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Developing environmentally sustainable logistics Exploring themes and challenges from a logistics service providers' perspective



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ABSTRACT

The purpose of this paper is to explore themes and challenges in developing environmentally sustainable logistical activities.

The approach is explorative with a cross sectional design that takes advantage of ten case studies out of selected logistics service providers (LSPs) operating primarily in the Scandinavian countries.

The findings illustrate the major themes by analyzing current and future activities in developing environmentally sustainable logistical activities. In addition, four categories of challenges are identified: customer priorities, managerial complexity, network imbalance, and technological and legislative uncertainties. It is concluded that there is a great need for a holistic perspective where LSPs and product owners together analyze and design future logistical setups.

The suggested holistic and integrative model, building on a three-dimensional concurrent engineering framework, provides new opportunities for research. Further research is needed to improve the interrelationship between LSPs and their customers in the development of sustainable logistical solutions.

This paper puts forward recommendations for the sustainable development of logistics by combining the results from the case studies with a review of related literature. This will be beneficial for managers and policy makers when they approach sustainable logistical challenges. The emergence and synthesis of themes and challenges are critical for a sustainable society.

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Introduction

Logistical activities have several positive socio-economic effects while demand for mobility and accessibility are fulfilled; infrastructures are constructed; new jobs are created; poverty, hunger and crimes are lowered; and humans and nations become wealthy. On the other hand, logistical activities may have several negative effects on their surrounding (natural) environment and societies that should be minimized. For example, they are still dependent on fossil fuels and nonrenewable

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natural resources; have negative effects on residents' health and safety; give rise to atmospheric, land, water, noise, and visual pollution, congestion, intimidation, vibration, injuries, and accidents.

Sustainable development of logistics calls for activities that lead to the highest economic and social gains while reducing the negative environmental losses. However, in the long term these activities are complex and tied to great challenges, dilemmas, difficulties, and barriers. [European Union \(2011\)](#) highlights some of the current and future trends, such as migration and internal mobility, aging, urbanization, and globalization, all of which may challenge social and economic developments. The increasing scarcity of fossil fuels and global warming are examples of environmental challenges. [McCauley \(2008\)](#) sheds light on challenges in governing sustainable development. [Abbasi and Nilsson \(2012\)](#) elaborate on environmental challenges from a supply chain perspective and classify these into costs, complexity, operationalization, mindset and cultural changes, and uncertainties. [Rodrigue et al. \(2001\)](#) shed light on paradoxes of green logistics due to costs, time/speed, reliability, warehousing, and e-commerce.

The purpose of this paper is to explore themes and challenges in developing environmentally sustainable logistical activities from a logistics service providers' (LSPs) perspective. The two main reasons for choosing an LSP perspective are: (1) their dominant role in handling freight due to the increased outsourcing of logistical services to LSPs ([Wolf and Seuring, 2010](#)) and, (2) the limited research available with an LSP perspective on sustainable development ([Lieb and Lieb, 2010](#)).

The next section provides the frame of reference, and reviews previous research on connecting logistics to sustainable development and to LSPs. This is followed by a description of the methodology used. The research is based on case studies of selected LSPs operating in the Scandinavian countries. In the results section, emergent themes of environmentally sustainable logistical activities are presented, along with the challenges identified and discussed. The paper ends with the discussion and conclusions sections, of which the latter presents opportunities for future research.

Sustainable development and freight transportation

Popularized after the Brundtland Report, *Our Common Future* ([World Commission on Environment and Development, 1987](#)), and followed by the [United Nations 2005 World Summit](#), sustainable development (SD) encompasses the interdependent and mutually reinforcing pillars of economic development (Profit), social development (People) and environmental protection (Planet). The three 'P's of SD are sometimes called the 'three bottom lines (TBL or 3BL)' ([Elkington, 1997](#)).

The literature of the logistics and supply chain disciplines demonstrates the increasing appearance of SD. [Carter and Rogers \(2008\)](#) elaborate on its three pillars together with four supporting facets: risk management, transparency, strategy, and culture. Much of the remaining literature focuses on some of the pillars, such as corporate social responsibility ([Keating et al., 2008](#); [Dyllick and Hockerts, 2002](#)); environmental logistics ([Wu and Dunn, 1995](#)); and green logistics ([McKinnon et al., 2010](#); [Abukhader and Jönson, 2004](#); [Aronsson and Hüge Brodin, 2006](#)).

Although outsourcing of logistical activities to LSPs and their role in the creation of trust and value in supply chains are considered to be imperative ([Selviaridis and Spring, 2007](#); [Marasco, 2008](#)), little attention has been given to sustainability goals and aspects ([Lieb and Lieb, 2010](#); [Wolf and Seuring, 2010](#)). [Huemer \(2012\)](#) puts forward the limitation of most SCM research and practice in focusing on the manufacturer or the retailer perspective. He suggests further investigation of the LSP perspective as an alternative to the dominant product and/or value chain perspective, especially in the cooperation among manufacturers and/or retailers in making logistics more environmentally friendly. The prevailing manufacturer and/or retailer perspective (the demand side) is evident when it comes to research on logistical services in general (procurement or outsourcing of logistical services) ([Selviaridis and Spring, 2007](#)), but also when it comes to sustainability issues ([Philipp and Militaru, 2011](#)). [Wolf and Seuring's article \(2010\)](#) was the only one found that includes both buyers and LSPs in the same study.

