SUSTAINABILITY MODEL FRAMEWORK FOR ESTONIA THROUGH INTEGRATION OF REVERSE LOGISTICS: LITERATURE REVIEW

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Abstract

During the last decades, the environmental trend was steadily moving towards sustainability through control of gas emissions, switch to electrical vehicles, recycling in every industry and every European state. Being ranked 10th globally according to the Sustainable Development Report, Estonia has ambitious plans for its sustainability development for the upcoming 20 years. Implementing alternative supply chain models is vital to cover all routes to achieve a sustainable yet effective supply chain strategy. Reverse logistics can offer a solution to optimize the supply chain through recycling used goods on the one hand and rerouting defective products to prevent spoilage on the other hand. Creating a model based on reverse logistics will provide an opportunity to use the full capacity of existing supply chains by simply reversing product flow backward.

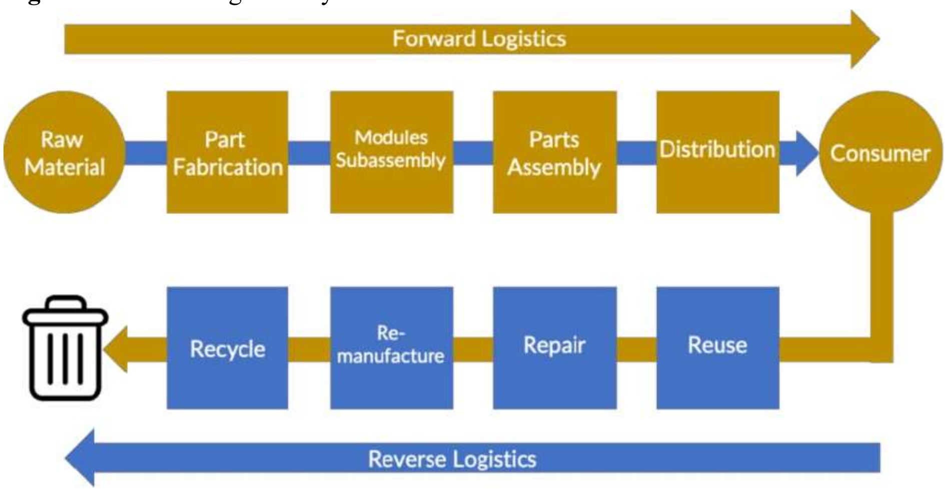
This paper seeks to analyze existing research and synthesize the current state of reverse logistics models against the background of the methodological approach, which will form an initial framework for further research in this direction. By conducting a deep theoretical overview and summarizing previous experience author seeks to create a strong theoretical basis and a corresponding starting point for the development of a successful sustainable reverse logistics model for Estonia, which has a lack of studies in this field both practical and theoretical, hence requires a strong framework for the future sustainability model based on reverse logistics practices that can have not only theoretical, but also practical implementation.

Keywords: sustainability model framework, reverse logistics, supply chain model framework, Estonian sustainability model

1. INTRODUCTION

The concept of sustainability has gained significant attention due to growing environmental concerns and the need for efficient resource management. Due to the shortening life cycles of almost every product on the consumption market, the amount of waste is snowballing. If this waste is not handled properly, significant damage to the ecosystem can be done (Hanafi et al., 2008). Countries now recognize the importance of adopting sustainable practices to mitigate the negative impacts of excessive consumption and industrialization and promote a circular economy to reduce waste. Governments and public administrations are forced to approve new initiatives to reduce environmental impact, extend the product life cycle and recycle raw materials where possible (Prakash and Barua, 2016). In a situation such as this, companies have to adopt sustainable policies (García-Arca et al., 2017) and product recovery reverse flows (Ravi et al., 2005) in extremely short time frames to correspond with newest agenda and legislation, meet society's expectations and at the same time increase the economic value of its product and manufacturing process where possible (Steeneck and Sarin, 2013; Pokharel and Mutha, 2009; Barker and Zabinsky, 2010). To summarize, companies from different industries must adopt various sustainable initiatives, including reverse logistics, to enhance their reputation, stay competitive, and stimulate economic growth (Shankar et al., 2008). Hidayat et al (2019) described a system that connected Forward Logistics and Reverse Logistics in one flow with diametrically opposite parts of the supply chain (Figure 1).

