

A Model For Green Freight Supply Chain Leadership

How the private sector can take leadership in reducing freight related emissions | Jean Charles Nyabusore

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Preface

This report was written to present the process and findings of my Master Thesis Project of the Systems Engineering, Policy Analysis and Management master program at the Delft University of Technology. The thesis is the result of an internship at the Smart Freight Centre and studies how the public sector can take leadership in reducing freight related emissions.

While most researches focus on how governments can use regulations and market schemes to reduce air pollution, there is considerably less focus on how the private sector can take the lead in reducing global emissions while this sector is responsible for a significant part of the global air pollution. This issue intrigued and motivated me to devote my Master's Thesis in identifying opportunities for firms to reduce their freight transport related emissions.

First I would like to thank Smart Freight Centre for offering me the opportunity to conduct my research on this subject. In particular, special thanks goes to the interviewees who were willing to participate and contribute to this research.

Furthermore, I would like to express my gratitude to all of my graduation committee for taking on this great challenge with me and for their valuable support throughout the complete research period. Their guidance, valuable feedback and kindness have significantly contributed to the realization of this report.

In addition, I would like to specially thank my first supervisor, Dr. Jafar Rezaei, who fulfilled the function of the first internal supervisor in my graduation committee. He has helped me with valuable feedback moments that enabled me to reach my final results.

Last but not least, I would like to thank my family and friends for their support during my student life and especially for their thoughtfulness during the graduation project.

J.C Nyabusore

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Summary

Enhancing environmental performance through leadership

Various studies suggest that effective and efficient collaborations in a supply chain improve the chain's overall performance and that they are achieved by an organization that acts as the supply chain leader by taking strategic decisions for the supply chain. This concept of supply chain leadership creates a window of opportunity for firms to take leadership in increasing the environmental performance of the global supply chain, i.e. green supply chain leadership. On this topic, other studies claim that a firm can enhance the environmental performance of its supply chain by leading its suppliers as the environmental performance of suppliers is mainly driven by the demands of their customers. This opportunity window of opportunity is important since various studies argue that environmental leadership from governments alone is not sufficient and that environmental pollution, that negatively affects the planet, is significantly increasing.

However a literature review revealed that literature on the process of supply chain leadership is limited and that literature on green supply chain leadership is virtually non-existent. As a consequence, viable opportunities for the private sector to take leadership in making supply chains more sustainable are missed. To this effect, this study recognized the following **knowledge gap:** *"There is no study that specifies how the concept of green supply chain leadership can be applied to improve the environmental performance in the global supply chain."*

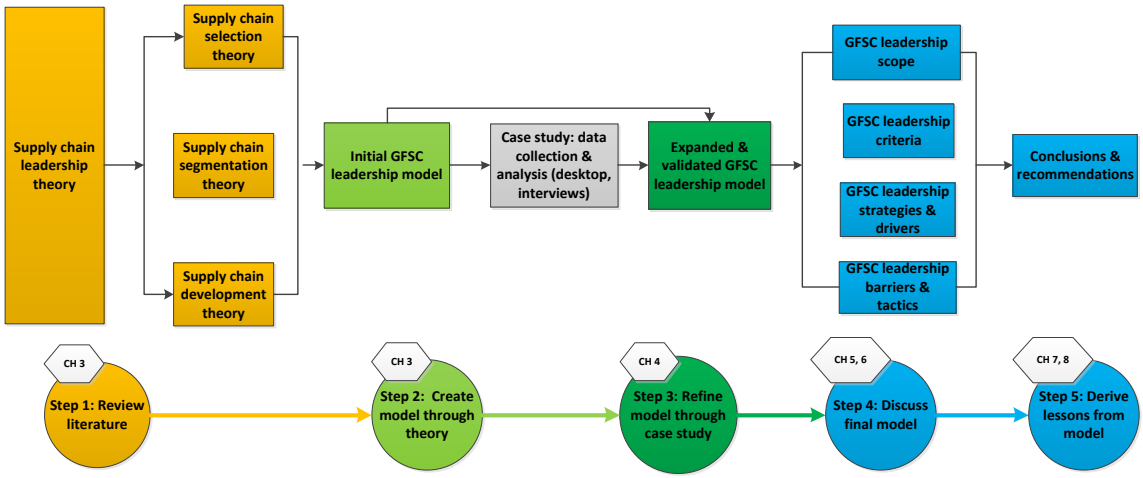
Delineation and research question

To fill this knowledge gap, emissions in the global freight transport sector were selected for an-in-depth case study since they represent one of the fastest-growing sources of pollution that lead to climate change and other environmental problems. To identify potential leaders and followers, various studies were consulted which suggested that large shippers can take the role of Green Freight Supply Chain Leaders (GFSC leaders); that carriers as the transport suppliers can assume the role of Green Freight Supply Chain Followers (GFSC followers); and that Large Logistics Services Providers (LSPs) can take both roles. On this basis, the main research question was formulated as: *" How can shippers and LSPs, as green freight supply chain leaders, influence their green freight supply chain followers, that consist of LSPs and carriers, to reduce freight related emissions? "*

Methodology

The research approach in Sum_Figure 1 shows that the study consisted of five steps where a literature review and a case study were used to fill the knowledge gap and answer the research question. In step 1, the literature review generated input that was used to build the initial GFSC leadership model in step 2. The literature review studied the theories on supply chain leadership, (green) suppliers selection, (green) supplier segmentation and (green) suppliers development. The later three theories were consulted as the current literature on supply chain leadership does not specify the process of leading followers/suppliers. Based on theory for developing inter-organizational relationships, the act of leading

transport suppliers was defined in the steps of: selecting/evaluating transport suppliers, segmenting them and actively developing them to reduce emissions.



Sum_Figure 1: Research approach

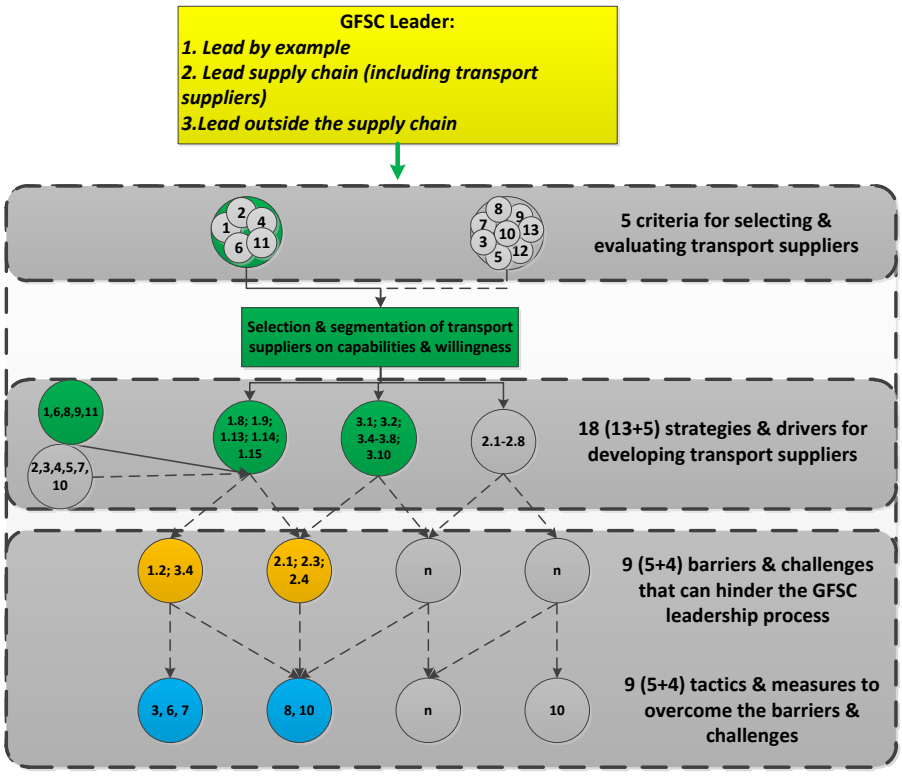
In step 3, the case study was conducted that consisted of a desktop research and semi-structured interviews. The case study studied the behaviors of firms that showed high potential of being green supply chain leaders as they would naturally display how such a model is executed in practice. These findings were used to expand, specify and validate the initial GFSC leadership model with empirical data. This enabled the making of the final GFSC leadership model that was discussed in detail in step 4. In the fifth and last step, conclusions and recommendations were formulated from the lessons derived from the final model.

Results of research: Final GFSC leadership model

The literature review provided data that can be used to build a GFSC leadership model that depicts the steps that a GFSC leader can take to reduce transport related emissions, starting with a shipper/LSP selecting/evaluating its transport suppliers and ending with collaborating with them to reduce emissions. As can be seen at the right hand side of sum_Figure 1, the model consisted of the following four components: (1) the criteria that distinguish a GFSC leader; (2) GFSC leadership criteria that can be used to select and evaluate transport suppliers; (3) GFSC leadership strategies and drivers that can be used to develop transport suppliers in reducing emissions; (4) barriers that can hinder the green collaborations and the tactics to overcome them.

The benefits of such a GFSC leadership model is that it can provide a shipper/LSP an overview of all different options that can be taken, where to focus on and what implications certain decisions can have. However, the model from the literature review would be complex to utilize as it consisted of 88 factors and would have a maximum of 7718 different options, if all strategies, drivers, barriers and tactics were to be connected. Since the literature review showed that not all factors are relevant for the transport sector, the case study identified which elements are not relevant for GFSC leadership and thus can be left out of the model. This would generate a smaller model with all the useful insights but without

compromising on the user-friendliness. This smaller final model is depicted in Sum_Figure 2 and has 41 factors that provide 175 options . These are elaborated further.



Sum_Figure 2: Final GFSC Leadership model

First component: GFSC leadership

GFSC leadership was found to be a relational concept involving a collaboration between a GFSC leader and transport suppliers where the GFSC leader is a shipper/LSP that needs to exercises leadership at the following three levels of GFSC leadership to effectively reduce transport related emissions: 1) Lead by example by showing commitment to reduce own emissions, (2) Lead firms within the supply chain to optimize the entire supply chain and (3) Leading outside the supply chain by collaborating with stakeholders to create standardization of methods and promote best practice sharing.

Second and third component: GFSC leadership criteria, drivers and strategies

Sum_Table 1 summarizes the criteria, drivers and strategies that were cited to be relevant for the freight transport sector.

Sum_Table 1: criteria, drivers and strategies cited to be relevant for GFSC leadership

Criteria for selecting/evaluating transport suppliers	**Drivers for incentivize transport suppliers**	**Strategies to develop transport suppliers**
Transport suppliers pollution production	Increased cost-efficiency	Green knowledge transfer and communication
Transport suppliers efforts to reduce emissions	Increased financial performance	Develop transport suppliers management and organizational practices
Transport suppliers transparency of environmental performance	Improved leader-transport supplier relationship	

Fourth component: GFSC leadership barriers and tactics

The fourth component consists of internal barriers and external barriers. Internal barriers can be attributed to the GFSC leader or to the transport supplier while external barriers are from the global freight transport industry. As external barriers are industry-wide, a GFSC leader will not be able to tackle them individually, but could contribute in the realization of industry-wide measures that decrease them. To distinguish these two types of barriers and the tactics that can tackle them, external barriers were named “challenges” and their corresponding tactics “measures”. Sum_Table 2 summarizes the barriers, challenges, tactics and measures that were found to be relevant for the freight transport sector.

Sum_Table 2: barriers and tactics cited to be relevant for GFSC leadership

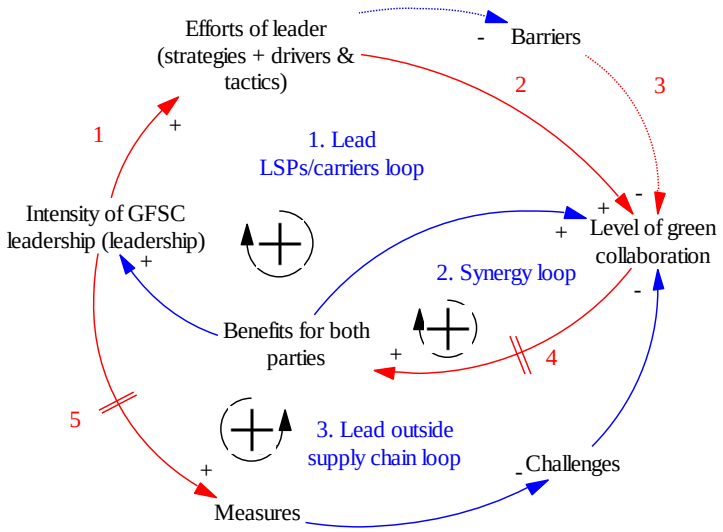
Barriers (internal)	**Tactics**
Transport suppliers have in insufficient resources	Financial and business incentives
Transport suppliers have low commitment to engage in green collaborations	Make clear and formal agreements
Transport suppliers are reluctant to share fuel consumption information in fear for price negotiations	Communicate the benefits
Shippers’LSPs have too many transport suppliers with different characteristics in different regions	
Challenges	**Measures**
Different emissions measuring methodologies that cause unstandardized and limited data	Standardization of measuring methodologies
Prevailing idea that transport emissions represent only a small part of shippers footprint	Making transport emissions data available for shippers/LSPs
Little priority for sustainability in transport industry	External pressure from the market, NGO’s and governments to increase the demand for green transport
High green investment costs vs low profit margins in transport industry	Sharing of best practices

Conclusions and recommendations

Summarizing the insights on how GFSC leadership is currently exercised and how it can be improved, sum_Figure 3 provides an overview of how the identified GFSC leadership related factors influence each other. The important element here is the feedback loop that consists of a factor that eventually influences itself through other factors and thus can significantly strengthen or weaken a certain effect. As can be seen in sum_Figure 3, three positive feedback loops were identified that describe how a GFSC leader can influence transport suppliers to reduce freight transport related emissions. Furthermore, three main weaknesses were identified that hinder the current GFSC leaders to function effectively. Their effects are visualized by the red numbered arrows.

