



Karelia University of Applied Sciences
Bachelor of Business Administration

Core Challenges of International Supply Chains

How Do E-bike Sellers of North Karelia Face International Supply Chain Challenges?

Ari Nieminen

Thesis, June 2024

www.karelia.fi



THESIS
June 2024
Degree Programme in International Business

Tikkarinne 9
80200 JOENSUU
+358 13 260 600 (switchboard)

Author
Ari Nieminen

Title
Core Challenges of International Supply Chains - How Do E-bike Sellers of North Karelia Face International Supply Chain Challenges?

Abstract
The visibility of electric bikes in the cityscape has increased. This thesis identifies the typical challenges of international supply chains of products and explores how these challenges are recognized in e-bike supply chains in the North Karelia region. First, the theoretical background is investigated and presented, providing a common and broad understanding of supply chain challenges. Many pictures and appendices are served to help the reader grasp the most essential issues of supply chains. In the second phase of the research, the qualitative methods are used by implementing an interview among regional e-bike sellers to explore whether the observations and perceptions of North Karelian bicycle vendors align with those in the literature review.

According to the findings of the theoretical examination, challenges can most often be localized to specific processes and costs involved in logistics and procurement. A particular challenge is the lack of cooperation in the exchange of information between supply chain parties and the interests of each actor. This challenge can be managed and facilitated with market technology solutions and information technology tools. Retailers' positions in the control of supply chains have been enforced, but there could be some dark clouds in the future threatening their place in the supply chains. The practical investigation (interviews) points out that regional entrepreneurs recognize most of the challenges presented in theory. Additionally, a couple of interesting new perspectives emerge.

Language
English

Pages 58
Appendices 7
Pages of Appendices 11

Keywords
International supply chain, supply chain challenge, demand-supply set up

Contents

1	Introduction	6
1.1	Background.....	6
1.2	Objectives of the research	6
1.3	Report outline	7
2	Key Concepts and Characteristics of an International Supply Chain	7
2.1	Logistics – and how it all began	10
2.2	International supply chains	11
3	Major Challenges of International Supply Chains	13
3.1	Retailers’ role in the Supply Chain.....	15
3.2	Market demand and supply dilemmas	17
3.3	Challenges of procurement.....	22
3.4	Logistical challenges.....	24
3.5	Delivery challenge	28
3.6	ICT Challenge – Strong Technology-Assisted Operations.....	29
3.7	Challenges and Trends affecting Supply Chains	32
4	Methodological Choices of the Thesis	35
4.1	Interviews among local vendors.....	36
4.2	Data acquisition and analysis	36
5	Results.....	37
5.1	Demand-supply setup and inventory control.....	40
5.2	Procurement’s challenge	44
5.3	Transportation and inventory logistics	47
5.4	Delivery and customer satisfaction	49
5.5	ICT utilization, trends, and future development.....	50
6	Conclusions	52
6.1	Key challenges (literature)	52
6.2	Key challenges (survey)	53
6.3	SWOT analysis of the e-bike supply chain (generally).....	57
7	Discussion	59
	References.....	61

Appendices

Appendix 1 Customer order decoupling points

Appendix 2 Core Procurement Activities

Appendix 3 Logistics operator’s approaches

Appendix 4 Supply Chain Digital Transformation Options

Appendix 5 An example of the challenges of supply chain management and how digital business technology can assist

Appendix 6 Example of the green supply chain

Appendix 7 Interview Questions

1 Introduction

1.1 Background

The number of e-bikes in North Karelia has increased in the last few years. Market research and statistics indicate that this is a Europe-wide phenomenon (Research and Markets, 2023). This rising demand for e-bikes necessitates increased efforts in optimizing e-bike supply chains. International publications on e-bike supply chains are scarce, highlighting the need for further examination in this area.

The author's interest in sports-related activities motivated the research into e-bike supply chain challenges. The research topic was chosen following a visit to a local retailer's store and an engaging conversation with the vendor staff. The researcher is particularly interested in managerial supply chain challenges.

1.2 Objectives of the research

This research aims to explore the challenges of the international e-bike supply chain in Finland. The theoretical examination investigates international supply chain challenges and compares these findings with the empirical experiences of e-bike dealers. This comparison seeks to determine how well the literature's findings align with regional practices. The focus is on demand and procurement, though the research aims to provide a comprehensive overview of the core challenges and phenomena within the entire supply chain.

The research addresses two main questions:

What are the biggest supply chain challenges for durable consumer products internationally?

What are the core challenges of international e-bike supply chains in North Karelia?

1.3 Report outline

The study begins with an examination of the literature (Chapters 2 and 3), which aims to identify the general challenges affecting international supply chains. Subsequently, local e-bike sellers are interviewed to gather information on the current situation in North Karelia (Chapter 5). Due to the scope of the study, the logistics arrangements between bike suppliers and last-level bike sellers will be reported only to the extent necessary to understand their position in the supply chain. The same applies to delivery and delivery methods. The results will be presented in Chapter 6, providing comparative information for companies and students interested in the e-bike market. AI (ChatGPT) was used for language revision in the finishing phase of the work.

2 Key Concepts and Characteristics of an International Supply Chain

The conceptual landscape of supply chains encompasses factors characterizing both manufacturing and distribution networks. Consequently, there is no single definition that can be rigidly applied within the realms of business or business science. This complexity extends beyond supply chain management (SCM) to other concepts within the field of supply chain (SC) as well (Rushton, Croucher & Baker 2022, 4-5.) The concepts often seem unclear even to professionals (Bowersox & Bowersox, Closs & Cooper 2013, 4; Rushton et al. 2022, 4-5). Therefore, a definition of SC will be provided first.

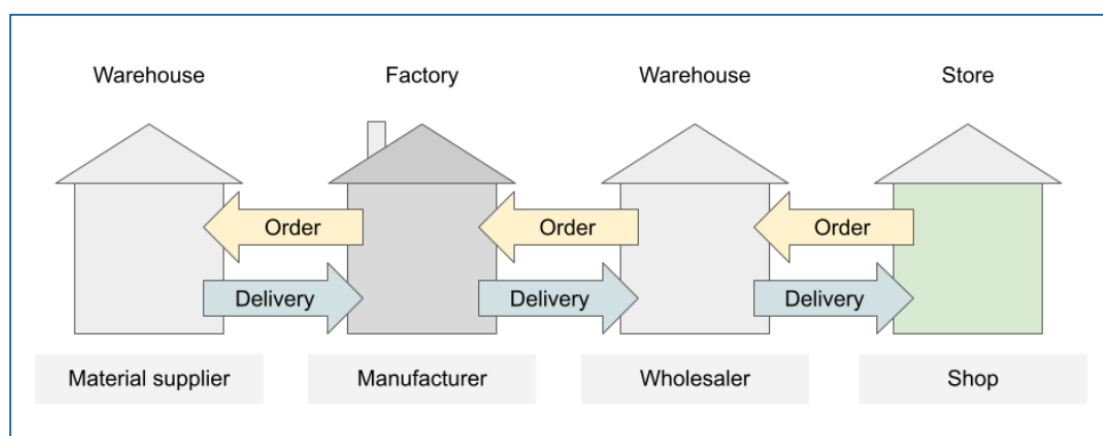
“A supply chain is an entire system of producing and delivering a product or service, from the very beginning stage of sourcing the raw materials to the final delivery of the product or service to end-users. The supply chain lays out all aspects of the production process, including the activities involved at each stage, information that is being communicated, natural resources that are transformed into useful materials, human resources, and other components that go into the finished product or service.” (CFI 2024.)

The word cluster illustrates the multifaceted nature of the supply chain (Picture 1).



Picture 1. The complexity and multifaceted nature of the supply chain (CFI 2024) (Modified by the author).

Picture 1 does not express all aspects that should be considered in supply chains. As this is a thesis-level work, it is not necessary to attempt to cover all aspects. Therefore, not all factors depicted in the first picture will be addressed in the research. Only elements directly related to the movement of goods and services in the chain between manufacturers and end-users will be examined. Hence, Picture 2 aims to simplify the subject under study and the related environment.



Picture 2. Supply Chain (Logistiikan Maailma 2024).

As depicted in the picture, in the traditional supply chain of material suppliers, manufacturers, wholesalers, and retailers, products and materials (delivery) as well as order documents move from end to end of the chain, with each member playing a necessary role (Logistiikan Maailma 2024). It is important to note that this basic system is in a state of transition.

To move products from one end of the supply chain to the other, someone must take control over several activities. This is where supply chain management (SCM) comes in. "Supply chain management is the discipline of ensuring that a business can deliver its products when and where a customer wants them" (Casey 2021). In this research, it is assumed that the supply chain is already established. Picture 3 clarifies the alliance of SC and SCM and the core principle of SCM.



Picture 3. Supply Chain Management – a simplified model of SC and SCM (Aims, UK 2024).

The right side of the image illustrates in a simplified manner how and where a product or commodity is manufactured and how it moves in a global operating environment between the parties in the process to the consumer. The left side indicates that the process involves three types of transactions: information, physical commodities, and money (including capital), all of which move within the chain. (Slack, Brandon-Jones & Burgess 2022, 19-20.)

The field of logistics and supply chain has changed dramatically due to consumers' increased expectations regarding product features and rapid order fulfillment. Managing the logistic network, which is often highly complex due to customer expectations and the involvement of multiple goods and component suppliers, demands a high level of competency from those responsible for this sector. Managers in the retail sector possess the best knowledge of challenges, interrelations among different players, and demand-supply expectations concerning facilities. Consequently, they set the pace and direction for the development of supply chain and logistics practices. (Fernie & Sparks 2019, 1-8.)

2.1 Logistics – and how it all began

The roots of the logistics concept in Western Europe can be traced back to the Treaty of Rome (1958) and its decision to establish the European Community (EC). The treaty included strategic decisions and the principle of free movement of labor, capital, and physical resources. Originally, in the industrialized world, business operations entailed materials simply arriving at manufacturing points, with output products stored and later transported via limited channels to end users. (Pienaar & Vogt 2016, 7-9.) However, decades ago, it was recognized that logistics costs needed to be reduced (Gattorna 2010, 9).

By the early 1980s, the function of logistics was established as the connection between demand and supply was recognized. Inbound and outbound logistics subsystems, along with an independent production subsystem in the middle, were created. By the 1990s, internet usage had penetrated trading, leading to the development of various software and telecommunication systems. Consequently, the gradual integration of upstream and downstream parties accelerated, resulting in a more networked supply chain. As this development continued, joint operations and communication between parties and logistics systems in the chain evolved into what is now called supply chain management. (Gattorna 2010, 10-11.)

A useful logistics concept for large-scale industrial operators can be presented as: “Logistics concerns the efficient transfer of goods from the source of supply through the place of manufacture to the point of consumption in a cost-effective way while providing an appropriate service to the customer” (Rushton et al. 2022, 6). Generally, the aim is to control transportation costs, inventory costs, and opportunity costs. Internationally and globally, the challenge lies in constantly increasing logistics costs, particularly transportation costs, which continue to rise. (Pienaar & Vogt 2016, 35.)

2.2 International supply chains

The concept of supply chain is based on logistics ideas and functions (Rushton 2022, 28-29). According to Hugos and Thomas (2006, 4) a **supply chain** “consists of all stages involved, directly or indirectly, in fulfilling a customer request. The supply chain not only includes manufacturer and suppliers, but also transporters, warehouses, retailers, and customers themselves”.

Slack et al. (2022, 19-20, 407-408) have adopted a slightly different approach, extending the supply chain to include non-physical flows, as illustrated earlier in Picture 3. They share the traditional concept but expand the information flow to encompass processes as well. Furthermore, all processes are vital parts of the chain. Significant overlaps between logistics and supply chain exist (Bowersox et al. 2013, 4; Christopher 2011, 2-3; Rushton 2022, 28-29), leading Rushton et al. (2022, 4-5) to state:

Many different terms are used, often interchangeably, in literature and the business world. One of the key relationships can be described as follows:

Logistics = Materials management + Distribution

‘Materials management’ represents the activities concerning materials going into and through the production process and ‘distribution’

represents the process of making a product available to the consumer or business that needs it. An extension of this idea helps to illustrate that the supply chain covers an even broader scope of the business area. This includes the supply of raw materials and components as well as the delivery of products to the final customer. The logistics chain is completed into a supply chain: Hence:

Supply Chain = Suppliers + **Logistics** + Customers

The ultimate purpose and mission of the supply chain are to ensure that commodities (whether raw materials, components, or finished products) flow steadily through the chain and reach the customers. It includes all kinds of material and data transportation and flow between suppliers, manufacturers, warehouses, intermediaries, distribution depots, retailers, and customers. (Levy & Grewal 2023, 9; Rushton et al. 2022, 28-30.) International distribution arrangements and organizations (firms, stores, etc.) vary and depend on the infrastructure of the continent and country (population, economic situation, government policies, etc.) (Levy & Grewal 2023, 9).

Today's supply chains are characterized by being demand-driven (due to customer focus), aimed at inventory optimization, core capability-focused, and thus utilizing outsourcing for non-core activities. Additionally, they are IT-enabled, as most processes through the supply chain are digitally controlled or monitored. (Fernie & Sparks 2019, 11; Rushton et al. 2022, 696-697.) Optimal supply chains can form a competitive advantage and can be viewed as value chains (Christopher 2011, 4-11).

Companies regularly evaluate their supply chains, which includes mapping and analyzing the current situation (phenomena, activities, batch processes, information streams, resources) before possibly improving the supply chain (Bicheno 2016, 156-174). Solving supply chain issues and challenges always requires management and managerial skills. This is where supply chain management (SCM) expertise is crucial, although this research does not focus on SCM. The

purpose here is to define the main challenges in international supply chains, which will be covered in the next chapter.

3 Major Challenges of International Supply Chains

This chapter reports the major challenges in international supply chains, based primarily on research literature. The supply chain is considered end-to-end for this purpose, highlighting the most significant challenges and phenomena in each sub-process.

Global trading and product transportation face certain restrictions and provisions, such as quotas and tariffs, depending on the trade regions. Trade associations like the WTO (World Trade Organization) and NAFTA (North American Free Trade Agreement) aim to enhance free trade and reduce trade barriers and protectionism. (Manners-Bell 2017, 10-12.) The latter was replaced by USMCA (Agreement between the United States of America, the United Mexican States, and Canada). Technically, the agreement recognises the same principles as the old one, including the provisions of intellectual property and digital trade as a new element. That is why, it is called “New NAFTA” or “NAFTA 2.0”. (Wikipedia 2024.)

Currently, the largest free trade area in the world is the European Union (Manners-Bell 2017, 11-12), which operates a single internal market – the Single European Market (SEM) – without borders (EU 2024; EUR-LEX 2023). Despite this, the logistics industry is continuously reshaping its policies and patterns (Manners-Bell 2017, 16-18, 56). Notably, there has been a significant shift in the roles of retailers and manufacturers.

Retailers were once effectively the passive recipients of products that were allocated to stores by manufacturers in anticipation of demand. Today, retailers are the active designers and controllers of product supply in reaction to known customer demand. They control, organize, and manage the supply chain from production to consumption. This is the essence of the retail logistics and supply chain transformation. (Fernie & Sparks 2019, 8.)