Figure 1 Reverse Logistics Cycle



Source: Hidayat et al. (2019)

Reverse logistics can be identified as a form of management and configuration of the supply chain that allows products or materials to move not only from distributors or manufacturers to the consumers but also to move backward- from consumers to distributors to ensure the final disposal of the product, whether it is recycling, renewal or resale (Shekarian, 2020). The ultimate aim of this process, or strategy, is to return the product's value, maximize the value, or dispose of the product. According to Krstev and Krstev (2022), due to the growth of e-commerce, the yearly profitability of reverse logistics in the consumer goods market is estimated at almost a trillion dollars.

In the constant search for a universal solution to the current waste problem, the Triple Bottom Line (3BL) balance must be considered: social, economic, and environmental (Arnette et al., 2014). From a social point of view, sustainability assists in improving the labor and health conditions of the employees, increasing motivation, and reducing turnover and recruitment costs. From an economic perspective, sustainability helps reduce energy and labor costs and provides wider availability of resources. And finally, from the environmental point of view, sustainability efforts are constantly aimed at preserving the planet by reducing waste and pollution generation (Singhry, 2015). Sustainability programs in Estonia at this point are mostly aimed at waste recycling and gas emission reduction, hence need a systematic 3BL approach. Before economic and social factors will be considered, a strong environmental policy must be implemented.

This research seeks to start creating a framework for a strong sustainability model through the integration of reverse logistics in Estonia, which has a weak basis for practical and theoretical studies in this field.

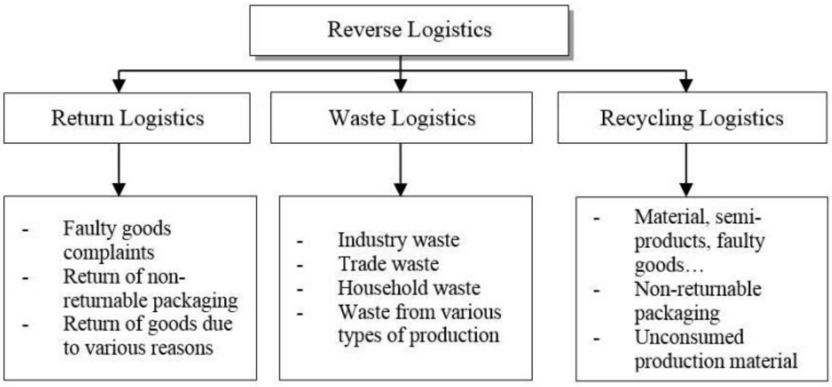
2. METHODOLOGY

For a preliminary literature review qualitative research method was applied to analyze and summarize previously published articles. Most relevant articles were selected and sorted according to the year of publication, as the author aimed to research the evolution of such specific waste and recycling management methods as reverse logistics in the perspective of enhancing sustainability on various levels.

Even though Estonia is one of the most digitalized countries in the European Union and ranked 10th globally according to the Sustainable Development Report, Estonia's environmental sustainability is significantly under-researched on its territory, especially from the perspective of reverse logistics. This paper aims to build a framework for future deeper studies of the Estonian sustainability model in connection with reverse logistics, as this is one of the most sufficient ways of resolving waste and recycling issues.

Figure 2 illustrates a scheme of division of reverse logistics. The division consists of three types of specific logistic subsystems that are usually a part of a larger logistic system.

Figure 2 Division of Reverse Logistics



Source: Tomkova (2015)

The research questions:

1. In which ways was the sustainability model, through the integration of reverse logistics, formulated, shaped, and developed over the last two decades according to the three dimensions of reverse logistics?
2. What have been the main similarities and differences in relevant research?
3. What are the main theoretical models and theories on sustainability model through the integration of reverse logistics today?

The main goal of the research is to locate scientific articles on topics close to reaching sustainability in logistics by applying reverse logistics practices. Deeply analyze and highlight the main research paths and ideas. Gather all similarities and disagreements and conclude the current state of sustainability through reverse logistics. Moreover, the researcher aims to suggest how described theories can be applied to Estonian supply chain practices and make a strong basis for future studies.