In two literature reviews on third-party logistics ([Selviaridis and Spring, 2007](#); [Marasco, 2008](#)) a number of themes and challenges are raised. However, as also noted by [Wolf and Seuring \(2010\)](#), the discussion of sustainability and environmental issues are neither highlighted as central themes nor as areas for further research. The low level of interest is confirmed when examining the empirical literature on environmentally related activities of LSPs. For example, [Maas et al. \(2012\)](#) conclude in their study on third-party logistics actors that environmental differentiation is only a minor part in differentiating their practices. [Lieb and Lieb \(2010\)](#) report that 13% of LSPs receive substantial attention and 50% moderate attention from their customers on environmental initiatives. [Lin and Ho \(2008\)](#) argue that despite the great environmental impact of logistical activities, the logistics industry is still in its infancy when it comes to environmental issues. They go on to investigate the intentions of LSPs to adopt green innovation in Taiwan and find a number of significant factors needed in these organizations: explicitness and accumulation of green technology, organizational encouragement, quality of human resources, environmental uncertainty, and governmental support.

In order to gain insights into the role and perspectives of LSPs in relevant domains of logistics research, a manual systematic review of title, keywords and abstract was carried out in this study of all articles published in top-ranking supply chain, logistics, and operations management journals² up to the end of 2012 ([Table 1](#)). It resulted in 115 articles that focused on LSPs and LSP activities. Of these, only 5 dealt with the environmental aspects of sustainability and none dealt with all three pillars.

² The journals were selected based on Journal Citation Reports available on the ISI Web of Knowledge.

Table 1

Number of LSP and LSP environmentally/sustainability relevant articles published in top-ranking supply chain and logistics journals.

Journals reviewed	Number of LSP articles found	Number of LSP environmentally/sustainability relevant articles found
Supply chain management: an international journal	5	0
Journal of supply chain management	8	0
International journal of physical distribution and logistics management	53	3 (Lieb and Lieb, 2010; Wolf and Seuring, 2010; Perotti et al., 2012)
Journal of business logistics	16	0
International journal of logistics management	12	0
International journal of logistics research and applications	13	1 (Philipp and Militaru, 2011)
Journal of operations management	1	0
International journal of operations & production management	7	1 (Jeffers, 2010)

This is evidence of the lack of research dealing with environmental issues, in particular, the integration of all three pillars of sustainable development, in the context of logistics service providers.

The results of Wolf and Seuring (2010) and Philipp and Militaru (2011) elaborate on the buying behavior of shippers when purchasing environmentally friendly services offered by LSPs. Perotti et al. (2012) reflect on green supply chain practices adopted by third-party logistics (3PLs) in Italy and explore how they can affect company performance. Jeffers (2010) addresses sustainability from an economic perspective, especially related to IT investments by LSPs. Lieb and Lieb's survey (2010) is similar to ours as it also addresses the identification of environmental sustainability initiatives and challenges undertaken by 3PLs. However, our study digs into the challenges in more detail. In addition, the sample in our study was selected from major LSPs operating in the Scandinavian countries and the results are based on semi-structured interviews. The Scandinavian countries have solid and well-connected logistical infrastructures, strategic collaboration, and strict considerations and regulations when it comes to environmental issues.

Methodology

In researching themes and challenges confronted by LSPs to make goods flow in an environmentally sustainable manner, an explorative and mainly qualitative method was found most appropriate. Cruz et al. (2006, p. 872) state that sustainable development is “perhaps one of the most complex and important demands that has occupied managers' reflection.” Hall and Vredenburg (2003) also report that managers have great difficulties in dealing with sustainable development. Due to the absence of literature dealing with environmental and sustainability issues from LSPs' perspective (Table 1), and the need for research in this field argued by several researchers, an inductive research approach was chosen in order to gain in-depth understanding of themes and challenges. Inspired by grounded theory (Glaser and Strauss, 1967; Charmaz, 2006) and the way the methodology has been used in logistics research (Nilsson, 2006; Flint and Golicic, 2009) the research was designed as a combination of case studies (including interviews, secondary data from websites and reports) and a literature review. The case studies were the main source of empirical data.

Case studies

For the empirical studies, the case study procedure suggested by Yin (2003) was adopted together with the seven stages of a qualitative interview investigation suggested by Kvale and Brinkmann (2009). Initially three documents were created: an interview study protocol, an interview study database, and an interview study report. This was done to ensure high-quality research. The protocol had two major purposes: (1) to document all relevant information to make the process of the interview study as effective and efficient as possible (overall purpose, names, addresses, maps, interview questions, etc.), and (2) to function as a logbook where impressions and experiences from each interview and company visit were documented. The purpose of the database was to collect the bulk of material investigated. The raw data (company reports, website documentation, sound files, interview transcriptions, presentations, photos, etc.) were assembled and stored there in the research process. It was beneficial to be able to go back to the source when doing the analysis. The final document used in the research was the case study report encompassing all the material in an interpreted and analyzed form.