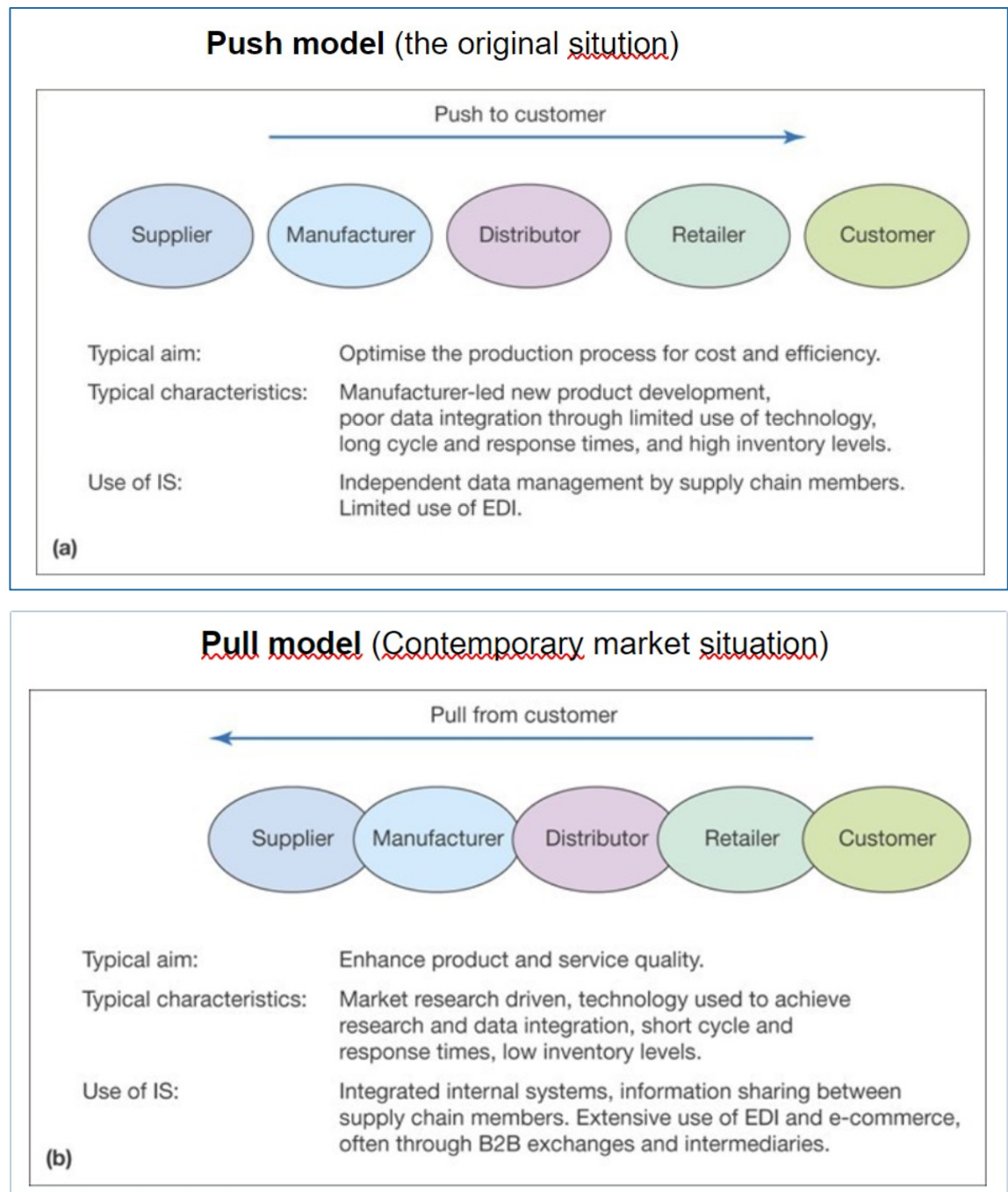
Over the last 30-40 years, there has been a shift from manufacturer-led to retailer-led supply chains (Fernie & Sparks 2019, 1-2, 8-10). While this is true for large

retail chains, smaller retailers do not necessarily play the same role (Levy & Grewal 2023, 271).

Simultaneously, there has been a transition from physical distribution management to supply chain management (Fernie & Sparks 2019, 1-2). Retail supply chain arrangements vary significantly depending on the size and type of the retailer (Levy & Grewal 2023, 8).

Large retailers, such as Home Depot and Costco, may operate in both retailing and wholesaling. Companies like Amazon and Walmart have their own distribution centers, making direct purchases from manufacturers, shipping merchandise to their warehouses, and distributing it to their stores. Some retailers manage the design but outsource manufacturing, while others, like IKEA and Zara, manage the entire supply chain from end to end. (Levy & Grewal 2023, 8.)

Major events, such as financial crises, the internet revolution, the rise of e-commerce, and notably COVID-19, have driven changes in the retail supply chain (Pilkington 2021, 1-6, 83-84, 87-88, 136). COVID-19, in particular, has shifted the traditional manufacturer-driven market (push) to a consumer-driven market (pull) (Pilkington 2021, 87-88, 93-94). The following picture illustrates this transition (Picture 4).



Picture 4. Push-pull model comparisons of the supply chain (Slideplayer 2023).

3.1 Retailers' role in the Supply Chain

Retailing involves business activities that add value to products and services sold to consumers for personal or family use, encompassing both in-store and online efforts. Retailers are crucial intermediaries between manufacturers and customers, typically buying products from manufacturers or wholesalers to resell to

consumers at a profit. (Levy & Grewal 2023, 4, 6.) Retailing is characterized by thin margins, presenting challenges (Cachon & Terwiesch 2013, 2-3; Weele 2014, 395, 397). Figure 1 illustrates the cost-value-profit mechanism in the supply chain.

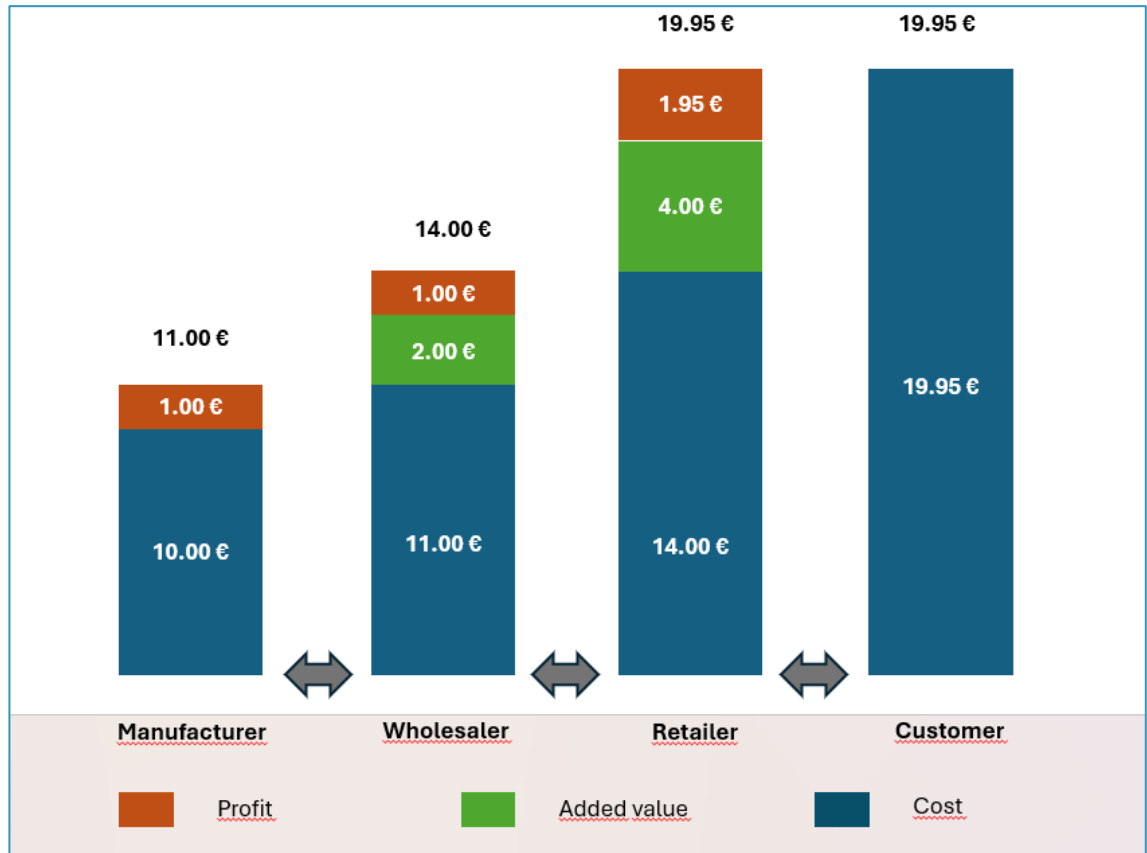


Figure 1. Costs of value-added activities of a T-shirt for a customer (Levy & Grewal 2023, 7) (Modified by the author).

A successful supply chain hinges on creating customer value while managing costs. Efficient supply chains leverage IT for demand-supply forecasting, minimizing transaction costs, especially transportation, and maintaining low inventories. Speed and flexibility in deliveries are paramount. (Fernie & Sparks 2019, 10-17.)

Retailers must make timely and accurate purchasing decisions due to thin margins. Comparing actual sales across product categories ensures optimal inventory and ROI (return on investment). (Weele 2014, 395, 397, 406.)

Agile and flexible supply chains driven by customer demand offer a competitive advantage (Weele 2014, 16, 18). Enterprises continuously seek to improve operations in response to competition, technological advancements, and evolving customer needs. Customer-centricity has become a vital part, but not at 'any price'. However, it compels balancing the interests of customers and the company. (Slack et al. 2022, 513 – 516, 519, 521, 523.)

3.2 Market demand and supply dilemmas

Demand-Supply Set-up

Retailers and traders respond to customer demand by procuring and supplying desired products, though this process is complex. Accurate demand forecasting is crucial, despite inherent uncertainties. (Cachon & Terwiesch 2013, 10.) Reliable forecasts enhance customer satisfaction and business success (Pienaar & Vogt 2016, 111). Supplier insights are also vital for supply chain operations (Gattorna 2010, 35-49, 291-300).

Collaboration between retailers and suppliers in product packaging and understanding customer behavior enhances value. Effective communication within and outside the company is key. (Berkhout 2019, 2, 3-4, 11, 39-40.) Multi-channel and omnichannel approaches in the supply chain improve customer value and experience (Levy & Grewal 2023, 106-108, 120; Rushton et al. 2022, 174-176, 178-183).

Balancing Demand Forecasts, Resources, and Space

Accurate demand forecasting and constant monitoring of inventory are essential. Historical sales data helps manage product assortments to meet expectations while avoiding unprofitable items. Available store space also influences inventory management decisions. (Berkhout 2019, 1 – 2, 7 – 9, 32 – 35; Weele 2014, 395 – 397.) The rise of online shopping increases the need for efficient space utilization in physical stores (Berkhout 2019, 32 – 35).

Customer Order Decoupling Point and Order Lead Time

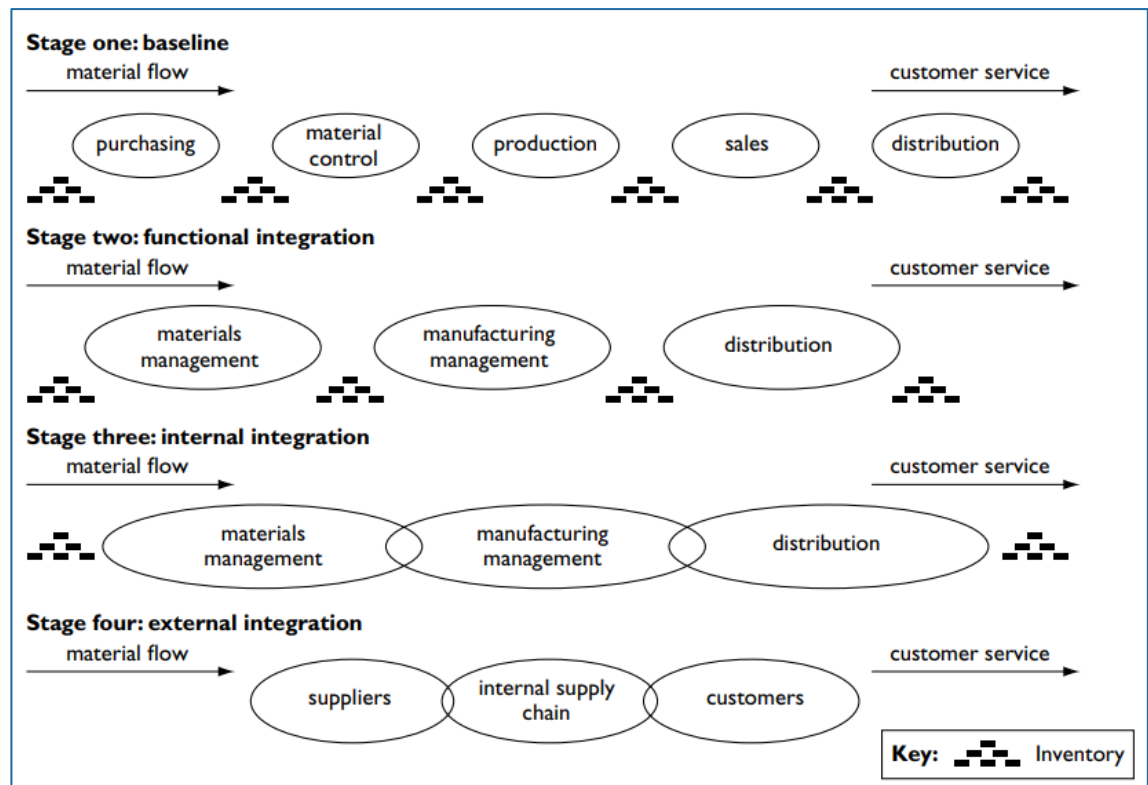
The point at which a customer order enters the production process (Customer Order Decoupling Point, CODP) and order lead times are critical. Approaches like assemble-to-order (ATO) and make-to-order (MTO) depend on order timing. Minimizing order lead times with effective planning improves customer satisfaction. (Pienaar & Vogt 2016, 70, 75 – 77.)

From a systematic perspective or SC's angle, above mentioned challenges also serve opportunities for the improvement of the whole chain, or system. Then the overview – tracking of pain points/development points – must be reached to the whole chain from end-to-end. (Pienaar & Vogt 2016, 77-80.) Appendix 1 lists the rest of the CODP approaches.

Inventory Management

Inventory management involves maintaining sufficient stock to meet demand while minimizing costs. Inventories act as buffers against supply and demand uncertainties and support smooth business operations. Effective inventory management includes strategic placement and collaboration among supply chain partners. (Cachon & Terwiesch 2013, 26-27; Pienaar & Vogt 2016, 224-227.)

The goal is to minimize inventory costs while ensuring order fulfillment. This involves continuous improvement and cooperation among supply chain participants. (Krajewski et al. 2013, 36-37; Rushton et al. 2022, 29-30, 109-110,112; Slack et al. 2022, 432.) Picture 5 shows the ideal of zero SKUs (Stock Keeping Units) in inventory in a fully integrated supply chain.