Feedback loops

The first feedback loop, "**Lead LSPs/carriers**", starts with a higher intensity of leadership leading to increased efforts by the GFSC leader to develop suppliers. Efforts can take the form of deployed strategies + drivers and of deployed tactics (indicated with dotted lines). Higher intensity of these two forms of efforts will lead to higher levels of green collaborations that will increase the green benefits for both parties and these will on their turn intensify the level of GFSC leadership. The second feedback loop **"synergic partnership"** concerns increased "level of green collaborations" leading to higher "benefits for both parties". This increases green collaborations further.



Sum_Figure 3: visualization of the current GFSC system

The third feedback loop, "**Lead LSPs/carriers"** involves external challenges from the global transport industry that hinder green collaborations. As the challenges are industry wide, the measures to tackle them cannot be implemented by an individual firm but a GFSC leader can contribute to the realization of

a measure. Such measures can increase green collaborations, which increase the involved benefits. The benefits on their turn increase the intensity of GFSC leadership.

Weaknesses that hinder current GFSC leaders

The weakness can be found in the first and second red arrow and concerns the making and deployment of strategies to develop transport suppliers. Here it was found that the shippers/LSPs did not have a clear picture of the effectiveness strategies they deployed. Another issue that can be attributed to this fault is the lack of a long-term perspective to see past the delays involved that are indicated in the fourth and fifth red arrow by double crossed lines.

The second fault has also its effect in the first and second red arrows and concerns the prevailing business approach to green transportation. The interviews namely showed that green strategies were mostly implemented for costs savings and improving business and not for their long-term emissions reduction potential.

The third fault can be found in the third red arrow and concerns the fact that all but one barrier, that were cited to be relevant in hindering green collaborations, were attributed to transport suppliers. As all interviewees were shippers/LSPs, it might suggest that they are not-self-critical enough to recognise their part in issues that hinder green collaborations.

These weaknesses hinder an effective system as the case study illustrated a significant mismatch between the effectiveness of strategies and the rate in which they are deployed. These weakness hinder effective GFSC leadership as the case study illustrated a significant mismatch between the effectiveness of strategies and frequency in which they are deployed. For instance, about six out of eleven of the above average deployed strategies are found to be ineffective in reducing freight emissions. While about half of the under average applied strategies were found to be effective. This indicates that, although the studied firms belonged in the group of potential GFSC leaders, they often did not apply effective strategies implying that the current resources used to reduce transport related emissions can be utilized more efficiently.

Recommendations

Current GFSC leadership can be improved by shippers/LSPs taking a less business approach to sustainability, taking a more self-critical view, and taking a long-term perspective to see the benefits of implementing the more advanced strategies. To generate the bigger picture in terms of what strategies to apply, the research showed that shippers/LSPs can lead transport suppliers with the support of the GFSC model presented in this study.

For shippers/LSPs aspiring to effectively reduce their transport related emissions, the model provides a means of overcoming the many identified barriers as it provides a process that starts with the selection/evaluation of transport suppliers and ends with developing them. This includes an overview of the different strategies that can be taken with the corresponding drivers, barriers, tactics, challenges and measures. The GFSC leadership model can also provide a solution for the only barrier for which no

tactic was found to be relevant as the “too many transport suppliers to engage individually” can be segmented on their willingness and capabilities, easing the process of developing the suppliers.

For Smart Freight Centre (SFC) as the commissioner of this report, the recommendation can be given to facilitate in the realization of the measures to address the industry wide challenges. The interviewees namely suggested that a neutral party will mostly likely have the credibility to collect fuel consumption data from transport suppliers, translate that into emissions production and share the information with shippers/LSPs. Also it was suggested that such a third party can facilitate the standardization of methodologies and the sharing of best practices.

Furthermore SFC can help the transport industry to tackle the identified “weaknesses in the GFSC system” by providing an overview of the current system, studying whether other shipper/LSPs related barriers are relevant and providing a roadmap of how shippers/LSPs can eventually deploy strategies that considered to be more advanced and effective.

Future research

Concerning scientific literature, this thesis provided new insights that future research can use as a basis to expand and validate current theories on green (freight) supply chain leadership. Future research can be conducted to validate the GFSC leadership model proposed in this study on a control group of shippers/LSPs to confirm the connections made between the drivers, strategies, barriers and tactics. Also transport suppliers can be included to test whether the model can also be applied from their perspective. Here, the role of conditional characteristics of transport suppliers on the effectiveness of GFSC strategies can be an interesting subject. In addition, future research can extend the findings of this report by studying the other two levels of GFSC leadership that this study did not focus on, being leading by example and leading outside the supply chain.

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1 Enhancing environmental performance through leadership

Across the globe firms are shifting from horizontally to vertically aligned networks where they focus on their core competencies and effectively manage their suppliers (Tan, Kannan, Handfield, & Ghosh, 1999) (O'Keeffe & Fearne, 2002). This is in line with the development where firms secure competitive advantage by collaborating with and developing their suppliers "since competition is no longer between organizations, but among supply chains" (Li, Ragu-Nathan, Ragu-Nathan, & Subba Rao, 2006). The significance of this trend can be seen from the fact that it has been the subject of various studies that have generated numerous methodologies, frameworks and techniques that include (Rezaei, Fahim, & Tavasszy, 2014). Other studies further argue that collaborating with and developing suppliers improves a firm's performance and competitive advantage (Li, Ragu-Nathan, Ragu-Nathan, & Subba Rao, 2006) (Fabbe-Costes & Jahre, 2007) (Richey Jr, Chen, Upreti, Fawcett, & Adams, 2009).

Contemporary studies on this subject suggest that effective and efficient collaborations in a supply chain are achieved through explicit leadership as opposed to naturally occurring (Birasnav, 2013) (Sharif & Irani, 2012) (Defee, Stank, & Esper, 2010). For instance, Lambert et al., (2000) argue that having an organization that acts as the supply chain leader by taking strategic decisions for the supply chain, is essential as the lack of it will result in a chaos (Lambert(1), Cooper, & Pagh, 1998) (Lambert(2) & Cooper, 2000). This concept of supply chain leadership creates a window of opportunity for firms to take leadership in increasing the environmental performance of the global supply chain, i.e. green supply chain leadership. This is important as various studies claim that leadership from governments alone is not sufficient since current policies are not efficient and face challenges in financing, coordination, standards, monitoring and enforcement mechanisms. (Keohane & Victor, 2011) (National Academy of Sciences, 1992) (McKibbin & Wilcoxen, 1997) (Böhringer, 2002). For instance, current efforts to reduce emissions and combat climate change are described by some as "a loosely-coupled set of specific regimes" that do not fully cover the complex economic processes and the wide range of actors involved (Keohane & Victor, 2011) (Betsill & Bulkeley, 2006).

The notion that a firm can enhance environmental performance by leading its suppliers is strengthened by various studies which argue that the environmental performance of a whole industry can be improved by measures taken by the buyers in a supply chain (Humphreys, Wong, & Chan, 2003) (Lamming & Hampson, 1996). Furthermore other studies suggest that environmental performance of suppliers is mainly driven by the demands of their customers and that sustainability in a supply chain can be significantly enhanced through collaborations between customers and suppliers (Lieb & Lieb, 2010) (Colicchia, Marchet, Melacini, & Perotti, 2013) (Rossi, Colicchia, Cozzolino, & Christopher, 2013). Also the fact that various studies find a positive correlation between environmental performance, financial performance and competitive advantage strengths the argument for green supply chain leadership (Molina-Azorín, Claver-Cortés, López-Gamero, & Tarí, 2009) (Rao & Holt, 2005) (McKinnon, 2014) (Lai, Lun, Wong, & Cheng, 2011) (McGuire, Sundgren, & Schneeweis, 1988) (Lai, Lun, Wong, & Cheng, 2011).

1.1 Research problem

Knowledge gap and problem definition

This study focuses on the potential of green supply chain leadership as elaborated in chapter 1.1, i.e. how firms can use the concept of supply chain leadership, with respect to their suppliers, to increase supply chains' environmental performance. A literature review on this subject revealed that literature on the process of supply chain leadership is limited and that literature on green supply chain leadership is virtually non-existent. As a consequence, viable opportunities for the private sector to take leadership in making supply chains more sustainable are missed. This reveals a serious problem as the need of such knowledge is emphasized by the earlier mentioned fact that government's leadership alone is not a sufficient option. Considering the lack of a structured and comprehensive research in this area and with respect to current scientific literature, the knowledge gap is defined as follow:

"There is no study that specifies how the concept of green supply chain leadership can be applied to improve the environmental performance in the global supply chain."

With regard to this knowledge gap, the problem definition of this research has been formulated as:

"Viable opportunities are missed for the firms to take leadership in increasing environmental performance of the global supply chain. This problem is aggravated by the fact that governments' leadership alone is not a feasible alternative."

To fill this knowledge gap, a literature review and a case study were conducted to gain an understanding of what green supply chain leadership is and how firms can use it with respect to their suppliers.

Delineation

Due to time restraints and feasibility, the scope of the research was narrowed down to emissions in the global freight transport sector. Here large shippers are considered to be the potential Green Freight Supply Chain Leaders (GFSC leaders), carriers as the transport suppliers are considered to be the potential Green Freight Supply Chain Followers (GFSC followers) and large Logistics Services Providers (LSPs) can take both roles. These choices will be elaborated in greater detail.

The choice for emissions in the global freight transport sector was made since it represents one of the fastest-growing sources of pollutions that lead to climate change and other related problems (Piecyk, 2010) (Fuglestvedt, 2008). This stems from the increased globalized trade, increased online sales, shorter lead times and more frequent deliveries (Piecyk, 2010). As an illustration, the global average C02 emissions have increased by 13% between 1990 and 2000 while emissions from road transport and aviation increased by 25% each (Fuglestvedt, 2008). With no effective measures, transport related carbon emissions will grow from 6 gigaton to more than 14 gigaton, making 30-50% of the global emissions by 2050 (Fuglestvedt, 2008) (Abbasi M. &., 2012) (Piecyk, 2010).

With respect to shippers and LSPs as the GFSC leaders, the choice was based on studies which claim that these parties have the capability to implement green initiatives in the global freight transport sector (McKinnon, 2014) (Colicchia, Marchet, Melacini, & Perotti, 2013). As illustrated in Figure 1, shippers are the goods owners and LSPs provide logistics services for the shippers (McKinnon, 2014) (Tongzon, 2009). Carriers move the goods from origin to destination at the request of LSPs (thus indirectly for shippers) or at the direct request of shippers (Stefansson, 2006).

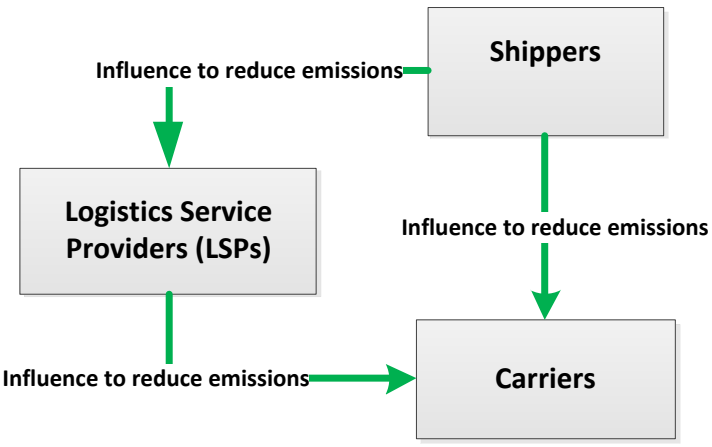


Figure 1: relationships between shippers, LSPs and carriers

The choice for large shippers and LSPs (i.e. that are multinationals) was based on studies which suggested that large shippers have the power and incentive to stimulate their LSPs and carriers to reduce supply chain emissions (Styhre, Lammgård, & Andersson, 2012) (Lammgård & Andersson, 2014) (Lintukangas, Hallikas, & Kähkönen, 2013). As is further elaborated in Appendix 1, the argument is that the power is derived from the fact that shippers and LSPs are customers and they can have an effect on the type of transport modes to be used, the choices in routing and the scheduling (McKinnon, 2014) (Wolf & Seuring, 2010). The incentives are derived from the fact that fuel efficiency leads costs and emissions reduction as 42% of transport costs are accounted to fuel (Bretzke, 2011) (Rao & Holt, 2005). Other studies argue that this also applies to large LSPs as they can effectively stimulate their carriers to reduce emissions through "environmental purchasing" (Zsidisin & Siferd, 2001) (Björklund M. , 2011) (Evangelista, Huge-Brodin, Isaksson, & Sweeney, 2011). It is furthermore argued that large LSPs have the potential to influence shippers by providing green solutions (Lieb & Lieb, 2010) (Colicchia, Marchet, Melacini, & Perotti, 2013).

Research objective

As this report is commissioned by Smart Freight Centre (SFC), the research objective is aligned with the goal of SFC to increase the number of shippers and LSPs that are GFSC leaders. In this context, the issue at hand is that studies show that only a small portion of shippers and LSPs take up the role of a green supply chain leader and that they rank carriers environmental performance as one of the unimportant selection criterion (Van den Berg & De Langen, 2014) (Lai, Lun, Wong, & Cheng, 2011). For instance, a research by McKinnon argued that about 40% of the shippers measure their supply chain emissions and only 6% implement explicit carbon reduction initiatives (McKinnon, 2014). The same can also be said for LSPs as other studies claim that most are not focused in making their supply chains sustainable and that the top management considers a green reputation as of secondary importance (Evangelista, Huge-Brodin, Isaksson, & Sweeney, 2011) (Wolf & Seuring, 2010).

With respect to SFC's interests, the main research objective is to *"add a green (freight) element on the existing supply chain leadership theory and build a model that can support large shippers and LSPs to take a leading role in reducing emissions in the global freight transport sector".*

Based on this research objective this report produces a model for green freight supply chain leadership that includes:

- A clear cut definition and scope of green freight supply chain leadership.
- Strategies and drivers that shippers and LSPs can use to reduce freight transport related emissions.
- The barriers that shippers and LSPs can face in this process.
- The tactics that shippers and LSPs can use to overcome these barriers.

