Green e-commerce distribution alternatives – a mission impossible for retailers?

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Abstract

Purpose – Whilst green distribution alternatives for consumers have the potential to decrease environmental impact from logistics, retailers struggle to provide such alternatives. The purpose of this paper is to increase the understanding of the factors that hinder retailers from offering green distribution alternatives to consumers.

Design/methodology/approach – The paper relies on a multiple case-study of three cases, with one retailer constituting each case. Semi-structured interviews with seven respondents and visits to the retailers' checkouts were used for data collection.

Findings – The offering of green distribution alternatives is a complex task for retailers, with barriers related to six categories (organisational, financial, retailer-logistic service provider (LSP) market, retailer-consumer market, governmental and technological barriers) obstructing the way forward. A process towards offering green distribution services, including barriers and potential mitigation strategies, is suggested.

Research limitations/implications – The study is limited to a Swedish context, and further research could consider how barriers would manifest themselves in countries with other characteristics.

Practical implications – A framework with barriers and mitigation strategies offers guidance for managers within e-commerce.

Social implications – The greening of logistics is an important quest towards world-wide sustainability goals, and this paper contributes with an increased understanding of how to decrease environmental impact from e-commerce distribution.

Originality/value – The paper is one of few that takes the consumer side of the greening of logistics into account, thus contributing with valuable perspectives to this scarce body of literature.

Keywords Retail logistics, Last-mile deliveries, Logistics services, Omnichannel, Sustainability

Paper type Research paper

1. Introduction

E-commerce was early recognised as having the potential to decrease the environmental impact from distribution compared to conventional shopping (e.g. Edwards *et al.*, 2010; Pålsson *et al.*, 2017). There are many factors that influence this environmental impact (see, e.g. Halldórsson and Wehner, 2020; van Loon *et al.*, 2015). In a literature review on distribution in e-commerce, Mangiaracina *et al.* (2015) find such factors: transportation planning and management, distribution

network design, warehousing and packaging. They argue that the two former factors are of higher importance in tackling the environmental impact of e-commerce. In a similar manner, Gevaers *et al.* (2014) and Halldórsson and Wehner (2020) point out that the last leg, i.e. the last-mile distribution, is the most inefficient and energy consuming part of the of the logistics chain. Recent research shows the potential in improved logistics performance in last-mile distribution through, e.g. blockchain technology and development towards omnichannel (Naclerio and De Giovanni, 2022). Regarding sustainability, there are a variety of factors influencing environmental impact from e-commerce distribution, and there is no easy answer as to what constitutes the most environmentally beneficial solution. To exemplify, express deliveries may cause more environmental impact than choosing longer lead-time, as logistics planning suffers and fill-rates run the risk of being low (Allen *et al.*, 2017). Further, deliveries to pick-up points or locker stations can be more beneficial for consolidated transports, thereby causing less environmental impact than, e.g. home deliveries (Halldórsson and Wehner, 2020). In line with the more general literature on greening distribution (see, e.g. Martinsen and Huge-Brodin, 2014), the selection of transport mode, vehicle technology and fuels can have a large impact on last-mile distribution. For example, consumers preferences of innovative transport modes such as drones (Merkert *et al.*, 2022) or the transfer to electric cargo vehicles (Ngoc *et al.*, 2022) can also influence the environmental impact from distribution.

In relation to e-commerce distribution, recent research pinpoints three key actors that influence its environmental sustainability: retailers, logistics service providers (LSPs) and consumers (Buldeo Rai *et al.*, 2019). While retailers present various distribution alternatives for consumers, such as express deliveries or home deliveries, consumers choose which alternative they prefer (Sallnäs and Björklund, 2020). Based on the selected alternative, LSPs, in turn, conduct the actual distribution. Through their choice of distribution alternatives, consumers thus have an influence on the environmental impact of e-commerce distribution (Buldeo Rai *et al.*, 2019; Halldórsson and Wehner, 2020). This indicate the need for all three actors to take action, or as expressed by Edwards *et al.* (2010), *"With a little planning and thought on both the part of consumers and carriers/retailers, emissions related to the transport element of any shopping activity could be minimised through a few simple actions" (p. 118).*

Similar to the approach applied by Ignat and Chankov (2020), we argue that there is a possibility for retailers to influence consumers' choices already at the checkout, when consumers select a distribution alternative. This also corresponds to research stating that consumers should be given a more active role to achieve more environmentally sustainable e-commerce distribution (e.g. Wiese *et al.*, 2015), Indeed, in a time when environmental sustainability is increasing in importance, retailers must be able to support consumers to make well-grounded decisions with regards to environmentally sustainable distribution (Wiese *et al.*, 2015). Research shows, however, that this is not yet the case and that retailers struggle to provide environmental alternatives to consumers, despite their good intentions (Sallnäs and Björklund, 2020). There is a need to better understand what is standing in the way of retailers guiding consumers' environmental behaviour. Several questions need to be addressed: what are these barriers, what are their characteristics and which of them are the most challenging for managers to address? Therefore, the purpose of this paper is to accomplish the following: *Increase the understanding of the factors that hinder retailers from offering green distribution alternatives to consumers.*

To address this purpose, three research questions will guide this research. The first question aims to identify, exemplify and describe main barriers experienced by retailers, thus the barriers that are put forward by several. The second question aim to structure the barriers to gain a deeper insight into the different characters of the main barriers identified. The third question has a more normative aim to provide guidance on how to manage the identified barriers.

RQ1. What barriers are perceived by retailers in their strive towards offering green distribution alternatives?

RQ2. What categorises the identified barriers?

RQ3. How can the identified barriers be managed to facilitate green distribution alternatives?

The remainder of this paper is organised as follows: In the next section, a literature overview is presented, including one sub-section about distribution alternatives for consumers and one about barriers for greening logistics and environmentally sustainable distribution. Next, the methodology is presented, after which the results of barriers found are provided. A discussion of the results follows. The paper ends with a section on implications for research, practice and society and finally a section on conclusions. Research question 1 and 2 are answered in the analysis and discussion sections, with support from the literature overview. Research question 3 is answered in the implications section.

2. Literature overview

2.1 Distribution alternatives for consumers

Consumers' shopping online is typically met by several choices related to distribution alternatives at the check-out. The choices include, for example, delivery location (Buldeo Rai *et al.*, 2019), delivery lead times (Ignat and Chankov, 2020; Xing *et al.*, 2011) and delivery windows (Xing *et al.*, 2011).

As for delivery location, Buldeo Rai *et al.* (2019) suggest that consumers are often presented with two options: home delivery or delivery to a pick-up point or locker. Halldórsson and Wehner (2020) provide a more nuanced picture in their study of energy efficiency in last-mile distribution, with six options on ways in which consumers can receive their orders: Conventional shopping in physical retail stores, click and collect, pick-up point, locker station, home delivery and in-car delivery. There is no unanimous answer to the question of which delivery location is the most beneficial from an environmental perspective (Edwards *et al.*, 2010; Halldórsson and Wehner, 2020), but researchers have identified different factors that affect the environmental impact of delivery locations. For example, vehicle fill-rates are important for low environmental impact (Allen *et al.*, 2017), which favours delivery location options that enable large quantities in consolidated transports to collection points (Halldórsson and Wehner, 2020). Another important factor is consumer behaviour (e.g. Pålsson *et al.*, 2017; van Loon *et al.*, 2015). Research shows that consumer transport of goods by car is highly inefficient and can cause as much transport energy as the total of all upstream freight transport activities (Browne *et al.*, 2006). Therefore, closeness to pick-up points or the equivalent can have a significant effect on the environmental sustainability of e-commerce distribution (Pålsson *et al.*, 2017), as this can enable a change from consumer trips by car to public transportation or even transport by bike or foot (Halldórsson and Wehner, 2020).