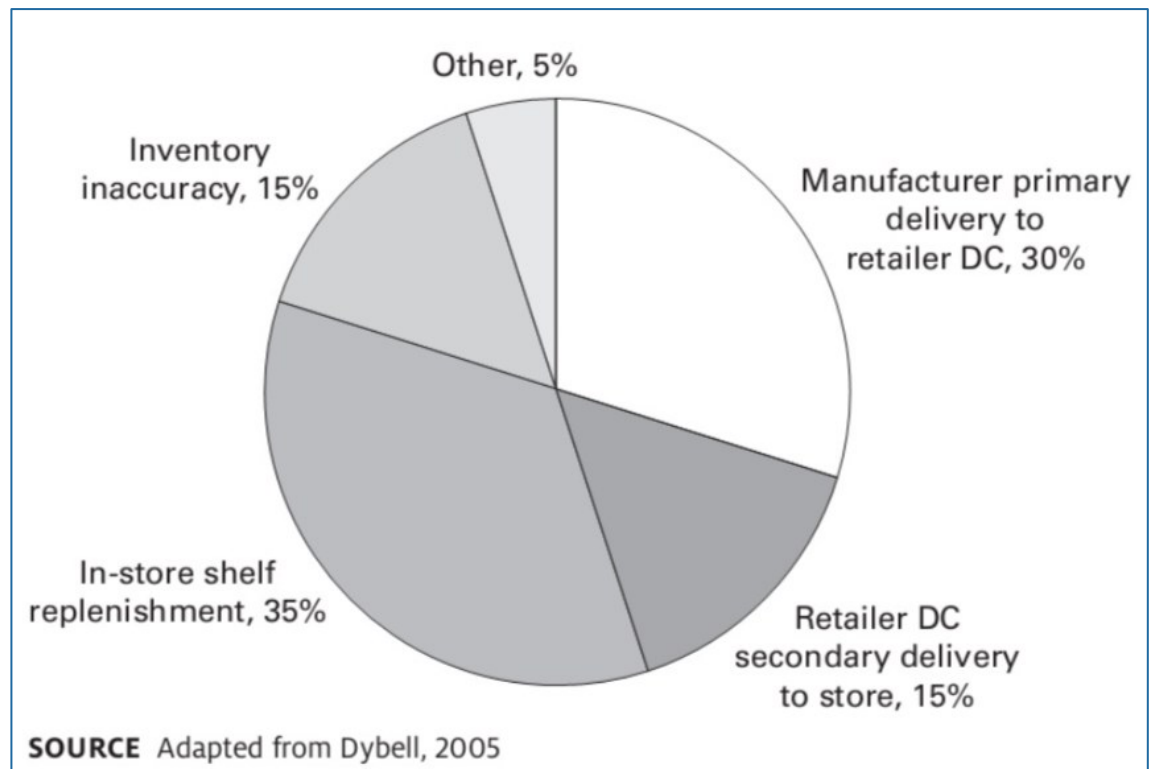


Picture 5. Gradual integration of processes and partners cooperation (Rushton et al. 2022, 30) (Original source: Stevens 1989).

Avoiding Stock-outs and Customer Dissatisfaction

Effective inventory management includes day-to-day decisions on ordering and replenishment. Stock-outs occur when desired products are unavailable, leading to customer dissatisfaction. A clear inventory system helps avoid such negative impacts. (Slack et al. 2022, 450-472.)

A demand-supply mismatch occurs when products are not available on the shelf as expected by consumers. The primary cause of stock-outs, accounting for 35%, is in-store replenishment issues. (Fernie & Sparks 2019, 223-224.) The source does not specify whether this data pertains to grocery or non-grocery retailers, but it can be inferred that the percentages represent an average of both categories. Picture 6 clarifies the phenomenon.



Picture 6. Causes of retail stockouts (Fernie & Sparks 2019, 223).

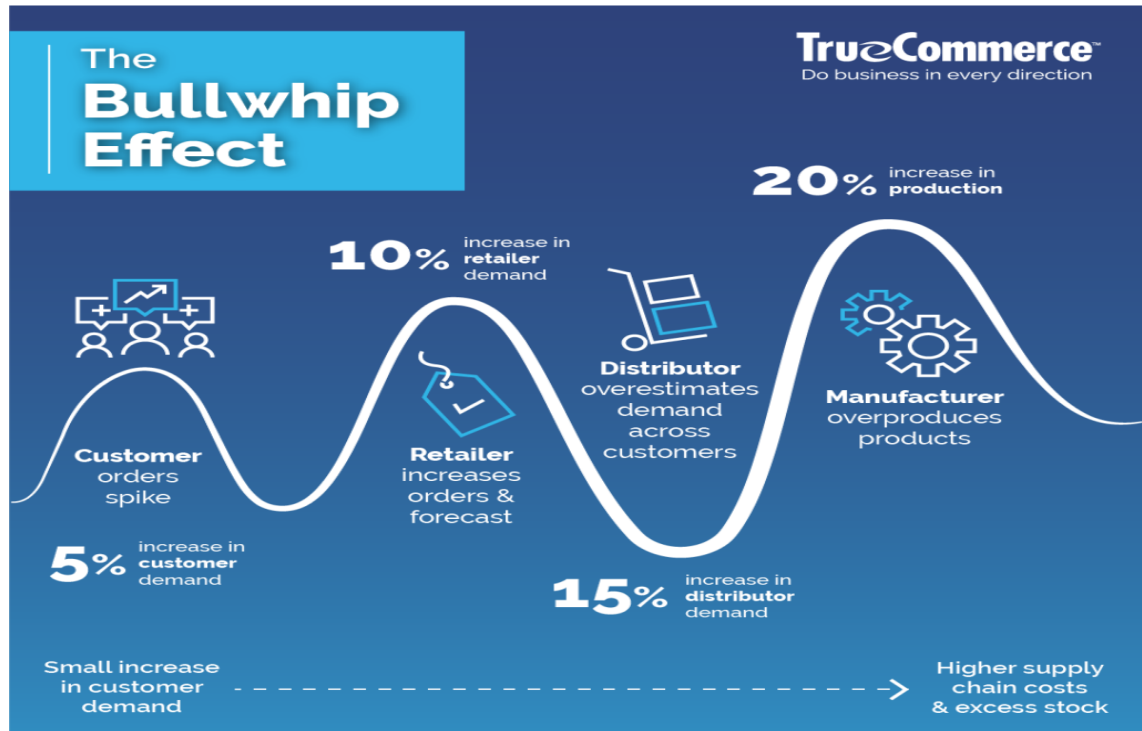
In an in-store product stock-out situation, customers typically respond in one of five ways: 1) switching to a different store, 2) postponing the purchase but remaining at the same store, 3) deciding not to buy at all (resulting in a lost sale), 4) finding a substitute within the same brand, or 5) switching to a substitute under a different brand. Most customers generally choose one of the first three options. When brand loyalty or hedonic values are significant, customers are more likely to switch stores or brands to obtain the desired product. This behaviour is most common in grocery categories, but it also occurs in non-grocery categories. (Fernie & Sparks 2019, 222-224.)

Long-term stockouts negatively affect sales volume, customer satisfaction, and overall business performance. However, this challenge can motivate retailers to improve their practices by enhancing resources (e.g., staff), integrating and networking with people, organizations, and systems, and reorganizing supply chains, inventory, warehousing, and delivery systems through IT utilization. (Fernie & Sparks 2019, 222, 224-228, 230-231.)

The Bullwhip Effect

Mismatches between suppliers and retailers often lead to the bullwhip effect, where small downstream fluctuations cause significant upstream disruptions. Sharing accurate demand data helps mitigate this effect. Retailers, being closest to customer demand data, play a crucial role in preventing the bullwhip effect by sharing information with suppliers. (Cachon & Terwiesch 2013, 384-385, 373-398; Hugos & Thomas 2006, 114-117.)

When an unwanted action, reaction, or measure occurs in the supply chain, it typically propagates through the chain, causing increasingly harmful effects such as delays, order-supply errors, price fluctuations, and other upstream volatilities. Even a small downstream disturbance can amplify as it moves upstream, a phenomenon known as the bullwhip effect. (Cachon & Terwiesch 2013, 373-398; Hugos & Thomas 2006, 114-117; Krajewski, Ritzman & Malhotra 2013, 433; Rushton et al. 2022, 230-232; Slack et al. 2022, 429-430.) Picture 7 illustrates this concept.



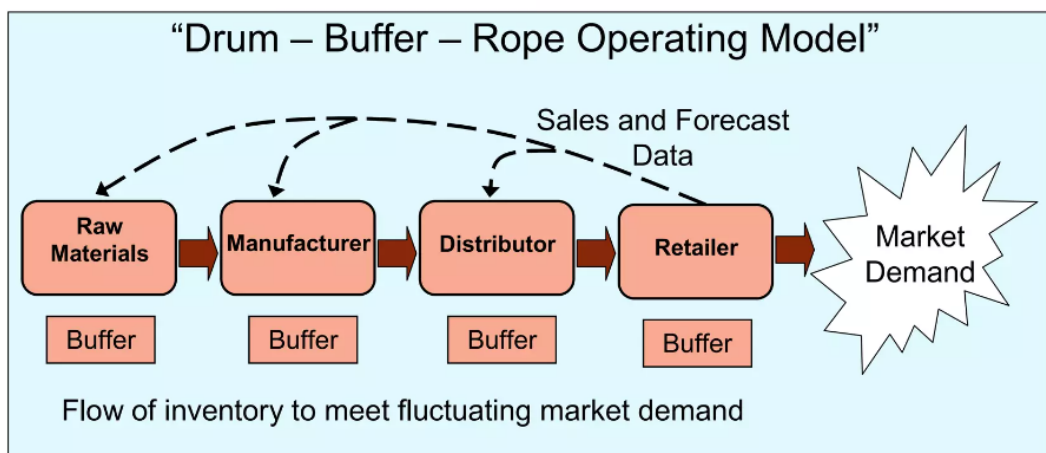
Picture 7. The bullwhip effect (TrueCommerce 2024).

Cachon and Terwiech (2013, 384-385) note that inaccuracies in retailers' shared demand data, a root cause of the bullwhip effect, are influenced not only by

demand forecasts but also by retailers' pricing, advertising, and assortment policies, which affect customer demand. To mitigate the bullwhip effect, suppliers should share information, such as capacity shortages, with downstream retailers (Cachon & Terwiech 2013, 385).

Since the retailer is closest to the fluctuating customer demand data, it is logical for them to share this information to combat the bullwhip effect. This data sharing helps maintain appropriate buffer levels and timely replenishment. (Hugos & Thomas 2006, 114-115, 118-119, 122-124.) Picture 8 demonstrates how data sharing prevents the bullwhip effect.

Synchronized Supply Chain



Picture 8. Data sharing prevents the bullwhip effect (Hugos & Thomas 2006, 118).

Retailers and intermediaries must manage products and volumes effectively to meet market demand, emphasizing the importance of shared data for successful procurement and customer satisfaction.

3.3 Challenges of procurement

Effective procurement begins with understanding consumption patterns and product demand. Lack of cooperation between departments such as marketing, procurement, and sales can lead to uncontrolled operations. Procurement must

identify and specify customer needs. (Hugos & Thomas 2006, 71.) Principally, the purpose of procurement is to ensure the right quantity and quality of products at the right time and price (Pienaar & Vogt 2016, 199-200).

The lowest input cost doesn't always equate to the best price. Buyers must consider Total Cost of Ownership (TCO), which includes potential issues like future product quality and post-transactional obligations. (Pienaar & Vogt 2016, 199-200, 205-206.) Although TCO tools are challenging to implement, they provide valuable insights (Iloranta & Pajunen-Muhonen 2018, 152-153, 166-168).

Procurement involves sourcing merchandise and suppliers, evaluating alternatives, and negotiating contracts, which are time-consuming but essential processes. Retailers often rely on wholesalers to supply products, necessitating strong relationships with multiple wholesalers (Weele, 2014, p. 397). Procurement is an umbrella concept to define the whole scale of a retailer's activities and efforts that are aimed at getting goods to sell in the retailer's outlet. Appendix 2 clarifies the different sub-activities inside the procurement.

Retailers and wholesalers, acting as industrial buyers, aim to support their primary processes (Weele 2014, 22 – 23). Procurement can account for up to 80% of an organization's total costs, directly affecting profitability (Iloranta & Pajunen-Muhonen 2018, 21-27). Effective supplier and supply chain management can offer competitive advantages, and the trend towards outsourcing has led to more complex partnerships and service agreements (Iloranta & Pajunen-Muhonen 2018, 21-27, 33, 43).

However, competitive tendering alone no longer ensures competitiveness. Managers must develop skills to identify and maintain cooperative supplier partnerships and navigate international business complexities. (Iloranta & Pajunen-Muhonen 2018, 67-70, 78-79, 83.)

Challenges include unorganized, decentralized procurement processes, which reduce negotiation power, and siloed departmental operations that hinder

collaboration. Limited resources and time constraints often result in unprepared negotiations and poor supplier choices. (Iloranta & Pajunen-Muhonen 2018, 83-85.)

Procurement costs, competitive pressures, aging technology, and IT challenges can trigger development projects. Addressing these challenges can turn them into strengths, provided there are adequate financial and skill-related resources. (Iloranta & Pajunen-Muhonen 2018, 78-79, 87-88.) Of course, they need resources, both financial and skills-related, to do that.

From the customer's perspective, product quality, security, logistics, lead time, and after-sales services are crucial. Attention is also given to brand name, product performance, design, materials, and manufacturing methods. (Pienaar & Vogt 2016, 200, 205-208.)

Globalization and advanced ICT have transformed procurement, enabling 24/7 negotiations and cooperation with suppliers (Iloranta & Pajunen-Muhonen 2018, 67-70). Fast data communication and electronic procurement reduce transaction, logistics, and inventory costs, shorten lead times, and improve customer satisfaction (Pienaar & Vogt 2016, 216-217). These benefits should ideally result in lower product prices.

3.4 Logistical challenges

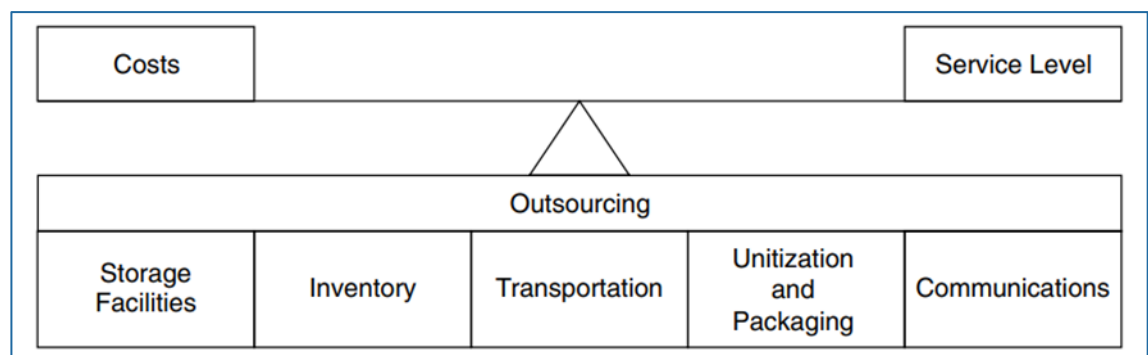
Logistics, while excluded from this research's primary focus, significantly impacts the entire supply chain, including customer satisfaction. Key logistical challenges are illustrated in Picture 9, showcasing the seven Rs of logistics.



Picture 9. Challenges of Logistics and Supply Chain (AIMS, UK 2024).

Logistical Cost and Service Optimization

Logistics aims to minimize costs and maximize service levels, necessitating integration into the overall operational environment. Firms must balance being either cost leaders or service leaders to maintain efficiency. (Bowersox et al. 2013, 32-33; Rushton et al. 2022, 27-28.) The purpose of logistics is not only to make the right products available in the right place at the right time. This involves managing transportation, warehousing, packaging, and information flow throughout the supply chain (Ferne & Sparks 2019, 4-8, 30.) Different operator leader approaches are presented in Appendix 3 and Picture 10 below showcases logistics tasks.



Picture 10. The task dimensions in logistics (Ferne & Sparks 2019, 7).

The organizing trader (triangle in the pic.) balances between cost pressures and customer service expectations (the board on the top of the triangle). Outsourcing may be necessary for transportation or warehousing activities. Overemphasis on either the supply or demand side can negatively impact the business or customers. (Ferne & Sparks 2019, 4-8.)

Storage and Transportation Challenges

Centralizing inventories near customers, while reducing transportation costs, has introduced extra costs (Manners-Bell 2017, 20-30). Clients' contributions to the complex logistics service portfolio – either through self-involvement or involvement – has become more pronounced the further the logistics evolution has progressed (Manners-Bell 2017, 26, 29-30). The transportation costs and lead times are seen as the most significant logistical challenges (Manners-Bell 2017, 26-27).

Recently, transportation has covered roughly 60% of the overall logistic cost structure, while inventory systems and warehousing took a 40% slice of the total (Manners-Bell, 2017, 21-22). The freight carriers transport products in the chain and the freight costs are not the only challenge. After the pandemic hit, the European company Zoomo, for example, experienced huge delays in e-vehicle deliveries due to supply chain disruptions. business aims. Their “main shipment of batteries, parts and a few hundred bikes” were stuck on a container ship in the Suez Canal. This hampered the whole e-bike industry. (BikeBiz 2024.)