Thematizing and designing

Based on our earlier research and experience of sustainable development in the context of logistics together with a number of discussions and seminars with logistics managers, several challenges in developing environmentally sustainable logistical activities were identified. As LSPs are the main actors offering logistical services in supply chains, in an explorative manner, it became natural to obtain LSPs' perspective on challenges of developing environmentally sustainable logistical activities. The research focused on LSPs active in the Scandinavian countries to ensure a comprehensive yet feasible sample. We drafted a list of 30 LSP companies based on our experience, contacts during research projects, and after asking other

Table 2
Information about interviewees.

Case study number	Size of the company	Main transportation mode	Position of the interviewee(s)
1	Medium	Rail	Regional managing director
2	Medium	Road	Regional managing director
3	Large	All modes	Regional manager
4	Large	Sea	Sustainability manager
5	Large	Air	Environmental manager
6	Large	Land (rail and road)	Environmental and quality manager
7	Small	Road	Managing director
8	Medium	Land (rail and road)	Environmental and quality manager
9	Small	Road	Managing director, environmental manager, quality manager, and business developer
10	Small	Road	Environmental manager and business developer

experts. The list included small, medium-sized, and large³ LSPs. Each potential representative was then contacted by e-mails that included the purpose of the study, a description of the research area (sustainable logistics), and an invitation to be interviewed. Telephone calls were then made to those who responded that they were willing to participate. They were told about purpose and the structure of the case studies. In total, we conducted ten case studies (see Table 2).

The data collection process ended when saturation was reached. After case study seven, we evaluated the process and found that no more significant or new information was gained for the purpose of the study. To ensure research quality, however, three more case studies were conducted from which we then concluded that theoretical saturation had been reached.

Interviewing and data gathering

The interviews were semi-structured (Bryman and Bell, 2007, p. 474), based on open-ended questions. They lasted about 90 min and were primarily carried out in English. Interview guidelines were created for the open-ended questions and were structured into three major areas: current activities for sustainable development, future activities and trends for sustainable development (up to 2050), and challenges of sustainable development. If essential, the sequence of the questions was changed or additional questions were asked. Prior to each interview, the website of each LSP was studied in depth and information was compiled about the company in general and about sustainability-related activities, statements, reports, etc. All relevant information was documented in the interview study database so it would be accessible at other stages of the study. Other data related to sustainable development and environmental issues for each case company was gathered from company homepages and environmental/sustainability reports.

Transcribing

Every interview was taped and transcribed. If there were any misinterpretations, uncertainties or questions found in the transcriptions, the interviewee was contacted. Interviewees were asked to read and review the transcribed text and return it to the authors. Each sound file and its transcription were then entered into the interview study database.

Analyzing

The principle of grounded theory is that sampling, data collection, and analysis are interrelated and carried out in** parallel (Glaser, 2002; Corbin and Strauss, 1990) until theoretical saturation (Bryman and Bell, 2007, p. 459). The analysis of the interviews was conducted during the whole process and included the use of secondary material such as reports, websites, and documents.

The interview data collection process ended when saturation was reached. After interview seven, we evaluated the process and found that no more significant or new information was being gained for the purpose of the study. To ensure research quality, however, three more interviews were conducted from which we then concluded that theoretical saturation had been reached. The sample size for this type of research is, according to McCracken et al. (1990), eight for homogeneous samples. Carter and Jennings (2002) suggest 12–20 for heterogeneous samples. In this case, the companies and interviewees operate in the same geographical regions, working on similar issues and customers. Consequently, compared to global studies or ones in different industries, the sample can be regarded as homogeneous.

The analysis was inspired by the principles of critical discourse analysis suggested by Winther and Philips (2000) as the assumption was that what interviewees said and how they said what they said would construct reality of their environmentally/sustainability oriented practices and challenges which are subject to change over time and subjectively interpreted by the interviewees. The analysis started by the transcribed interviews being copied into an Excel file. They were divided into segments (a sentence or group of sentences) that were individually interpreted to identify their relevance to current and future activities, and/or challenges. At this stage, we were interested in the content of what the interviewees said as well

³ According to the European Commission, small companies have between 10 and 50 employees, medium-sized companies between 50 and 250 employees, and large companies more than 250 employees.

as how strongly they expressed their views. The latter were determined by weighing each segment on a Likert scale from 1 to 3, where 1 meant implicit (e.g. “we do not own any trucks and shall not either”), 2 explicit (e.g., “maybe we do not need to always send the container empty the whole way back”), and 3 strongly explicit (e.g., “our government has to do something to promote these new techniques”). Afterwards, a coding process was initiated where each segment of current and future activities, as well as challenges, was openly coded. This led to the emergence of different themes in each category. A second step, ‘focused coding’, was carried out (Charmaz, 2006; Winther and Philips, 2000) and resulted in the emergence of the major themes and challenges reported in this paper.