Delivery lead time, i.e. the time from the order to the delivery, such as one or three days, also influences the environmental sustainability of e-commerce distribution. Retailers commonly offer a variety of lead times for consumers to choose from (Sallnäs and Björklund, 2020). Short lead times are more the rule than the exception with regards to what retailers offer, as retailers use speed to compete with other retailers (e.g. Allen *et al.*, 2017; Buldeo Rai *et al.*, 2019). van Loon *et al.* (2015) found that some retailers split orders into two deliveries to increase delivery lead times, thereby causing a larger environmental impact. In general, short delivery lead times provide little time for efficient planning and consolidation of goods, resulting in a higher risk of increased environmental impact (Allen *et al.*, 2017).

Another important term, delivery window, refers to the specific time of delivery such as in the afternoon or between 6 and 8 p.m. This is relevant for home deliveries where the consumer must be at home to receive the delivery, so called attended deliveries (Edwards *et al.*, 2010).

Such deliveries run the risk of failure, forcing the LSP to come back once, or even several times, thus increasing environmental impact of deliveries (Edwards *et al.*, 2010; Halldórsson and Wehner, 2020). Delivery window becomes less of an issue for unattended home deliveries, as deliveries can be made in mailbox or at the door (Halldórsson and Wehner, 2020).

2.2 Barriers for greening logistics and environmentally sustainable distribution
In this paper, barriers refer to factors that negatively affect the adoption of green initiatives (Centobelli *et al.*, 2017). Due to the exploratory nature of this paper, potential barriers have been identified in neighbouring research streams, such as those barriers experienced by the logistics industry when implementing green logistics practices (e.g. Lin and Ho, 2011; Jovanovic *et al.*, 2020; Evangelista *et al.*, 2017; Abbasi and Nilsson, 2016; Isaksson and Huge-Brodin, 2013), or those experienced by retailers or the manufacturing industry in the greening of transportation (e.g. Pålsson and Johansson, 2016; Björklund, 2011).

There are several suggestions concerning how to structure the large number of potential barriers that can exist. One way is to distinguish the factors based on their origin such as internal and external barriers (see, e.g. Björklund, 2011; Evangelista *et al.*, 2017). Another way, which often provides a more nuanced picture, is to distinguish the factors based on their character. This last approach is, for example, adapted in several studies of barriers in the greening of the transport industry (see, e.g. Centobelli *et al.*, 2017; Lin and Ho, 2011; Jovanovic *et al.*, 2020). By combining these frameworks, five barrier categories have been identified and are applied in this paper: organisational barriers, financial barriers, market barriers, governmental barriers and technological barriers. These will be elaborated below.

Organisational barriers: Lin and Ho (2011) found a relation between organisational support, the quality of human resources and company size in the adoption of green practices. The small size of the firm was also identified as barrier effecting the adoption of green initiatives in the logistics industry (Ho *et al.*, 2014; Oberhofer and Fürst, 2013). Lacking organisational encouragement in terms of top management commitment was identified in several studies as a barrier to the implementation of green practices (e.g. Luthra *et al.*, 2011; Mudgal *et al.*, 2010) as well as their internal development (Seroka-Stolka, 2014). However, in a study by Isaksson and Huge-Brodin (2013), they found amongst three of the six LSPs studied a top-controlled passiveness featured by a top-down management of green aspects, which included a "wait-and-see attitude" towards introducing new green logistics technologies. Moreover, for all six companies, the integration of green thinking in daily work was described as a considerable barrier and the lack of training for employees was also identified as a hindrance to the adoption of green practices in the supply chain (Carter and Dresner, 2001). In line with this, employees' knowledge and priorities were identified as a major barrier in the purchase of green transport services (Björklund, 2011).

Financial barriers: Some authors claim that companies need a large amount of capital to implement green practices (see, e.g. Balasubramanian, 2012). Indeed, costs, as well as financial constraints, are mentioned as a barrier in greening supply chains (e.g. Walker *et al.*, 2008; Luthra *et al.*, 2011; Mudgal *et al.*, 2010), as well as in the purchase of green transport services with, e.g. cleaner vehicle technologies (Abbasi and Nilsson, 2016; Björklund, 2011; Pålsson and Johansson, 2016). Investment costs (Ho *et al.*, 2014; Isaksson and Huge-Brodin, 2013; El Baz and Laguir, 2017) and doubtful payback and pay back times (Ho *et al.*, 2014; Evangelista *et al.*, 2017) are also identified as barriers affecting the adoption of green initiatives within the logistics industry. To exemplify, Jazairy (2020) found that the implementation of bio-fuel-powered fleets, which are more costly than conventional vehicles, was only first facilitated after the prolongment of the transport contract to five years.

Market barriers: In the context of this study, two different markets emerge: the one between the retailer and the consumer and the other between the retailer and the LSP. In the

first market, customers' unawareness, lack of knowledge and experience in green logistics (Holt and Ghobadian, 2009; Luthra *et al.*, 2011; Evangelista *et al.*, 2017), as well as customers' unpredictable or conflicting demands (Lin and Ho, 2011; Björklund, 2011), such as the demand for fast and green transports, are examples of market related barriers. Furthermore, Jazairy (2020) found that also the green demands of the shippers may hinder the LSPs application of green practices. However, Lin and Ho (2011) did not find a significant relation between customer pressure and the adoption of green practices. In the other market, namely that between retailers and LSPs, the lack of supplier commitment (Walker *et al.*, 2008) and preparedness of suppliers (Mudgal *et al.*, 2010) are also put forward as barriers, whilst barriers that can exist in both markets are, for example, market competition (Luthra *et al.*, 2011) and low-level supply chain integration (Mudgal *et al.*, 2010).

Governmental barriers: Lin and Ho (2011) found a statistically significant relation between regulatory pressure, governmental support and the adoption of green practices. Regulation and standards (Oberhofer and Fürst, 2013; El Baz and Laguir, 2017); a lack of support and guidance from the regulatory authority (Mudgal *et al.*, 2010); a lack of government initiative systems (Balasubramanian, 2012); and poorly defined regulatory frameworks (Evangelista *et al.*, 2017) are examples of governmental related barriers mentioned in the literature. Regulations and standards are also put forward as effecting the adoption of green initiatives in the logistics industry (Oberhofer and Fürst, 2013; Tacken *et al.*, 2014). Moreover, Abbasi and Nilsson (2016) found that the different standards, methods and platforms for measuring emissions used by different LSPs could be a considerable challenge. They also found the uncertainty in regulations and legislation problematic as the lack of clear and long-term directions from regulators decreases the LSPs' willingness to take risks, such as those inherent in, e.g. changing transport modes or investments in bio-fuel alternatives.

Technological barriers: The influence of technological factors on green practice adoption in the supply chain is not as commonly discussed in the literature. However, in a study on Swedish shippers, Pålsson and Johansson (2016) found that the use of cleaner vehicle technologies is hindered by the lack of commercial solutions and technical know-how. The lack of information technology (IT) implementation, IT systems integration (Mudgal *et al.*, 2010), technology advancement (Mudgal *et al.*, 2010; Luthra *et al.*, 2011) and acceptance of such advancement (Balasubramanian, 2012) are some examples of such hindrances. The complexity of technology is described as another barrier that affects the adoption of green initiatives in the logistics industry (Ho and Lin, 2012).

3. Methodology

This paper is based on case-study research (Yin, 2018), being a suitable approach then the aim is to increase understanding and gain access to in-depth information on a sparsely examined phenomenon (see, e.g. Yin, 2018; Bell and Bryman, 2022), namely which factors hinder retailers in their pursuit to offer green distribution alternatives to consumers. The study can be categorised as theory elaboration, in accordance with Ketokivi and Choi (2014). Specifically, the research at hand applies a theoretical framework, i.e. the five barrier categories presented previously, whilst at the same time allowing for the researchers to *"explore the empirical context with more latitude and serendipity"* (p. 236). A multiple case-study comprising three cases was conducted, with one retailer constituting each case.