Zoomo is an interesting e-transportation business operating British company that offers solutions for e-transportation, light e-courier suitable vehicles, and e-bikes, for example (Zoomo 2024). The express line itself – including a slightly tricky last mile B2C deliveries to customers' homes – could be a competitive choice for transportation (Manners-Bell 2017, 292, 295-297, 299). Despite opportunities, e-commerce, click-and-collect and brick-and-mortar dimensions plus home deliveries and the need for lockers, have caused challenges to retailers and their logistic infrastructure (pick-center- and store fulfillments together with returns) in e-retailing (Fernie & Sparks 2019, 260-262; Manners-Bell 2017, 293-303, 312).

The importance of the Total Logistics Concept (TLC)

TLC is essential for avoiding sub-optimization in logistics. Picture 11 offers a possibility to understand the concept (Rushton et al. 2022, 6).

A company produces plastic toys that are packaged in cardboard boxes. These boxes are packed on to wooden pallets that are used as the basic unit load in the warehouse and in the transport vehicles for delivery to customers.

A study indicates that the cardboard box is an unnecessary cost because it does not provide any significant additional protection to the quite robust plastic toys and it does not appear to offer any significant marketing advantage. Thus, the box is discarded, lowering the unit cost of the toy and so providing a potential advantage in the marketplace.

One unforeseen result, however, is that the toys, without their boxes, cannot be stacked on to wooden pallets, because they are unstable, but must be stored and moved instead in special trays. These trays are totally different to the unit load that is currently used in the warehouse and on the vehicles (ie the wooden pallet). The additional cost penalty in providing special trays and catering for another type of unit load for storage and delivery is a high one – much higher than the savings made on the product packaging.

Picture 11. An example of the importance of TLC (Rushton et al. 2022, 17).

Picture illuminates what happens if managers or other players think too narrowly and ignore other independent players and their intentions somewhere in the supply chain. The lack of total logistics cost control may cause business damaging problems (Rushton et al. 2022, 6-7). The originally good intention, namely customers getting cheaper toys, may turn into bad business and losses (increased total costs). It points out dramatically how important the integration and communication of different systems and departments (people) are and that all possible costs must be considered (Rushton et al. 2022, 16-17).

Outsourcing vs. In-House Control

Many firms outsource logistics to reliable Logistics Service Providers (LSPs) due to resource or expertise limitations. However, this can lead to reduced control over supply chains. The decision to outsource hinges on cost considerations. (Levy & Grewal 2023, 284; Manners-Bell 2017, 22-25, 132-135.) By the 2010s transportation doubled its cost share (from roughly 30% to 60%) in the supply chain over the previous 30 years. (Manners-Bell 2017, 22, 24-25.)

3.5 Delivery challenge

The importance of speed and accuracy in delivery

Customers expect prompt, accurate deliveries, and rapid responses to inquiries, sharing negative experiences widely if dissatisfied (Weinswig & Hartmann 2023, 22-23). Various delivery methods—online, brick-and-mortar, click-and-collect, home delivery—affect customer satisfaction. Eventually, the customer decides how to pick the product. There has been a gradual retail shift from in-store merchandising to online channels over the last 20 years (Pilkington 2021, 129, 136).

Nevertheless, balancing costs across different delivery methods can be problematic. For example, click-and-collect may incur high inventory costs, reducing the benefits of increased sales. (Rushton et al. 2022, 182-183.)

The moment of product delivery is crucial in defining the customer's purchasing journey. One matter which might be blurred even among retailers is the importance of packaging and product placement in the store (e.g., packing materials, labelling, space, shelves/location) when the same packaging does not necessarily fit for both online-store and brick-and-mortar stores (Berkhout 2019, 3-4). Managers and merchandisers must think about the opening moment of the product as a part of the entertainment, but on the other hand, shipping methods and warehousing also affect how the product packaging must be done (Berkhout 2019, 4; Rushton et al. 2022, 6-7). Failures in delivery can negate previous positive experiences (Ferne & Sparks 2019, 29).

Gradually, online companies (e.g. Amazon) have taken space in the marketplace by enabling fast and direct deliveries to consumers, thus gaining a competitive advantage through increased customer satisfaction (Weele 2014, 397). This will be discussed next.

Every delivery and after-sales interface include a possibility

Every delivery and after-sales interaction presents an opportunity for retailers to enhance customer satisfaction and gain a competitive advantage. Successful management of these moments allows retailers to differentiate from competitors,

retain customers, and build long-term loyalty. Retailers should continuously seek improvements in customer service and after-sales processes, offering personalized or standardized services at the appropriate times. Key factors are responsiveness and reliability, although ultimately, customers determine the level of service. (Levy & Grewal 2023, 511-519.)

After-sales service encompasses many dimensions, contributing to long-term customer loyalty, which requires effective customer relationship management (CRM). Identifying and retaining loyal customers often necessitates specific programs and the use of retail analytics and big data. (Levy & Grewal 2023, 294-300.) CRM aims to maintain high performance in all retailer-customer interactions. (Levy & Grewal 2023, 292-308).

However, achieving positive customer satisfaction is complex, particularly due to challenges in freight carrier reliability and the limited use of innovations in the service sector. Issues such as shipment tracking and delivery reliability necessitate the development of larger and more reliable carrier pools. (Manners-Bell 2017, 236-238.) Therefore, not all factors are within retailers' control, and finding reliable partners remains crucial.

E-retailing Logistics

The last delivery challenge to be presented relates to common e-retailing logistics. The rise of online retailing increases the need for efficient logistics, including space for returns and fulfillment. Click-and-collect services require retailers to manage additional inventory and space effectively. Namely, in a click-and-collect arrangement, a customer can choose and pick a product online and then collect it from the retailer's store. (Manners-Bell 2017, 296.)

3.6 ICT Challenge – Strong Technology-Assisted Operations

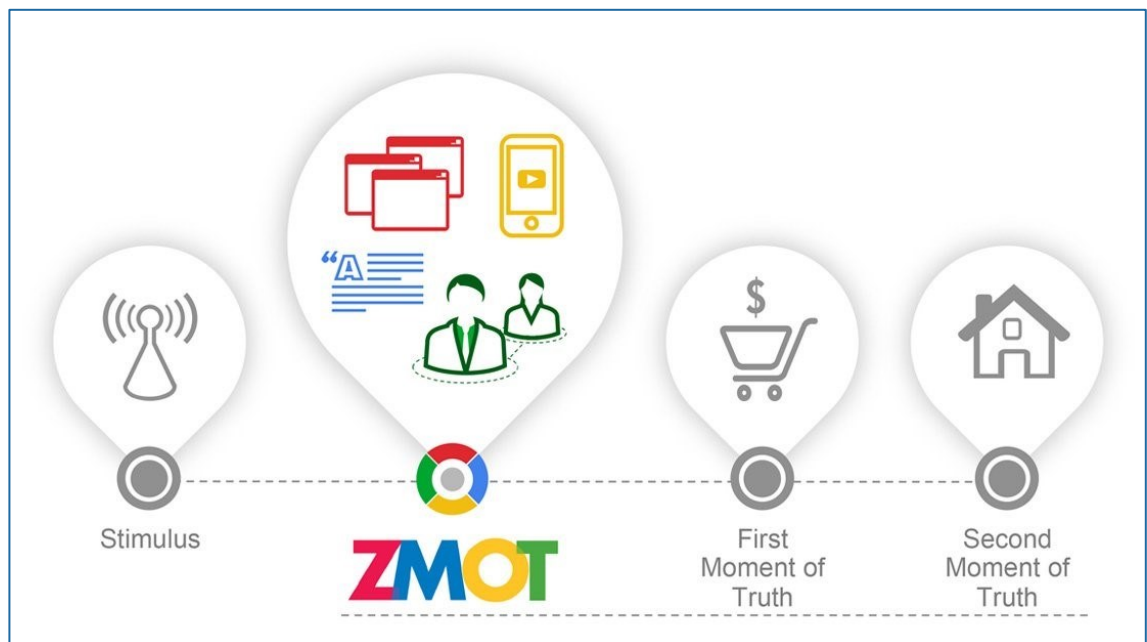
Role of IT solutions in logistics and outsourcing dilemma

IT solutions facilitate cost management and service development in logistics. Data management systems, driven by customer demand, are crucial for reducing

transit times and enhancing competitive edge. (Aktas, Bourlakis, Minis & Zeimpekis 2021, 8-9, 16-17, 189-193; Manners-Bell 2017, 18-19, 26-27, 29-30.) Retail analytics and AI play significant roles in modern retail operations (Levy & Grewal 2023, 15). SaaS providers, like SpendEdge, assist firms in choosing reliable partners for outsourcing logistics tasks (SpendEdge 2024). Reliability remains a priority for customers regardless of the logistics system used.

Customer-driven digital environment and the Zero Moment of Truth

Customers increasingly use electronic platforms and social media to decide on purchases, a process termed the Zero Moment of Truth (ZMOT) by Google (Chaffey, Hemphill & Edmundson-Bird 2019, 6-7, 12-13). The following picture illustrates this decision-making process. (Picture 12).



Picture 12. The Zero Moment of Truth and the Buying Decision Process (Think with Google 2024).

The illustration highlights a pre-purchase decision-making process where consumers initially explore online stores and social media channels to evaluate, share, and compare product details and reviews. This process begins with a stimulus that drives the consumer to digital channels for product research. The "Zero Moment of Truth" (ZMOT) represents the critical decision point following social media engagement. If convinced, the consumer proceeds to the purchase stage,

adding the item to their cart and completing the transaction. (Chaffey et al. 2019, 6.)

Social media platforms increasingly shape brand perceptions and multichannel influenced buying decisions, necessitating distributors' comprehension of these behaviours and the customer journey. Effective supply chain management now requires the integration of various channels and systems to facilitate seamless communication. (Chaffey et al. 2019, 6-7, 52.)

The rise of digital platforms, e-commerce, mobile commerce, and social media commerce underscores the importance of a robust digital presence for retailers. Digital channels are integral to the supply chain, influencing both supply and demand sides. (Chaffey et al. 2019, 6-15, 49.) However, it is not only consumers who share data in digital channels.

For a while, manufacturers, intermediaries, and retailers have utilized digitalization to share information on product movements and transactions via electronic data interchange (EDI). For instance, the Electronic Point of Sale (EPOS) system allows retailers to share sales data with warehouses and manufacturers. Vendor Managed Inventory (VMI) systems enable vendors to manage inventory levels, reducing human errors and enhancing predictability in supply chains. (Rushton et al. 2022, 40, 205, 685.)

A comparative study indicates that Collaborative Planning, Forecasting, and Replenishment (CPFR) positively impacts financial and operational performance. However, resource constraints, trust issues, and inadequate communication systems hinder its implementation. ICT advancements could facilitate CPFR adoption. (Aamer & Yani 2023.)

Interestingly, Boardwalktech's "Boardwalktech CPFR" application enhances collaboration and visibility in supply chain transactions, improving profitability. Its automated inventory replenishment feature allows retailers to set variables, with the app managing the rest, though it does not account for losses such as theft. (Levy & Grewal 2023, 338-339.)

Advanced warehousing and SKU management are pivotal in modern logistics. Systems like Warehouse Management System (WMS), Transport Management System (TMS), Enterprise Resource Planning (ERP), and EDI enable seamless business operations. TMS manages transport logistics data and can be integrated with EDI systems. (Manners-Bell 2017, 225-238.)

For example, an order received via EDI triggers SKU identification, picking, packing, and labeling. The WMS updates order status and alerts the TMS, allowing stakeholders to track the entire fulfillment process. (Manners-Bell 2017, 229-231.) This integration of software, AI, and IT solutions is a growing trend in supply chain management (Manners-Bell 2017, 224-231; Soupage 2024). Appendix 4 describes SaaS provider Appinventive's services.

The shift to digital channels and advanced ICT and AI applications must be considered in supply chain design. While these developments present challenges, they also offer opportunities for improved operations through the adoption of digital solutions. (Chaffey et al. 2019, 253.) Appendix 5 illuminates some challenges of SC that can be helped by digital solutions.

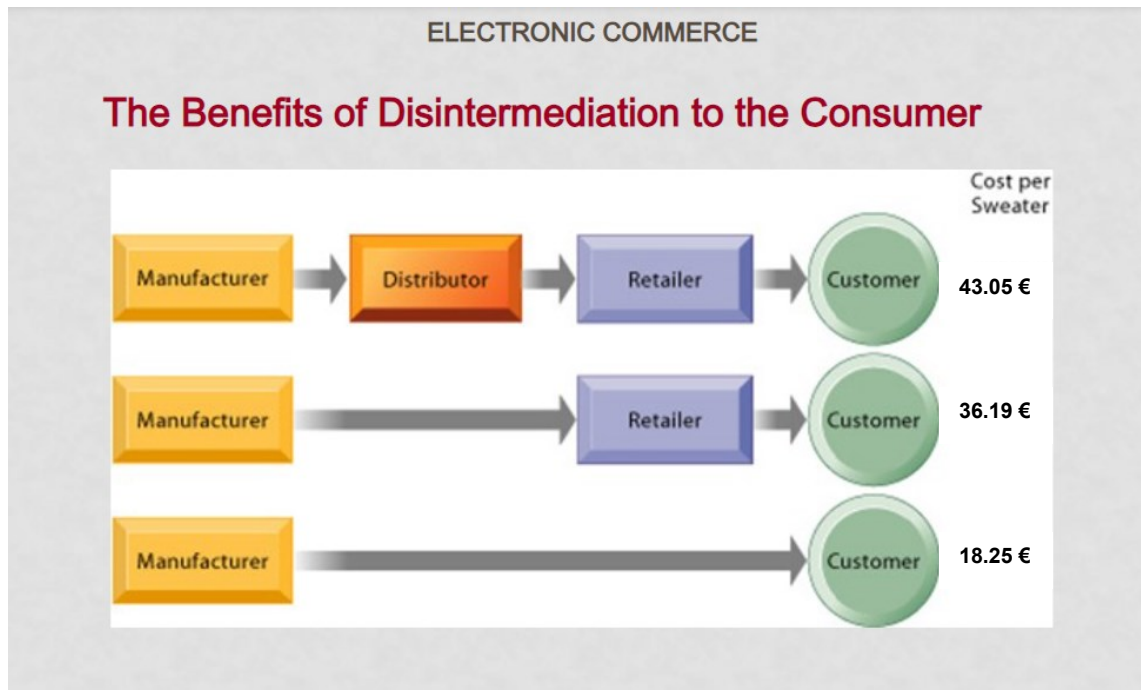
3.7 Challenges and Trends affecting Supply Chains

Retail remains the primary channel for delivering products to consumers, yet several emerging challenges are expected to impact international supply chains in 2024 and beyond. A notable challenge is the threat of disintermediation.

Disintermediation threatens traditional intermediaries

As illustrated in Chapter 3.1 (Figure 1), the trend towards disintermediation—cutting out intermediaries—appears increasingly likely, driven by the rise of direct-to-consumer (D2C) models and e-business. This trend poses significant threats to traditional intermediaries and even retailers. The potential benefits are clear, particularly for consumers, as manufacturers can achieve substantial cost savings by eliminating intermediary-related sales and promotion expenses. These

savings can be passed on to consumers in the form of lower prices. (Chaffey et al. 2019, 49-51.) An example of such disintermediation is depicted in Picture 13.



Picture 13. The Benefits of Disintermediation to the Consumer (Slideplayer 2023) (Modified by the author).

In the example, the cost of a shirt after full disintermediation is less than half of the original maximum price. While this thesis does not aim to predict the likelihood, timing, or extent of this development across various industries, it is feasible in many sectors. Several other significant challenges and transitions are on the horizon, some of which are highlighted below.

Changing trading channels: The Omnichannel challenge

Labor shortages in logistics and transportation pose a threat to international supply chains. Rising costs due to inflation and increased energy prices also present major challenges. Additionally, consumers expect retailers to provide a seamless omnichannel shopping experience across in-store, online, social media, applications, and marketplaces. Meeting these expectations is complex and costly for retailers. (RETAILDIVE 2023.)