Verifying

The results of the interview analyses were discussed by the authors on several occasions. With the help of secondary sources, syntheses of the analyzed interviews were conducted. After verification of the results by the authors, a first draft of this paper was sent to the interviewees. They were asked to comment on the overall quality and any missing points. The verified results were then used as input text for the final version of this paper.

Reporting

The interview study report was mainly used for our own research purposes. A final version of it was sent to all the interviewees and used for scientific communication with other researchers.

Research quality

Two criteria for evaluating the quality of our qualitative research were adapted: authenticity and trustworthiness (Bryman and Bell, 2007). To increase authenticity of the interview study, different measures were considered. In the thematizing and designing phases, a literature review and additional discussions with researchers were conducted to ensure that the perspective would be that of LSPs and that a sufficient number of them were interviewed. In the interviewing phase, an interview introduction and guidelines were sent to interviewees in advance. Both interviewers (the authors) and interviewees did their best to communicate enthusiastically and use their best conversation and language skills. To increase trustworthiness, websites, relevant reports, and documents of each LSP were read in advance of meetings by the interviewers. This was done to reduce the possible misunderstanding mismatch of understanding between interviewers and interviewees. In the transcription phase, sound files were saved in the database. In other phases, interviewees were sent the transcribed interview texts for verification as well as comments on the final version of the study. For the sake of research ethics, interview transcriptions have been kept as confidential.

Results

Following the setup of the study, the results are presented in three sections: current activities, future activities, and challenges in developing environmentally sustainable logistical activities.

Current activities in developing environmentally sustainable logistics

Although all LSPs have plans and objectives for sustainable development, only a few of them have included such objectives in their mission or vision statements. Only one of the LSPs has designed its business model based on green and environmentally friendly offers. The analysis of current activities resulted in eight categories (summarized in Table 3). Three were strongly and explicitly emphasized by most of the cases (primary activities) while the other five were less emphasized (secondary activities). The primary activities are further elaborated below.

Internal resources efficiency, effectiveness, and utilization

The most common activities to increase effectiveness and efficiency of internal logistical resources were related to the mode of transportation used and vehicle energy usage. The right combination of available modes to meet the transportation demand with the right cost at the right time with the lowest negative environmental effects was something all LSPs put forward. Their current activities and their aims were to take advantage of several modes of transportation in their operations and to continuously improve the efficiency of each mode. Nonetheless, due to the dominant drivers of cost and time on their services, road-based solutions were the most common. For any mode chosen, lowering vehicle energy use was prioritized (e.g., electric trains and EU 5.0 trucks⁴).

Another current activity mentioned by LSPs is to increase the utilization of internal movable and static resources. Higher internal resource utilization was suggested to increase load factor, fill rate, efficiency, as well as economic benefits. On the other hand, as some of the interviewees explained, it may decrease fuel/energy consumption and GHGs emissions per tonne-km, and/or volume-km.

⁴ The latest emissions standards for the vehicles operating in the EU.

Table 3

Categories of current activities in developing environmentally sustainable logistical activities from LSPs' perspective.

Categories of primary activities	Categories of secondary activities
<ul style="list-style-type: none"> • Internal resources efficiency, effectiveness, and utilization • Sustainability behavioral cautiousness • Measurement and assessment 	<ul style="list-style-type: none"> • Taking initiatives (UN Global Compact, UN Development Program [UNDP], Logistics Emergency Teams [LET]) • Compliance with legislation and standards (ISO 14001, EMAS certification, Sulfur emission and ballast water legislation by IMO) • Efficient utilization of external logistical infrastructure (Single European sky, Coordinated air traffic control) • Well-connected information and goods flows (by implementing “intelligent transportation” or “track-and-trace” systems) • Vertical and horizontal collaboration (collaboration and lobbying with other LSPs, authorities, and stakeholders)

Finally, several LSPs have started to be energy- and eco-efficient by acting more responsibly with, and in, their internal static resources, such as terminals, hubs, distribution centers, warehouses, and offices.

Sustainability behavioral cautiousness

The behavior of different stakeholders was emphasized by most of the cases as an important area affecting sustainable development. Eight of the LSPs had started programs to make the behavior of stakeholders more environmentally/sustainably cautious. Some examples are:

- Educating all staff about ethical and environmental operations, like the Go-Green and Go-Teach programs started by DHL.
- Training all fleet staff for ‘eco-driving’ in road and rail transportation, ‘eco-sailing’ in sea transportation, and ‘green take off and approach’ in air transportation.
- Responsible sourcing/procurement in order to scan suppliers to ensure that they fulfill social and environmental requirements. One of the interviewees stated, “What we do is that we make a risk assessment on each supplier and if we find that there is a risk connected to that supplier, we work more with the supplier until we have either decided that there is not any risk or irresponsible behavior.”