Scientific and social relevance

From a scientific perspective, this research contributes to scientific knowledge by expanding the current limited literature on supply chain leadership and by adding the "green element" in this field. This is done through a model that illustrates the process and specific steps that a firm can take in practicing green supply chain leadership with respect to its suppliers. Additional practical value is also added by using to real-life cases through a case study.

The societal relevance of the research expresses itself in the benefits for shippers, LSPs, carriers, good receivers, governments and the society as a whole. This concerns the costs savings and the increased environmental performance as a result of energy savings for the shippers, LSPs and carriers. For the society, it will be a cleaner environment with less emission pollution and more available energy. Additionally, using the model can assist shippers and LSPs to strategically position themselves as sustainable and provide the leadership role in fostering a cleaner global freight transport sector.

1.2 Research questions

The research objective and deliverables of this report are related to the fact that research shows that shippers and LSPs have the power and incentive to reduce freight transport related emissions, as green freight supply chain leaders, by influencing their green freight supply chain followers, that consist of LSPs and carriers. Furthermore, it is perceived that only a small portion of the shippers and LSPs take up the role of green freight supply chain leader and this hinders the realization of a sustainable global supply chain.

To reach the defined research objective and deliverables the following main research question guided the study:

" How can shippers and LSPs, as green freight supply chain leaders, influence their green freight supply chain followers, that consist of LSPs and carriers, to reduce freight related emissions? "

To answer this question in a structural and comprehensive manner, the following sub-questions were formulated and addressed:

1 What is green freight supply chain leadership and followship and to what extent do these concepts apply? I.e. What is the appropriate scope of these concepts?
2 What strategies and drivers can shippers/LSPs use, as green freight supply chain leaders, to reduce freight related emissions through LSPs/carriers as their followers ?
3 What barriers can hinder shippers/LSPs to implement these strategies and to achieve the desired emissions reduction?
4 What tactics can shippers and LSPs use to overcome these barriers?
5 To what extent are the identified strategies, drivers, barriers and tactics effective or relevant?

Research methods

Two research methods were used to answer the main research question and the corresponding sub-questions, being a literature review and a case study. The literature review was used to find answers to all of the sub-questions from a theoretical point of view. The case study consisted of a desktop research and semi-structured interviews. These were used to expand, specify and validate the findings of the literature review from a practical point of view. Chapter two elaborates further on the research approach and methods.

1.3 Outline

Excluding this introduction, this report consists of seven other chapters. Chapter two, the research methodology, discusses the utilized research approach, the research framework and elaborates on the research methods in greater detail. Chapter three, the green freight supply chain leadership model, is the literature review that provides an overview of the developed model that consists of four components being, (1) defining and scoping GFSC leadership and followship, (2) the GFSC leadership selection and evaluation criteria, (3) the GFSC leadership strategies and drivers and (4) the GFSC leadership barriers and tactics. Chapter four discusses the practical insights to the GFSC leadership model that were gained from the case study through a desktop research and interviews. Chapter five compares the findings of literature review with the findings of the case study. Chapter six presents the final GFSC leadership model and chapter seven summarizes the lessons learned by providing the conclusion, recommendations. As last, chapter eight provides reflections and proposals for future research.

2 Research methodology

This chapter discusses the research framework, approach and the research methods used to achieve the research objective by answering the defined research questions.

2.1 Research framework and approach

The research framework in Figure 2 visualizes the research approach that was used to answer the research questions. This approach will be discussed by explaining the five steps of activities that were undertaken to fulfill the research objective.

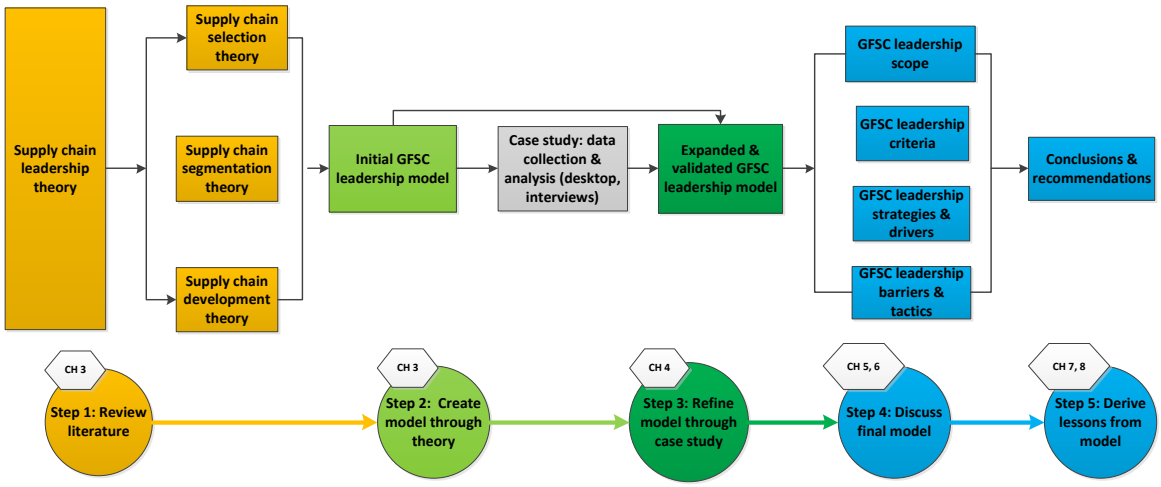


Figure 2: The applied research framework

Step 1: literature review (chapter 3)

As elaborated in the introduction, the theory found on supply chain leadership is limited and does not specify the process (the practical steps) that the leading firm can use to guide its transport suppliers. For this reason, literature on was consulted that provide approaches for firms that have certain targets for their suppliers. Here it was found that there are generally three approaches with respect to suppliers, being switching suppliers, developing suppliers and vertical integration (Chavhan, Mahajan, & Joshi Sarang, 2012).

As vertical integration generally requests significant investments, it is commonly considered a less feasible option (Amad, Hamid, Salleh, & Choy, 2008). This would mostly likely apply to GFSC leadership, as transportation is not a part of shippers core business and would thus imply a major shift from core business. For this reason, this option was not considered leaving the options of switching and developing LSPs/carriers as the two main approaches.

Further research found that switching and developing suppliers falls within the well-documented general framework “for developing any inter-organizational relationship”, as defined by (Rezaei, 2012). This framework was used as the basis to specify the practical steps of GFSC leadership, by specifying the

act of leading transport suppliers as implementing the following three steps: selecting suppliers, segmenting them, managing the relationships with them and actively developing their role over time" (Rezaei & Ortt, 2012).



Figure 3: the longitudinal process of collaborating and developing suppliers (Rezaei, 2012)

As illustrated in Figure 3, supplier selection is the process of selecting suitable suppliers (Cousins, Lamming, Lawson, & Squire, 2008). Supplier segmentation is the classification of the selected suppliers to enable the making of strategies to handle the different segments (Day, Magnan, & Moeller, 2010). Supplier development is implementing the strategies to improve the performance of suppliers as a means of improving the goods and services supplied to the buying firm (Krause, Scannel, & Calantone, 2000) (Krause, Handfield, & Scannell, 1998).

Step 2: Create model through theory (chapter 3)

The findings of the literature review provided the components of the initial GFSC leadership model. This was based on the model by Lambert et al., that provides a process of developing, implementing and improving partnerships between buyers and suppliers, as is further explained in appendix 3. The theory on supply chain leadership provided a definition of supply chain leadership and followship and the scope to which these concepts apply. This provided four criteria that were key for conducting step 3, as potential GFSC leaders needed to be identified. The theory on supplier selection delivered GFSC leadership criteria that a GFSC leader can use to select and evaluate transport suppliers.

The theory on supplier segmentation delivered a framework that a GFSC leader can use to categorize transport suppliers in different segments using the GFSC leadership criteria. This is essential for large firms with many transport suppliers since guiding each firm individually would be an unfeasible task. The theory on supplier development will deliver drivers and strategies that a GFSC leader can use to develop transport suppliers. Furthermore the barriers that might hinder the GFSC leader in the process will be identified with the tactics that can be used to overcome them. These components can be seen on the right hand side of the research framework in Figure 2.

Step 3: Refine model through case study (chapter 4)

The model built by theory was expanded and validated with empirical data that was gathered through a case study. Consisting of a desktop research and interviews, the case study studied the behaviors of firms that showed high potential of being green supply chain leaders as they would naturally display how such a model is executed in practice.

Step 4: Discuss the final model (chapter 5, 6)

As the fourth step of the research approach, the literature is first compared with the case study findings and this generates an overview of the validated, falsified and new aspects. This enables the making of the final model that is discussed in detail.

Step 5: Derive lessons from model (chapter 7, 8)
In the fifth and last step of the research, lessons are derived from the model and are summarized in the conclusions and recommendations. The reports ends with reflections and proposals for future research.

2.2 Research methods

For implementing the above mentioned research framework and research approach two research methods were used, being a case study and a literature review. Both will be discussed in detail in this paragraph.

As the literature review generated input for building the initial GFSC leadership model, an extensive review of the theories of supply chain leadership, (green) suppliers selection, (green) supplier segmentation and (green) suppliers development was required. The findings enabled the construction of the four components as elaborated in step two of the research approach.

Defined by Yin as "an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context", a case study was chosen as the methodology to collect and analyze empirical data. The process was guided by the book of (Yin, 2014) and the choice was based on the facts that (1) the type of research question is the "how/why", (2) the investigator has no control over the actual behavioral events and (3) the focus is on the contemporary events (Yin, 2014). The initial GFSC leadership model was applied to real-life cases and thereby generated data that expanded and validated the model. This was conducted by means of a desktop research and seven semi-structured interviews. More information on the procedures and choices made for the case study can be found in appendix 2.

Desktop research

The goal of the desktop research was twofold, being (1) the selection of firms that have a high likelihood of being GFSC leaders as more firms would claim the leadership title and (2) to map the strategies that the selected firms use to influence their transport suppliers in reducing freight transport related emissions.

As the research objective focuses on large shippers and LSPs in the global freight sector, effort was done to select firms that have a geographical and sectorial global representation. In practice, this means that the set of firms should be multinationals that operate in divers sectors and have supply chains that cover multiple countries. This would increase the generalizability of the framework.

To come to a sample of firms with the above mentioned conditions and maintain a high likelihood of obtaining potential GFSC leaders amongst them, firms were selected that are a member of regional green freight initiatives[1]. The line of reasoning is that a firm's voluntarily membership of an initiative, with the goal to enhance sustainability in the freight sector, demonstrates the firm's willingness to reduce freight related emissions in its supply chain. The regional initiatives were found via the Global Logistics Emissions Council of industry led initiatives, that aims at aligning regional initiatives across the

[1] Meaning firms that are members of the initiatives as of July the 27th 2014, the date that the selection took place

global multimodal supply chain (GFA, 2013) (SFC, 2014). Respectively, this concerns the initiatives and regions that are elaborated in Table 1.

Table 1: list of initiatives and their corresponding regions

Initiative	Region
Green Freight Europe	Europe
Green Freight Asia	Asia
Smart Way	North-America
Clean Cargo Working Group	Global (Marine)
Lean & Green	Europe

This generated a sample of 373 firms that were classified in following 8 sectors: (1) food and beverages, (2) industry & manufacturing, (3) information technology, (4) utilities, (5) consumer goods, (6) health care and (7) transportation and logistics. These sectors are further elaborated in appendix 2.

As Gilbride & Allenby argue that a selection process becomes more difficult with the increasing number of alternatives (Gilbride & Allenby, 2004), a two-phased selection process was applied to effectively select potential GFSC leaders from such a large sample. The first phase was a rough screening which aimed at reducing the initial sample of firms prior to the detailed selection phase. In the first phase, only firms were selected that were multinationals and for which environmental reporting was found on their websites. As an additional requirement from the commissioner, the LSPs were to be a member of two or more of the regional initiatives. This additional condition stems from the fact that various researchers found that the environmental performance of LSPs is mainly driven by pressure from shippers and that many LSPs do not focus on environmental performance (Lieb & Lieb, 2010) (Colicchia, Marchet, Melacini, & Perotti, 2013). The procedure and results of the first phase are depicted in Table 2.

Table 2: first phase of selection process

Activity	Number of companies
1. Started with all companies that are members of the following initiatives as of July the 27th: Green Freight Asia, Green Freight Europe, Smart Way, Clean Cargo Working Group and Lean & Green.	373
2. Selected Logistic Service Providers that are members of min 2 initiatives and report	5
3. Selected to analyze shippers that have obvious information on emission reporting	59
Total of companies to be fully analyzed in desktop research	**64**

The second and detailed selection phase enabled the identification of the green supply chain leaders. This phase involved a thoroughly analysis of a broad variety of documents, including: websites of the five initiatives, websites of the firms that are a member of the initiatives, company environmental reports, annual and evaluation reports and press articles and other publications on the environmental performances of the firms.

For analyzing the data, a conjunctive screening method was chosen in which suppliers were evaluated against the green leadership criteria defined by the literature review. The conjunctive screening method is a widely used and recognized method that sets a threshold, also called a cut-off value, for each

criterion that a firm must meet in order to be considered a green supply chain leader (Gilbride & Allenby, 2004). This implies that each criterion is considered to be of equal importance and that a firm is considered a non-leader when it does not meet a minimum score for all criteria. The equation, the implication and the reason for choosing this particular method can be found in appendix 2.

The two-phased selection process resulted in 37 firms being selected as potential GFSC leaders. Subsequently, the strategies, that they use to influence their transport suppliers were studied in greater and these firms were contacted to participate in the interviews.

Industry validation through interviews:

To validate the model with industry and strengthen conclusions and recommendations, semi-structured interviews with 7 potential GFSC leaders were conducted where 3 were LSPs and 4 were shippers as shown in Table 3.

