand why customers behave as they do as their decisions effect the entire supply chain. Using the three-stage approach method provided by Lv & Liu, (2022) can for example address non-desired customer behavior. Furthermore, increasing customer awareness of RL practices might result in a greater coordination and communication between companies and their customers. This can for example be done through awareness campaigns (Prajapati et al., 2022).

6. CONCLUSION

In this following chapter, conclusion of this bachelor thesis will be presented. In a structured manner, each of the three research questions will be answered by providing the most significant findings on each topic.

6.1 Research question 1

To fulfil the purpose of this bachelor thesis, RQ1 was provided in the following manner:

“Which barriers hinder the implementation and adoption of reverse logistics within e-commerce?”

From the literature gathering and along the course of this thesis, key barriers have been identified and are presented below:

- E-commerce enterprises are not being able to efficiently do forecasting on demand or return volumes, which hinders economy of scale, resource allocation, operational efficiency, transportation- and inventory management, and capturing possible financial benefits.
- Lack of commitment, support, and knowledge from top management results in poor decision making of implementation of reverse logistic practices, in for example poorly designed return policies. This cause complexity and insufficient performance of the reverse supply chain, which can lead to higher accumulated costs and decreased profits.
- Reverse logistics practices in e-commerce are dependent of efficient internal infrastructure. The lack of sufficient technology and physical infrastructure consequently lead to decreased operational efficiency, less collaboration and coordination in the supply chain, and decreased financial performance.
- Lack of coordination and support in the supply chain leads to uncoordinated return management due to low supply chain visibility, information sharing and collaboration.

Consequently, difficulties with supply chain members can limit the possibility of optimizing the reverse supply chain network design.

- Political and governmental policies and laws can pose as barriers for reverse logistics implementation. This includes lack of specific- and motivational laws, and lack of policies for returned products as well as lack of regulated return policies. Additionally, companies can also misuse existing legislations.

6.2 Research question 2

To fulfil the purpose of this bachelor thesis, RQ2 was provided in the following manner:

“Which solutions and opportunities can facilitate reverse logistics implementation and adoption within e-commerce operations?”

From the literature gathering and along the course of this thesis, critical solutions have been identified and are presented below:

- To implement RL sufficiently, clear internal policies, especially delinquently designed return policies, are crucial. Being aware of customer behavior and customer price sensitivity is consequently vital for the design of efficient policies as they will result in increased revenue.
- Standardization of RL practices and infrastructure developments are critical to overcome barriers within the field. Technical solutions include automation, RFID technology, and the closed loop inventory problem. Crowdsourcing models and intelligent modular containers are also proposed to enchase efficiency and traceability.
- Collaboration and coordination in the supply chain can facilitate exchange of information, enhance operational ability, and result in decreased costs in the entire supply chain.
- To optimize the reverse supply chain, collaboration and communication with customers are important as it facilitates increased operational efficiency, reduces return volumes, and leading to customers to making informed purchasing decisions.
- Technology enables companies to handle reverse logistics operations efficiently, as well as optimizing such operations over time.
- Top management awareness, support, and knowledge directly or indirectly impact the solving of multiple barriers.

6.3 Research question 3

To fulfil the purpose of this bachelor thesis, RQ3 was provided in the following manner:

“How can e-commerce enterprises overcome identified barriers to reverse logistics by applying identified solutions?”

Through synthesizing the literature in the analysis, identified solutions have been paired with identified barriers as presented in the discussion, and below are the conclusive remarks to RQ3:

- Commitment, awareness, and support from top management is an exceedingly decisive solution for overcoming multiple barriers. Top management influence quality decision making, policy design, and investments into RL practices.
- The significance of internal infrastructure barriers in RL are prominent. Collaboration and information exchange between supply chain stakeholders can mitigate these

barriers with effective RL procedures. Furthermore, aided by data analysis and viability technologies. A standardized implementation of these technologies is recommended and highlighted of its importance.

- Even if governmental barriers are not shown to be significant barriers, they can have a casual effect. One reason might be that forcing legislation might not have a very significant impact. Consequently, governments could provide incentives towards companies rather than explicit legislation.
- RL are associated with high costs, primarily due to the lack of economies of scale and expensive investments. To address this issue, technology, top management, and understanding customer behavior can have efficient impact in overcoming this obstacle.
- To address challenges with supply chain and its coordination, supply chain collaboration, sufficient information exchange, cooperative policies, and customer communication and awareness can have significant impact.

6.4 Recommendations for further research

Based on the conclusion reached in this thesis, it is evident that the concept of RL is critical for the advancement of online purchasing and the emerging paradigm of electronic commerce. Consequently, we recommend that additional research be undertaken to establish a standardized implementation of the concept in its entirety. Concerning future research, it would be interesting to see more extensive studies on the ranking on barriers specifically focused on markets in developed countries. For this thesis, many of the extensive studies we have examined during the systematic literature review have been conducted as a comprehensive overview of RL in e-commerce, rather than focusing on for example the e-commerce textile industry. Consequently, this thesis was adopted to synthesize knowledge on e-commerce reverse logistics, rather than for example e-commerce textile reverse logistics. For example, studies in Sweden could be conducted. Furthermore, RL is gaining prominence and significance in entire societies, mainly based on societies striving towards circular economy principles. However, companies are the ones primarily concerned with how RL operations actually work on a day-to-day basis. Therefore, it would be compelling to see future case studies with large manufacturers and retailers to see what barriers they perceive as most prominent, and how they could overcome they perceived barriers and consequently, how they optimize their RL operations. In the gathered literature, there is very little material on what types of specific solutions they are in relation to specific barriers. Consequently, studies could be performed that make in-depth analyses of specific barriers, such as economic barriers, and then provide tailored solutions. Finally, a wider, extensive base of literature covering reverse logistics and its barriers would have been beneficial to the study's credibility.

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