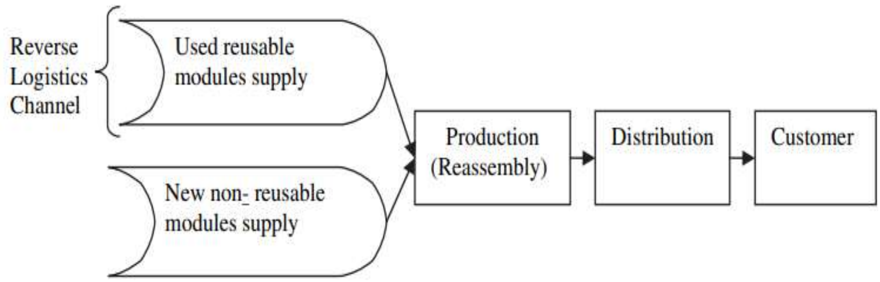
3. SUSTAINABILITY MODEL THROUGH REVERSE LOGISTICS

Reverse logistics is a concept that has been formulating and changing shapes for a few decades. According to Kerr and Ryan (2001), a system of remanufacturing end-of-life products has had several economic, social, and environmental benefits, even though it requires a product to fit specific remanufacturing standards (Sundin and Bras, 2005). An impact on the supply chain system is even more significant, requiring the product to be collected, remanufactured, and remarketed (El Korchi and Millet, 2011). At this point, the researchers decided to design a reverse supply chain system; additional research is required to create a systematic approach to business instead of narrow optimization research of local optimization (Guide and Van Wassenhove, 2009). Remodeling the supply chain to integrate reverse supply chain elements enormously impacts the whole value chain.

3.1 Reverse logistics studies conducted between 2010 and 2020

El Korchi and Millet (2011) established the main difference between the reverse supply chain and forward supply chain as the presence of a Reverse logistics channel (RLC) within the reverse supply chain as it is illustrated in Figure 3. This channel provides a way to return the reusable used products to the manufacturer to reassemble them. Other logistic flows of the reverse supply chain bringing non-reusable products, production, and distribution, generally use the same ways as the forward supply chain.

Figure 3 Reverse Supply Chain



Source: El Korchi and Millet (2011)

According to Dowlatshahi (2005), Fleischmann et al. (2001), and Guide and Van Wassenhove (2009), the demand for an integrated approach in the design and implementation of reverse logistics practices has been steadily increasing. To answer this demand, a framework that integrates relevant economic factors of reverse logistics was proposed by Dowlatshahi (2005). Managerial guidelines for designing and applying reverse logistics practices were presented within the framework. El Korchi and Millet (2011) moved in the same direction in their research. They offered a framework to integrate with other stages of the remanufacturing system and product design stages. This specific design of the framework allows managers to have a broad view of all stages of production that impact RLC sustainability and make weighed decisions in creating their reverse supply chain. Using a case study on remanufacturing electric-and-electronic equipment study created 18 different frameworks for building an RLC. It compared the results from economic, social, and environmental points of view. The main idea of the study is that a strategic approach to creating a framework provides an opportunity to create a more complex yet effective framework that can be adapted to the specific needs of a supply chain. Reverse logistics or reverse supply chain systems proved effective in achieving a certain level of sustainability, depending on the company's goals. This can also be reflected in the choice of a specific framework.

Sustainability through the integration of a reverse supply chain was studied from the perspective of digitalization by Cullinane et al. (2017). The researchers explained the choice of this perspective by the increase of e-commerce, especially in the consumer goods area. The growth of e-commerce inevitably leads to a rise in returns.

A study conducted by Cullinane et al. (2017) provided an example of two Nordic companies with different marketing approaches, but similar return logistic chains, where product return numbers were presented and compared by country (Table 1).

Table 1 Returns by country and brand, 2016.