Table 3: the interviewed firms

Interviewee	Firm	Function
Eric Majoor	AkzoNobel	Sourcing manager, Sea containers EMEA
Ana Davila Martinez	Heineken	Manager transport & green logistics, Global Logistics
Vladimir Poppel	Intel corporation	Corporate commodity manager, supply chain analyst
Georgios Yiannakou	Protector and Gamble	Project Leader, Europe transport operations
Björn Hannappel	Deutsche Post DHL	Senior Expert, Go Green
Bjorn Sawilla	TNT	Manager C02 services, Business development & revenue management
Curt Rousseau	UPS	Vice President Information Technology, Asia Pacific Region

The interviews provided input for the model in terms of the significance of the different elements of the GFSC model. For instance, a comparison was made whether GFSC leadership strategies that literature argues to be more effective or most applied are also considered to be so by the industry. Guided by Yin's recommendations on techniques for drawing conclusions from case studies, pattern matching was chosen to draw conclusions from the interviews. This technique is used to "compare empirically based patterns or data with theoretical ones" and assumes that a theory is more confirmed when a predicted pattern from theory is observed in empirical data (Yin, 2014).

For determining the patterns from the data, the direct rating method and unstructured sorting procedure as applied by (Trochim W. M., 1985) (Rosenberg & Park Kim, 1975) were used. This implies that interviewees rated the expected effects/significance of elements and that the total ratings constituted the pattern (Trochim & Cook, 1992). The latter means that contradicting opinions of experts could cancel each other off as equal value was given to experts opinions. More information on the techniques, the procedures and choices made can be found in appendix 2.

3 Literature review: GFSC Leadership Model

As was elaborated in the research framework and approach (chapter 2.1), the GFSC model adopted the model by Lambert et al., that provides a process of developing, implementing and improving relationships between a firm and its suppliers (Lambert, Emmelhainz, & Gardner, 1996). This model, that also consists of four elements, provided the basis for describing the process of GFSC leadership as is illustrated in Figure 4. The model by Lambert et al., and the reasons why it was chosen as the basis for describing the GFSC leadership process are elaborated further in appendix 3.

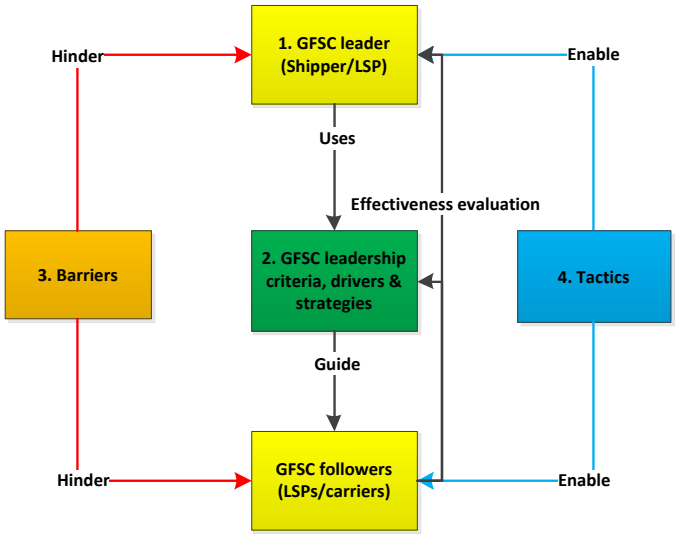


Figure 4: description of the GFSC leadership process

As is illustrated in Figure 4, the GFSC leadership process can be interpreted by starting with the top yellow block where the GFSC leader (shipper/LSP) uses GFSC leadership criteria to select and evaluate its GFSC followers (transport suppliers) in the bottom yellow block. Subsequently, the GFSC leader uses strategies and drivers in the green block to guide its GFSC followers to reduce freight transport related emissions. Here drivers represent the "benefits that a partnership brings for both firms" and can support the strategies as they can incentivize the transport suppliers to cooperate with the GFSC leader. The barriers in the orange block represent the hinders that can hinder the process while the tactics in the blue block represent the solutions to overcome the barriers. The effectiveness evaluation arrow represents the feedback on the performance and/or relevance of the different components.

This chapter elaborates on the GFSC leadership process, as illustrated in Figure 4, through an extensive literature review that is divided in the following five paragraphs: the first paragraph discusses the concepts of GFSC leadership and followship, the second paragraph discusses GFSC leadership criteria, the third paragraph elaborates on the GFSC leadership drivers and strategies, the fourth paragraph explains the GFSC leadership barriers and tactics and the fifth paragraph summarizes all the findings by presenting the initial GFSC leadership model.

3.1 First component: GFSC leadership

This paragraph first elaborates on the contemporary literature on supply chain leadership, then discusses the different types of supply chain leadership and ends by defining green freight supply chain leadership.

3.1.1 Defining supply chain leadership

The notion of supply chain leadership can be traced back to a study by (Etgar, 1977)that defined channel leadership for marketing purposes. Maloni and Benton later identified the most powerful firm in a supply chain as the leader (Maloni & Benton, 2000). The power-based approach was extended by Harrison and New describing leadership as outperforming competitors (Harrison & New, 2002) and by Byrne referring to the firm with industries best practices as the supply chain leader (Byrne, 2004). Defee et al. criticized the power-based approaches for being too narrow, referring to organizational leadership theories like (Hollander, 2009) that have broader scopes and are more behavior oriented (Defee, Stank, & Esper, 2010) (Defee C. , 2007).

To the best of knowledge, the only research that attempted to develop an all-inclusive definition of supply chain leadership is a dissertation by (Defee C. , 2007) that defined the concept of supply chain leadership by reviewing literature on organizational leadership and extending this to supply chain management theories. Other existing literature on the subject that include (Birasnav, 2013) and (Sharif & Irani, 2012) were deemed to be not suitable for this study as they focused more on the personal characteristics of supply chain managers and less on the management of a firms relationships with its suppliers. For instance, Birasnav studies the role of transformational leadership in the context of supply chain management while Shaeif & Irani provide a model that relates supply chain leadership capabilities to the responsibilities of a supply chain manager. They are for this reason not deemed to be suitable for the purpose of this research.

Referring to researches on leadership that include (House & Aditya, 1997) and (Kouzes & Posner, 2004) Defee took a relationship-oriented view that includes the perspective of the leader and follower and adopted the following definition of leadership:

"*Leadership is a relational concept involving the leader and one or more followers who interact in a dynamic, co-influencing process. Leaders strive to understand the needs and goals of followers, form and effectively communicate a vision of the future, and project behaviours consistent with achieving the long-term objectives of the organization. Each of these actions reinforces and motivates followers*" (Defee C. , 2007).

From this micro-level leadership that focuses on individuals, the concept was expanded to a macro-level concerning relationships between firms in supply chains. This was done through supply chain literature, which includes (Bowersox & Closs, 1996) (Lambert(1), Cooper, & Pagh, 1998), that elaborates on coordination efforts of firms within supply chains. Based on this, Defee proposed four elements on which the concept of supply chain leadership is based. These are:

1. The supply chain leader is the organization with the ability to influence the actions of other organizations, i.e. supply chain followers.
2. The supply chain leader can be identified and distinguished from supply chain followers through its behavior. These behaviors can be observed as they are projected in the leaders policies, procedures, standards and actions that span across boundaries of organizations.
3. The supply chain leader identifies the need for change and subsequently makes a vision to achieve this change in the future.
4. The supply chain leader and supply chain followers are involved in an interactive relational concept, where they both have the ability to influence each other.

From these elements, the following definition of supply chain leadership was proposed:

""*Supply chain leadership is a relational concept involving the supply chain leader and one or more supply chain follower organizations that interact in a dynamic, co-influencing process. The supply chain leader is characterized as the organization that demonstrates higher levels of the four elements of leadership in relation to other member organizations (i.e. the organization capable of greater influence, readily identifiable by its behaviors, creator of the vision and that establishes a relationship with other supply chain organizations*" (Defee C. , 2007).

The same approach was taken for defining supply chain followership, where literature on individual-level leadership, that includes (Kelley, 2004) and (Chaleff, 2003), was reviewed and extended to supply chain-level leadership. Here the important findings were that (1) there is no leadership without a group of followers, (2) followers provide the greatest share of an organization's performance and are critical for success and (3) are pro-active in relation to achieving their leader's and organizations goals (Defee C. , 2007). These elements were summarized in following relationship-oriented definition of supply followership:

"Supply chain followership is a relational concept between leader and follower supply chain organizations in which the follower organization exhibits behaviors intended to help the leader organization and the supply chain achieve goals so long as they are aligned with the follower organization's own goals, and the overall vision and long-term objectives of the supply chain."

By reflecting the perspective of the leader and follower, Defee claimed that these concepts recognizes that the followers can also influence the outcome and the leaders in the decision making process.

3.1.2 Types of leadership in supply chains

As a complement to the study by Defee, other literature was found mainly describing the types of supply chain leaderships and how they impact performance of a supply chain. These can be summarized into five groups, being: (1) transformational supply chain leadership, (2) transactional supply chain leadership, (3) the servant supply chain leadership, (4) electronic supply chain leadership and (5)category leadership. Each type will be discussed.

1. Transformational supply chain leadership: Defee et al. derived this leadership type from transformational leadership that lies in the well-researched field of organizational leadership. Here, transformational leadership is described as a long-term relationship oriented way of leading. The leader achieves the desired performance by inspiring the minds, changing the beliefs and obtaining the confidence of followers (Rowold & Heinitz, 2007) (Jung & Avolio, 2000). Defee et al. elevated this concept to establish the definition of transformational supply chain leadership. A transformational supply chain leader was defined as the organization that sets a clear vision for the entire supply chain and inspires the involved organizations to achieve it. In this collaborative approach, the leader takes the specific needs of each follower in consideration and encourages the followers to develop creative solutions to achieve the vision (Defee, Stank, & Esper, 2010). A leadership type with similar characteristics is referred to as "participative supply chain leadership" by Williams et al. stating that, as each organization in a supply chain is independently owned, the supply chain leader takes collaborative approach, shares information and is open to other viewpoints of followers (Williams, Esper, & Ozment, 2002). . In the context of green supply chain leadership, Defee et al. argue that transformational supply chain leadership is most appropriate when dealing with environmental issues in supply chains (Defee, Esper, & Mollenkopf, Leveraging closed-loop orientation and leadership for environmental sustainability, 2009).

2. Transactional supply chain leadership: also this leadership type stems from the field of organizational leadership. Often contrasted with transformational leadership, the leader does not develop long-term relationships and achieves the desired performance by creating incentives for the followers (Podsakoff, MacKenzie, Moorman, & Fetter, 1990) (Hinkin & Schriesheim, 2008). Transactional supply chain leadership is therefore considered as an arm-length approach where the leader manages the followers with rewards and punishments through contracts. Williams et al. discussed a leadership type with similar characteristics, referred to as autocratic supply chain leadership, and agree with Defee et al. that supply chain organizations under this leadership type are more flexible in switching partners than under the more time and effort consuming transformational supply chain leadership (Williams, Esper, & Ozment, 2002). Williams et al. further argue that weaknesses of such leadership include a decreased creative input from followers and the risk of a tunnel vision when leading the supply chain as the leader is ultimately responsible for each component.

3. Servant supply chain leadership: Overstreet et al. focus on the human aspect of supply chain management by arguing that servant supply chain leadership can ultimately enhance (financial) performance by increasing commitment of followers (Overstreet, Hazen, Skipper, & Hanna, 2014). Similar to the first two types, also this type of leadership is derived from organizational leadership literature. Here, leadership has a human-centric organizational approach and focuses on serving the needs of employees to enhance their attitudes and the overall performance (Jones, 2011). Overstreet et al. indicate that, although their study merely provides initial insight of the potential of servant leadership in the area of supply chain management, servant supply chain leadership has the same potential as transactional and transformational leadership styles followers (Overstreet, Hazen, Skipper, & Hanna, 2014).

4. Electronic supply chain leadership: presented as the hybrid between arm-length (transactional) and long-term (transformational) leadership, the electronic supply chain leadership is enabled by technical advancements in the areas of the internet and electronic communications (Williams, Esper, & Ozment, 2002). These transform the traditional supply chains into partners that are electronically linked and make decisions upon efficiency benefits. This is re-affirmed in the context of green supply chain logistics, by Schwind et al. who argue that electronic information systems, such as environmental decision support systems, have the potential to promote sustainability in the exchange of logistics services between shippers, carriers and LSPs (Schwind, Stenger, & Aponte, 2011). This is achieved as such systems enable intelligent solutions, transparent collaborations and a higher overall higher operational efficiency (Sternberg, Germann, & Klaas-Wissing, 2013).

   Williams et al. follow this line of reasoning, stating that the ease access of information sharing and transparency provides the stability and long-range costs benefits of partnership-based supply chain leadership. While the low switching costs (to a more beneficial partner), adaptability and flexibility allow the partnership to last as long as the objectives are met. Thus also providing the benefits of arms-length supply chain leadership. Williams et al. argue that the e-supply chain leadership type is likely to be the most successful type of leadership and that it is comparable with the transformational supply chain leadership when applied in an electronic supply chain setting.

5. Category leadership: applied only to one case of fresh produce, O'Keeffe et al. define the category leadership strategy as aiming to align the entire supply chain with the needs of the final consumer (O'Keeffe & Fearne, 2002). The argument is made that in current supply chains, the focus of collaboration is within the supply chain organizations (internal), while the supply chains are eventually driven by the final consumer. Therefore the paper argues for a category leadership where the entire supply chain is flexible and responsive according the changes in the final consumers demands.

Conclusion on types of supply chain leadership:

In the context of this thesis, the important conclusion that can be derived from analyzing the five supply chain leadership types, is that the transformational supply chain leadership type is likely to be the most appropriate when dealing with environmental issues in supply chains. This is in line with the argumentation of Defee et al, and the adopted relationship-oriented and collaborative approach of supply chain leadership. Also it can be argued that applying this type of leadership in an E-supply chain environment will increase the effectiveness.