Measurement and assessment

Measurement and assessment are inseparable LSPs’ activities for sustainable development. As one of the interviewees stated, “We have developed an internal standard as well as scorecards regarding how to collect and measure different kinds of parameters connected to sustainability.” Some LSPs have taken advantage of independently verifying authorities for the execution of such activities. One of the interviewees emphasized, “We would like that all measures and figures are checked by independent parties. [...] We are also asking our clients to ask for similar independent verification for our competitors’ figures. . . so, the figures are really accurate and possible to use in real benchmarking. . . because we believe that we have figures that you can trust and can be used for your procurement process and that will also drive performance.” All LSPs collaborate actively with other stakeholders to increase the validity and reliability of their emissions calculations. Four out of ten LSPs investigated offer online platforms for the calculation of GHG emissions from transportation operations. Eight out of ten publish annual sustainability reports that are openly available to customers, clients, and other stakeholders.

Future activities in developing environmentally sustainable logistics

All highlighted the tremendous difficulty and uncertainty in designing future sustainability-related activities and strategies in a long-term perspective such as 40 years from now. Most of them have shorter perspectives (two up to 2020, 3–5 years for others). The analysis of future activities resulted in seven categories (summarized in Table 4). Three were strongly and explicitly emphasized in the case studies (primary activities) while the other four were less emphasized (secondary activities). The primary activities are explained below. It is worth mentioning that the LSPs are planning to continue their current activities mentioned in section ‘Current activities in developing environmentally sustainable logistics’.

Innovation and research

The need for innovation for sustainable development was stated by all the interviewees in different ways. For example, one of the case LSPs with core competence in sea transportation elaborated on the role of innovation and research on energy consumption of vessels: “Long-term investments in research, technical developments, and innovation are behind our strategies towards reduction of [total] energy consumption [...] we would like to be pioneers, prime movers, in reduction of emissions.” The need to further increase collaboration with researchers and advisory councils in research and development is something that several of them put forward.

Table 4

Categories of future activities in developing environmentally sustainable logistical activities from LSPs' perspective.

Categories of primary activities	Categories of secondary activities
<ul style="list-style-type: none"> • Innovation and research • Energy and fuel efficiency • Increasing awareness 	<ul style="list-style-type: none"> • Technological development (development or adaptation of Transportation Management System's [TMS], Intelligent Transportation Systems [ITS], Enterprise Resource Planning [ERP]) • Design for sustainability (better design of supply chain nodes like number and arrangement of terminals, hubs, distribution centers, etc.) • Adaptation to future policies and corporate governance (collaboration with authorities and policy makers regarding future policies and directives) • Taking supply/value chain view (collaboration with product producers/manufacturers and consumers as well as passenger carriers)

Energy and fuel efficiency

Energy is an inseparable part of environmentally sustainable logistical activities. The interviewees reflected on one or more of the following issues for future activities related to energy- and fuel efficiency:

- To energize and utilize resources like vehicles and facilities fed by non-fossil/renewable fuels.
- Collaboration with vehicle manufacturers (e.g., Volvo, Scania) to design more environmentally friendly trucks, trains, vessels, as well as aircrafts that are lighter and more aerodynamic, have more efficient engines, and emit zero GHG emissions.
- To move towards zero emission from energy production and consumption. In this regard, LSPs will collaborate with base industries, like energy producers, to find alternative fuels that are produced without using raw material from food sources or endangering forests or biodiversity. As one of the interviewees stated, "It is very important that renewable energies be globally and ethically produced in a way that does not increase GHG emissions."
- To benchmark energy efficiency with other businesses, as well as investments in innovation, research, and technical development, for lower energy consumption and higher efficiency.

Increasing awareness

LSPs are going to work with other stockholders on organizational, national, and international levels to increase the awareness of new generations about the dimensions and importance of sustainable logistics. One of the interviewees stated, "In general, we have been much more aware of sustainable development after Al Gore and the [IPCC Nobel Peace Prize in 2007](#). In fact, a new world has been opened. I think that future generations will be even more aware when it comes to energy resources, climate change, the environment, ethical trade, and so on." The need to increase awareness among suppliers and customers (shippers and recipients/consignors and consignees) as well as carriers, forwarders, and logistics service intermediaries were elaborated on by LSPs several times in the interviews. They also emphasized the significance of changes in customer behavior and outlooks when it comes to purchasing sustainable logistical services. However, it was clear from all cases that, at the moment, cost and time are much more prioritized than environmental friendliness.

Challenges in developing environmentally sustainable logistics

The third part of our investigation focused on the challenges LSPs perceived in making their operations environmentally sustainable. The following four categories emerged from the analysis: customer priorities, managerial complexity, network imbalance, and technological and legislative uncertainties.