3.1 Case selection and description

A crucial aspect of case studies is the selection of cases, and for this study an intensity sampling logic (Patton, 2015) was followed. This allowed for information-rich cases that could

shed light on issues in relation to green distribution alternatives. Intensity sampling here means finding retailers with a high sustainability engagement and a desire to offer green distribution alternatives to consumers. Swedish retailers were targeted, as Sweden is a relatively mature country with regards to e-commerce (PostNord, 2021). In addition, Sweden is at the forefront with respect to sustainability awareness, with a long tradition of open and free access to environmental information and a top ranking in eco-innovativeness, thereby assuming a world leading role in climate change mitigation (OECD, 2014). Three retailers were selected due to their high ambitions in the greening of e-commerce: Retailer A for being a forerunner in sustainability within Swedish retail and for reaching out to the university to ask for guidance on green distribution alternatives; Retailer B for its ongoing interaction with the university, where its high sustainability ambitions have become apparent; and Retailer C for its high ambitions within sustainability as shown, for example, through a novel approach to the high return rates within e-commerce. All three retailers have an aim to present green distribution alternatives at their checkouts. At the beginning of this study, Retailer A had already tested "its own" alternative, whereas the other two had the goal of presenting some form of green alternatives very soon. More details about the case companies can be found in Table 1.

3.2 Case data collection
The main method applied was semi-structured interviews with a total of seven respondents. The interviews were complemented with visits at the retailers' checkouts and workshops with two of the companies, and these two data collection methods will be described first, after which the interviews are described in more detail. By selecting products as if we were intending to make a purchase, it was possible to gain a first impression of how green distribution alternatives, as well as sustainability in general, were, or were not, communicated. Additionally, both Retailer A and B was a part of a larger project and both actors participated in workshops (March 2021; September 2021; June 2022; November 2022) with a focus on green distribution. In the workshops, the retailers gave updates on their progress (or sometimes non-progress) towards offering green distribution alternatives for consumers. Data triangulation (Patton, 2015) was thereby made possible through a variety of

Retailer	Position of respondents	Time at retailer (years)	Founded (decade)	Industry	Turnover MEUR (approx.)	Number of empoyees (approx.)	Sales channels
A	Director of logistics development	7	2000's	Pharmaceutical retailer	1,400	3,000	Physical stores and online
	Business developer e-commerce	2					
	Director of sustainability	7					
B	Supply chain director	>20	1970's	Sportswear and sports equipment	600	4,000	Physical stores and online
	Sustainability coordinator	1					
C	Project director	10	2010's	Fashion retailer	500	1,000	Online
	Sustainability manager	4					

Table 1.
Overview of case companies

data sources, increasing credibility and confirmability (see, e.g. Halldórsson and Aastrup, 2003: Pedrosa *et al.*, 2012). Specifically, the workshops opened for the possibility to uncover barriers that had not been mentioned during the interviews. No additional barriers were, however, detected during the workshops. More importantly, the workshops confirmed many of the barriers identified during the interviews (strengthening credibility) and strengthened the identification of the most prominent barriers. For example, the lack of standards and terminology identified as a governmental barrier (see Section 4 for details) was emphasised to a larger extent in the workshops than what was revealed during the interviews.

Respondents were selected based on their engagement and involvement in green distribution. The respondents working directly with sustainability manage the strategical sustainability development and are involved in the focused communication of LSPs sustainability performance to consumers, amongst several other sustainability related issues. The supply chain/logistics directors have a strategic responsibility for the e-commerce distribution to consumers. Finally, the project director has ten years of experience from developing the company's own e-platform, among other things. Please see Table 1 for more details about the respondents.

The interviews were conducted between May 2020 and November 2021 and lasted approximately sixty minutes. They were recorded and transcribed in order to strengthen credibility. To ensure high dependability (Bell and Bryman, 2022), the interviews were structured according to an interview guide. The interviews started with the respondents presenting their role in the company, followed by their own description of the process towards offering green distribution alternatives and their experiences of this. A general question was asked about the experienced barriers, followed by a probing approach (Adams, 2015) targeting each category of barriers identified in the literature not already answered by the general question (i.e. if they had encountered, e.g. technological or governmental barriers). This allowed us to gain deepener insights into the different barriers, including their relative importance and whether all the barriers identified in the literature were covered. An overview of questions can be found in Appendix 1. The interview protocols were sent to the respondents to increase credibility through respondent validation (Bell and Bryman, 2022). Two researchers participated during the interviews, increasing trustworthiness by investigator triangulation (Patton, 2015). The respondents did confirm, to a large extent, the data gathered from the other interviews, but they also complemented it due to their different areas of responsibility. No contradictory information was given by the respondents nor found in comparison with the information about green distribution alternatives presented on their webpages. After the seven interviews, saturation was thereby assessed to be achieved, and this has been further confirmed by the workshops that have been held after the interviews were completed.

3.3 Data analysis
In the data analysis, the interview protocols were studied in five steps, inspired by Gioia *et al.* (2012). The coding was conducted in the qualitative analysis tool NVivo and both researchers participated in the analysis to increase the dependability of the study (Bell and Bryman, 2022).

(1) Step 1: In the first step, each interview protocol was analysed separately by both involved researchers. All barriers mentioned, or implied, during the interviews were highlighted as 1st order concepts (Gioia *et al.*, 2012). This analysis was done inductively, without the five barrier categories (see Section 2) as guidance.

(2) Step 2 included further analysis of the identified concepts, into 2nd order themes (Gioia *et al.*, 2012). Both researchers were involved in the analysis. Discussions

included e.g. which concepts should belong to which 2nd order theme, as there sometimes were overlapping concepts. At the end of step 2, all concepts were included in a 2nd order theme, although some of these included only one concept.

(3) Step 3 was then to identify the aggregate dimensions (Gioia *et al.*, 2012). The 2nd order themes were then compared to the framework with five categories of barriers described in the literature overview and classified into these categories if possible. Thus, the framework was used to structure the data. An effect of this was a test of the framework resulting in the need to separate the market category into two categories (retailer-consumer market and retailer-LSP market) due to their different character. Both researchers jointly conducted this analysis, and although some discussions arose, consensus was achieved. NVivo supported this step, in which 1st order concepts and 2nd order themes were categorised into the six categories.

(4) Step 4 included a cross-case analysis of each barrier, on a category level as well as on the 2nd order theme level, to deepen the understanding regarding each of the categories. NVivo enabled this analysis and annotations were used to highlight similarities and differences between the categories. Lastly, the results from all three retailers were compared, focussing on similarities as well as differences in the respondents' views of barriers.

(5) Step 5 encompassed analysis on a more general level, with the aim to answer RQ3, i.e. how the identified barriers can be managed.

3.4 Trustworthiness

To end this chapter, the additional actions taken to secure trustworthiness (credibility, transferability, dependability and confirmability; see Halldórsson and Aastrup, 2003; Pedrosa *et al.*, 2012) are presented: (1) Credibility: Use of citations to highlight the links between data sources and their contributions and to use investigator triangulation by having two researchers involved in all stages of the research process; (2) Transferability: Inclusion of multiple representatives from the organisations with different expertise and areas of responsibility; Reflections regarding the context in interpreting results; Theoretical saturation in the identification of potential categories; Clear outline of the study's implications to literature and practice and clearly state the study's limitations and important future research area; (3) Dependability: Use the same template form to ensure that all interviewees addressed the pre-determined areas and the respondent were asked to reflect on both present and more distant experiences; (4) Confirmability: Triangulation by having multiple researchers included in all stages of the research process and conducting interviews with different respondents at each company to provide data triangulation.

4. Results

The results encompass several barriers experienced by the retailers for each of the barrier categories presented in the literature overview, and these are described below. Citations are used to provide more detailed, insightful and illustrate key points and thereby create a more traceable and convincing narrative (Fawcett *et al.*, 2014; Pratt, 2008) and a more extensive overview of citations from the case companies can be found in Appendix 2. Both RQ1 and RQ2 are addressed in this section, as the categorisation (RQ2) provides the structure for the section, whilst the actual content relates mainly to RQ1.