3.1.3 Defining green freight supply chain leadership

As no literature exists on the Green Freight Supply Chain Leadership, this study adopted and specified the only found all-inclusive definition of supply chain leadership by (Defee C. , 2007) and is stated as follows:

"*Green freight supply chain leadership is a relational concept involving a collaboration between a green freight supply chain leader and one or more green freight supply chain followers. The green freight supply chain leader is a shipper or LSP that clearly fulfills the four requirements for green freight supply chain leadership in relation to followers that are carriers and/or LSPs. This concerns (1) setting of the targets to reduce supply chain freight emissions through LSPs/carriers, (2) setting and executing strategies to achieve these targets through LSPs/carriers, (3) reducing the supply chain freight emissions through LSPs/carriers and (4)reporting the supply chain freight emissions in a comprehensive and transparent manner including LSPs'/carriers' emissions.*"

The following corresponding definition of green supply chain followership was adopted:

" *Green freight supply chain followership is a relational concept between a green freight supply follower and a green freight leader in which the follower takes actions, as a reaction to the leader's strategies, intended to achieve the transport emissions-related objectives of the leader. The leader's objectives include a comprehensive and transparent reporting of the followers freight emissions and the reduction of the freight supply chain emissions through the follower*."

The four elements on which Defee based the concept of supply chain leadership were used to specify the four criteria that define GFSC leadership. These are elaborated in Table 4 and were also used to identify GFSC leaders to participate in the interviews for validating and expanding the GFSC model.

Table 4: criteria for green freight supply chain leadership

Criteria for green freight supply chain leadership	
1. Set targets to reduce supply chain freight emissions through LSPs /carriers	2. Set and execute strategies to achieve these targets through LSPs /carriers
3. Reduce supply chain freight emissions through LSPs /carriers	4. Report supply chain freight emissions in a comprehensive and transparent manner including LSPs' /carriers' emissions

A research by (Watts & Hahn, 1993) that assessed supplier development programs was utilized to reaffirm the four elements by Defee while various other studies on green supply chain management provided support for the four criteria. Each criterion will be discussed separately.

Criterion 1: Set targets to reduce supply chain freight emissions through carriers/LSPs

This criterion is derived from the second and third element. The second element states that supply chain leaders are distinguished from followers by their behaviors, that include policies that span across boundaries of organizations. The third element maintains that the supply chain leader makes the vision for the entire supply chain to achieve the change perceived to be necessary by the supply chain leader. In the context of GFSC leadership, the mentioned policies and vision can be perceived as the leader setting up targets for the supply chain to reduce freight emissions. Such targets would concern transport suppliers as they are most affiliated with freight emissions.

An argument that further strengthens this criterion stems from the research by Watts et al. Here, the conclusion is made that clear goals and objectives are essential as there is a strong correlation between program objectives and effectiveness of a supplier development program (Watts & Hahn, 1993).

Relating this line of thinking to literature on green supplier development, it can be generally argued that setting green cooperate targets is important as they guide the process of implementing green initiatives. For instance, assuming that these targets are set and pursued by the management of firms, (Björklund & Forslund, 2013) argue that a high management involvement in environmental issues translates itself into more environmental demands in contracts. This is affirmed by Gavronski et al. that argues that management's commitment to environmental issues enhances green supply chain initiatives (Gavronski I. , Klassen, Vachon, & Nascimento, 2011).

Another argument that supports this criterion can be found in the research by Bouwen et al. that claims that green supply chains can best be realized by firms focusing on the development and deployment of internal resources and not on external pressures (Bowen, Cousins, Lamming, & Farukt, 2001). It further argues that there is a positive relationship between the proactivity of the firm's environmental approach and the likelihood of achieving a greener supply chain. The later argument is strengthened by various other studies that include (Min & Galle, 1997) (Min & Galle, 1997) (Lamming & Hampson, 1996) and (Noci, 1997). In the light of this criterion, it can be reasoned that a firm setting emission reduction targets for its supply chain is an act that depicts proactivity and a focus on deploying its resources irrespective of external pressures. This should thus increase the firms chances to become a successful in green supply chain leadership.

The notion of a leader focusing on developing and deploying internal resources instead of external factors is also emphasized by a book by (Covey, 1989) that discusses what effective leadership entails in 7 habits (personal characteristics). Here, the habits 1-3 put emphasis on coming from dependency to independency that demonstrates leadership, i.e. effective leadership is primarily an internal issue. A summary of all the 7 habits can be found in appendix 4.

Criterion 2: Set and execute strategies to achieve these targets through carriers/LSPs

This criterion can be derived from all the four elements on which the definition of supply chain leadership by Defee is based on. For the first element it can be argued that setting and executing strategies to reduce freight emissions by involving LSPs/carriers illustrates an ability to influence these supply chain followers (LSPs/carriers). For the second element, the claim can be made that setting and executing the strategies in question, demonstrates distinguishable leadership behavior as the strategies and related actions stir the followers within the scope of the freight sector. Looking at the third element, setting and executing strategies can be perceived as a GFSC leader's ability to detect the changes that are necessary in the supply chain and create a vision for achieving them. This is based on the assumption that the implemented strategies will have been conceived to address the environmental issues that the leader perceives as necessary to address. The same applies for the fourth element, as implementing such strategies will likely be an interactive process that involves the freight supply chain followers, i.e. LSPs/carriers.

Relating this criterion to other literature on supplier development, it can be generally argued that the step of setting and implementing strategies, is the link between setting targets and achieving results. This is in line with Watts et al. finding that there is "a strong linkage between a supplier development program objectives and improvement as a result of implementing the program" (Watts & Hahn, 1993).

Looking at the literature on green supply chain management, support for the significance of this criterion can be found in a research by Philipp and Militaru which claims that company specific characteristics, that include strategies to improve the environmental performance, are more important drivers than regulatory measures (Philipp & Militaru, 2011). Also (Wolf & Seuring, 2010) demonstrate the uniqueness of having strategies by claiming that firms that do have an environmentally orientated procurement process when purchasing logistical services do not always translate it into clear strategies in terms of consistent demands. On the same topic, (Björklund & Forslund, 2013) argue that firms that have clear environmental strategies, in terms of contractual environmental requirements, seem to have the concept of a green supply chain on top of their agenda.

Furthermore, when assuming that the management of a firm is involved in conceiving (green) strategies of handling suppliers and that this demonstrates environmental commitment, the studies by Gavronski et al. and Björklund et al. support this criteria. As earlier mentioned, they conclude that management's commitment to environmental issues enhances green supply chain initiatives (Gavronski I. , Klassen, Vachon, & Nascimento, 2011) (Björklund & Forslund, 2013). The same statement can be made for the earlier mentioned studies conducted by (Bowen, Cousins, Lamming, & Farukt, 2001) (Min & Galle, 1997) (Min & Galle, 1997) (Lamming & Hampson, 1996) and (Noci, 1997). Assuming that setting and implementing green strategies through LSPs/carriers demonstrates proactivity of the firm's environmental approach, these studies support the rational that applying this criterion will increase the likelihood of achieving a greener supply chain.

Similar to the first criterion, also this criterion can be perceived through Covey's theory of the 7 habits of effective leadership. The habits 4-6 start from independency and go to interdependency, i.e. effective leadership can only occur in collaboration with other parties (Covey, 1989). Looking at the conclusion on the types of supply chain leadership, "that the transformational supply chain leadership type is likely the most appropriate to address environmental issues in supply chains", the argument can be made that setting up and implementing green strategies will require interdependent collaboration between the leader and followers.

Criterion 3: Reduce supply chain freight emissions through LSPs/carriers

This criterion stems from Defee's first two elements of supply chain leadership. Reducing supply chain emissions through carriers/LSPs would clearly demonstrate a firm's ability to influence the actions of its followers, i.e. influencing them to reduce their freight transport emissions. In the context of achieving a greener supply chain, such acts would also be considered an observable leadership behavior since they would span across the boundaries of the supply chain followers (LSPs/carriers). This is in line with McKinnon line of reasoning that firms that outsource their entire transport also have a certain degree of responsibility for reducing the related freight transport emissions (McKinnon, 2014).

Regarding literature on supplier development in this context, successfully being able to reduce emissions through, can be considered as the improvement that is the result of clear program objectives and their implementation (Watts & Hahn, 1993).

With respect to green supply chain literature, the studies by (Bowen, Cousins, Lamming, & Farukt, 2001) (Min & Galle, 1997) (Min & Galle, 1997) (Lamming & Hampson, 1996) and (Noci, 1997) can be used to support this criterion. This would be based on the assumption that reducing supply chain emissions through LSPs/carriers is a proactivity demonstration of the firm's environmental approach.

Like the first two critera, also this criterion can be perceived through Covey's theory of the 7 habits of effective leadership. Similarly, assuming that the transformational supply chain leadership type is likely the most appropriate when dealing with environmental issues in supply chains, the leader will most likely need an interdependent collaboration with LSPs/carriers to reduce freight emissions. This is in line with the habits 4-6 that argue that effective leadership can only occur in collaboration with other parties (Covey, 1989).

Criterion 4: Report supply chain freight emissions in a comprehensive and transparent manner including LSPs/carriers emissions

This criterion can be derived from the second and fourth element on which the definition of supply chain leadership by Defee is based on. In the context of reducing emissions in supply chains, a firm that reports the freight emissions of its LSPs/carriers can be perceived as showing observable leadership behaviors that span across boundaries of the involved LSPs/carriers. Evidently, reporting these emissions will be an interactive relational process as the LSPs/carriers will have to cooperate for the reporting to occur.

Relating this criterion to other literature on supplier development, Watts et al. conclude that supplier evaluation is critical for supplier development programs to succeed as they guide efforts and aid in identifying the suppliers or areas that need most improvement (Watts & Hahn, 1993).

Regarding green supply chain literature, Mckinnon argues that quantifying carbon emissions is the first stage in the process of making supply chains more sustainable (McKinnon, 2014). Furthermore, , the studies by (Bowen, Cousins, Lamming, & Farukt, 2001) (Min & Galle, 1997) (Min & Galle, 1997) (Lamming & Hampson, 1996) and (Noci, 1997) can be used to support this criterion as well. This would be based on the assumption that reporting freight emissions of LSPs/carriers is a proactivity demonstration of the firm's environmental approach.

In respect to Covey's theory of the 7 habits of effective leadership, the seventh habit focuses on maintaining a sustainable growth of effectiveness by balancing efforts with resources renewal. Combined with Watts argument on the significance of supplier evaluation, this habit is in line with this criterion as reporting LSPs/carriers emissions is the basis of sustaining emissions reductions. This will namely allow resources to be directed to the suppliers that need them the most (Covey, 1989).

Operationalization of four criteria for GFSC leadership

To operationalize the four criteria for GFSC leadership, a flow chart was constructed that is illustrated in Figure 5. This displays the steps that a firm can take to become a GFSC leader and will be used to identify GFSC leaders for the interviews.

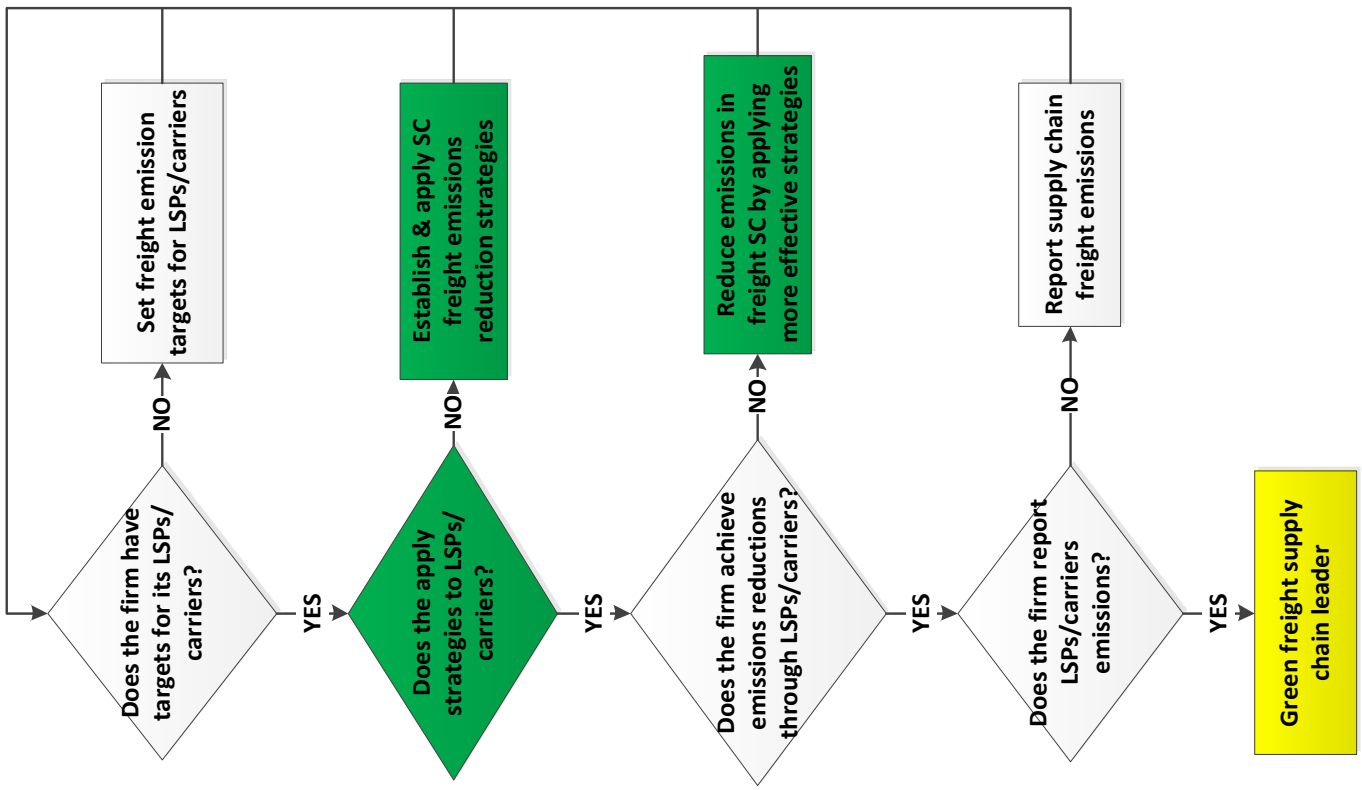


Figure 5: operationalization of the four criteria for GFSC leadership

3.2 Second component: GFSC leadership criteria

As explained in the research framework in chapter 2.1, leading transport suppliers was specified in the following three steps: selecting transport suppliers, segmenting them, and developing them. The second component of the model concerns the two steps and provides the GFSC leadership criteria that a shipper/LSP, as a green supply chain leader, can use to select and segment transport suppliers.