Country	Brand A (low fashion)		Brand B (high fashion)	
	% returns (on an item basis)	Items returned	% returns (on an item basis)	Items returned
Finland	24.5	126,000	45	51,700
Sweden	15.6	248,000	31.6	176,000
Denmark	13.9	44,000	25.7	10,000
Norway	14.2	74,000	25.3	7,500

Source: Cullinane et al. (2017)

On the contrary, outward logistics is well organized and executed; the return process, directly related to reverse logistics, must be better organized and significantly under-researched. Reaching a sustainable business model through the integration of reverse logistics with major appliances of digital tools is studied from the perspective of social media, apps, electronic data interchange (EDI), and customer profiling was the main purpose of the research.

The research results were controversial. On the one hand, implementing some technologies such as virtual reality helped to improve visualization, allowing consumers to make weighed decisions on the purchase. On the other hand, making the return process easier by using EDI encouraged consumers to make more frequent returns. In conclusion, the authors suggest appealing to consumers' conscience and environmental responsibility through digital channels. The goal of improving sustainability can be reached using two main paths, by reducing the number of returns and by improving reverse logistics efficiency through deep integration of digital tools that are currently available.

Companies can generate additional profit and sustain the business long-term by implementing sustainable principles (Székely and Knirsch, 2005). This makes achieving a competitive advantage through adopting sustainable practices a crucial goal for every organization (Hart, 2005; Pfeffer, 2010).

Banihashemi et al. (2019) conducted a deep overview of existing articles aimed at analyzing product disposition as a key feature in reverse logistics and its impact on sustainability from the perspective of 3BL- economic, social, and environmental, mentioned in previous articles. The research group found a significant correlation between implementing a reverse logistics system and improving environmental sustainability. Several relevant papers were studied and evaluated based on the 3BL dimensions. Table 2 demonstrates the analysis of articles that investigated the sustainability performance of firms from economic, environmental, and social perspective performed by Banihashemi et al (2019).

Table 2 Reverse logistics and sustainability performance from the perspective of Green supply chain management (GSCM).

Author	RL Economic	RL Environmental	RL Social
Wu *et al.* (2015)	✓	✓	✓
Govindan, Khodaverdi and Vafadarnikjoo (2015)	✓	✓	
Azevedo *et al.* (2011)	✓	✓	✓
Eltayeb *et al.* (2011)	✓	✓	✓
Diabat *et al.* (2013)	✓	✓	✓
Laosirihongthong *et al.* (2013)	✓	✓	✓
Govindan *et al.* (2014)	✓	✓	✓
Geng *et al.* (2017)	✓	✓	✓
Younis *et al.* (2016)	✓	✓	✓
Eltayeb *et al.* (2010)	✓	✓	✓
Abdel-Baset *et al.* (2019)	✓	✓	

Source: Banihashemi et al (2019)

The research team concluded that previous research needed more attention to the disposition decision in reverse logistics and their influence on sustainability results. A deeper analysis of the potential impact of disposition options as a way of extending product life and hence impacting an organization's sustainability performance was suggested using the 3BL approach to measure sustainability performance.

Considerable interest in recycling and reusing the materials was indicated in Europe due to the limited number of dumping sites and strict regulations regarding removing the product's packaging and handling outdated products (Skrucany et al., 2018; Dolinayova and Loch, 2015). The research conducted by Zitricky et al. (2019) aimed to create an optimal way to collect a specific recycled type of waste within a case study.

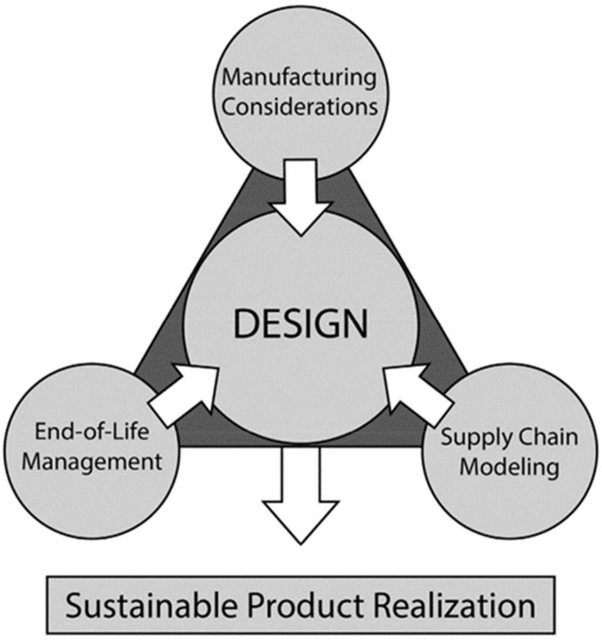
Because no society can function without producing a considerable amount of waste, ways to reduce this must be treated with great attention (Caban et al., 2018). Even though reverse logistics is a relatively new direction in supply chain management, its role in achieving sustainability is undeniable. The use of reverse logistics to achieve sustainability is mostly applied in European states; here, it is considered one of the few means for utilizing waste generated by the previous stages of the supply chain.