A summary of the barriers found can be seen in Table 2. Please note that an "x" represents a barrier, and an "–" means that the retailer does not perceive the item as a barrier. Further, even though the framework with the five categories from literature was used to structure the

Barrier category	Barrier	Retailer A	Retailer B	Retailer C
Organisational barriers	Relative importance of environmental sustainability	x	x	x
	Structure of companies	x	x	x
	Competencies and internal roles	x	x	x
Financial barriers	Consumers' low willingness to pay	x	x	x
	Large investments necessary	x	x	x
Market barriers: Retailer-consumer	Trustworthiness towards consumers	x	x	
	Consumer culture	x	x	x
	Communication of sustainability	x	x	x
Market barriers: Retailer-LSP	Trustworthiness towards LSPs	x	x	x
	Roles and responsibilities	x	x	x
	Competitive aspects	x	x	x
	Lack of homogeneity	x	x	x
Governmental barriers	Lack of standards and terminology	x		–
Technological barriers	Measuring of emissions			x
	Transport technology	x	x	
	Dependence on platform developer	x		–

Note(s): X = Barrier; – = non-barrier

Table 2.
Main barriers found in the case companies

analysis, the application of the framework resulted in the need to split the category market barrier into two categories, one for each market, as the barriers on these markets were very different. Thus, six barrier categories are presented below.

4.1 Organisational barriers

One of the barriers found within the organisational domain is the *relative importance of environmental sustainability* in the organisations. Retailer A, for example, emphasises the importance of knowing what sustainability means to their company and says that it needs to be highly prioritised. This is echoed by Retailer C, who explains: *"It needs to come from the top [management]./ . . . /I've tried in the past not to go that route [include top management] and do it myself, and it was just a lot of work and it was not as successful. And it was exhausting."* Both Retailer B and C point out that transports have a relatively low climate impact compared to manufacturing; nevertheless, both retailers strive towards green distribution alternatives for consumers. Further, the relative importance of environmental sustainability is influenced by short-sighted financial interests. Specifically, investors want to see results quickly and KPIs are developed to be able to measure financial development.

The *structure of companies* represents the second barrier. Retailer A is a relatively small player in a larger group of companies, and although they try to take advantage of sustainability being high on the agenda in the group, the companies' needs, in terms of logistics flows and quality requirements, differ within the group, which makes it difficult to coordinate. Retailer C points to the size of its company, stating that *"We have that size and strength now, so we should be able to take responsibility for sustainability in a better way" (Project director)*. In relation to LSPs, it is also worth noting that both Retailer B and C point to some large and traditional LSPs who have difficulties with the fast changes needed in e-commerce, which in turn hinders the development of green distribution alternatives.

Finally, *competencies and internal roles* are also identified as barriers. The wish for external actors to take charge of what constitutes green distribution alternatives is put forward by Retailer A. The same retailer has also noted the need to involve a consultancy firm to validate calculations from different LSPs. At Retailer B, there is, naturally, considerable competence related to e-commerce distribution, but the competencies are restricted to a

few, people. This is a risk that needs to be handled but is not uncomplicated: *"But it's difficult. Especially since many of these individuals [employees at the company] are so engaged in sustainability issues and sincerely want to push forward. There is a risk of killing that motivation by hitting the brakes." (Sustainability coordinator).*

4.2 Financial barriers
The retailers identify different aspects of the *consumers' low willingness to pay* for environmental alternatives, something that can act as an additional barrier to the introduction of, e.g. new and more expensive green vehicle technology. One retailer states that *"If we ask the customer 'Would you choose climate smart?', the answer is 'Yes', but 'Would you pay for it?', then perhaps not so many would do that . . ." (Project director, Retailer C).* Retailer A also notes that there are financial aspects of green distribution and that consumers are not always aware of this. The director of sustainability notes that external labels often have a price tag and questions whether consumers would be willing to pay for such "green labels" of distribution.

Another barrier identified is the *necessity of large investments* to succeed in offering green distribution alternatives to consumers. Both Retailer A and B relate such an investment to time as a resource needed to be able to understand and evaluate different alternatives. For example, Retailer A points out the vast number of resources needed to put their own green distribution alternative in place and keep it updated. At Retailer B, the sustainability coordinator says: *"It is a barrier that so many resources are required to work with sustainability; there is no given solution, and there is a lot of trial and error.".* Retailer A highlight the difficulty in placing demands: *"You need to be fairly well-read to be able to place those demands and to question, otherwise you run the risk of being . . . not tricked, but it is really difficult to know what we really get and what we are paying for." (Director of Logistics Development).* Retailer C moreover points out that new ways of distribution can require large investments and that electric vehicles are an example of that.

4.3 Market barriers: retailer – consumer
The retailers find *trustworthiness towards consumers* to be crucial, and they do not want to run the risk of participating in green washing. For example, Retailer B explains that communication about sustainability is always challenging and that there is a need to find a balance between giving the right information and not risking green washing: *"We want to tell a story, to simplify for the consumer, but there is always the risk of backfire: 'You sell products. The more people buy, the more money you make.' So even if we show good things that we do, there is always the risk of getting rejected" (Sustainability coordinator).* Retailer A noticed that the development of green distribution alternatives for consumers is moving fast, highlighting, for example, "fossil free" offers from LSPs, but herein lies a challenge for retailers in following-up and offering trustworthy alternatives.

Another barrier is found in the *consumer culture*, more specifically in the expectations of quick deliveries, free deliveries and free returns. This " *. . . creates expectations, a belief that this is normal. It's not normal. I know the cost of having streamlined goods flows and so many pick-ups." (Retailer A, Director of logistics development).* For Retailer C, free returns are an important selling point and they are reluctant to change this. However, some consumers take advantage of this and return 90–95% of big orders. The retailer has thus blocked or paused consumers with this type of behaviour to achieve more reasonable return rates. Another aspect of consumer culture is the "greenness" of the consumers. Although retailers A and C acknowledge that the consumers state that they want green delivery alternatives, Retailer C adds that: *"Consumer surveys often needs to be taken with a pinch of salt, they [the consumers] usually say one thing and do another, so we usually look at how they actually behave on the*

webpages" (Project director). Hence it is important to maintaining a more nuanced view of consumers' actual expectations.

The empirical data further point to consensus in that communication of sustainability is a barrier to offering green distribution alternatives. Simply put: "How can we communicate this to our customers? That's one of the challenges" (Retailer C, Sustainability manager). Retailer A points out that environmental sustainability should be relative, not quantitative, so that the consumers do not have to invest too much time in making their choice of distribution. On the other hand, the Supply chain director of Retailer B would like sustainability to be binary, so that it is clear whether the alternative is, in fact, sustainable. However, how to communicate this is unclear, and Retailer B has contemplated a symbol that illustrates sustainability, which allows consumers to find out more information via a link: "So that you understand that 'If I chose this transport, why is it climate smart?'" (Retailer B, Supply chain director).

4.4 Market barriers: retailer – LSP
One barrier identified for the retailer-LSP market is the issue of *trustworthiness towards LSPs* regarding offerings of green distribution alternatives. The retailers find several different reasons for this. For example, the measuring of emissions is questioned, and Retailer B struggles with the emissions data it receives from the LSPs and how to make it relevant to its own company. Both Retailer A and B point out the difficulty for retailers to compare LSPs' stated emissions. For example, Retailer B struggles with the emissions data from LSPs, as they often include errors, and there is a need for much coordination to gain accurate and comparable numbers. Similarly, Retailer A has had to involve a consultancy firm for validation of calculations. Further, many LSPs that focus on e-commerce distribution are relatively new actors, which has consequences for the data: *"I sometimes feel like these smaller start-ups can be really good, that they can offer more alternatives, but that changes happen very fast, and they switch people quite often, so sometimes there is an insecurity in the data you get from them." (Retailer B, Sustainability coordinator)*

There is also a barrier related to *roles and responsibilities* in the interface between retailers and LSPs. On the one hand, retailers have *"an extremely important role to push [LSPs to improve in terms of sustainability]" (Retailer A, Director of logistics development)*. At the same time, the LSPs have a large responsibility to drive change. As Retailer B explains: *"/ . . . /So yes, we place demands. But to drive towards increased sustainability, the LSPs must take a large responsibility". (Supply chain director)*