3.2.1 Supplier selection

Considered as the starting point of managing suppliers, the process of supplier selection has been well documented in literature. Supplier selection is defined as the process of selecting suitable suppliers and involves defining criteria to be used to select the suppliers that are most suitable, making it in essence a multi-criteria decision analysis (Cousins, Lamming, Lawson, & Squire, 2008). Cousins et al defined four stages for the supplier selection process, that start with an initial supplier qualification and ends with making the selection as depicted in Figure 6. Each stage will be elaborated and will be extended to the concept of green freight supply chain leadership by explaining how the leader can use the process in respects to the followers.

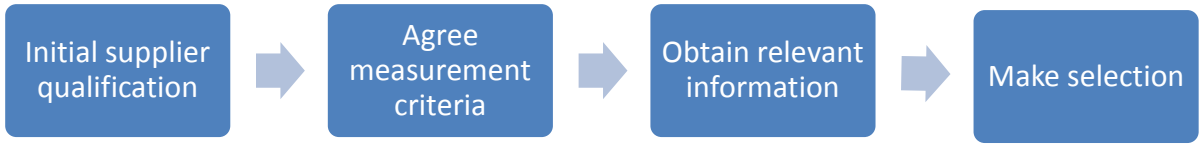


Figure 6: the four stages of selecting suppliers (Cousins et al., 2008)

Stage 1: Initial supplier qualification

Intended to decrease the number of potential suppliers to a more manageable number, a firm uses the first stage to identify the suppliers that can meet the minimum standards for a product, service or process. The corresponding activities concern collecting information to assess supplier's capabilities and subsequently making a pool of potential suppliers that can be evaluated in more detail at a later stage. In the context of green freight supply chain leadership this stage would imply the green supply chain leader assessing which LSPs/carriers can fulfil the firm's goals to reduce emissions.

Stage 2: Agree measurement criteria

The second stage aims at delivering as set of criteria that are used to select criteria. In this area, Dickson, Weber et al. and Deshmukh et al. performed extensive literature reviews that identified and ranked selection criteria in terms of their importance. These studies revealed 23 criteria but did not explicitly mention sustainability as one of criteria (Weber, Current, & Benton, 1991) (Dickson, 1966) (Deshmukh & Chaudhari, 2011). The first studies to include sustainability related criteria include studies by (Noci, 1997) that provided 4 main criteria specified in 13 sub-criteria; (Handfield, Walton, Sroufe, & Melnyk, 2002) that provided 10 criteria; (Humphreys, Wong, & Chan, 2003) that provided a framework for incorporating 30 criteria environmental criteria in the selection process and (Tuzkaya, Ozgen, Ozgen, & Tuzkaya, 2009) that provided 6 criteria specified in 31 sub-criteria.

Shen et al. extended and summarized the work of all these researchers with a literature review that aimed at identifying all the commonly used green suppliers selection and evaluation criteria (Shen, Olfat, Govindan, Khodaverdi, & Diabat, 2013). From all the found criteria, nine were identified as being the important. The list of all the criteria is included in appendix 5 while the nine that were considered as important are elaborated in their order of importance in Table 5. From these only two criteria, that are highlighted in grey, cannot be related to freight transport emissions as they primary concern the manufacturing of goods. The list of criteria was complemented with six additional criteria from two other studies by (Wang, 2014) and (Vana, 2014) that studied criteria for suppliers selection, that can be found in Table 6.

Table 5: Important criteria for green supplier selection/evaluation (Shen et al., 2013)

Criterion	Definition
Pollution production	Average volume of air emission pollutant, waste water, solid wastes and harmful materials releases per day during measurement period
Resource consumption	Resource consumption in terms of raw material, energy and water during the measurement period
Eco-design	Design of products for reduced consumption of material/energy, design of products for reuse, recycle, recovery of material, design of products to avoid or reduce use of hazardous materials
Green image	The ratio of green customers to total customers
Environmental management system	Environmental certifications such as ISO 14000, environmental policies, planning of environmental objectives, checking and control of environmental activities
Commitment of GSCM from managers	Senior and mid-level managers commitment and support to improve green supply chain management practices and environmental performance
Use of environmentally friendly technology	The application of the environmental science to conserve the natural environment and resources, and to curb the negative impacts of human involvement.
Use of environmentally friendly materials	The level of green recyclable material used in packaging and manufacturing of goods
Staff environmental training	Staff training on environmental targets

Table 6: criteria for supplier selection and evaluation (Wang, 2014; Vana, 2014)

Public disclosure of environmental record	Willingness to share information
Performance awards	Willingness to rely on each other
Reputation of LSPs/carriers	Willingness to get involved in a long-term relationship
Management competencies (support, partners & training)[2]	

[2] "This criterion is considered to include the criterion "staff and environmental training" from the study by Shen et al. These two criteria will thus considered to be one in the case study.

Stage 3: Obtain relevant information

After the identification of the criteria, the subsequent third stage aims at obtaining comparable and valid information of suppliers on the criteria. In their research, Cousins et al. suggest three methods of attaining this information that include (1) requesting the information from the suppliers, (2) visiting suppliers and (3) evaluating existing suppliers using their current and past performances (Cousins, Lamming, Lawson, & Squire, 2008).

Stage 4: Make selection

The last step concerns the making of the selection using the identified criteria and the attained information. This implies a multi-criteria decision making where trade-offs are made among criteria, that are often given weights, and this results in a raking of the suppliers. In the context of GFSC leadership, the green leader would thus rank the potential followers according their performances on the criteria and select the best ones. Various approaches that vary from linear weighting to probabilistic approaches can facilitate this step. This concerns methods like analytic hierarchy process (AHP), case-based reasoning (CBR) and cluster analysis (CA) (Weber, Current, & Benton, 1991) (Deshmukh & Chaudhari, 2011).

3.2.2 Supplier segmentation

As a firm has limited resources and time to allocate to its (many) relationships with suppliers but aims at doing this in an efficient way that ensures the highest return for each relationship, suppliers need to be segmented after the selection process (Choi & Krause, 2006) (Wagner & Johnson, 2004). Supplier segmentation is referred to as the classification of the selected suppliers to enable the determination of strategies to handle the different segments of suppliers (Day, Magnan, & Moeller, 2010).

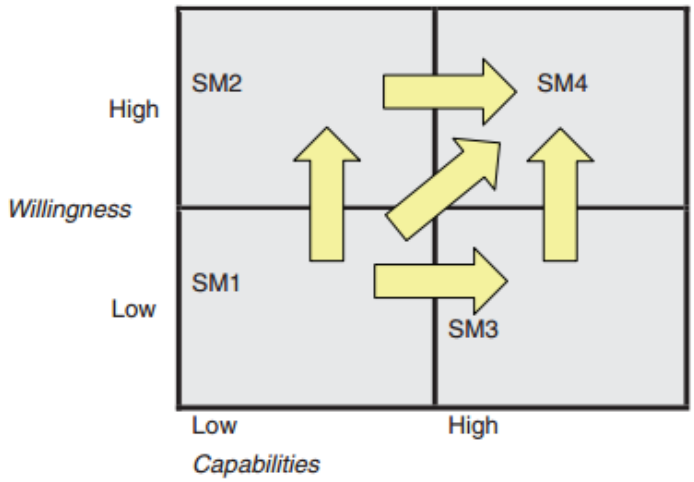
The well-documented literature on this subject, that dates back to (Kraljic, 1983), provided various approaches to assess and categorize suppliers. A literature review by Day et al., that aimed at mapping all the approaches provided a list of 15 approaches that are elaborated in appendix 6. The important remark here is that all approaches segmented suppliers using two dimensions and delivered a 2x2 matrix, thus distinguishing four segments of suppliers.

In the context of green supply chain management, the limited literature that has been performed on "green supplier's segmentation" include (Cousinsa, Lamming, Lawson, & Squire, 2007) and (Zhu, Dou, & Sarkis, 2010). The study by Cousinsa et al. was limited to adding an environmental dimension referred to as "environmental risk" on the framework developed by (Kraljic, 1983). Zhu et al. extended the work on green supplier segmentation by providing a segmentation framework that was specified for buyers. As is illustrated in appendix 6, this framework consisted of four segments that were constructed from two

dimensions, being " supplier's relative power" (referring to the buyer's dependence) and "supplier's overall performance"

A literature review by Rezaei et al. argued that, although various approaches for supplier segmentation covering different variables were available, no comprehensive approach existed that covered all identified variables (Rezaei & Ortt, 2012). This would naturally create the risk for a buyer using one approach to leave out other relevant variables. To reduce this risk, Rezaei et al. developed a new approach that aimed at unifying previous approaches by including all former identified relevant variables in the term of suppliers long-term potential.

Suppliers long-term potential was defined as the suppliers capabilities and suppliers willingness (Rezaei & Ortt, 2012). Suppliers capabilities were specified as *" the complex bundles of skills and accumulated knowledge, exercised through organizational processes that enable firms to co-ordinate activities and make use of their assets in different business functions that are important for the buyer*". While suppliers willingness concerned "*the confidence, commitment and motivation to engage in a (long-term) relationship with the buyer*". With these dimensions, four suppliers segments were made that enabled the making of strategies to drive firms from the SM1-SM3 quadrants to the upper right SM4 quadrant, as illustrated in Graph 1.



Graph 1: Segmentation of suppliers according their capability and willingness (Rezaei & Ortt, 2012)

Rezaei et al. further argued that these two dimensions included previously identified variables through a literature review that grouped variables identified in a large number of papers into the dimensions of capabilities and willingness. This illustrated the flexibility of the approach and that it leaves room for including specific variables that are in line with the buyer's corporate objectives.

Evaluating the discussed approaches in this paragraph and in appendix 6, it can be argued that, except for the approach by Rezaei et al., all approaches have the risk of excluding variables that can be relevant to achieve a buyers goal. Furthermore, as this study on GFSC leadership has a specific focus, the approach by Rezaei et al. provides room to include variables that concern freight emissions reduction. In this context, this refers to the GFSC leadership strategies that are the subject of the next paragraph.

Based on these reasons, the approach by Rezaei et al. is deemed to be the most suitable for shippers/LSPs as GFSC leaders to lead their followers.

3.3 Third component: GFSC leadership strategies and drivers

With regard to the second component, the third component consists of the GFSC leadership strategies and drivers that a GFSC leader can use to increase the willingness and capability of transport suppliers, i.e. move all transport suppliers to the upper right SM4 quadrant. A wide range of literature exists on how a buying firm can effectively develop its suppliers to reach certain targets. This concerns literature that elaborates on the "what", referring to the strategies and drivers that a firm can use and the "how" referring to the process of implementing these strategies. These subjects will be discussed in different sub-paragraphs.

3.3.1 Strategies to develop suppliers

As numerous strategies exist that buyers can use to develop their suppliers, two extensive literature reviews were consulted to ensure a comprehensive understanding of the subject. The first review by Humphreys et al. classified all identified strategies into 7 groups of strategies while the second review by Krause et al provided 4 groups of strategies. Table 7 provides the list of both strategies, illustrating how the 7 strategies identified by Humphreys et al. fit in the four strategies found by Krause et al.

Table 7: a comparison of supplier development strategies groups

Supplier development strategies by (Krause, Scannel, & Calantone, 2000)	**Supplier development strategies by** (Humphreys, Li, & Chan, 2004)
Competitive pressure: motivating suppliers by for example giving the best-performing supplier longer/bigger contracts.	
Evaluation and certification systems: making suppliers performance explicit and comparing them to buyers expectations	• Evaluating supplier performance
Incentives: increasing motivation via incentives e.g sharing costs savings or awards.	• Recognising supplier progress in the form of awards. • Increasing the supplier performance goals.
Direct involvement: directly investing in suppliers.	• Providing the supplier with investments • Providing the supplier with equipment and technological support • Training the supplier • Exchanging personnel

Regarding the effectiveness of the strategies, Krause et al. argue that the direct involvement strategies would lead to higher performance improvements although they might cost more effort (Krause, Scannel, & Calantone, 2000). The other strategies are considered to be more suitable for supporting the direct involvement strategies.

With respect to GFSC leadership strategies, a study by (Bai & Sarkis, 2010) was the only literature review found that aimed at providing a comprehensive list of green supplier development strategies. The identified strategies are included in Table 8.