The Phygital and Omnichannel approaches are integral to this transition. Delivering a combined offline-online (Phygital) and omnichannel customer experience is

increasingly important. In omnichannel commerce, sellers offer customers seamless interactions across all communication channels, creating a unique shopping experience. (Bjorqvist 2023.) Additionally, there is a growing consumer shift towards environmentally friendly products.

Greening the supply chain

Retailers and consumers are increasingly aware of the environmental impact of supply chains. The influence of customers on Corporate Social Responsibility (CSR) practices and other eco-friendly initiatives in supply chains is becoming a significant trend. (Bowersox et al. 2013, pp. 404-405; Fernie & Sparks 2019, 279-285.) An example of greening the supply chain is provided in Appendix 6. Green products, green supply chains, and CSR are crucial values for customers and essential for traders to fulfill their environmental responsibilities (C4R 2023; Levy & Grewal 2023, 12-13). Picture 14 illustrates some greening principles.



Picture 14. Some greening principles (Cummins 2024).

However, guarantees of a green supply chain or green products are not always reliable, as some claims are merely marketing tactics without real accountability from manufacturers and vendors. Some customers value green practices highly

and seek assurance regarding the environmental impact of products and supply chains (e.g., the use of recycled carbon fibre in bike frames). For companies operating within supply chains, blockchain technology offers a transparent platform to verify greening levels and circular economy targets. Future regulatory support comes from the new European Union directive. (Aditya 2024.)

The "Greenwashing Directive," officially Directive (EU) 2024/825, which took effect in March 2024, provides consumers with better protection against misleading practices and can be accessed on the European Parliament's website (EP 2024). Consequently, supply chain stakeholders, including consumers, now have better safeguards against false green claims. An overview of blockchain technology's role in this context is provided in Appendix 4.

4 Methodological Choices of the Thesis

The theoretical framework was developed based on research science. Initially, the broader context was examined, and potential e-bike vendors in the Joensuu region were identified through an internet survey. Concurrently, the survey questions were drafted. A semi-structured questionnaire with thematically arranged main themes was designed and administered. The collected data was then transcribed, organized, compared, and analyzed, followed by the documentation of the results.

The researcher's limited subject expertise, contrasted with the respondents' extensive experience as resellers and suppliers, warranted the use of a semi-structured questionnaire instead of a structured one. This approach aimed to enhance the understanding of the basic knowledge within the target group (Brace & Bolton 2022, 3). Semi-structured, mainly open-ended questionnaires are particularly suitable for exploring questions like "why" or "how" (Miles & Gilbert 2020, 66). Given the main research question, "What are the core challenges of the international e-bike supply chain?", a structured format would have constrained the outcomes. The semi-structured format allowed participants to clarify, elaborate, and rephrase their responses (George 2022).

This research is qualitative and comparative, identifying similarities and differences and drawing observations from both scientific literature and real-world data. It highlights critical points and areas for development.

4.1 Interviews among local vendors

Electric bicycle vendors in Joensuu, Eastern Finland, were chosen as the target group, with one vendor from Outokumpu included due to the author's residence in Joensuu. The aim was to conduct interactive interviews within the vendor shops and to observe the vendors' premises and e-bikes. Six of the seven invited merchants agreed to participate.

The promise of participant anonymity likely contributed to the low refusal rate, although the name of the selling store was permitted to be published. Interviews were conducted from February to March 2024, with five conducted in-store and one via Microsoft Teams.

There are fifteen to seventeen e-bike dealers in North Karelia, with nine or ten operating in Joensuu. Almost one-third of the area's e-bike dealers were interviewed, making the research sample comprehensive. The interviewed resellers represent larger chains, SMEs, and a start-up, thus embodying various stages of the e-bike market and supply chain.

4.2 Data acquisition and analysis

Data acquisition

The theoretical framework provided the reference for data acquisition. Data was sourced from libraries, library databases, and internet databases. This theoretical exploration served as a basis for gathering practical information. The company website survey initiated the practical data collection, followed by personal interviews in the stores that accepted the request. Six out of eight candidates agreed to participate. All interviews were recorded with permission, and all but one were conducted offline. The interview questions are listed in Appendix 7.

Data Analysis

The analysis began during the literature review and continued with the practical data collection. This continuous process evolved as the study progressed, culminating in a final analysis after the practical survey data was collected and organized.

5 Results

This chapter details the challenges reported by North Karelian e-bike sellers in the e-bike supply chain, based on interviews. The results are organized in subchapters 5.1 to 5.5, corresponding to the structure in subchapters 3.2 to 3.6, facilitating comparison with findings in the research literature. Several new insights emerged.

Before presenting the interview results with local vendors, it is essential to introduce the e-bike, which is central to the supply chain under investigation. This section also includes a brief overview of the stores involved in the e-bike market that were interviewed for this study. This segment combines interview results and the author's web-based survey of the company, aiming to elucidate the nature of the e-bike product and the diverse market and customer perspectives.

E-bike

E-bikes come in various types, including cruiser, road, mountain, gravel, and hybrid. The product is notably damage-sensitive, with key components highlighted in yellow in the accompanying image (Picture 15). These components, which contribute significantly to the bike's cost, are critical technical features and differentiation factors for both sellers and customers.



Picture 15. E-fatbike (Aug Shimano Autoshift 24) (Modified by author).

Differentiating factors of stores

The study investigates six types (numbers 1 – 6 in the table) of vendors:

1. A small local start-up, an Original Equipment Manufacturer (OEM), and specialized e-bike vendor.
2. A local SME reselling motorbikes and e-bikes.
3. An independent bike and e-bike reseller within a larger sports equipment chain.
4. An independent bike and e-bike reseller in a large hypermarket chain.
5. An SME specialized in bicycle resales, part of a larger chain.
6. An importer-vendor specializing in e-bikes.

Vendor	UVP ⁹⁾	Number of brands/mod-els	Price range of the e-bikes	Maintenance services
Niekka ¹⁾	Deficient	1/2	5 k – 6 990 €	In-house
Eastmx ²⁾	Deficient	3/25	2 k – 10 500 €	In-house
Intersport ^{3), 7)}	Missing	6/22	2 k – 11 000 €	In-house
Prisma ^{4), 7)}	Missing	5/40	2.2 k – 6 300 €	In-house
Pyörävarikko ^{5), 8)}	Deficient	7/50	1.7 k – 14 400 €	In-house
Sähköpyöräkauppa ⁶⁾	Deficient	3/11	1 k – 4 200 €	Not available

Table 1. E-bike supply chain-related comparison of vendors.

Table's number clarification

- 1) - 6) = Vendors' belongingness to the above-mentioned categories
- 7) = Applying the chain's bonus system
- 8) = Applying the Pyörävarikko club system (better benefits for club members)
- 9) = Clearly stated e-bikes' UVP (Unique Value Proposition) in the company websites

The table highlights factors significant for both sellers and buyers, influencing planning and targeting within the broader supply chain context. Key aspects such as after-sales services are critical due to the vulnerability of e-bike batteries and electric transmission systems. E-bike prices range from €1,000 to €14,400.

Five out of the six vendors offer in-house e-bike maintenance services. Major differences lie in the brand and model options, as well as the price range. Notably, some companies lack a Unique Value Proposition (UVP) on their websites, which is crucial for conveying strategic messages to customers. Websites often emphasize bike features over the unique value and benefits, potentially confusing customers who are unclear about their needs and available options (Table 1).

A UVP is a succinct statement of the value a store offers to solve customer problems, helping them choose one store over competitors. Crafting a UVP is challenging but valuable. Examples include "Everything under the same roof" (Omni-convert 2024) and "Durability, functionality, beauty" (Pelago 2024).

Other observed differences include variations in annual e-bike sales, availability of cycling clothes, footwear, and gear, with the most extensive product ranges found at Intersport and Prisma. These observations are based on the author's survey and website analysis.

General observations of interviews and the e-bike market in North Karelia

Post-COVID-19, the scarcity of components, particularly e-bike batteries, has receded. Interestingly, the interviewed importer and hypermarket representative reported minimal impact due to established partnerships with European suppliers (Prisma iw. 2024; Sähköpyöräkauppa iw. 2024).

Currently, most bikes sold are benefit bikes, introducing new practices and operators in the bicycle market and supply chains. The purchase of a benefit bike involves the employee, the employer, and the bike operator, with tax-exempt treatment (up to a certain limit) allowing acquisition of high-quality bikes for personal use beyond commuting. As of 2024, a bike benefit for an employee is tax-free up to €1,200 of taxable value per year (Vero 2024).

5.1 Demand-supply setup and inventory control

Customer Interactions and Demand Forecasting

Dealers find customer conversations challenging, as many customers are unsure of their needs and available solutions. These discussions occur primarily face-to-face or via email, with limited use of social media. Due to the continuous evolution of e-bike technology, vendors must actively shape demand and guide customers.

Most dealers rely on past sales data for demand forecasting and pre-orders, often without computer-aided tools. For instance, Prisma uses a specific tool for demand forecasting. E-bikes for the upcoming season (April-September) are typically ordered in the previous autumn, with additional orders placed as needed. Accurate ordering is crucial to avoid excess inventory when new models are released. Apart from groceries, e-bikes are not ordered, or stocks replenished continuously.

Responding to Customer Expectations

Vendors strive to meet customer demands for specific models or customizations, such as replacing bike components. Special requests are often influenced by online research and social media interactions. Dealers try to fulfill these requests through their supply chain networks.

However, brand loyalty and market limitations can pose challenges. For example, some factories do not produce e-fatbikes due to perceived limited demand, creating difficulties for Nordic dealers where such bikes are popular. (Pyörävarikko iw. 2024.)

In one case, demand for electric fat bikes with factory-installed mudguards and luggage racks led an importer to collaborate with a manufacturer to meet this regional demand (Sähköpyöräkauppa iw. 2024). This highlights the diversity in European consumer preferences and the need for tailored product offerings (Manners-Bell 2017, 21-22).

OEM operator's demand-supply set-up

eBike Finland Oy, a small start-up from Outokumpu, manufactures and sells its Niekka brand e-bikes. Operating on an assemble-to-order (ATO) basis, bikes are built only after customer specifications are confirmed, typically within two to three weeks. This model prioritizes quality over quantity and maintains the brand's value. Niekka's OEM manufacturing and supply chain is as follows: Only when the customer has accepted all the specs of the order the assembly of the bike is started. Order is completed in two or three weeks and bikes are not made to increase inventory. That implies the ATO-based supply system, which was presented in Chapter 3.2. (eBike Finland iw. 2024.)

The biggest challenge of Niekka is to find and create the right model series for their customer field and to be able to manufacture and assemble bikes cost-effectively. It means that the OEM's component SC needs to be established and maintained. Moreover, Niekka's product catalogue does not focus on quantity or price competition, but on higher quality. As a result, the manufacturer strives to invest in the familiarity of the brand and the preservation of the value of bicycles. (eBike Finland iw. 2024.)

Post-Pandemic competition and inventory control

Post-pandemic, European e-bike manufacturers faced overproduction, leading to a price war among resellers. Manufacturers' unexpected price reductions forced retailers to lower their prices, affecting the entire supply chain. (Eastmx iw. 2024; Sähköpyöräkauppa iw.2024.) This phenomenon, akin to the bullwhip effect (such as described in Chapter 3.2), does not leave many choices to retailers.

The dealer cannot be prepared for the price adjustments of the manufacturer as their preorders are already in the store (Eastmx iw. 2024). The missing

information and timing of the manufacturer ruin the operational ability of the dealer, and the waves can reach the wider industry. Originally, the purpose of the manufacturer was probably good and targeting clearances of its storage. The problem arises as the target and intentions of the manufacturer do not pay enough attention to other players, especially bike sellers interests, in the supply chain.

Only two years ago the situation could have been that when a bike arrived at the vendor's premises it was already ring-fenced (reserved for a certain customer). Now the store is looking for customers, and tracking buyers is a marketing challenge. (Eastmx iw. 2024.)

The price-war description and examples above show that there is certain fluctuation in SC, and the competition has tightened. On the other hand, these observations could also indicate that there might be room for better data sharing (sales and forecasting data) between bike sellers and suppliers in the chain. This was previously illustrated in Chapter 3.2 (Picture 8).

Future of e-bikes, store displays and inventory space challenges

Bike sellers must predict how long the e-bike boom will last and adjust their strategies accordingly. Despite some industry skepticism, the demand for benefit bikes and new manufacturers entering the market were suggested to continued growth. As one interviewee stated: Especially when operators are offering a bike benefit (tax advantage based on employment relationship), the demand for e-bikes and benefit bikes can be expected to continue. Currently, the majority of all sold bikes are benefit bikes. (Eastmx iw. 2024.) Other operators' predictions and observations are parallel with that.

Most bikes are sold directly from store stock. It is believed that e-bikes will also be on display in the store in the future due to the requirements of the buyer and the geometry of the bike and the rider. As a relatively expensive purchase, consumers want to see the physical product and have a test drive before the purchase decision. The display circumstances vary in stores and vendors face space constraints, particularly at the start of the season. Specialized bike stores and

hypermarkets have varying storage capacities, but the trend of maintaining models for multiple years aids inventory management.

Inventory control systems and stock-outs

Inventory control is primarily digital, with EAN barcode readers and POS systems, though smaller companies may lack ERP systems. Stock-outs are rare and usually due to factory delays or end-of-year shortages. Most vendors can track and fulfill customer orders within two to three days locally or two to three weeks for international orders.

Sometimes stock-outs appear when certain factories cannot deliver pre-orders in the promised time. Hence, bikes are not available when the season starts. However, in most cases, if the customer can use the vendor store's bonus- and benefits system, he/she patiently waits as long as needed without changing the store. (Prisma iw. 2024.)

Immediate response and delivery times

E-bike purchases are often carefully planned, with delivery times varying. Local network tracking typically results in 2-3 day deliveries, while orders from European warehouses take about two to three weeks. This is the delivery pace in all interviewed companies except in one: Niekka's delivery requires an explicit order, after which the bike is assembled in two to three weeks (eBike Finland iw. 2024). This could include the risk of losing impatient customers, but often suits well-prepared buyers.

In summary, most vendors can supply requested bikes immediately from stock or within a few weeks through their supply chain. This flexibility helps manage customer expectations and maintain sales even during peak seasons.

5.2 Procurement's challenge

The development of the last four-five years

Consumer durables ordering differs from that applied in daily consumer goods sold in grocery. Thus, there are no continuous product streams to stores as there are with groceries. In general, bikes entering the Finnish market come mainly from European, Chinese, or other Far Eastern manufacturers as well as from North America.

Availability of e-bikes and access to representations

Referring to the previous chapter, there is now an oversupply in the e-bike market. As far as possible, bicycle shops strive to stick to the "old" reliable and proven selling brands, and there has been little need for new supplier partnerships on the bike manufacturer's side. Therefore, procurement policy and efforts are mainly conducted with well-proven partners.

Supplier sourcing

Only a few years ago, there were a lot of import and reseller representations (i.e. manufacturer suppliers) from the well-known (premium) brands in the manufacturer market available. The situation has changed dramatically, and representations of well-known brands are scarcely available as distribution networks and representations are already built. The premium class brands are the most challenging segment in new representation seeking.

The importer states that pursuing the bikes of German bike manufacturers is challenging. Although the bikes are of very high quality, the buy-in prices are too expensive from the importer's point of view. The importer managed to find Czech manufacturers with good price-quality ratios and the bikes are much cheaper compared to the Germans, and suitable for their customer segment. That is why they stick to the current assortment. (Sähköpyöräkauppa iw. 2024.)

The interviewed OEM entrepreneur sources and aim to utilize reliable brands' components, such as Shimano. The components can be expected to be of high-quality parts. The OEM entrepreneur has had to convince the component

manufacturers in the negotiations to use OEM parts for the assembly of Niekka bikes. (eBike Finland iw. 2024.)