Green distribution can be further hindered by *competitive aspects* such as the order in which distribution alternatives are presented at the checkout. Specifically, LSPs compete to be the first choice, i.e. presented first at the checkout, as consumers often choose this option: *"Let me put it like this: 80% of all consumers choose the first alternative presented" (Project director, Retailer C)*. As retailers are the ones deciding on the order in which to display the offers from different LSPs, this becomes a part of the negotiation, and LSPs could, for example, offer a lower price in exchange for that spot. One retailer even stated that it has taken a different approach and no longer ranks the LSP in any particular order based on their green distribution alternatives as a way to solve the dilemma. Nevertheless, offering green distribution alternatives can become a competitive advantage for retailers, so the issue remains an important topic, as Retailer B clarifies: *"We have said to all [the LSPs]: 'Come to me and tell me when you have a completely environmentally friendly transport that we can advertise for, because then you will end up high up [at the checkout].*

A final market related barrier is the *lack of homogeneity*. Retailer A notes that LSPs do not work in a similar manner and question whether it is productive for each one to try and develop their own way of working. Differences in the data have already been mentioned, but this applies here as well. For instance, retailers note that several locker-solutions exist, but

there are no standard ways to label or visualise green distribution alternatives. Retailer C also mentions an overall lack of coordination between LSPs. Another aspect of green distribution alternatives is climate offsets, which provides an opportunity to out of the issue with emissions, an approach questioned by some retailers: *"We would rather work with our distributors to reduce their emissions, push them to go towards electric options for example. But some of the big ones, they are very hard to change." (Retailer C, Sustainability manager)*

4.5 Governmental barriers
In terms of governmental barriers, the most evident one is related to a *lack of standards and terminology*. Specifically, the studied retailers point out that there are no mutual agreements regarding the use of "green labels" for green distribution alternatives to consumers. Although not purely governmental, the lack of standards relates to the lack of industry standards and here governmental regulations can play a role. For example, Retailer A is a strong believer that external actors on, e.g. national governmental levels can remedy this barrier, even though, at present, it has its own label for green distribution. It claims: *"We made our own climate choice for lack of other things, but it is also resource-intensive for us to update it every year. As the change happens so incredibly fast, there will be a need for external parties who focus and do this in a uniform way. Also for the sake of trustworthiness." (Director of sustainability)*
Interestingly, Retailer C is not convinced that external involvement can solve the issue of green distribution alternatives. It instead puts forward the need for collaboration with, for example, LSPs and customers to form standardised "methods". A related difficulty, however, is the lack of standards on how to calculate emissions, as retailers, such as Retailer B, need to do their own calculations to understand and verify the data they receive from the LSPs.

Despite that *law and regulation* are put forward in literature as potential governmental barriers, and thereby addressed in the probing approach during the interviews, no barriers within this area were identified. On the contrary, one respondent mentioned that the laws are not updated taking into consideration the demands of, e.g. temperature in storage when, e.g. the consumers mail box becomes an important storage place in the e-commerce flow.

4.6 Technological barriers
One technological barrier regards the *measuring of emissions*. The retailers perceive a lack of data and Retailer C states that *"We have no data available to know. We have no de facto information on what the climate impact looks like, on which we can base ourselves, in a credible way." (Project director)*. This barrier is closely related to the barrier "trustworthiness in LSPs", specifically the lack of trust in emissions data, mentioned in the retailer-LSP market; however, the technological aspects of emissions data is also found to be an important barrier. Retailer C explains it like this: *"Here is how it is: At the checkout, we want to be able to call on our distributors and receive information about 'This [distribution alternative] will generate this much CO2', or some sort of scale. We send in items and information about location and want to get the CO2 emissions along with all the other data we receive." (Retailer C, Project Director)*. Such technological support is not provided by any actor and this is clearly a barrier perceived by the retailers.

Another technological barrier identified is related to *transport technology* and the difficulty to understand how environmentally sustainable an alternative is. Retailer B underlines the need to be able to trust the green alternatives at all times: *"It must be climate-smart throughout the chain, from the distribution centre to the consumer. It would not feel quite right to say from one month to the next: this was climate-smart, but not now, but now it is again." (Supply chain director)*. Likewise, Retailer A identifies the reliance on hydrogenated vegetable oil (HVO) as a sustainable fuel alternative but says that this is likely not the best solution in the long run.

A final technological barrier regards the *dependence on the platform developer*, who develops the platform where consumers choose their distribution alternative. Even though Retailer A suggested that the collaboration with the platform developer has worked well, there is a challenge imbedded in understanding how green distribution alternatives can be visualised. Retailer A approached the platform developer and expressed a wish: *"This is what we want to do. What possibilities are there to make it even better through you?" (Business developer e-commerce)*. In contrast, Retailer C has its own platform for this and describes this as positive, as there is no dependence on an external actor. However, the Project director at Retailer C recognises that a common platform would make it easier to, for example, integrate new distributors in the system.

5. Discussion

Barriers have been found for all five categories suggested in the literature overview (as identified in, e.g. Lin and Ho, 2011; Jovanovic *et al.*, 2020), albeit the market category was divided into two separate categories as mentioned above. The barriers, of which some are more prominent than others, are elaborated on below, providing answers to research question 1 and 2.

The results of examining *organisational barriers* identify substantial organisational resources as a barrier in the work with green distribution alternatives. Given that the studied retailers are fairly large, smaller retailers might struggle even more to gather the sufficient resources needed to succeed. The number of resources needed can also be related to the individuals that the findings point to as vital to offering environmentally sustainable distribution to consumers. Together, these two issues highlight the sensitivity of this type of sustainability commitment, where, e.g. a person changing workplaces could radically alter the process towards green distribution alternatives. The findings also point to the importance of top management support. This is not surprising and in line with previous research into, e.g. the development of green practices (Seroka-Stolka, 2014). Nevertheless, since the retailers were selected based on a high ambition and progress, top management commitment (Luthra *et al.*, 2011) is not an issue hindering progress at the studied retailers. Instead, it is stressed as an important aspect of the sustainability work. While previous literature has pointed to the small size of firms as a potential barrier (Ho *et al.*, 2014; Oberhofer and Fürst, 2013), this study does not find any support for that as such, with one explanation being that the retailers are relatively large.

In terms of *financial barriers*, time as a costly resource was found to come into play to a considerable extent. The resources needed for working towards green distribution alternatives to some extent coincide with the findings of the organisational barriers as described above. Although overlapping somewhat, the vast number of resources needed was deemed to be linked to cost, i.e. a financial barrier and staff, i.e. an organisational barrier. Further, time as a resource was found to be of importance to gain knowledge, develop solutions and manage interorganisational relationships with, e.g. LSPs, as well as to make sense of information from other actors. In essence, time invested in sustainability appeared as the major financial barrier for green distribution alternatives. With a point of departure in the literature, in which, e.g. more expensive investments in green transport technology (see, e.g. Isaksson and Huge-Brodin, 2013; El Baz and Laguir, 2017) is regarded as a green logistics barrier, it was unexpected that this was not significantly emphasised by retailers. The fact that the cost of technical solutions is seldom an issue as such could be explained by the focus on retailers and not LSPs, as LSPs are the ones who own and invest in the vehicle fleet.

Next, *market barriers in the interface between retailers and consumers* were found to be one of the most prominent barriers to offering green distribution alternatives. Trustworthiness

was deemed vital, as retailers cannot risk losing their reputation to consumers and be associated with green washing. As customers' lack of knowledge within environmental sustainability can be a barrier to greener logistics (Holt and Ghobadian, 2009; Evangelista *et al.*, 2017), there is a need for the information given to consumers to be trustworthy so that they can, in fact, make sound choices regarding the different distribution alternatives offered. In other words: a retailer that promotes a distribution alternative as the best environmental choice needs to be sure that this is the case. At the same time, retailers strive to find a balance regarding what to communicate to consumers. While retailers might have a responsibility to educate consumers (Wiese *et al.*, 2015), this study points to many difficulties in the communication of environmental sustainability. Further, customer culture was found to be a barrier, in terms of demands for quick deliveries, free deliveries and free returns, corresponding to earlier research that has identified customer demands as a barrier to environmental sustainability (Lin and Ho, 2011; Björklund, 2011). Finally, whilst the findings point to a slight increase in consumer awareness on green distribution, consumer pressure does not appear to be prominent with respect to what drives retailers' engagement in green distribution. This further supports the findings of Lin and Ho (2011) that there is no significant relation between customer pressure and the adoption of green distribution. Encouragingly, retailers rather seem to aim for proactivity, rather than awaiting consumer demands.