The research calculated certain methods of gathering recycling for a certain type of waste. For plastic containers, which appear to be the most frequent type of waste- the Clarke-Wright method of organizing circular transport issues is the most suitable. The Nearest Neighbourhood Method was found to be most efficient for the second type of container. Glass haulage was only possible to gather and recycle with current routes. Calculating these methods allowed researchers to make calculations on annual savings and labor cost savings. However, the environmental and reputational positive impact was a lot more considerable. The study based on a specific case study showed that applying reverse logistics principles can lead the company towards sustainable operation and save costs. One of the main tasks of modern society includes various methods of reducing waste. It is the task of businesses and citizens to start saving the environment in any way available (Torok, 2017).

Increased consumption in the production market has considerably influenced the amount of waste (Raja Ghazilla et al. 2015). The population has pressured their governments to adopt regulations to resolve the issue of disposal of post-consumer waste and make manufacturers responsible (Afroz et al. 2013; Borthakur and Govind 2018; Choong et al. 2018) even though the traditional approach was known for total ignorance of the post-production waste disposal. A post-consumption lifecycle approach has been adopted in the framework of Extended Producer Responsibility (EPR) (Chari et al. 2014; Cheung et al. 2015).

Keeping this in mind, it was suggested to prioritize sustainability at all stages of product design and distribution. Along with traditional approaches, new ideas such as 3BL mentioned in previously discussed papers (Singhry 2015; Thomé et al. 2016; Ma and Kremer 2016) and EOL (End of Life Management) (Amelia et al. 2009; Ramani et al. 2010; Shevtshenko et al. 2012; Subramanian et al. 2014; Ziout et al. 2014) were proposed. According to the newest theories, a product lifecycle can be divided into five stages; pre-production, production, distribution, use, and disposal. An early design approach can significantly impact sustainability by affecting the choice of material and production processes and the product lifecycle, including distribution, transportation, and recycling. Figure 4 shows aspects that must be considered during the early stages of product design to achieve sustainable product development on early stages.

Figure 4 Design decisions that impact every stage of a product's lifecycle



Source: Ramani et al. (2010)

3.2 Newest reverse logistics studies conducted between 2020 and 2023

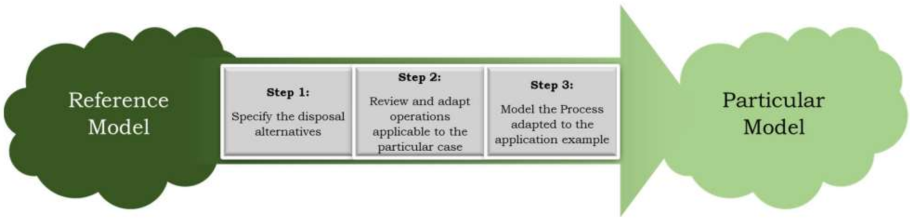
The systematic Review Protocol was used in the research conducted by Melo et al. (2021) to choose the most relevant publications and exclude irrelevant studies. The group analyzed previous publications from the perspective of the newest theories based on several Research Questions. They managed to identify a correlation between reverse logistics and sustainable design in the present business environment. Integration between reverse logistics and sustainable design needed to be further researched. Even though this conclusion opens several possibilities for further research, the researchers found it surprising that reverse logistics processes were not included in the end-of-life cycle and other stages of sustainable product design, considering there is a proven relationship between the two.

Several researchers point out the inevitable problem that corporations around the world are facing- the shortened product life cycle, which increases the amount of waste exponentially and forces governments to enforce laws to minimize environmental impact and focus on the reuse and recycling of raw materials (Prakash and Barua, 2016).