Continuous supplier assessment and procurement communications

Despite continuous supplier control, none of the interviewed participants used outsourced services or SaaS services in their possible partner assessments. As an importer (Sähköpyöräkauppa iw. 2024) states: Those services are relatively expensive for dealers. If the first five bikes supplied by the new bike manufacturer are poor quality bikes, the business relationship ends there.

The same importer-seller mentioned that at the beginning of their operation history, they imported more global bikes, including Chinese bikes. The Chinese brand was abandoned due to a lack of reliability and long delivery times related to warranty spare parts and/or wheels (the spare parts could show a total waiting time of more than one year for the customer). Now they only import bikes manufactured in the EU, because the European free trade area and shared customs provisions make it much easier. (Sähköpyöräkauppa iw. 2024.)

The same kind of reliability issues (production process/quality) were recognized in several interviews and were mostly related to Chinese and Far Eastern bicycle manufacturers. Ordering from there requires better supervision and the occasional presence/visits of the customer's representation at the supplier's factories. For example, the samples may be of high quality, but the quality of the ordered bikes differs from what was agreed. In that sense, procuring for the Far East involves higher risk, also from the angle of investors as some of the purchases may be made partly with debt money.

Balancing between pre-orders, additional orders, and batch prices

The interviewed importer mentioned that now when factories generally have shelves full of bikes, importers and dealers can take advantage of that situation: Vendors do not have to make as large of pre-orders as before but buy bikes in smaller batches. The moment of purchasing bikes and the buying price from manufacturers is the moment when the entrepreneur creates the circumstances for a profitable business. The importer's purchase price from the factory must be such

that dealers also have some margin in the supply chain. (Sähköpyöräkauppa iw. 2024.) Large enough pre-orders ensure the best batch prices for entrepreneurs.

In OEM business the component orders to factories must be made up to more than a year earlier to get the desired components to the assembly site in a decent time. Long supply chains which have in some cases been up to 1.5 years (Shimano's engine from Japan) are hampering OEM production. Spare parts could be ordered from the spare parts center of Europe faster, but then the price is much more expensive. (eBike Finland iw. 2024.)

Special questions of demand-supply and procurement

After 2016, an import/anti-dumping duty was in force in the European Union on electric bicycles manufactured in China or the Far East and imported into Europe or the territory of a European Member State. The customs duty, which was still factory-specific, varied between 30-70% of the purchase price of the imported bike. Probably, the reason behind the import duties was/is to prevent all bicycle manufacturing from escaping to the Far East. (eBike Finland iw. 2024.) However, current border formalities, customs tariffs, or exchange rates do not cause considerable concern among bike sellers as they have such partnerships.

The latest proof of variables in the market environment of Finland is the recent and current strike situation (political strikes) which hampered operations at sea-ports as stevedores were on strike in the winter of 2024. It impeded the Finnish Helkama brand's bike manufacturing as component shipments were stuck on the ship. Therefore, it was expected that the factory would not be able to deliver all bikes as agreed. (MTV3 2024.) According to local bike sellers, until now the strike has had no meaning to the upcoming sales season, as pre-ordered bikes are already in stores. If the strike would have continued longer the situation would have been different.

5.3 Transportation and inventory logistics

Despite the impact of freight expenses, logistics and transportation generally run smoothly. The primary challenge occurs at the start of the sales season when stores are filled with bikes. OEM's situation differs at this point from others. Vendors adapt to these conditions as needed.

Pyörävarikko faced space and capacity issues but resolved them by relocating to new premises in Joensuu and opening a central warehouse in Kerava in 2023. This improved the chain's ability to supply stores and fulfill online orders. (Pyörävarikko iw. 2024.) Photographs 16 and 17 illustrate the space and display arrangements in a hypermarket and a specialized bike store, respectively.



Picture 16. E-bikes on display in Prisma Sport Joensuu (Picture: Ari Nieminen).



Picture 17. E-bikes on display in Pyörävarikko Joensuu (Picture: Ari Nieminen).

Packaging e-bikes for shipment presents a multifaceted challenge due to their size, fragility, and the presence of sensitive technology, as depicted in Picture 15. It is imperative to ensure that the bikes reach customers undamaged and, in a state, ready for almost immediate use, typically around 85-90% readiness. The prevailing solution involves employing cardboard boxes with appropriate padding, with 90% of packaging materials being recycled within the supply chain. Picture 18 provides an innovative e-bike packaging example.



Picture 18. Example of packaged e-bike to the customer (Medium 2024).

An innovative approach adopted by bike operator VanMoof, as depicted in Picture 18, involves packaging e-bikes in cardboard boxes resembling those used for large flat-screen TVs, resulting in an 80% reduction in bike damage within the company (Bicycling, 2024). However, logistical challenges persist, particularly when multiple bikes are palletized together, as illustrated in Picture 19.



Picture 19. Several e-bikes are loaded on wooden pallets (AliExpress 2024).

Special logistic challenges

In one instance, a retailer experienced delays during the Christmas holidays when a shipment of bikes got stuck in Europe due to a lack of available truck drivers willing to transport the cargo to Finland. The absence of a return load for the driver led to a significant delay in delivery until after Epiphany. (Eastmx iw. 2024.) Another example:

There might be a rising problem which is related to the transportation of separate bike batteries: The dilemma shows up when freight carriers reject or do not accept batteries transported in bulk at all. As a rule of transport companies, it may be, for example, that they only carry batteries attached to the bicycle frame. The price of transport for batteries transported as loose batteries can be very high and may become an inappropriate means of funding (rip-off) for transport companies. Signs of the phenomenon are already seen. (Sähköpyöräkauppa iw. 2024.)

5.4 Delivery and customer satisfaction

Basic procedures on the road toward the order fulfillment

The delivery of the bike (i.e., the moment when the customer takes possession of the product) can be conducted in ten minutes. The delivery of a bike involves several key steps, including final assembly (if required), providing manuals,

conducting a handover inspection, and generating inspection documents. Collaboration with the customer during this process not only helps meet after-sales targets but also reduces the likelihood of customer complaints. Neglecting or poorly executing these steps, particularly the final assembly and inspection, can present significant challenges.

Typically, when a customer completes a purchase at a physical store, they are responsible for transporting the bike themselves. Instances where the vendor assists in packing the bike for transportation are rare in brick-and-mortar stores. For online deliveries, careful packaging is essential to ensure the product's safety during transit. Regardless of the delivery method, stores ensure that customers receive necessary guidance and manuals upon delivery or shipment of the bikes.

Online deliveries and after-sales challenge the service system

The rise of e-commerce in e-bike sales presents challenges for the service system, with online transactions accounting for a significant portion of total sales. Customers often browse options online before visiting local stores for further examination. However, the increasing popularity of e-commerce poses spatial challenges for vendors, particularly concerning storage limitations. Consequently, there is a growing trend towards centralizing e-commerce operations to overcome such challenges.

Maintenance and spare parts services are primarily handled in-house by dealers, leveraging the expertise of service technicians. This model facilitates easier tracking and resolution of issues that may arise post-sale. Regular customer visits for maintenance further enable service personnel to address any issues promptly and provide guidance on proper bike usage.

5.5 ICT utilization, trends, and future development

ICT and social media usage are thin

The utilization of Information and Communication Technology (ICT) and social media within the e-bike industry is relatively modest. While some dealers employ

digital service management systems, larger establishments leverage digitalization and specialized service software to streamline operations and enhance customer service. Customer inquiries are managed using Software as a Service (SaaS) platforms and partly automated systems to ensure efficient responses. However, adoption of SaaS services varies among dealers, often influenced by cost considerations.

Although few dealers utilize SaaS services extensively, some incorporate Enterprise Resource Planning (ERP) software, barcode readers, and Artificial Intelligence (AI). AI is particularly utilized for managing social media presence and addressing customer inquiries. However, Radio Frequency Identification (RFID) technology is not commonly employed in e-bike supply chains, primarily due to its perceived unnecessary for pre-order-based shipments (Sähköpyöräkauppa iw. 2024). Furthermore, according to Sähköpyöräkauppa (iw. 2024), AI will change the market environment of social media and marketing in the future.

The content creation in social media was experienced as the biggest challenge. Partnerships related to social media content and marketing material are expensive, so in many cases entrepreneurs do those themselves, without outsourcing the case. However, outsourcing related to certain campaigns or new model launching is utilized.

Sustainability- and CSR requirements

In terms of sustainability and Corporate Social Responsibility (CSR), interviewed e-bike sellers are increasingly emphasizing recycling and sustainability within their supply chains. Many of those trade used bikes to extend their lifecycle, contributing to sustainability efforts. However, specific details regarding CSR practices are often absent from company websites. Additionally, efforts are made to utilize recycled packing materials for bike shipments whenever possible.

Anticipating future development

Some interviewees afforded their vision. According to one: A shift towards a more customer-centric supply chain in the e-bike industry will take place over the next

ten years. This transition involves customizing production to align with customer preferences, potentially reducing the reliance on wholesalers and resellers.

Furthermore, advancements such as automatic transmissions and improvements in battery technology are anticipated to drive innovation in e-bikes. The increasing popularity of freight bikes is also noted as a potential trend, potentially replacing traditional freight cars. (Pyörävarikko iw. 2024.)

6 Conclusions

This study aimed to identify the core challenges of international supply chains and assess their relevance to regional entrepreneurs' e-bike supply chains. The literature review identified only three specific challenges pertinent to the e-bike supply chain, with additional industry-specific phenomena and solutions gathered from local bike sellers. It was anticipated that general challenges from the literature would also apply across industries, a hypothesis confirmed by the field survey. Both theoretical and practical insights revealed several significant challenges, summarized in the following sub-chapters.

6.1 Key challenges (literature)

Global supply chains operate under various trade regulations, despite a trend towards free trade. Global phenomena, notably the COVID-19 pandemic, have significantly influenced consumer-driven supply chains. Retailers now play a critical role, possessing deep insights into customer needs and influencing supply chain development.

From a customer perspective, product value and cost are crucial in purchasing decisions, a concern shared by procurement sectors. The challenge for procurement is to make timely purchases at the lowest cost to deliver value to customers and meet business objectives. The Total Cost of Ownership (TCO) approach and supplier assessments are essential for cost-effective supply chains. Logistics also play a crucial role, as procurement and logistics constitute a substantial

portion of total enterprise costs, necessitating a balance among customer, investor, and company interests.

Demand forecasting guides supply, but fluctuating demand challenges inventory management, leading to the bullwhip effect when information is insufficient or inaccurate. This hampers the order-delivery system and negatively impacts the supply chain.

Solutions include better coordination, cooperation, and integration of supply chain partners, facilitated by advanced ICT systems for improved inventory control and reduced stock-outs. Zero inventory is often idealistic, with safety stocks necessary to prevent customer dissatisfaction.

Digitalization, e-commerce, and new sales channels are reshaping product merchandising and supply chains. Customer-centric approaches and green supply chain initiatives are expected to increase. There is also a trend towards eliminating intermediaries in supply chains. The next subchapter summarizes findings from the field study of North Karelian bike sellers.

6.2 Key challenges (survey)

E-bike sellers identified many challenges from the literature, such as rising costs and inflation, while highlighting new phenomena. There is no shortage of components or bikes, as suppliers maintain a steady stream of products. New stakeholders in the buyer-seller relationship have emerged, with tax and employer incentives increasing the prevalence of e-bikes.

The pandemic demonstrated that global supply chain disruptions, such as delays and stock-outs, can have immediate and widespread impacts. Local factors, such as political strikes in Finland, also significantly affect supply chains. Most challenges identified in the literature were recognized by local vendors. These phenomena and solutions are detailed in Table 2, with the last four lines addressing new, real-life challenges.

Followed challenge/case	Main solutions in managing the challenge in regional e-bike SC	Remarks
Demand forecasting	Preorders and additional orders	Previous seasons' sales data guide orders
Special order after customer's request	Tracking the bike in chain/network/warehouses, DCs/factories	A case when the demanded/desired e-bike is not available in the store's assortment. ¹⁾
Inventory keeping	Digital inventory control, manual replenishment orders, all bikes displayed/on the floor	E-bike inventory challenges at the beginning of the season as all or almost all bikes are displayed.
Stock-out (battery based)	Vendors had to wait for the factory deliveries (e-bikes), they also offered substitutes.	Two vendors did not suffer from the delays caused by the scarcity of batteries after the pandemic hit.
Bullwhip effect	Adjusting price level to follow rivals' prices	Manufacturing-oriented bullwhip effect. ²⁾
Procurement: supplier sourcing and assessment	Maintaining established partnerships is important for both parties, abandoning partnership if the supplier or product reliability issue	New e-bike representations of premium brands are tricky to achieve. Oversaturation on supplier market.
Storage facilities – space scarcity	Space arrangements, aim to keep all bikes on the floor.	E-bike inventory challenges at the beginning of the season as all or almost all bikes are displayed.
Transportation of products	Outsourced transportation services	Both small and large freight carriers are used.
Product packaging for shipment from the store	Large cardboard boxes with necessary padding, wheel 85-90% ready for use.	E-bike packaging for customer shipment. Fragile components cause some issues in SC.
e-commerce	Concentrating e-commerce deliveries in one place.	Vendors aim to adapt to the situation by centralized deliveries and by investing in warehouses. ³⁾
After-sales (maintenance)	E-bike maintenance in-house, partly usage of season mechanics partly full-time	five out of six bike vendors provide bike maintenance services at their store
ICT-usage in SC	Basic ICT systems	Bigger operators' ICT infra is better than small ones.
Anti-dumping duties	Bike seller search for new bike suppliers	EU's anti-dumping duty for the Far East/Chinese e-bikes. ⁴⁾
Seaport strikes	Preparing for long truck transportation.	Political strikes in Finland in Spring 2024.
Stucked shipments	Reseller's cooperation with the freight carrier co.	A true story reported by Eastmx in chapter 5.3. ⁵⁾
Bulk battery dilemma	Negotiations with freight carriers	Possible rising issue and new phenomenon ⁶⁾

Table 2. The sum up of literature-based SC challenges and how the interviewed stores have faced the challenges.

Clarification of the numbers in the table:

1) = Can be also a stock-out case because the item is “sold-out”. The solution is still the same if a customer wants the product to be tracked.

2) = Case emerged in an interview: where in factory’s supply chain operating vendor (Eastmx) faced the challenge. The manufacturer’s negligence to its partner’s interests is what amazes the author at this point. There emerged other phenomena in vendor interviews too, that can be interpreted as bullwhip effects although they were not titled by that name in interviews. Those bullwhip effects are more vendor (interviewed bike sellers) oriented. The signs of those situations are clearance sales and sales of e-bikes which take or have taken place up and then, virtually in all stores.

3) = The vendor operating in a big hypermarket chain, such as Prisma Sport Joensuu, utilizes and centralizes e-commerce at one spot, meaning that the chain has one central warehouse for e-commerce. Prisma Sport Joensuu also utilizes a click-and-collect delivery method.

From newer entrepreneurs, Pyörävarikko recently opened a central warehouse in Kerava to manage the increasing e-commerce.

4) = Not applied now. This kind of regulation has emerged up and then inside the EU, mainly addressed to Chinese and/or Far East bicycles. The purpose has been to protect the European bike industry. There is nothing to prevent such arrangements from being repeated.

5) = Although some examples of the stucked shipments (Suez Canal jams) were perceived in the literature review, they originated from larger phenomena. The reason for this is much more mundane but still very understandable from the perspective of the entrepreneur and the wage earner.

6) = Only one interviewee mentioned this kind of issue. It does not mean that the others have not faced it.

Each interviewee acknowledged that customers are more demanding than in previous years. Stores strive to meet customer needs and have enhanced their supply chains (SCs) by establishing warehouses, offering in-house e-bike maintenance, and participating in product development (e.g., mudguards and luggage racks). Contrary to literature, inventory management and consistent product streams are not emphasized challenges, as e-bikes are seasonal products. Entrepreneurs have ample time to prepare for the season, ensuring SKUs are available on time. It remains uncertain if the rising demand for benefit bikes will alter SC management or seasonality.