Market barriers in the interface between retailers and LSPs were also found to be quite common, thus suggesting that an aggregated market barrier category is of great importance for the development of green distribution alternatives. Although a lack of commitment to environmental sustainability from suppliers has been highlighted as a barrier in previous research (Walker *et al.*, 2008), this does seem to correspond to the retailers view of the LSPs as transport suppliers in this study. Instead, LSPs appear eager to negotiate with the retailers to be placed as the first distribution alternative at checkout, and if retailers are looking for environmental sustainability, LSPs can compete with green distribution alternatives as a selling argument. Market competition between different LSPs thus becomes a barrier, in line with Luthra *et al.* (2011), as LSPs might try too hard to call a distribution alternative "green". Related to this, another identified barrier was indeed trustworthiness, similarly to the retailer-consumer market. For one, retailers struggle to make sense of emissions data received from LSP to compare the data from different LSPs. However, trustworthiness is also likely to come as a consequence of the competition between LSPs and their desire to be placed first at the checkout. This drive runs the risk of LSPs trying to find their own green distribution alternative that is better than others, whilst at the same time making it even more difficult for retailers to rank alternatives according to a scale that is trustworthy for consumers.

In terms of *governmental barriers*, there is a lack of standards, a potential barrier put forward by, e.g. El Baz and Laguir (2017) and Centobelli *et al.* (2017) and guidance from authorities (Mudgal *et al.*, 2010). The empirical findings suggest that standards would help retailers understand and make use of emissions data from LSPs to a larger extent. Another barrier identified regarding standards and guidance lies in the lack of common terminology, and the findings show differing results with regards to the lack of involvement from regulators. One view is that governmental interference in the form of, e.g. standards could simplify matters for retailers aiming to offer green distribution alternatives. Another view is that the market will solve the matter itself, though collaboration with LSPs and customers. However, in sum, governmental barriers are not found to be the most prominent barrier category, and only one respondent mentioned regulation as a barrier (as legal demands were not up to date on e-commerce concerning pharmaceutical products) as opposed to the literature (see, e.g. Oberhofer and Fürst, 2013).
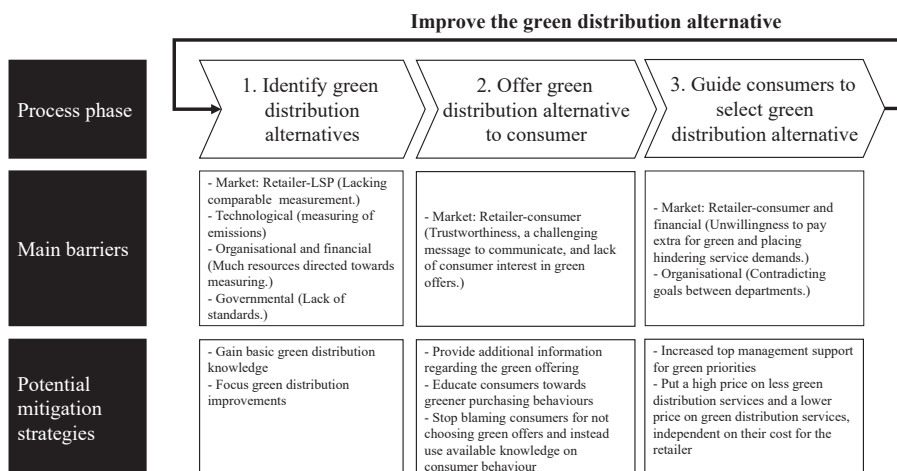
Similarly, *technological barriers* do not appear as the most prominent barriers according to the empirical results. Although vehicle technology is mentioned as an important measure towards environmental sustainability in the green logistics literature (e.g. Isaksson and Huge-Brodin, 2013), the findings point to few instances in which technology itself is perceived as a barrier. The barriers that were identified instead relate to the use of technology, e.g. IT implementation integration of IT systems and technology advancement (Mudgal *et al.*, 2010). One aspect of this is the lack of detailed data for each consumer purchase, which retailers would like to have but which does not seem as a viable technical solution as of today. Such a technological solution would enable retailers to rank distribution alternatives differently depending on the specific consumer and its location. Given that consumer transports have a large effect on the environmental impact from transports (Browne *et al.*, 2006; Halldórsson and Wehner, 2020), this could lead to more precise offerings to consumers, influencing them in a consumer-specific way.

6. Implications for research, practice and society

In terms of research implications, this paper adds to the small, but growing, body of literature that takes the consumer side of green distribution into account, thus adding to, e.g. Sallnäs and Björklund (2020), Buldeo Rai *et al.* (2019) and Ignat and Chankov (2020). For example, whilst Sallnäs and Björklund (2020) focus on communication between retailers, LSPs and consumers as a barrier preventing consumers from making insightful choices concerning green distribution, this paper expands the findings to include a wider set of barriers. The research at hand also confirms what researchers have recently suggested, namely that consumers should be given a larger role in the greening of logistics (see Halldórsson and Wehner, 2020; Ignat and Chankov, 2020; Wiese *et al.*, 2015). How this is to be conducted is, however, relatively vague in previous research. This paper contributes by identifying the barriers that need to be mitigated by retailers to, in fact, being able to offer green distribution alternatives for consumers. By combining the content in present frameworks of barrier categories (see, e.g. Centobelli *et al.*, 2017; Lin and Ho, 2011; Jovanovic *et al.*, 2020) a five category framework was developed and applied in order to structure the empirical data. However, applying the framework indicated a need to split the market barrier category into two categories, one for each market, as the barriers on these markets were very different.

As for managerial implications, the findings give grounds for the development of a framework that can guide retailers in their strive towards green distribution alternatives for consumers (see Figure 1). The framework provides an answer to research question 3. The retailers describe how they continuously work with and improve their green distribution alternatives, suggesting an ongoing and repeating process instead of a one-time project. The framework takes a point of departure in the main barriers identified, as presented in Table 2. Three phases can be identified that characterise the process towards offering green distribution alternatives, each one with its own set of barriers that needs to be managed.

First, and perhaps most challenging, is to identify the greenest distribution alternatives. Among the six categories identified, it is furthermost retailer-LSP market-oriented barriers related to the quantification and measurement of distribution alternatives' environmental impact that emerge as a major barrier. How can a retailer be certain that a green distribution alternative offered by one LSP is greener than a green, or standard, distribution alternative offered by another LSP? Much of the retailers' time and resources (i.e. barriers identified in the organisational and financial categories) are directed towards measuring and comparing distribution alternatives, which also is described as a major barrier. This might be overcome in a future with complex systems for data gathering, data management and data sharing,

Improve the green distribution alternative

Process phase	1. Identify green distribution alternatives	2. Offer green distribution alternative to consumer	3. Guide consumers to select green distribution alternative
Main barriers	- Market: Retailer-LSP (Lacking comparable measurement.) - Technological (measuring of emissions) - Organisational and financial (Much resources directed towards measuring.) - Governmental (Lack of standards.)	- Market: Retailer-consumer (Trustworthiness, a challenging message to communicate, and lack of consumer interest in green offers.)	- Market: Retailer-consumer and financial (Unwillingness to pay extra for green and placing hindering service demands.) - Organisational (Contradicting goals between departments.)
Potential mitigation strategies	- Gain basic green distribution knowledge - Focus green distribution improvements	- Provide additional information regarding the green offering - Educate consumers towards greener purchasing behaviours - Stop blaming consumers for not choosing green offers and instead use available knowledge on consumer behaviour	- Increased top management support for green priorities - Put a high price on less green distribution services and a lower price on green distribution services, independent on their cost for the retailer

Figure 1.
A framework for offering green distribution alternatives, including the main barriers and suggested mitigation strategies

applying similar systems and measurement standards, but how can this barrier be managed today? Perhaps the most important thing for the retailer is gaining a basic understanding of the technology applied (e.g. fuels) as well as securing a resource efficient management of the transport flows (e.g. vehicle sizes and fill-rates) and then placing demands on an ongoing green improvement. However, amongst these aspects, fill rate might be the most important to focus on, in line with Allen *et al.* (2017), as green demands on fuel used and other technologies might result in the use of additional vehicles with low fill-rates, instead of securing full truckloads on the vehicles already applied.