Reverse logistics have become the answer to increasing pressure companies face to make their business processes sustainable yet financially acceptable. In other words, efficiently managing returns have become a crucial success factor for many companies (Autry, 2005).

In the pursuit of creating a reference RLP (Reverse logistics processes) model that companies could use as a starting point to increase supply chain sustainability, research conducted by Alarcón et al. (2021) three-step methodology based on selecting or eliminating basic activities in the reference model according to each company's specific needs. The research group also presented an example to demonstrate the proposal's effectiveness. Figure 5 shows the methodology consisting of three main steps to adapt the Reference Model-Reverse Logistics Process based on a particular case.

Figure 5 Graph of the methodology to adapt the RM-RLP.



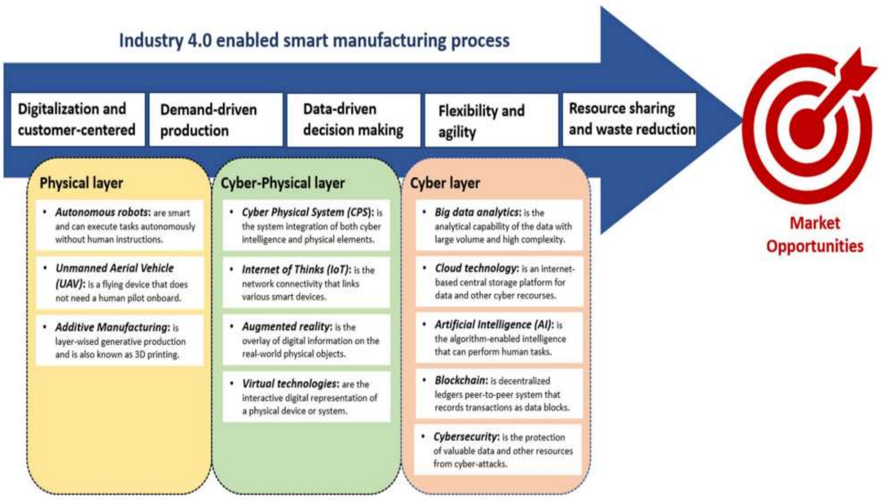
Source: Alarcón et al. (2021).

The authors concluded that reverse logistics processes have become crucial in achieving sustainability within the supply chain, mostly because of managing product disposal and recycling. They also managed to create a reference model that can be adapted to the company's specific needs. The reference model includes three stages: collection and transport, inspection and evaluation, and product disposition. The reverse logistics processes must be informal to bend and adapt to a specific market requirement easily. The research group points out that the proposed model suits any business moving towards sustainability. A case study was used as an example to prove this point. Even though the research results in terms of the practical implementation were sufficient, the authors still point out the need for more relevant studies on the topic and suggest further research from theoretical and practical perspectives.

Nowadays, companies are forced to take responsibility for the whole product lifecycle, the new reality in which reverse logistics is used to maximize the remaining value of end-of-life products through various processes such as product design, operations, control, and organizing effective and efficient flows from consumers to suppliers (Rogers and Tibben-Lembke, 2001). Ramos et al. (2014) point out that a properly designed and operated reverse logistics system must always balance economic, environmental, and social sustainability. The concept of Industry 4.0 (Fourth Industrial Revolution) and other state-of-the-art technologies has provided an opportunity to create Logistics 4.0 (Wang 2016; Winkelhaus and Grosse 2020). Integrating technologies like the Internet of things (IoT), big data analytics, and artificial intelligence (AI) with a cyber-physical system (CPS) a Logistics 4.0 can potentially start a new era of actual real-time monitoring and decision-making, systematic and timely information update and effective product flow, a lack of which has always been an obstacle on the way to effective supply chain. These tools can also considerably impact improving reverse logistics systems' economic, environmental, and social sustainability.

Figure 6 reflects three categories: the physical, cyber, and cyber-physical layer of Industry 4.0 major technologies. Manufacturing system created with the use of Industry 4.0 consists of an enormous amount of interconnected devices, which are constantly in connection with one another in real-time (Sun et al. 2022).