Stock-outs are rare, likely due to the adequate preparation time for the season and customers' pre-purchase research via online catalogues. A field study indicates price competition in the industry, necessitating increased marketing investments. Interviewees unanimously believe e-bikes will remain available in stores. Display challenges vary between stores due to differing resources and priorities.

Independent dealers now have more flexibility in making smaller pre-orders, thanks to improved production capacity post-pandemic. Real-time orders at profitable batch prices are essential for profitability and procurement. Interviewed bike sellers reported minimal difficulties in procurement. Long-term relationships with manufacturers, importers, dealers, and other stakeholders facilitate reliable quality, delivery, and solvency assessments. While well-known brands are easier to trust, rising new brands pose challenges for assessment. Retailers part of larger chains benefit from support in evaluating supplier reliability.

Transportation, inventory logistics, and delivery arrangements are not particularly challenging due to established partnerships. However, vendors must manage space and packaging constraints, as bikes are large and fragile. The trend of increased online deliveries and e-commerce is recognized, with vendors adapting their strategies accordingly.

ICT utilization and CSR values are acknowledged, though opportunities for increased ICT use exist, such as SaaS services. High costs currently limit their

adoption, but technological advancements and reduced prices may encourage future uptake. All interviewees expect e-bikes to continue developing.

Some interviewees suggested that importers, wholesalers, and retailers might be phased out of the SC within the next decade. However, this transition is unlikely to occur rapidly or on a large scale, as current SCs efficiently serve diverse customer segments, keeping manufacturing costs and prices accessible. The existing SC infrastructure, including distribution centres and retailers, provides various bike models and advanced maintenance services, meeting customer expectations.

Transitioning away from the current infrastructure would be costly. For instance, Amazon, originally an e-commerce company, now operates in retail and logistics, with its control over deliveries rising significantly (Levy & Grewal 2023, 5). Additionally, theoretical research suggests that transitions are gradual and multidimensional rather than immediate. Customer preferences and behaviour will play a crucial role in shaping future developments.

6.3 SWOT analysis of the e-bike supply chain (generally)

A critical aspect still needing clarification is identifying the most important factors in managing and maintaining e-bike supply chains. This will be addressed in the final SWOT table (Table 3). The table extends beyond merely identifying challenges, as initially intended. Given the interrelation between challenges and management, omitting these insights would be a disservice to the comprehensive understanding of supply chain (SC) management. Consequently, the key findings concerning the SWOT factors of the e-bike SC are presented.

<p style="text-align: center;">STRENGTHS</p> <ul style="list-style-type: none"> • Established supplier- and co-operation partnerships • The price-quality ratio of good products in several price categories • Comprehensive after-sales (spare parts and maintenance) services • E-bike business and industry knowledgeable and motivated personnel 	<p style="text-align: center;">WEAKNESSES</p> <ul style="list-style-type: none"> • Oversized and difficult-to-manage assortment • Inadequate range of quality or premium models • Too thin utilization of the ICT field • Insufficient cooperation inside the enterprise and between SC parties
<p style="text-align: center;">OPPORTUNITIES</p> <ul style="list-style-type: none"> • The development and popularity of the benefit bike segment • ICT • Transportation and procurement alliances plus cooperation with other companies • Omnichannel communication 	<p style="text-align: center;">THREATS</p> <ul style="list-style-type: none"> • Increasing costs and expenses • Changing political and market environment • Price competition in e-bike industry, bullwhip effects • (Disintermediation/cutting e.g., retailers out of the SC)

Table 3. SWOT analysis of factors affecting e-bikes' supply chains.

A SWOT analysis of a company's supply chain serves as a valuable tool for evaluating factors pertinent to the condition of its supply chains. The approach to analysing various SWOT factors in this context is derived from the author's experience and observations during the study. The table does not detail the supply chain of any specific interviewed company; rather, it consolidates factors deserving general consideration. Additionally, various other factors influence supply chain management and company capabilities. The next chapter provides a summary of the study project, encompassing its findings, limitations, and recommendations for future research.

7 Discussion

The research posed several challenges due to the author's status as a student and limited industry expertise, compounded by a scarcity of international publications on e-bike supply chains. Consequently, the focus shifted to conducting research interviews to gather data. The study aimed to provide a comprehensive overview of the primary challenges within e-bike supply chains, with interviews revealing new insights.

Findings largely aligned with the researcher's expectations, with basic challenges across different supply chain stages consistent with prior views. However, navigating the ICT landscape emerged as particularly challenging, given its novelty. Contrary to the author's hypothesis, interviewees did not perceive store location as a significant additional challenge.

Theoretical research yielded limited material, often generalized and partly applicable to grocery trade products. Despite this, interpreting findings alongside existing knowledge enabled some conclusions. Notably, research interviews provided new dimensions and perspectives, challenging theoretical notions, such as the necessity of RFID technology for e-bike pre-order deliveries.

While certain elements like risk management or reverse logistics were not explored due to project scope limitations, speculation regarding the future threat of disintermediation suggests potential industry shifts. Advances in ICT, AI, and robotics offer promising solutions for enhancing supply chain responsiveness, particularly in large distribution centers and logistics hubs.

Furthermore, data analytics enables retailers to make customer-focused decisions, reflecting the evolving direct-to-consumer business model. Cultural challenges among merchandisers, such as resistance to online channels, may require organizational training and attitude shifts. The resilience of independent small retailers, leveraging online and social media channels, underscores their survival amidst pandemic pressures and competition from larger chains.

Future research opportunities include investigating SC process developments, disintermediation, and other modifying themes. Specific studies on e-bike procurement or sector-specific phenomena offer avenues for smaller investigations. Alternatively, larger-scale studies on e-bike supply chain management present substantial challenges and opportunities, given the dearth of international research in this area.

As e-bikes evolve and are increasingly used in supply chain logistics, especially in last-mile deliveries, related research topics remain fruitful and relevant. The trajectory of the e-bike industry and supply chains will become clearer in the coming years.

The research journey, despite its challenges, proved to be instructive in comprehending the complexities inherent in supply chains from a novel perspective. Approaching this subject as an outsider to both the industry and its cultural nuances offers unique insights, yet immersion within the industry enhances knowledge and proficiency. However, insider status does not inherently ensure the appropriate mindset or a comprehensive understanding of business and industry intricacies. This underscores a vital consideration for future researchers and practitioners.

Specifically, cultural impediments among merchandisers present a notable challenge within supply chains. For instance, biases against utilizing online channels for business transactions may prevail among retail staff, necessitating comprehensive retraining initiatives. Similar shifts in attitude are requisite in managing and leveraging customer profiles and behavioral data across product sales and communication channels.

Moreover, an intriguing observation from the literature pertains to the resilience of independent small retailers amidst the pandemic and competition from larger chains. Their success appears attributed to swift adoption of online and social media sales channels. This trend aligns with forecasts from 2019, which anticipated a growing significance of Small and Medium-sized Enterprises (SMEs) within international supply chains.

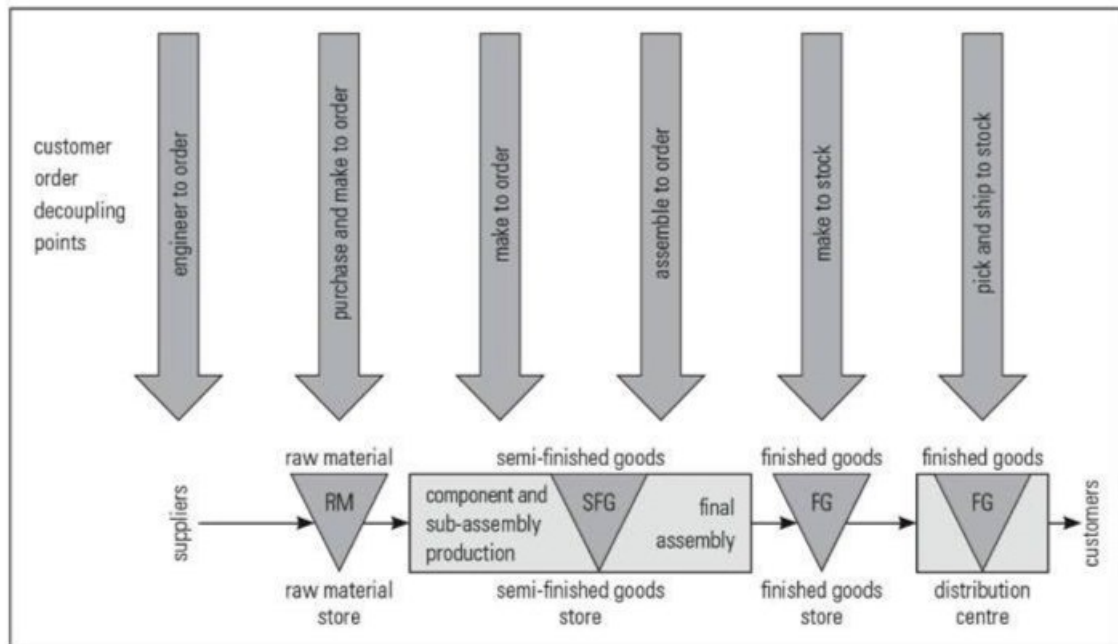
References

- Aamer, A.M. & Yani, L.P.E. 2023. Supply Chain Collaborative Planning, Forecasting, and Replenishment. AIP Conference Proceedings 2646, 050044 (2023). ResearchGate. https://www.researchgate.net/publication/370342637_Supply_chain_collaborative_planning_forecasting_and_replenishment. 10.12.2023.
- Academy for International Modern Studies (AIMS, UK). 2024. Supply Chain Management and Supply Chains. <https://aims.education/study-online/what-is-supply-chain-management-definition/>. 18.04.2024.
- Aditya, RAJ. 2024. The Future of E-Bike Supply Chain is Circular and Blockchain-Powered. 24.4.2023. LinkedIn. <https://www.linkedin.com/pulse/future-e-bike-supply-chain-circular-aditya-raj/>. 23.1.2024.
- Aktas, E., Bourlakis, M., Minis, Ionnis. & Zeimpekis, Vasileios. 2021. Supply Chain 4.0. Improving Supply Chains with Analytics and Industry 4.0 Technologies. London, United Kingdom: Kogan Page Limited.
- AliExpress. 2024. https://ae01.alicdn.com/kf/Seec223b8f280467091a228b4ca9e9121W.jpg_640x640q90.jpg?width=800&height=447&hash=1247. 19.4.2024.
- Berkhout, C. 2019. Assortment and Merchandising Strategy. Building a Retail Plan to Improve Shopper Experience. Cham, Switzerland: Palgrave Macmillan.
- Bicycling. 2024. When This Bike Company Put a TV on its Box, Shipping Damages Went Way Down. Hurford, M. 11.10.2017. Read on 22.4.2024. <https://www.bicycling.com/news/a20027122/vanmoof-tv-on-box-damaged-bikes/>.
- BikeBiz. 2024. How have supply chain shortages affected the e-bike industry? Article. 27.12.2021. <https://bikebiz.com/how-have-supply-chain-shortages-affected-the-e-bike-industry/>. 3.1.2024.
- Bjorqvist, N. 2023. Customer Experience: Why “phygital” is the future of customer experience. 22.8.2023. Blog. <https://contentsquare.com/blog/phygital-customer-experience/>. 30.11.2023.
- Boardwalktech 2023. CPFR – Collaborative Planning, Forecasting & Replenishment. <https://www.boardwalktech.com/applications/cpfr>. 9.12.2023.
- Bowersox, D., Bowersox, J., Closs, D. & Cooper, M. 2013. Supply Chain Logistics Management. New York: McGraw-Hill.
- Brace, I. & Bolton, K. 2022. Questionnaire design: how to plan, structure and write survey material for effective market research. London, United Kingdom: KoganPage.
- Casey, K. The Enterprisers Project. How to explain supply chain management in plain English. <https://enterpriseproject.com/article/2021/5/supply-chain-management-explained-plain-english>. 11.12.2023.
- Chaffey, D., Hemphill, T. & Edmundson-Bird, D. 2019. Digital Business and e-commerce Management. Harlow, England: Pearson.
- Cachon, G. & Terwiesch, C. 2013. Matching Supply with Demand. An Introduction to Operations Management. New York: McGraw-Hill.
- CFI (Corporate Finance Institute). 2024. Supply Chain. <https://corporatefinanceinstitute.com/resources/management/supply-chain/>. 18.04.2024.

- Christopher, M. 2011. Logistics & Supply Chain Management. New York: Financial Times Prentice Hall.
- C4R (Consulting for Retail). 2023. Supply Chain Management Trends in Retail 2024. <https://www.c4r.eu/blog/trendy-riteyla/supply-chain-management-trends-in-retail-2024/>. 29.11.2023.
- Daly, P. 2019. International Supply Chain Relationships. Creating competitive advantage in a globalized economy. London; New York: Kogan Page Limited.
- Eastmx. 2023/-24. <https://eastmx.fi/>. Autumn 2023/spring 2024.
- Eastmx iw. 2024. Eastmx, Joensuu. Recorded interview with a company representative. 9.2.2024.
- European Parliament (EP). 2024. PROVISIONAL AGREEMENT RESULTING FROM INTERINSTITUTIONAL NEGOTIATIONS IN THE SUBJECT: Proposal for a directive of the European Parliament and of the Council amending Directives 2005/29/EC and 2011/83/EU as regards empowering consumers for the green transition through better protection against unfair practices and better information. https://www.europarl.europa.eu/meetdocs/2014_2019/plmrep/COMMIT-TEES/IMCO/AG/2023/11-28/1289669EN.pdf. 18.2.2024.
- European Union (EU). 2024. Single European Market. https://european-union.europa.eu/priorities-and-actions/actions-topic/single-market_en. 10.01.2024.
- EUR-Lex. 2023. Internal Market. https://eur-lex.europa.eu/summary/chapter/internal_market.html?root_default=SUM_1_CODED%3D24&locale=en. 30.11.2023.
- Fernie, J. & Sparks, L. 2019. Logistics and Retail Management. Emerging issues and new challenges in the retail supply chain. London, United Kingdom: Kogan Page Limited.
- Gattorna, J. 2010. Dynamic Supply Chains. Delivering value through people. Harlow: Financial Times Prentice Hall.
- George, T. 2022. Semi-Structured Interview. Definition, Guide & Examples. <https://www.scribbr.com/methodology/semi-structured-interview/>. 10.11.2023.
- Hugos, M. & Thomas, C. 2006. Supply Chain Management in the Retail Industry. Hoboken, N.J: John Wiley & Sons, Inc.
- Iloranta, K. & Pajunen-Muhonen, H. 2018. Hankintojen Johtaminen. Ostamisesta toimittajamarkkinoiden hallintaan. Helsinki: Tietosanoma.
- IntechOpen. 2023. Introduction of Green Supply Chain Management. <https://www.intechopen.com/chapters/63678>. 22.12.2023.
- Intersport. 2023/-24. Intersport Joensuu. <https://www.intersport.fi/fi/>. Autumn 2023/spring 2024.
- Intersport iw. 2024. Intersport, Joensuu. Recorded interview with a company representative. 7.2.2024.
- Levy, M. & Grewal, D. 2023. Retailing Management. New York: McGraw Hill.
- Logistiikan Maailma (The World of Logistics). 2024. Logistics and Supply Chain. <https://www.logistiikanmaailma.fi/en/logistics/logistics-and-supply-chain/>. 25.4.2024.
- Manners-Bell, John. 2017. Introduction to Global Logistics. London: Kogan Page Limited.
- Miles, J & Gilbert, P. 2005. A Handbook of Research Methods for Clinical and Health Psychology. Oxford: Oxford University Press.