The second phase in the retailers' process is less challenging: To offer green distribution alternatives to consumers. In fact, two of the studied cases have already done this, despite the perceived lack of knowledge regarding their "true" environmental impact (i.e. jumping over phase 1). However, here the retailers studied raise concerns regarding consumer trust (i.e. a barrier in the category consumer-retailer market). One important empirical finding is that even if consumers are offered a green distribution alternative, they might not select it. Some retailers could then choose to put the "blame" on the consumer arguing that they are not using their consumer power, but more proactive retailers can instead use their knowledge of consumer behaviour (that consumers are more likely to choose a pre-selected and/or the first distribution alternative offered) and present the green distribution in such a way.

The third phase, targeting furthermost the more proactive retailers, is therefore to guide the consumers to select the green distribution alternative. This phase includes overcoming large barriers in the financial category, such as the consumers unwillingness to pay extra for green alternatives, as well as their preferences regarding, e.g. free returns and quick deliveries in the retailer-consumer market category. Besides the above-mentioned barriers on the consumer market, large barriers in the organisational category might hinder the use of nudging, as different departments and economically oriented KPIs might direct decisions towards increased transport costs or decreased service levels in favour of environmental sustainability. An alternative way forward could be to wait for consumers incitements, as selecting green alternatives increases.

As for social implications, this paper potentially contributes to decreased environmental impact from e-commerce distribution. Indeed, the last mile of distribution is the most inefficient and energy consuming part of the supply chain (Gevaers *et al.*, 2014;

Halldórsson and Wehner, 2020) and changes made to increase the efficiency is highly relevant to achieve environmental sustainability. Further, by focussing on "greener" consumer choices in the checkout, the paper could in the long run help raise awareness about environmental sustainability in a wider sense than merely for e-commerce distribution.

7. Conclusions, limitations and avenues for further research

This paper addresses the factors that hinder retailers from offering green distribution alternatives to consumers. Several such barriers have been identified, analysed and discussed in the preceding sections. The findings show that the offering of green distribution alternatives is a complex task for retailers, with barriers related to six categories (organisational, financial, retailer-LSP market, retailer-consumer market, governmental and technological) obstructing the way forward. To mitigate these barriers, a proposed framework of for the development and management has been proposed (Figure 1).

No study is without limitations, but with limitations come new avenues for research. The research at hand is no exception. Firstly, the research has been carried out in a Swedish context. As Sweden is a relatively mature country, both with regards to e-commerce (PostNord, 2021) and sustainability (OECD, 2014), it would be interesting to consider how barriers would manifest themselves in countries with other characteristics. A comparative study between countries has the potential to validate and expand the findings of this study. Further, as the empirical data is based on the retailer perspective, a much-needed area for further research is to illuminate the perspective of the LSPs in more detail than been previously done. Although Sallnäs and Björklund (2020) shed some light into LSPs and green distribution, there are many questions still to be answered related to hinders, drivers and business models, to name a few. Another vital actor is the consumer and studies are needed to further understand the consumers' perceptions of green distribution alternatives. Such knowledge could simplify retailers' path towards offering green distribution alternatives. Yet another limitation is the fact that this research does not go into detail as to what a truly green distribution alternative really is. Although complex, there is a need for logistics and transport research to provide more guidance to managers, as well as governance, concerning what constitutes such alternatives, so that managers can be more confident in phase 1 of Figure 1 and thereby steer e-commerce to become more environmentally sustainable through the support from consumers.

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Appendix 1
Overview of interview questions

General questions

(1) Briefly tell us about the company.

(2) Tell us about your role at the company.

Overview of green distribution alternatives

(1) What are your thoughts on green distribution to consumers?

(2) Why is it important to be able to offer green distribution to consumers?

(3) What opportunities are there in being able to offer green distribution to consumers?

(4) Are there prerequisites that must be in place to succeed? Which?

(5) How many distribution alternatives do the consumers have?

(6) What barriers are there to achieve green distribution alternatives?

(7) Which actors need to collaborate with in order to succeed? How?

(8) Are there different ways forward? Develop.

Roles

(1) What role do you as a retailer have in the development of green alternatives for consumers?

(2) What is the role of logistics companies?

(3) Other actors?

Final questions

(1) How far have you come in the development of green alternatives for consumers?

(2) How prioritised is the development of green alternatives for consumers at the company?

(3) Will you achieve green alternatives in the foreseeable future?

Appendix 2

Organisational barriers	Illustrative quotes
Relative importance of environmental sustainability	"It should be clear that it [environmental sustainability] is, for real, is high up on the agenda in businesses" (Retailer A, Director of logistics development) "There are no temporal goals or goals in terms of results [in relation to the green distribution alternatives], the project is strategic, and a part of the value-system" (Retailer A, Business developer e-commerce) "From that perspective, production [of products] is more important. But then again, the transport is closer to the customer, and for the customer it [green alternatives] can be important to be able to choose." (Retailer B, Sustainability coordinator) "It needs to come from the top [management]./ . . ./I've tried in the past not to go that route [include top management] and do it myself, and it was just a lot of work and it was not as successful. And it was exhausting." (Retailer C, Sustainability manager) "The biggest impact is within manufacturing, but that doesn't mean we cannot reduce it [environmental impact from transport] as much as we can, where we can". (Retailer C, Sustainability manager)
Structure of companies	"We are relatively large [company size], coordinate with [the owning company] and make use of their muscles, so that $1 + 2$ equals more than three. It can be difficult sometimes, though, we have different types of goods flows and quality demands, which makes it more difficult to coordinate fully. (Retailer A, Director of logistics development) "It takes time for [example of large, Swedish LSP] to change, like a very large ferry with a small steering wheel. But when it finally turns, the change will probably be fast." (Retailer B, Supply chain director) "We have that size and strength now, so we should be able to take responsibility for sustainability in a better way" (Retailer C, Project director)
Competencies and internal roles	"A consultancy firm validated the calculations from the LSPs and made sure that a comparison [between the data from different LSPs] was possible." (Retailer A, Business developer e-commerce) "But it's difficult. Especially since many of these individuals [employees at the company] are so engaged in sustainability issues and sincerely want to push forward. There is a risk of killing that motivation by hitting the brakes."(Retailer B, Sustainability coordinator) "The competence is up here [points to own head] at the moment, and with my operative logistics manager. If I were to disappear tomorrow, well, then it would probably be challenging to, for example, do calculations on [LSPs'] emission reports." (Retailer B, Supply chain director)

Table A1.
Identified barriers with examples and illustrative quotes

(continued)

Organisational barriers	Illustrative quotes
	"If you want to have true change, you must have true [internal] collaboration. And it's not easy if you have departments who don't want to talk to each other for some reason" (Retailer C, Sustainability manager)

Financial barriers	Illustrative quotes
Consumers' low willingness to pay	*"From a logistics perspective, time and time precision is extremely costly. Sometimes, it might be necessary, but it is important to understand the environmental impact of that time precision." (Director of logistics development, Retailer A)* *"It is a challenge that labels cost [due to inclusion of a third party], as it raises the cost of the product./—/In this business [e-commerce] it might be even more challenging, as customers, as I perceive them, are used to free deliveries." (Retailer A, Director of sustainability)* *"If we ask the customer 'Would you choose climate smart?', the answer is 'Yes', but 'Would you pay for it?', then perhaps not so many would do that . . ." (Project director, Retailer C)*
Large investments necessary	*"You need to be fairly well-read to be able to place those demands and to question, otherwise you run the risk of being . . . not tricked, but it is really difficult to know what we really get and what we are paying for." (Retailer A, Director of Logistic development)* *"We developed our own climate alternative, due to a lack of other solutions, but it is resource demanding to update this every year/ . . . /" (Retailer A, Director of sustainability)* *"We have enthusiasts who can do the impossible, you don't even get how they do it. There is always a need for more resources, always a need for more time." (Retailer B, Sustainability coordinator)* *"It is a barrier that so many resources are required to work with sustainability; there is no given solution, and there is a lot of trial and error." (Retailer B, Sustainability coordinator)* *"The financial challenge can require strong initial investments for new ways of distribution, or new electric." (Retailer C, Sustainability manager)* *"We need to be able to modify [the distribution alternatives offered]– that is probably the most important. To have the possibility to modify, but that doesn't mean that you always need to modify."(Retailer C, Project director)"*