Table 8: green supplier development strategies and categorization (Bai & Sarkis, 2010)

Strategy category	Initiative
1. Green knowledge transfer and communication	1. Training LSP/carrier employees on environmental issues
	2. Train LSPs/carriers in stakeholder expectations
	3. Train users in environmental capabilities
	4. Train LSPs/carriers on environmental and cost controls
	Giving green manufacturing related advice and awareness raising for suppliers
	5. Giving green technological advice to LSPs/carriers
	Giving eco-design product development related advice to suppliers
	6. Conduct training and education programs for LSP/carrier personnel
	7. Supplier environmental evaluation and feedback
	8. Develop LSP/carrier environmental assessment programs
	9. Providing feedback about LSP/carrier environmental performance
	10. Strong formal LSP/carrier environmental evaluation
	11. Setting environmental improvement targets for LSPs/carriers
	12. Auditing LSPs/carriers
	13. Joint and team problem solving on environmental issues
	14. Information sharing on environmental topics
	15. On-going communication with LSP/carrier community via LSP/carrier environmental councils
2. Investment and resource transfer	1. Invest in improvement of transaction processes
	2. Reduce LSP/carrier environmental costs
	3. Solve LSP/carrier environmental technical problems
	4. Finance LSP/carrier major capital environmental expenditures
	5. Transferring LSP/carrier employees with environmental expertise to buying firm
	6. Transferring employees with environmental expertise to LSP/carrier
	7. Investment in LSP/carrier capacity building
	8. LSP/carrier rewards and incentives for environmental performance
3. Management and organizational practices	1. Requiring ISO 14000 certification for LSPs/carriers
	2. Long-term contracts with environmental dimensions incorporated
	3. Introduce a cross-functional supply chain team with environmental presence
	4. Building top management commitment/support within shipper/LSP organization for green supply practices
	5. Building top management commitment/support within LSP/carrier organization for green supply practices
	6. Organization management has formal long-term plans to improve LSP/carrier performance
	7. Formal process for LSP/carrier development
	8. Identification of critical LSPs/carriers for improvement opportunities
	9. Criteria established about when to enter into LSP/carrier development
	10. Formal process to identify LSP/carrier emission reduction targets
	11. The participation level of LSP/carrier in the eco-design stage
	The participation level of suppliers in the process of procurement and production

Three strategies that can clearly not be used to develop freight transport suppliers have been marked in grey and are not numbered as they are more related to manufacturing. Concerning the effectiveness of the strategies, Bai & Sarkis suggested that the strategies in the " investment and resource transfer" category (2.1-2.8) are the ineffective as they do not lead to higher environmental and business performance. This can be seen as contradicting the earlier mentioned findings of Krause et al. that the "direct involvement" strategies are the effective.It will be attempted to find an explanation for this through the interviews.

Furthermore, Bai and Sarkis argued that the strategies 1.1, 3.1, 3.2 and 3.5 generally improve environmental performance to a higher degree. Here, organizational characteristics that include the profitability and size of the firm positively affect and are a condition to the performance of green strategies. Strategy 1.1 is rendered to enhance business performance the most than all other strategies.

Another research by (Fu, Zhu, & Sarkis, 2012) that studied the effectiveness of the same list of strategies using the case of a telecommunications systems provider came to slightly different conclusions. The study argued that the effective strategies concern 3.5 and 1.10 with strategy 3.1 being the most applied. The diverging conclusions on the effectiveness of the strategies, make it necessary to study the issue further in the interviews to be conducted.

Classification of strategies

As was elaborated in chapter 3.2.2 the strategies can either be deployed to increase the willingness and/or capability of transport suppliers. To this end, the strategies from Table 7 were classified in these two dimensions through expert opinions as is elaborated in appendix 7. The results can be seen in Figure 7.

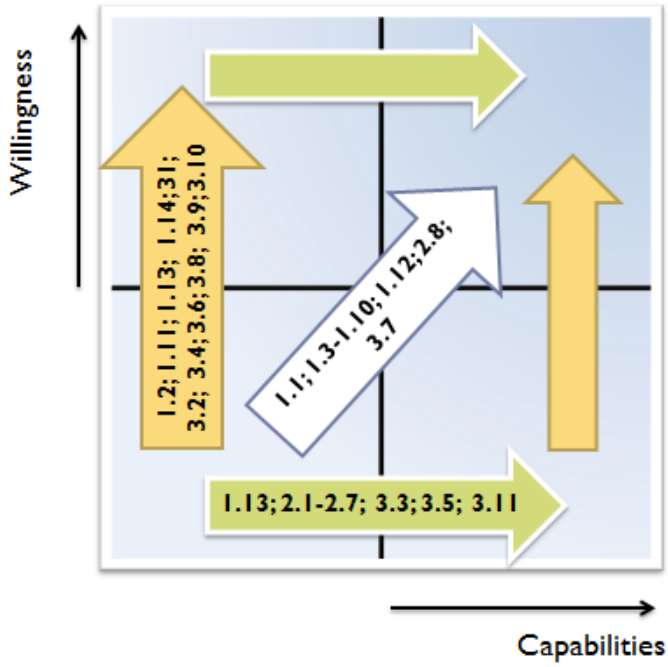


Figure 7: : categorizing strategies in capabilities and willingness dimension

3.3.2 Drivers for transport suppliers

Drivers are the benefits for both the transport suppliers and the GFSC leader to collaborate to reduce emissions. They can thus be communicated and used as incentives for the transport suppliers to comply with the strategies. Such information will especially be relevant to specify and implement "green knowledge transfer an communication" group of strategies. Various studies have provided a number of financial, business and environmental benefits that are associated with green supplier development. This involves benefits like increased (fuel) efficiency, costs reductions, performance enhancement, improved market and environmental performance (Blome, Hollos, & Paulraj, 2014) (Lai, Lun, Wong, & Cheng, 2011) (McKinnon, 2014) (Bowen, Cousins, Lamming, & Farukt, 2001) (Abbasi & Nilsson, 2012). Table 9, provides a list attained from a study by Wang as it is the only research found that aimed at generating a list of the benefits associated with developing suppliers. Here, the environmental performance benefits are considered to be a part of the quality and operations improvements.

Table 9: potential drivers of (green) supplier development (Wang, 2014)

Suppliers development drivers
1. Cost reduction
2. Productivity improvement
3. Buyer performance improvement
4. Improvement in quality
5. Increased financial performance
6. Operations improvement
7. Collaboration between leader and follower
8. Optimal resource utilization
9. Competitive advantage
10. Follower performance
11. Improved shipper/LSP-LSP/carrier relationships

3.3.3 Supplier development process

Literature provides a number of generic processes to deploy supplier development strategies that can be categorized in three orientations. As a demonstration, three conventional approaches are elaborated in Table 10. The first approach concerns the 7 step process map developed by Handfield et al., that can be considered to be more result oriented as it starts with identifying critical goods and suppliers and working to develop them (Handfield R. , Krause, Scannell, & Monczka, 2000). The second approach concerns the 4-step supplier development process by Hartely & Jones that takes a process orientation as starts with building suppliers commitment through collaboration and extends this to supplier development strategies (Hartley & Jones, 1997). The third approach concerns a conceptual model for supplier development programs developed by Hahn et al. This model can be considered as having a managerial orientation as it starts with the management recognizing the need to develop suppliers. This is subsequently followed by the design and implementation of a development plan and evaluating the results (Hahn, Watts, & Kim, 1990). The three approaches are summarized in Table 10.

Table 10: generic supplier development processes

Supplier development process	Elaboration
7 step supplier development process map (Handfield R. , Krause, Scannell, & Monczka, 2000)	Result oriented: identify critical goods/suppliers, make agreements and monitor/modify strategies
4-step supplier development process (Hartley & Jones, 1997)	Process oriented: build commitment through collaboration and implement strategies
Conceptual model for supplier development program (Hahn, Watts, & Kim, 1990)	Managerial orientation: management recognizes the need for developing suppliers, designs and implements a development plan, evaluates the results

As the GFSC leader can considered to be the "manager" of the supply chain in reducing emissions, the conceptual model by Hahn et al. is deemed to be most suitable for the purpose of this thesis. In this respect, the flowchart depicted in Figure 8 adopts this conceptual model by showing the steps that a GFSC leader can take to develop transport suppliers to reduce their emissions. Here, the process starts with the GFSC leader identifying whether the GFSC leadership criteria are met and thus whether certain transport suppliers need to be replaced. Here it is important to highlight that other criteria (that are not related to the environment) will be taken into consideration because sustainability is not the only criterion for firms. Afterwards, the suppliers are assessed on their performance and on this basis the areas for improvement are identified. In this case it concerns the willingness and capabilities to collaborate to reduce emissions. Subsequently, the GFSC leadership strategies are conceived and implemented. The final step is the evaluation and monitoring of the performance over time.

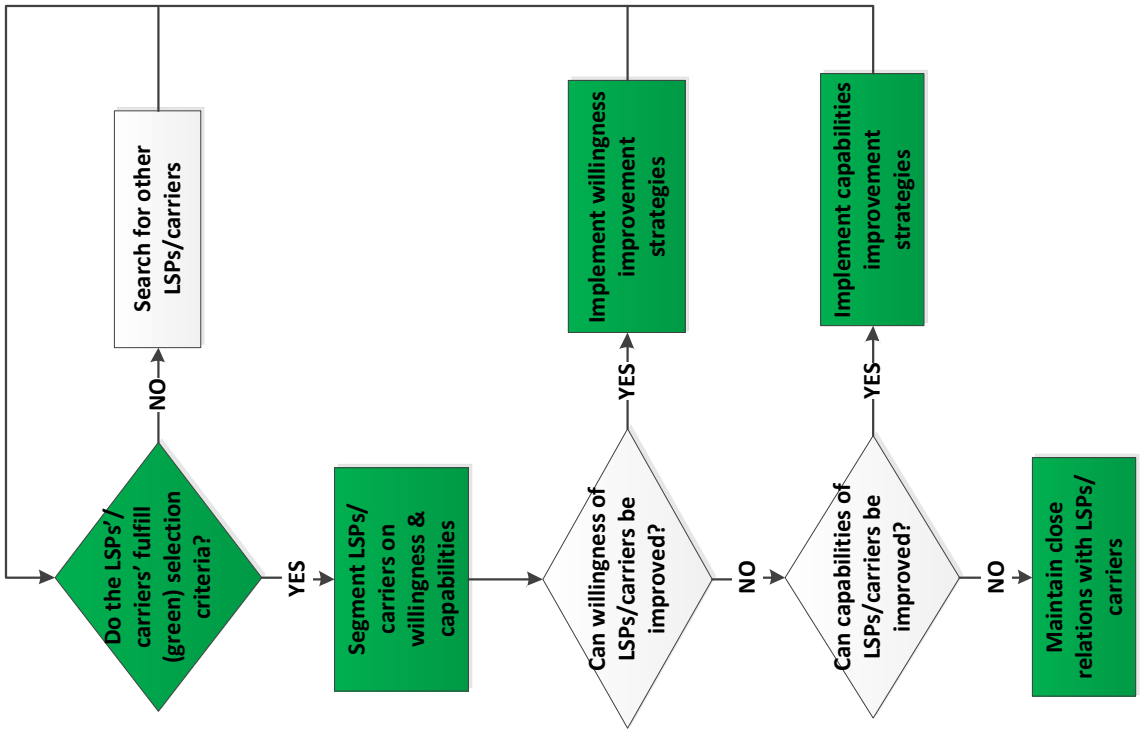


Figure 8: flow chart for deploying GFSC strategies

3.4 Fourth component: GFSC leadership barriers and tactics

The fourth component of the GFSC leadership model consists of the barriers that can hinder the process of GFSC leadership and the tactics that can be used to overcome these barriers. The literature review identified two types of barriers and tactics that are relevant as they can hinder and enable the GFSC leadership process. As depicted in Figure 9 by an "A", the first type concerns the "barriers and tactics" that come from within the GFSC leader-follower relationship while the second type concerns external "challenges and measures" that are caused by the global transport industry environment, illustrated by a "B". As challenges come from the environment, individual firms will not have the ability to implement them as opposed to tactics. This might imply that challenges and measures fall out of the scope set in chapter 1. However, as literature argued that challenges significantly hinder the realization of sustainable supply chains, they could not be excluded. Both types will be discussed in separate paragraphs.

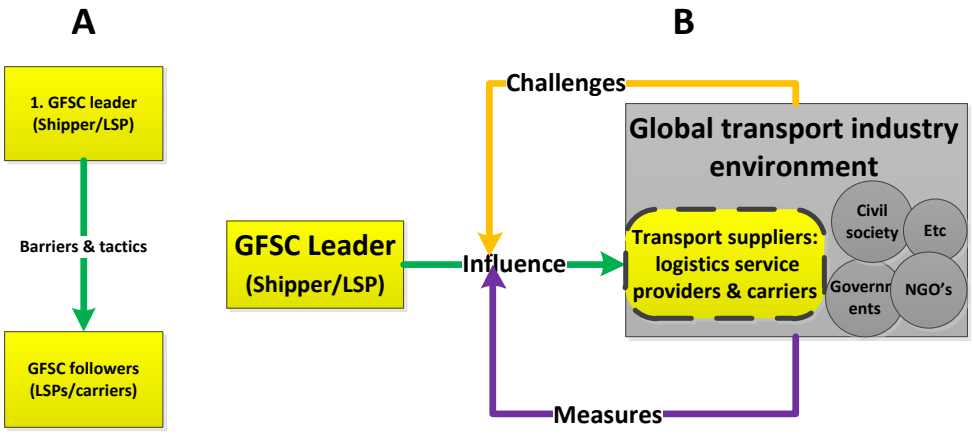


Figure 9: the two types of barriers and tactics

3.4.1 GFSC leadership barriers and tactics

GFSC leadership barriers

A study by Handfield et al. identified the major "pit-falls" that hinder supplier development on the side of the buyers. Here, the argument was that these are mainly caused by reluctances due to the lack of the buyer to see benefits of supplier development. The study mentioned five cases, being (1) small-quantity purchases from numerous suppliers not justifying the investment in one supplier (2) a supplier not being important enough to justify the investment, (3) the lack of immediate monetary benefits, (4) little support of the top management and (5) high expectations in the past that were unrealized (Handfield R. B., Krause, Scannell, & Monczka, 2000). Cousins et al. extended this by aiming to comprehensively list all key barriers that can hinder the successful development of suppliers. As elaborated in Table 11. These were categorized in three areas according the stakeholder that they

effect, being buyer-specific barriers, supplier-specific barriers and interface barriers (Cousins, Lamming, Lawson, & Squire, 2008). These.

Table 11: General barriers for supplier development (Cousins e al., 2008)

Key barriers to successful supplier development	
Area	**Main issues**
Buyer-specific	Lack of buyer top management commitment
	Too small purchases by the buyer firm spread across too many suppliers
	Supplier not important enough to buyer
	Overly ambitious expectations that go unrealised
Supplier-specific	Lack of supplier commitment
	Lack of buying firm power creates supplier reluctance to participate
	Insufficient supplier human resources
	Insufficient supplier technical capabilities
Buyer-supplier interface	Lack of mutual trust
	Ineffective communication of potential benefits
	Insufficient inducements to the supplier
	Supplier is reluctant to share cost/process information
	Poor cultural alignment

GFSC leadership tactics

In a study on the major barriers that hinder supplier development, Handfield et al. provided tactics that can be used to avoid such pitfalls taking into account the stakeholders that such barriers have an effect on. These are elaborated in Table 12. Buyer-centric tactics (1-6) concern actions that buyers can take to overcome the barriers that they face, while supplier-centric tactics (7-10) concern gaining commitment from suppliers. According to Handfield et al. these are mainly related to communicating the benefits for investing in supplier-development efforts to the suppliers (Handfield R. B., Krause, Scannell, & Monczka, 2000).