Customer priorities

All of the interviewees stated that customer interest in sustainable development is essential in order to develop and deliver more sustainable solutions. All LSPs felt that customers had a rather low interest in prioritizing more sustainable solutions. One interviewee explained that in dealing with customers, "The challenges are mostly about time and price!" Most of the LSPs put forward that, today, customer behavior is the opposite of environmental cautiousness. Customers usually look at transportation and logistical services as non-value-added activities that must be carried out quickly and at the lowest price. Consequently, LSP fill rates and resource utilization deteriorate which leads to higher emissions and negative environmental impacts. As one of the interviewees claimed, "In conclusion, it is very difficult to balance the cost, time, environmental friendliness, and at the same time competition with other LSPs." Consequently, there is a great challenge in finding ways to overcome the economically driven solutions. As explained by one interviewee, "... it is not the environmentally friendly solutions that should be costly. The non-environmental solutions should be more costly." However, as another explained, "We have an eco-friendly solution [...] which is actually cheaper but then we need more time to plan the transportation. But there are not many companies using it even if it is cheaper because of time limits."

Managerial complexity

Developing sustainable logistical services was found to be tied to several managerial challenges. One dimension is that of difficulties in measurement and assessment. For example, different LSPs use different standards, methods, and platforms for

measuring GHG emissions or for assessing the environmental impacts of logistical operations. One of the interviewees from the air sector stated, “Together with IATA and Star Alliance, we work with issues like global Emissions Trading Scheme (ETS)... This is an absolute challenge to reach the goals and I do not know if we can succeed!” Another dimension is different demands from customers in different markets. Working with different types of industries calls for a highly flexible logistics system. For example, on some occasions resources are restricted by volume (cubic meter) and on others by weight (tonne). Finding cooperative ways to develop sustainable solutions is also recognized as a major challenge due to the fragmented nature of the logistics industry. For example, while all LSPs offer freight transportation services using all modes of transportation, they typically contract with several logistics service intermediaries (LSI), forwarders, and carriers to perform out their services. Consequently, the management of all LSIs, forwarders, and carriers is challenging, especially when it comes to all the pillars of SD. Finally, change and adaptation take time and can be expensive. All the cases highlight the complexity of implementation: It takes a long time and is expensive to change the fleet to newer, more environmental vehicles; to adapt to new sustainability legislation; to synchronize internal thinking about the environment; to find adequate staff and educate and train them; to inform all actors of a global supply chain, and sometimes politicians and decision makers, about the importance of all aspects of sustainability; and to get suppliers to adapt to sustainability criteria.

Network imbalance

Another identified challenge is to balance the flows of goods and resources in the network. Imbalances in goods flows are mostly due to restrictions in the system, such as delivery at an exact time as well as daily, and usually diverse, load and unload (pick and delivery) operations. Geographical positions may also lead to both imbalances in goods and resources flows. Network imbalances reduce fill rates as well as resource utilization, which mean higher emissions and more negative environmental impacts. The scenario becomes worse when it comes to network imbalances in international markets. Globalization, exports, and free trade can all lead to imbalances in freight transportation networks. One of the interviewees from case 4 highlighted that, “If you look at global commerce – it is very easy to say that everything should be locally sourced ... but you should have in mind that no country has ever gone from extreme poverty to being developed without very heavy commerce with other countries.”

Technological and legislative uncertainties

Uncertainties about future fossil-free fuels and infrastructural changes for production of such fuels, especially in global markets, are very challenging. One of the interviewees stated, “My guess is that finding a fossil-free fuel for the future is not easy [...] so, if we can cut consumption that would be really very good. But to take it to the very far end of finding fossil-free fuel that can be produced in enough quantity without other external negative effects is very tricky.” Other dimensions of uncertainties are related to future changes in the transportation infrastructure. Taking initiatives like investment in new infrastructures, or a combination of passenger and goods transportation infrastructures, such as rail networks in cities was also found involving tremendous uncertainties.

Uncertainty in legislation and regulations is also a challenge central in the cases. Without clear and long-term directions from regulators, the willingness in the LSP industry to take risks by increasing transportation by train and/or go for bio-fuel alternatives are low. As explained by one interviewee, “Regulators and governments must create concrete strategies and stay with these.” Global legislation was also emphasized in most cases. As one of the interviewees stated: “We believe that ... if you look at the development on the landside ... [how the truck emissions and energy efficiency has increased over the years] ... it has very little to do with voluntary actions ... It is very connected to legislation ... so, voluntary action can of course, be a very good [demonstration] to show examples, etc. ... but to really get the speed going for development, you need international political decisions ... otherwise, if the shipping industry remains forgotten, we will not develop as fast as we would like.” In general, it was found that uncertainties make the LSPs more reactive and less willing to act proactively by taking initiatives.

Discussion

The results of our study confirm a number of areas that have been addressed in the literature, albeit to a limited extent. Few academic contributions address environmental and sustainability activities and challenges from LSPs' perspective. This is somewhat remarkable since the impacts their services have on the environment are substantial. Furthermore – although already concluded by [Wu and Dunn in 1995](#) (p. 34) that “Logistics has been a missing link in providing green products and services to the consumer” – advancements in the area in research or practice seem not to have been prioritized.