Market barriers: Retailer-consumer	Illustrative quotes
Trustworthiness towards consumers	*"Offerings such as 'We have fossil free deliveries' have started to become a matter of competitive advantage, but there is another important side to this as well, which is about work environment and rights." (Retailer A, Director of sustainability)* *"It wouldn't feel okay to say from one month to the next: 'This [distribution alternative] was climate smart, but it isn't right now; and then it's climate smart again'. It has to be consistent; you need to know for real." (Retailer B, Supply chain director)* *"We want to tell a story, to simplify for the consumer, but there is always the risk of backfire: 'You sell products. The more people buy, the more money you make.' So even if we show good things that we do, there is always the risk of getting rejected" (Retailer B, Sustainability coordinator)*

(continued)

Table A1.

Market barriers: Retailer-consumer	Illustrative quotes
Consumer culture	The expectations of quick deliveries, free deliveries and free returns *". . . creates expectations, a belief that this is normal. It's not normal. I know the cost of having streamlined goods flows and so many pick-ups." (Retailer A, Director of logistics development)* *"I'm not sure yet, but there will possibly be a pendulum, as has been within fashion in terms of fast fashion and slow fashion, that the same will happen for transport. Perhaps it was cool in the beginning, that everything should go so fast. But 'Well, it might take five days until I get that [an order].'. And five days is still pretty fast. I think there will be a larger acceptance for that it is not necessary to think 'I need this tomorrow'." (Retailer B, Sustainability coordinator)* *"Consumer surveys often needs to be taken with a pinch of salt, they [the consumers] usually say one thing and do another, so we usually look at how they actually behave on the webpages" (Retailer C, Project director)*
Communication of sustainability	*"But this [the sustainability aspect of e-commerce] becomes more and more important and it is extremely important from a communication perspective, in our customer promise, and what we convey as a company." (Retailer A, Director of logistics development)* *"So that you understand that 'If I chose this transport, why is it climate smart?'" (Retailer B, Supply chain director)* *"How can we communicate this to our customers? That's one of the challenges" (Retailer C, Sustainability manager)* *"They [consumers] don't know what we are doing in terms of sustainability. They then talk to me, or I do a talk somewhere, and they're like 'Oh my God, it's incredible!'. Yeah, but I need to tell you on the website, when you're shopping, so how do we break all of this information down in a way that makes sense to them and that is not a lecture. Communication is very hard on this." (Retailer C, Sustainability manager)* *"The difficulty is making sure that you are giving enough information, so you need to verify what you are saying, but at the same time you have about two seconds to help them make that choice. Cause customers want fast service." (Retailer C, Sustainability manager)*
Dependence on other actors	*"Shouldn't they [a competitor] be reducing actual impact?" (Retailer C, Sustainability manager)*

Market barriers: Retailer-LSP	Illustrative quotes
Trustworthiness towards LSPs	Related to measuring of emissions: *" . . ., there is a large difference between conventional flows and e-commerce flows. This is to a large extent due to the extreme growth of e-commerce, uncertainties in forecasts, as well as that many of the actors are relatively new to the market. (Retailer A, Director of logistics development)* *"I sometimes feel like these smaller start-ups can be really good, that they can offer more alternatives, but that changes happen very fast, and they switch people quite often, so sometimes there is an insecurity in the data you get from them." (Retailer B, Sustainability coordinator)* *"Some LSPs say that they have fossil free transports. I really want to see in black and white that this is the case always, all year around". (Retailer B, Supply chain director)*

Table A1.

(continued)

Market barriers: Retailer-LSP	Illustrative quotes
Roles and responsibilities	*"We don't know with regards to [LSP 1 and LSP2]. They push for us to show which LSPs are climate smart, but the trouble is that they themselves are almost least climate smart. Not that they are really bad, but if we were to rate in the checkout, they would be after other better alternatives. (Retailer C, Project director)* Retailers have *"an extremely important role to push [LSPs to improve in terms of sustainability]" (Retailer A, Director of logistics development)* *"As transport buyers, we should place demands, because we are closer to our customer and know what the customer wants. We have our own values that say something about sustainability being important. So yes, we place demands. But to drive towards increased sustainability, the LSPs must take a large responsibility." (Retailer B, Supply chain director)* *"The responsibility lies firstly with the carriers, to be able to produce good data. In the next step, the responsibility lies with us, to show this in a good way. So that consumers understand, so that we do not hide it in any way, that we are very transparent in the data we receive." (Retailer C, Project Director)*
Competitive aspects	*"We have said to all [the LSPs]: 'Come to me and tell me when you have a completely environmentally friendly transport that we can advertise for, because then you will end up high up [at the checkout]. (Retailer B, Supply chain director)* *"All LSPs are fighting to be at the top of the checkout. For example, they can offer a cheaper price, if it gets them to the top. You know that the customer usually does not go further down, and in many cases, you choose what is pre-selected. That is why the LSPs want to be as high up in the checkout as possible." (Retailer B, Supply chain director)* *"Let me put it like this: 80% of all consumers choose the first alternative presented" (Retailer C, Project director)*
Lack of homogeneity	*"Every LSP can't have its own locker stations. We are drowning in locker stations." (Director of logistics development, Retailer A)* *"Reports [from LSPs] vary, from two boxes in excel to getting a detailed report with countries, services, kilos. There is a very big difference in what you can get out of systems, etc." (Retailer B, Supply chain director)* In relation to climate offsets: *"We would rather work with our distributors to reduce their emissions, push them to go towards electric options for example. But some of the big ones, they are very hard to change." (Retailer C, Sustainability manager)*

Governmental barriers	Illustrative quotes
Lack of standards and terminology	*"We made our own climate choice for lack of other things, but it is also resource-intensive for us to update it every year. As the change happens so incredibly fast, there will be a need for external parties who focus and do this in a uniform way. Also for the sake of trustworthiness." (Retailer A, Director of sustainability)* *"But I think that [governmental regulations] is the wrong way to do it. I think there is a very great will to want to show these things. So, we probably believe more in good collaboration with all partners – LSPs, us, who are responsible, and the customers, who are responsible" (Retailer C, Project director)*

Technological barriers	Illustrative quotes
Measuring of emissions	*"We have no data available to know. We have no de facto information on what the climate impact looks like, on which we can base ourselves, in a credible way." (Retailer C, Project director)*

(*continued*)

Table A1.

Technological barriers	Illustrative quotes
Transport technology	*"Here is how it is: At the checkout, we want to be able to call on our distributors and receive information about 'This [distribution alternative] will generate this much CO2', or some sort of scale. We send in items and information about location and want to get the CO2 emissions along with all the other data we receive." (Retailer C, Project Director)*
	"We are dependent on HVO, but this is probably not the long-term solution" (Retailer A, Director of logistics development)
	"It must be climate-smart throughout the chain, from the distribution centre to the consumer. It would not feel quite right to say from one month to the next: this was climate-smart, but not now, but now it is again." (Retailer B, Supply chain director)
Dependence on platform developer	*"This is what we want to do. What possibilities are there to make it even better through you?" (Retailer A, Business developer e-commerce)*
	"We control all systems ourselves, so we are not dependent on external platforms. In a way it would be good and smoother to integrate new carriers, but in all its good to control everything ourselves. (Retailer C, Project director)

Table A1.

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