Figure 6 Industry 4.0 enabled smart manufacturing process.

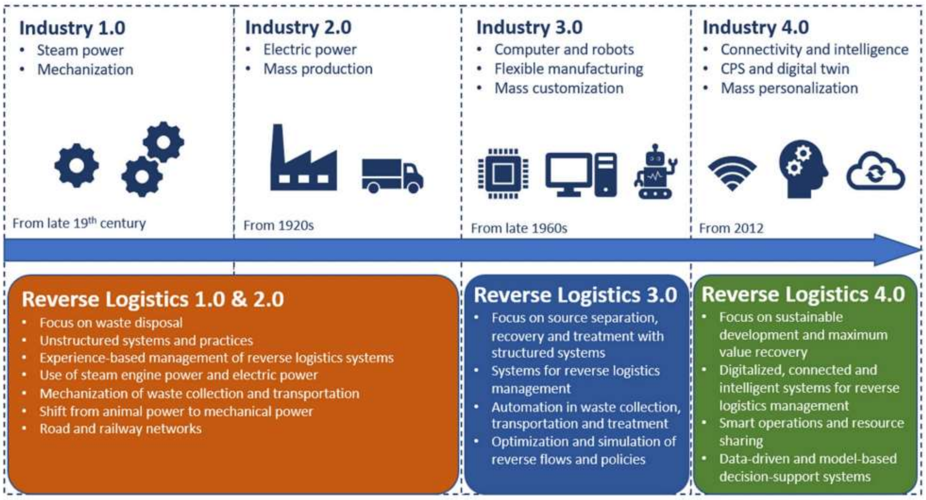


Source: Sun et al. (2022)

The research conducted by Sun et al. (2022) sets an ambitious goal of developing a conceptual approach and research agenda on transforming conventional reverse logistics into Reverse Logistics 4.0 as an analogy to Industry 4.0 using theoretical and practical tools.

The authors present a fresh approach to integrating technology into reverse logistics systems. The major difference is how they see the industry or logistics system and incorporate this vision into their study. Extending the idea of Industry 4.0 to the supply chain allows us to see the big picture from a technological angle and develop the principles to achieve sustainability by systematically integrating technology. Figure 7 demonstrates the evolution of reverse logistics keeping in mind four industrial revolutions. The concept of reverse logistics was widely used before the early 1990s, even though its basic rules were not written yet.

Figure 7 Reverse logistics evolution compared to the four Industrial Revolutions.



Source: Sun et al. (2022)

In conclusion, the authors highlight opportunities to combine conventional elements of reverse logistics and state-of-the-art technology, such as data, autonomous technologies, internet- and cloud-based connectivity, etc. However, a lack of systematic approach prevents the transition of reverse logistics into Reverse Logistics 4.0. The paper contributed to developing a definition and conceptual direction of Reverse Logistics 4.0 and created a general framework for future transformation to achieve sustainability from the perspective of the previously discussed 3BL. The researchers also underline the need for additional research to deeply investigate service innovation and the role of humans as a major influencing factor.

4. RESEARCH RESULTS AND RECOMMENDATIONS FOR BUILDING ENVIRONMENTAL SUSTAINABILITY IN ESTONIA

2018 Estonia held the Presidency of the Council of the European Union for the first time. On the verge of its Presidency, Estonia established priorities based on four major themes, two directly connected to environmental issues. Another step towards ecological sustainability was the establishment of an Interministerial Sustainable Development Working Group to guarantee coordination among all ministries involved (www.consilium.europa.eu/media).

According to statistical data, 32 out of 231 global indicators are currently measurable in Estonia. The country shows good results in achieving a high proportion of renewable energy in overall energy consumption and rich biodiversity protection. The main challenges lie in reducing CO2 emissions and creating a point- and resource-efficient economy (UN DESA, 2020).

Estonia has shown good results in implementing new programs nationwide in a concise time frame. It was proven by «Tiigrihüppe» which can be translated as «Tiger Leap» the governmental program of developing and integrating computers and networks (https://kompass.harno.ee/tiigrihupe/). In just a few years, computers and networks were integrated into every household, a first step toward E-Government that we can see today. This is a promising example of well-organized and delivered teamwork. Even though the Estonian government pays close attention to the environmental sustainability topic from different angles, some issues still need to be uncovered. One of them is integrating reverse logistics principles into the supply chain model to reach greater sustainability.