While there are a number of current, ongoing activities, and some being planned, mainly for the short period of time (3–5 years), the question remains whether these are enough to meet the sustainability challenges raised by the IPCC (90% reduction of CO_{2e} by 2050) or raised by the UN or the World Bank. An overall impression from the interviews is that the main strategy for LSPs is “wait-and-see”. While the activities they perform are mainly internally focused, the challenges identified are mostly of an external character. This means that it is customers, who have to reprioritize, or technology and/or governments that have to become more stable and more concrete. The management of different stakeholders (suppliers, partners, etc.) is rather complex. Categorizing the activities in the spectrum of Welford's greening framework [2000, p. 18](#)), the activities are all on the lower levels; what he states are superficial changes where the focus is on a technological fix, pollution

control, and environmental auditing. However, while the interviews raised “increasing awareness” as a key area in future activities; this relates to the higher level, i.e., cultural change, in Welford’s framework.

Based on the findings gained from LSPs’ perspective, we argue that there is a great need for holistic models and frameworks that take into consideration the complexity present, instead of solely trying to reduce or eliminate it. Without such a perspective, decisions and policy making will not be based on a comprehensive picture of reality or the consequences that can arise from the process. This is often the case right now when dominant/prevaling perspectives, often economically driven and based on simplified assumptions, have both negative ecological and social effects. By analogy, LSPs must also have a holistic perspective of the whole of the supply chain in order to avoid suboptimal and isolated decisions for sustainable development of logistical activities.

The role and perspective of LSPs in supply chains opens up for new perspectives in making supply chains sustainable. As highlighted by [Huemer \(2012\)](#), the LSPs’ perspective opens up for the question to be asked: What is the right product for the supply chain at hand? This could be especially interesting if it is integrated with the prevailing perspective in both research and practice; the product perspective. This perspective has been manifested for a long time whereas in supply chain contexts, research has very much focused on what [Fisher \(1997\)](#) puts forward in the question: What is the right supply chain for your product? In this line of reasoning, the concept of three-dimensional concurrent engineering (3DCE), in which the product, process, and supply chain are designed in parallel, was proposed by [Fine \(1998\)](#), [Ellram et al. \(2007\)](#) and [Ellram and Stanley \(2008\)](#). It is valuable for the discussion of holistic models and frameworks for SD and LSPs. [Ellram et al. \(2007, p. 322\)](#) state that, “Because three-dimensional concurrent engineering is itself a multifaceted combination of processes that exist within a complex adaptive system, research methods that allow the modeling and understanding of such complexity are required.” This is applicable to the complex situation of SC and LSPs, and a base for both theoretical development and practical implications. Factors such as interdependences among the actors in supply chains, human factors, and other emerging phenomena such as resource reductions in logistics operations or legislative changes, ought to be considered as integrative with the design of the product, the processes, and the SC.

Putting the 3DCE concept on sustainability pillars provides a holistic framework where the role of LSPs and their competences are interesting ([Fig. 1](#)). While the design of products and production processes are core to Original Equipment Manufacturers (OEMs), the source and delivery processes as well as the structure of supply chains, are where LSPs can provide knowledge and competence. Currently, logistics is most often seen as a service which has to be acquired after products have been designed and developed ([Zacharia and Mentzer, 2004](#)). [Chapman et al. \(2003, p. 645\)](#) conclude that, by increasing knowledge sharing with logistics functions and/or providers in the SC, the achievement of greater efficiency, increased customer satisfaction, and better strategic planning can all lead to more flexibility, and adaptation to market changes, rapid and flexible supply chain management processes, and other benefits like rapid innovation capabilities. As a result, the possibility to influence products in the early phases is low. Instead, logistics services are to be adjusted and have to handle suboptimal product flows. Consequently, if customers of logistical services could involve LSPs in the early phases of product design and development not only would there be opportunities to optimize the movement of goods and products, but improved collaboration could also lead to increased prioritization of LSPs and their operations.

Conclusions

In this paper, we have explored major themes and challenges in developing environmentally sustainable logistical activities from a LSPs’ perspective. A major conclusion is that sustainability issues from the LSPs’ perspective have a strong tendency towards economic/profit-related issues followed by environmental concerns, and thereafter, social/people-related ones. It is also concluded that LSPs recognize cost and time to be of major importance to their customers; most of them feel that their efforts to provide more environmental solutions do not pay off since they are not prioritized when they come in conflict with cost or time. Furthermore, there are a number of uncertainties that restrain LSPs, such as uncertainty in technological development, regulations and legislation, and how their customers chose to prioritize.