- Medium. 2024. <https://medium.com/>. 22.4.2024.
- Medium. 2024. Think Outside the Box (or Bike Crate): VanMoof's Genius Packaging Hack. Abang, E. 31.1.2024. Read on 28.4.2024. https://miro.medium.com/v2/resize:fit:828/format:webp/1*TYpKqL-VdFiOFIis6N9Uqw.jpeg.
- MTV 3. 2024. Television news concerning the political strikes in Finland, e.g., at Finnish harbours. Spring 2024.
- Niekka. 2023/-24. <https://www.niekkabicycles.com/>. Autumn 2023/spring 2024.
- Niekka iw. 2024. Niekka, Outokumpu. Recorded interview with a company representative. 15.2.2024.
- Omniconvert. 2024. UVP (Unique Value Proposition). <https://www.omniconvert.com/what-is/uvp-unique-value-proposition/>. 22.4.2024.
- Pelago. 2024. <https://pelagobicycles.com/>. 22.4.2024.
- Pienaar, W.J. & Vogt, J.J. 2016. Business Logistics Management. Cape Town, South Africa: Oxford University Press.
- Prisma. 2023/-24. Prisma Sport, Joensuu. <https://www.prisma.fi/tuotteet/110017968/joensuu-50-vuotta-sitten-110017968>.
- Prisma iw. 2024. Prisma Sport, Joensuu. Recorded interview with a company representative. 25.3.2024.
- Pyörävarikko. 2023/-24. <https://pyoravarikko.fi/>. Autumn 2023/spring 2024.
- Pyörävarikko iw. 2024. Pyörävarikko, Joensuu. Recorded interview with a company representative. 19.2.2024.
- Quandary Consulting (Quandary). 2023. What's the Difference Between Sourcing, Purchasing, and Procurement? <https://quandarycg.com/difference-between-sourcing-purchasing-and-procurement/>. 17.12.2023.
- Research and Markets. 2023. Europe E-bike Market Report and Forecast 2023-2028. https://www.researchandmarkets.com/reports/5734389/europe-e-bike-market-report-forecast?gad_source=1&gclid=CjwKCAiA9ourBhAVEiwA3L5RFrwMli-GcUB-vyCe0eDIJKpSA30EymAYrk9whJAf9U36s7Ofd0FqxKsxoC5ZEQAvD_BwE. 13.11.2023.
- RETAILDIVE. 2023. Top 3 Supply Chain Challenges for Retailers in 2024. <https://www.retaildive.com/spons/top-3-supply-chain-challenges-for-retailers-in-2024/695866/>. 29.11.2023.
- Rushton, A., Croucher, P. & Baker, P. 2022. The Handbook of Logistics and Distribution Management. London, United Kingdom: KoganPage.
- Singh, S. 2024. Supply Chain Digital Transformation: Why It Should Matter to Your Organization? 12.1.2024. Digital Transformation Blog. <https://appinventiv.com/blog/digital-transformation-in-supply-chain-management/>. 30.3.2024.
- Slideplayer. 2024. E-commerce: The Benefits of Disintermediation to the Consumer. <https://slideplayer.com/slide/4897198/>. 16.12.2023.
- Soulpage. 2024. Importance of AI In Information Technology Blog. 18.2.2020. <https://soulpageit.com/importance-of-artificial-intelligence-ai-in-information-technology/>. 13.01.2024.
- SpendEdge. 2024. <https://www.spendedge.com/>. 14.1.2024.
- Slack, N., Brandon-Jones, A. & Burgess, N. 2022. Operations Management. Harlow, England; New York: Pearson.
- Sähköpyöräkauppa. 2023/-24. <https://www.sahkopyorakauppa.com/>. Autumn 2023/spring 2024.

- Sähköpyöräkauppa iw. 2024. Sähköpyöräkauppa, Joensuu. 2024. Recorded interview with a company representative. 5.3.2024.
- Think with Google. 2024. The Zero Moment of Truth. <https://www.thinkwithgoogle.com/consumer-insights/consumer-journey/micro-moments/zero-moment-truth/>. 3.1.2024.
- Vero. 2024. Employer-provided bicycle. <https://www.vero.fi/en/individuals/tax-cards-and-tax-returns/income/earned-income/fringe-benefits-from-employment/>. 5.4.2024.
- Weele, A. 2014. Purchasing & Supply Chain Management. Analysis, strategy, planning and practice. Andover: Cengage Learning.
- Weinswig, D. & Hartmann R. 2023. Next Generation Retail: How to Use New Technology to Innovate for the Future. London, United Kingdom: KoganPage.
- Wikipedia. 2024. United States–Mexico–Canada Agreement. https://en.wikipedia.org/wiki/United_States%E2%80%93Mexico%E2%80%93Canada_Agreement. 5.6.2024.
- Zoomo. 2024. <https://www.ridezoo.com/uk/home>. 13.12.2023.

Appendices**Appendix 1. Customer order decoupling points**

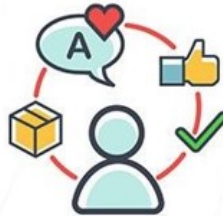
(Pienaar & Vogt 2016, 71).

Appendix 2. Core Procurement Activities



THE SOURCING PROCESS:

- Assessing Vendors (RFIs and RFPs)
- Supplier Cost Assessment
- Spend Analysis
- Target Setting
- Negotiating Discounts
- Choosing Vendors
- Contract/Vendor Management



THE PURCHASING PROCESS:

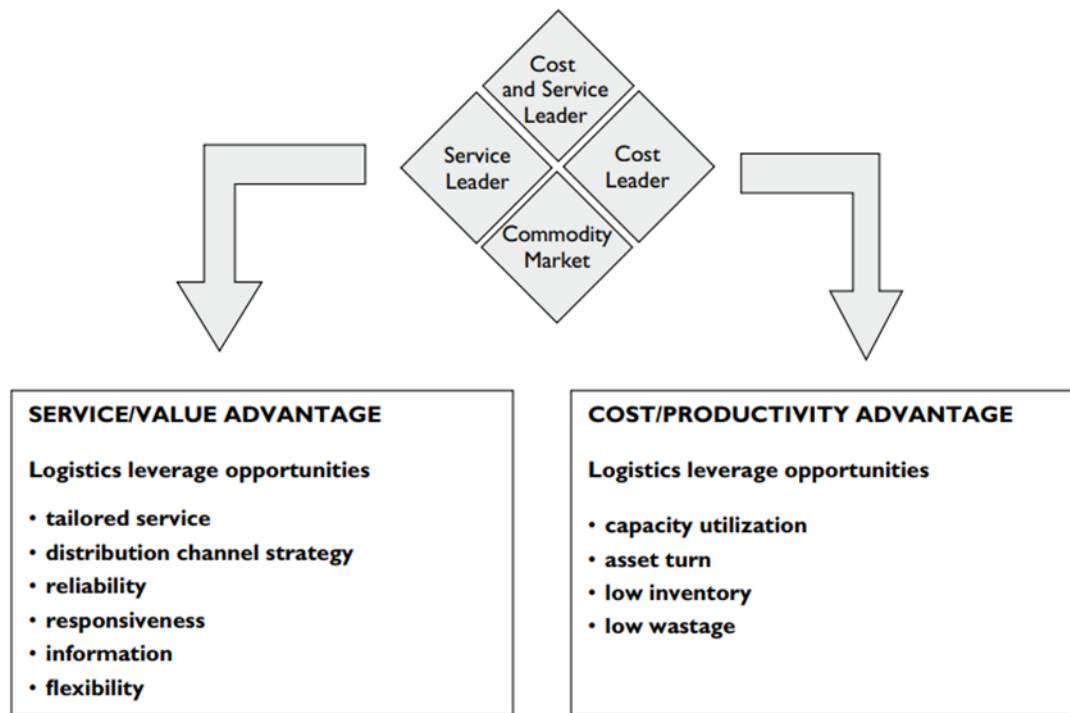
- Contract Negotiation
- Purchase Approval
- Payment/Transaction Processing



THE PROCUREMENT PROCESS:

- Purchase Request Processing
- Purchase Order Release
- Delivery Management
- Vendor Quality Assurance
- Three-Way Matching
- Invoicing
- Record Keeping

(Quandary 2023).

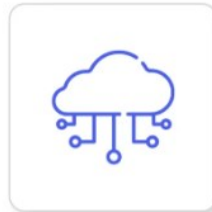
Appendix 3. Logistics operator's approaches

(Rushton et al. 2022, 28).

Appendix 4. Supply Chain Digital Transformation Options



eCommerce
Integration



Cloud
Computing



Artificial
intelligence



Internet of
Things (IoT)



Blockchain



Supply Chain
Digital Twins

(Singh 2024).

Clarification:

1. eCommerce Integration: Modern-day technology in supply chain management allows B2B sellers to identify and resolve any inefficiencies within their supply chain models.

Connected systems make it possible for them to offer seamless customer experiences and run efficient operations. Thus, companies are starting to utilize the benefits of interconnected supply chains for their eCommerce operations, enabling a free flow of information across departments.

2. Cloud Computing: The ever-rising demand for cloud computing is also an emerging tech practice that has helped accelerate supply chain digitization. Now, companies store the data on local servers instead of storing it on the cloud for easier and faster accessibility. In straight term, with cloud computing adoption in the supply chain, companies can easily access the needed information and share them with other companies or stakeholders anywhere, anytime.

3. Artificial intelligence: Artificial intelligence (AI) in the supply chain consists of a toolbox of technology options that help companies understand complex content, enhance human performance, and take over routine tasks.

AI and analytics help supply chain leaders solve long-standing data silos and governance challenges. Its capabilities allow for more integration and visibility across networks of previously remote or disparate stakeholders.

4. Internet of Things (IoT): IoT is a network of physical objects connected to the internet. The IoT already plays a significant role in the supply chain, but it will likely continue to grow in importance with increasingly diverse applications. In just a few years, 50% of companies could use other advanced technologies to support supply chain operations.

IoT in manufacturing and supply chains can also be used to improve warehouse management, fleet tracking, inventory control, and even technological and mechanical maintenance. It could even be used to create entirely smart warehouses and fleets, increasing efficiency.

5. Blockchain: Blockchain has been incredibly beneficial for businesses to minimize supply chain disruption and improve customer service. By 2024, global spending on blockchain solutions is projected to reach almost \$19 billion. Over the past few years, this technology trend has integrated different business streams, such as carriers, shipping lines, and logistic providers, into a single platform.

Blockchain also allows logistics business operations to process data by cutting out waste efficiently. The transparency offered by blockchain technology helps identify issues even before they occur.

[Further reading: On-demand logistics app development cost and its associated factors]

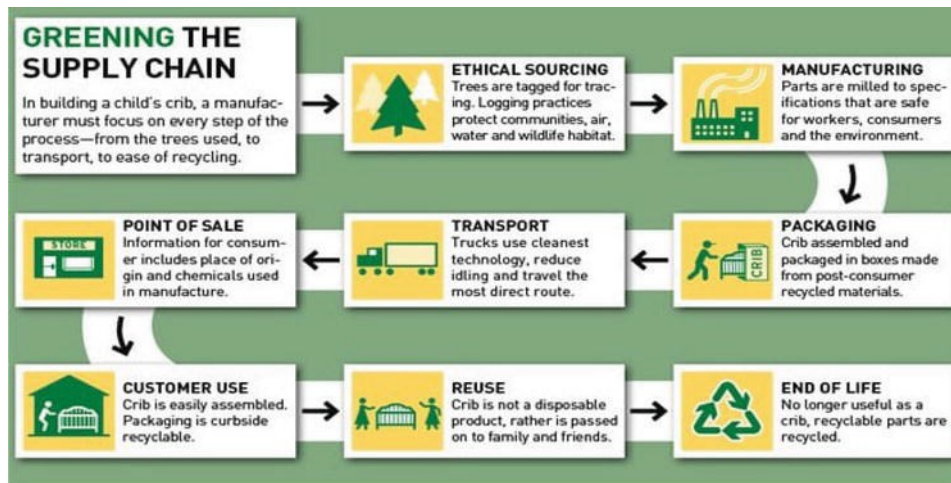
6. Supply Chain Digital Twins: It is a virtual representation of the supply chain that consists of hundreds of warehouses, inventory, assets, and logistics positions. The digital twin simulates the supply chain's performance using AI and advanced analytics, including all the complexities that drive risks and vulnerabilities. A digital twin also increases visibility and helps your workforce to take advantage of opportunities, particularly in complex supply chains.

Appendix 5. An example of the challenges of supply chain management and how digital business technology can assist

Problems of supply chain management	How digital technology can reduce problems in SCM
Pressure to reduce costs of manufacturing and distributing products in order to remain competitive	Reduction in paperwork through electronic transmission of orders, invoices and delivery notes. Reduced inventory holdings needed through better understanding of demand. Reduced time for information and component supply across the supply chain. Lower SCM system purchase and management costs through use of online services (SaaS)
Demand forecasting	Sharing of demand by customers with suppliers as part of efficient consumer response (ECR)
Failure to deliver products on time consistently or lack of items on shelf in retailer	Supplier becomes responsible for item availability through vendor-managed inventory
Failure to deliver or ship correct product	Human error reduced. 'Checks and balances can be built into system'
High inventory costs	Inventory reduced throughout the supply chain through better demand forecasting and more rapid replenishment of inventory
Time for new product development	Improved availability of information about potential suppliers and components, for example through online marketplaces

(Source: Chaffey et al. 2019, 253).

Appendix 6. Example of the green supply chain



(IntechOpen 2023).

Appendix 7. Interview Questions

STARTER QUESTIONS:

- Since when does your store sell electric bikes?
- How many electric bikes do you sell each year?
- What is your main client group?
- How many do you have (a) employee cycle customers and (b) regular private cyclists?
- What are your delivery channels? (stone shop, online shop, etc.)
- Are you on social media? Which one?

What are the main challenges in overall e-bike supply chain management in order of importance?

SUPPLY AND DEMAND:

- The biggest challenges for the supply and demand of e-bikes?
- How do you forecast the demand for electric bicycles?
- > Do you have a pre-order system or some other system? Which?
 - Do you have any wishes related to the product or delivery channel? Like what? How are they implemented/can be implemented?
 - Is it necessary to display e-bikes (sold models) in the store? Will this also be the case in the future?
 - How will you implement/take care of the management and replenishment of the stock situation (balances)?
- Are your systems EDI-, POS- and barcode readers enabled?
 - Are all the bikes for sale on the floor or is part of the stock to be replenished?
 - Is there a storage space challenge?
 - What are the average delivery times for your e-bikes? (What about the delivery times for subcomponents?) In which components are the biggest waiting times/challenges if they are not immediately available on the shelf?
 - Running out of e-bikes? What happens if a stock-out occurs?

- How is customer-centricity ([demand-driven]) reflected in your e-bike supply chain?
- What percentage of pre-ordered bikes will be sold during the intended sales period, i.e. how much so-called "old" stock will be left for sale, e.g a) at a discount/clearance sale, b) in the next sales period c) for sale to other resellers/etc.?
- Do you register your e-bike customers?

TRANSPORT AND STORAGE LOGISTICS:

- Mikä on haastavinta kuljetus- ja varastointilogistiikassa?
- Does the location of the dealer pose an additional challenge to supply chain management and/or customer relationship management (what)?
- Cost and service level balancing? What challenges?

PROCUREMENT:

- What's the most challenging thing about procurement?
- Are there challenges in finding suppliers?
- Is it easy/difficult to get a resale right for a particular brand?
- Do you use an electronic procurement management system/service software in your procurement process?
- What about service software companies in assessing the capabilities of your supplier candidates?
- How are the procurement negotiations?

- Customs and border formalities? (Are there (price) policy and regulatory challenges related to customs clearance and/or border formalities and exchange rates? What, if they exist?

ORDER DELIVERY/GIVING OF GOODS:

- Challenges of delivering an electric bike?
- What kind of After-sales services do you have? (Maintenance, warranty, spare parts?)
- Are your order-supply chains how technology-driven? (service software/applications)

--> Are there any technology control systems coming?

--> And what about your partners' technology usage?

OTHER COMMENTS ABOUT ELECTRIC BIKES AND THEIR DELIVERY CHAIN?

Can benefit bike sales or some other factors be considered a growing trend?