Over the last two decades, reverse logistics have moved from a concept that allows companies to control the backward flow of the product to maximize profit through recycling and reuse of materials to a vital part of creating environmental, social, and economic sustainability. It has grown to have various frameworks that can be used to develop a sustainable model within any company and any business area. Reverse logistics is now moving towards becoming a state-of-the-art technological system, with autonomous, interconnected devices working independently.

Studied papers showed similar views on environmental issues and ways to solve them. Excessive consumption and waste produced as a result of it is a major issue all over the world. Reverse logistics is considered one of the most logical steps toward responsible supply chain management. However, all researchers point out insufficient studies on the topic, which is a major obstacle to building a strong theoretical basis with the goal of future practical implementation of reverse logistics principles to build a sustainable supply chain model. Major differences are detected in choosing an approach. While some researchers focus on building a specific framework, others try to create a strong yet universal model that any company can implement. Finally, one research group has taken a step forward and tried to create a whole ecosystem analogical of yet to come Industry 4.0.

Reverse logistics is a relatively easy way to achieve sustainability in the supply chain, which does not require drastic measures like switching to electric vehicles or biofuel. Its principles can be integrated at any level, whether in single companies, corporations, or even governmental groups. However, the evidence from all papers studied during this research showed that the topic needs to be more researched in every country. The lack of data and practical case studies prevent the concept from developing faster. Estonia has limited resources and has yet to start toward environmental sustainability compared to other European states. Integrating Industry 4.0 principles would be most appropriate in a functioning E-government that Estonia has built over the years. E-government principles have many similarities with Industry 4.0 principles. Building an interconnected system of state-of-the-art technology based on conventional reverse logistics methods would be much easier in a country such as Estonia, which already has a strong technological base that can be extended further to create a sustainable model. An idea with such potential will surely get more attention from public authorities soon. This article will set a trend for future studies in this field.

One thing that all studies have in common is the fact that the world has changed. Companies must bear responsibility for the whole product lifecycle and try to make the best of it. Social, environmental, and economic approaches have become social, ecological, and economic responsibilities. Adopting a new philosophy would give companies an advantage from a financial and reputational perspective. And, of course, save the planet.

5. CONCLUSION

The world is moving toward sustainability in every major aspect, such as the economy, labor safety, and environmental protection. This study has gathered papers from Asia, Europe, the USA, etc., proving this point. We are facing issues like air and land pollution due to excessive consumption, which has taken over the world with the rise of e-commerce. Almost every government now recognizes the strong need to adopt sustainable initiatives to bend this flow backward (Prakash and Barua, 2016).

Logistics has been the source of pollution as it is a significant part of almost every business. The most popular answer to this issue is to switch to electric vehicles and biofuel. Even though these measures might lead to a promising result, some undeniable obstacles prevent this from happening soon. Reverse logistics has a strong advantage over the conventional approach to reaching environmental sustainability. It can be applied to existing supply chain systems or added to an extent. It can be extended to Reverse Logistics 4.0 or add a few changes to the supply chain. Reverse logistics is flexible and significantly under-researched. With all the studies discussed in this article, we „only scratched the surface" of it. All studies discussed in this paper indicate the need for further research, additional data, and case study collection. Estonia is even more under-researched when it comes to reaching sustainability through the integration of reverse logistics practices, from which it follows that the next logical step would be:

- to collect practical cases within the country,
- analyze and systemize cases using one of the proposed approaches,
- suggest a sustainability model that ideally will have a practical use in the nearest future.

Keywords for the future study development would be sustainability in Estonia, reverse logistics, recycling in Estonia, and waste management in Estonia.

Estonia has a promising tendency to move toward environmental sustainability. Its ability to adopt new practices within a very short time frame was proven by the «Tiger Leap» the governmental program of developing and integrating computers and networks. Keeping this in mind, the fact that the right steps toward environmental sustainability would be enforced within very short time frames is unquestionable.

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