The need for increased customer willingness to purchase the environmentally sustainable services offered by LSPs is pointed out in relevant literature as a prime challenge ([Philipp and Militaru, 2011](#); [Lieb and Lieb, 2010](#); [Abbasi and Nilsson, 2012](#)), and confirmed in our study. As [Wolf and Seuring \(2010\)](#) state, “customers still give value to traditional performance, such as price, quality, and timely delivery ahead of environmental concerns.” It is also a challenge to foster green practices ([Perotti et al., 2012](#)) and operationalize sustainability across entire supply chains ([Abbasi and Nilsson, 2012](#)) or internally within LSPs ([Lieb and Lieb, 2010](#); [Abbasi and Nilsson, 2012](#)). Lack of sufficient cooperation/partnership, insufficient information flow ([Wolf and Seuring, 2010](#)), and low sustainability awareness/knowledge ([Abbasi and Nilsson, 2012](#)) among LSPs and their supply chain stakeholders are others barriers that, according to our interviewees, affect sustainability behavior and more specifically, reduce opportunities to achieve high fill rates and optimal resource utilization. Uncertainties about governmental regulations ([Abbasi and Nilsson, 2012](#)), as well as unclear regulations and policies ([Wolf and Seuring, 2010](#)), are also experienced by the LSPs we investigated. The difficulties reported in the diagnosis, measurement, and assessment of the environmental impact of supply chain practices ([Abbasi and Nilsson, 2012](#); [Perotti et al., 2012](#)), and in setting appropriate environmental benchmarks/targets ([Lieb and Lieb, 2010](#)) are also in line with our findings. In addition, our results identify two other challenges that have not been addressed previously in relevant literature, namely network imbalance and uncertainties about infrastructural changes related to transportation.

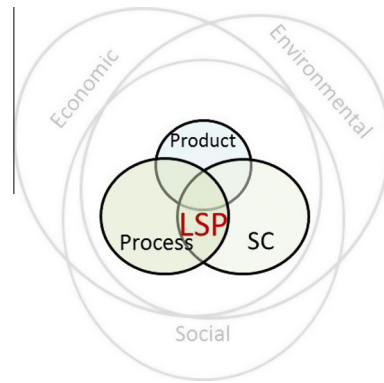


Fig. 1. The three-dimensional concurrent engineering concept put on sustainability pillars emphasizing the role and competence of LSPs in contributing to more sustainable development of products, processes, and supply chains.

There are some limitations that need to be reflected upon. This investigation has been explorative with a focus on an in-depth understanding of a limited number of representatives from LSPs together with websites and other reports. Furthermore, while several more LSPs were contacted it has only been those willing to participate we have investigated. This could potentially mean a bias towards those who are at least interested in environmental sustainability. Finally, the geographical focus has been the Scandinavian region, known for its environmental proactivity, and further studies are needed that both explore and exploit the results of this research in other regions, as well as globally.

Further research is needed to understand characteristics of interrelationships between LSPs and their stakeholders in the development of sustainable logistical solutions as well as the role and importance governments have in reaching the goals of 90% CO₂ reductions before 2050. The three-dimensional concurrent engineering framework should be further explored in this endeavor. A future step may be the analysis and design of logistical setups in collaboration with product producers and manufacturers, end-tier consumers, and passenger carriers. In addition, it is also necessary in further research to explore business models that focus on sustainable development and drive the prioritization of buyers not only towards cost and time but also to examine environmental and social aspects related to the movement of goods.

Implications

For logistics service providers this research provides a set of themes, both current and future, that LSP acting on the Scandinavian markets are doing and planning for. Furthermore, due to the low level of research taking a LSP perspective, managers of LSP are encouraged to engage in more research activities and thereby develop both their own knowledge, capabilities and contribute to an area lacking knowledge for the changes needed to happen in order to reach the GHG emission targets.

The themes identified can help managers, governors, and decision makers when they design future strategies, policies, and legislation to transform logistical activities towards sustainability. Since one of their tasks is to tackle challenges, the ones identified here may help them to obtain a more holistic view of those experienced by LSPs.

A further implication is that sustainable logistics will not emerge without collaborative interrelationships among the supply chain stakeholders. The sustainability strategies and challenges of one stakeholder both influence, and are influenced by, those of the others. Service buyers (such as cargo owners, shippers) have a direct influence on the sustainability strategies of LSPs by increasing resource utilization and fill rates, demanding environmentally and socially responsible services, and the calculation, measurement, and assessment of GHG emissions and carbon foot prints across supply chains. To tackle all the challenges identified calls for willingness and collaboration among cargo owners and shippers.

A final implication for both policy makers and LSP managers relates to one of the dominant pre-assumptions in developing sustainable logistics that more environmentally friendly modes should be used. This may be true in the short term but the standpoint from our analysis is that it will not solely solve the problem in the long term. The transportation system should develop in a resilient way in the long term while tradeoffs are taken into account. This means that in the event of peak loads for one mode, the other modes must be able to be replaced. Peaks can occur because of natural disasters, weather conditions, risk and security reasons, terrorist attacks, etc. In addition, optimal competition among transporters, and modes of transportation, may decrease the price of transportation services for customers. Hence, further research is needed on the resilience of transport systems in the supply chain context.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.trd.2016.04.004>.

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