Table 12: Tactics for supplier development barriers (Handfield et al., 2000)

Area	Tactics	Description
Buyer-centric	1. Consolidate to fewer followers	Focus only on few followers that are important for the firm's success
	2. Keep confidential information exclusive	Especially with new followers in high-technology areas, use nondisclosure agreements and exclusivity agreements.
	3. Spell it out	Use written, well-defined and signed agreements and terms instead of "gentleman's agreements".
	4. Minimize legal involvement	Use more alliance agreements and less formal contracts. Form close alliances with key followers and develop close relationships between top management.
	5. Adapt to local conditions	When operating in a different region, the buying firm needs to communicate and have face-to-face discussions with the followers so that both parties adapt to each other

		have aligned expectations
	6. Create an expectations road map	To clarify expectations, a manual/roadmap that shows followers where they are today and project where they should be in the short, medium and long term.
Supplier-centric	7. Clear communication of benefits	Communicate the benefits for the followers
	8. Offer financial incentives	Rewards increase with follower performance
	9. "Design in" motivation	Well performing followers services become" designed in" the leaders processes and thus have a greater potential for future business.
	10. Offer repeat business as an incentive	The perspective of contract renewal if suppliers meet expectations

3.4.2 GFSC leadership challenges and measures

GFSC leadership challenges

Challenges are defined as the obstacles from the environment that hinder firms to realize green supply chains. To come to a comprehensive list of these challenges various articles were studied where a literature review by (Abbasi & Nilsson, 2012)and a case study by (McKinnon, 2014) summarized the challenges in five categories that are included in Table 13.

Table 13: challenges for green supplier development

Challenges for green supplier development		
Challenges for green supply chains (Abbasi & Nilsson, 2012)	*Reasons for not measuring emissions* (McKinnon, 2014)	*% of shippers that cite reason for not measuring emissions* (McKinnon, 2014)
1. Costs	Insufficient resources, time or expertise	*± 57*
2. Complexity	Unsure about the measurement and reporting mechanisms	*± 50*
	Emissions too difficult to calculate	*±25*
3. Uncertainties	No demand from customers for emissions data	*± 32*
	No government requirement to report supply chain emissions	*± 25*
4. Operationalization		
5. Mindset and cultural changes	Supply chain emissions likely to be small % of the company total	*± 25*

1. Costs: resources and time

As it is argued that firms are primarily cost driven, costs (in terms of resources and time) is the most frequently highlighted factor that hinders sustainable supply chains (Min & Galle, 1997) (Abbasi &

Nilsson, 2012) (Tongzon, 2009). This can be related to the argument that there is prevailing mind-set among firms that reducing environmental impact will increase operating costs (Abbasi & Nilsson, 2012). Furthermore, other studies show that shippers value sustainability as the least important criterion in transport supplier selection while cost is ranked as the highest criteria by shippers (Van den Berg & De Langen, 2014) (Lai, Lun, Wong, & Cheng, 2011). To illustrate this, Figure 10 shows shippers ranking of criteria for selecting deep-sea container services, where cost has the highest score while environmental impact has the lowest score (McKinnon, 2014). A study by Lammgård and Andersson argued that this especially applies to smaller firms as larger firms have more capacity to make environment-related investments (Lammgård & Andersson, 2014).

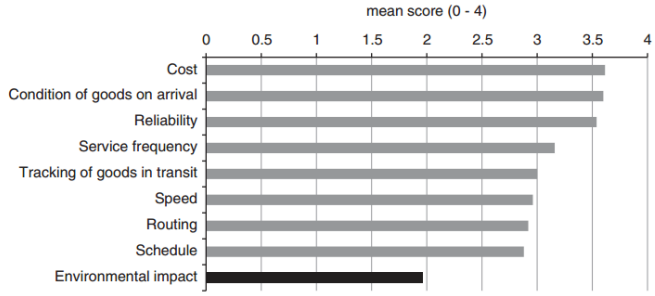


Figure 10: ranking of selection criteria (McKinnon, 2014)

2. Complexity

Especially in large supply chains, choices made by firms have multiple and different consequences on the carbon footprint of the supply chain. This concerns the choices for freight forwarders, transporters, route, ports, fuel, environmental contracts etc. According to Abbasi & Nilsson, this leads to inherent complexity and difficulties in how to "measure and assess the effects caused by different activities and processes within the supply chains" (Abbasi & Nilsson, 2012). This is confirmed by the case study by McKinnon where about 50% of the shippers pointed out that the insecurity about the appropriate measuring and reporting mechanisms was a reason not to measure emissions. Here, about 25% indicated that emissions were too difficult to measure. This is also mentioned by a research by Colicchia et al that concludes that a standard methodology for measuring environmental impact does not exist and that this hinders companies to share costs and benefits of environmental initiatives (Colicchia, Marchet, Melacini, & Perotti, 2013).

3. Uncertainties

The literature review by Abbassi and Nilsson found that uncertainties of firms with regard to the behaviors, demands and actions of governments and consumers form an obstacle for sustainability in supply chains (Abbasi & Nilsson, 2012). This factor was confirmed by McKinnon as about a third of the shippers in the case study indicated that the lack of demand from customers for emissions data is a reason not to measuring emissions (McKinnon, 2014). Furthermore, the lack of government requirements to report supply chain emissions was mentioned by about a quarter of the shippers. The significance of institutional and customer pressure was emphasized by other researches that found that firms encountering institutional forces, that include regulatory requirements, industrial norms and

strong customer pressures are likely to adopt green shipping practices (Lai, Lun, Wong, & Cheng, 2011) (Lintukangas, Hallikas, & Kähkönen, 2013) (Colicchia, Marchet, Melacini, & Perotti, 2013). An important sidenote here is that Colicchia et al. argue that although the presence of regulation can be an important driver, it can also function as a barrier. This can be caused by the lack of homogenic regulations across countries (Colicchia, Marchet, Melacini, & Perotti, 2013).

4. Operationalization

Operationalization is referred to as the challenge of making sustainable supply chains operationally feasible caused by difficulties in interpreting and inertia (Abbasi & Nilsson, 2012). Difficulties in interpretation is specified as not being able to comprehend and translate the notion of sustainability in different parts of the supply chain. Thus firms might be willing to work towards sustainable supply chains, but they would not know how to put that into practice in terms of process and activities. Inertia is related to this and is referred to as "a fear of change connected to difficulties of interpretation, the complexity involved, and the underlying business logic with its clear focus on financial aspects" (Abbasi & Nilsson, 2012).

5. Mindset and cultural changes

Abbasi and Nilsson found that a need for a change in mindset and culture is essential for realizing sustainable supply chains. This concerns the daily decisions, processes and the underlying assumptions that are taken for granted. This factor thus refers to shifting from the embedded "old way of doing things" to new and environmentally sustainable approaches. Furthermore, it is argued that this applies to both the top management as to the mass of people working in organisations that are responsible for the execution (Abbasi & Nilsson, 2012). Here, Björklund & Forslund argue that management will have a higher degree of influence since "a higher degree of managerial involvement is related to larger inclusion of environmental performance" (Björklund & Forslund, 2013). On this point, the study by McKinnon found that about a quarter of the participating shippers neglected transport emissions as they were considered to be a small percentage of the company's total footprint (McKinnon, 2014). This mindset confirms the challenge when looking at the studies cited in chapter 1 that point out the increase and severity of transport related emissions.

GFSC leadership measures

No comprehensive study was found that aimed at identifying all measures available that can address the challenges elaborated in the previous part. Highlighting the diversity and complexity of the challenges, Abbasi and Nilsson suggest that policies and laws that can mitigate and guide uncertainty can enhance firms willingness to invest in sustainable supply chains (Abbasi & Nilsson, 2012). On this subject, Mckinnon suggests that market-based mechanisms like emissions trading can incentivize firms and provide solutions for some of the challenges (McKinnon, 2014). Given the limited availability of information on this topic, the choice was made to attain information on the measures from the interviews.

3.5 Initial GFSC Leadership model

The literature review provided data that can be used to build a GFSC leadership model that consists of the following 88 variables:

- The 4 criteria that distinguish a GFSC leader
- The 13 criteria that can be used to select and evaluate transport suppliers
- The 34 strategies that can be used to improve transport suppliers capabilities and/or willingness with the 11 drivers that can be used to support these strategies.
- The 13 barriers and 5 challenges that can hinder the implementation and success of the GFSC leadership strategies.
- The 12 tactics and 2 measures that can be help to overcome the barriers and challenges. A side note here is that the measures are incomplete due to the lack of literature found on this topic and will be complemented with the case study.

Logically, drivers should be connected to strategies, strategies should be connected to barriers and challenges and these should on their turn be connected to tactics and measures. I.e. which barriers and challenges the GFSC leaders can meet when implementing each strategy and which tactics and measures can be used for each barrier and challenge. An aggregated illustration of such a model is illustrated in Figure 11.

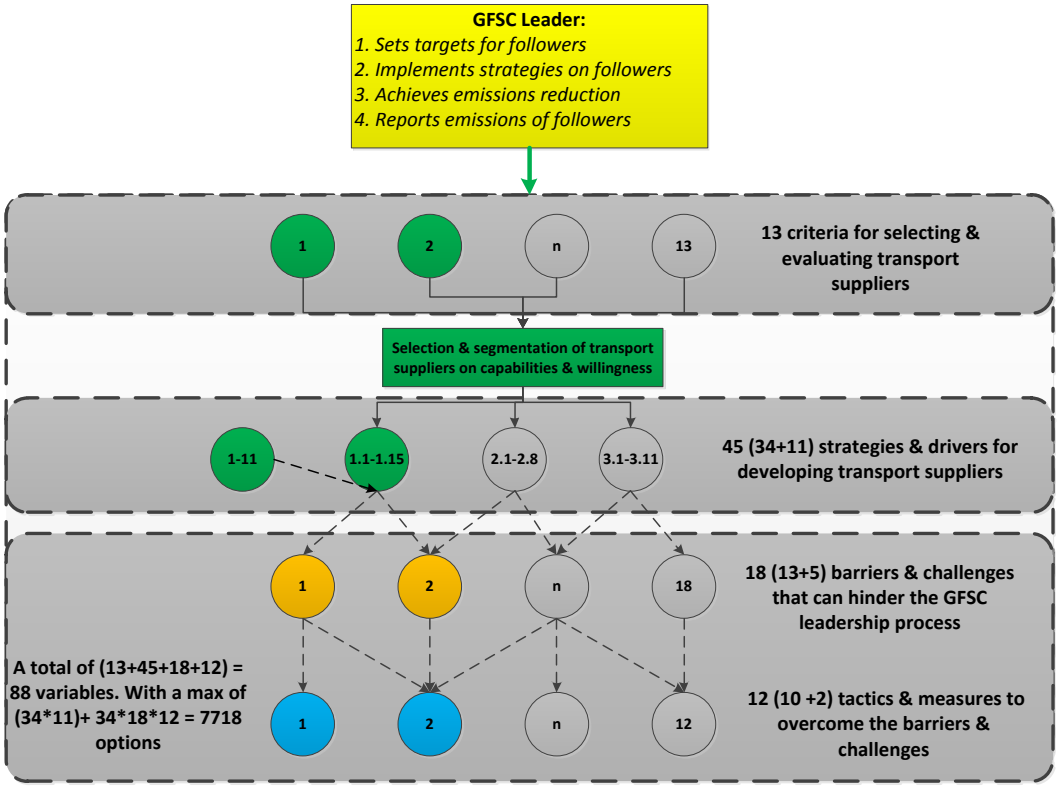


Figure 11: aggregated illustration of the GFSC leadership model

The model depicts the steps that a GFSC leader can take to reduce transport related emissions, starting with an shipper/LSP selecting/evaluating its transport suppliers and ending with collaborating with them to reduce emissions. The benefits of such a GFSC model is that it can provide a shipper/LSP an overview of all different options that can be taken, where to focus on and what implications certain decisions can have. For instance, such a model would allow a firm to see what barriers and challenges can be encountered if a certain strategy is chosen and what tactics and measures can overcome such these barriers and challenges. This would allow a shipper/LSP to focus only on the relevant barriers/challenges and tactics/measures given the choice for certain strategies. An example of such a case is depicted in Figure 11 illustrating the elements that would be taken into consideration in color and the elements that would be neglected in grey.

The drawbacks of such a comprehensive GFSC model would lie in the complexity as it would demand significant capacity to utilize, hindering the decision making process. For instance, taking all strategies, barriers/challenges and tactics/measures into account, the model would generate a maximum of (34*11) +(34*18*12)=7718 different options thereby reducing transparency. However, as the literature review showed that not all elements are equally important, transparency can be increased by eliminating the insignificant elements. Such a model would provide all the useful insights without compromising on the user-friendliness. The decision was therefore made to connect the different elements after the insignificant elements are identified. To this end, the case study as the second part of this study will aim at (1) verifying whether other significant elements can be added to the current GFSC model, (2) validate the findings on the current GFSC model and (3) identify which elements are insignificant and thus can be left out of the model. This will deliver a more transparent but complete GFSC leadership model.

4 Case study: practical insights

To deliver a transparent and comprehensive GFSC leadership model, a case study was conducted through a desktop research and interviews. The desktop research enabled the identification of shippers/LSPs that show high potential of being GFSC leaders given the four criteria for GFSC leadership . Furthermore, the desktop research provided an overview of supplier development strategies that these potential GFSC leaders deploy on their transport suppliers. The firms that were identified as GFSC leaders by the desktop research were approached for interviews and those that were willing to participate, generated input for the model. This chapter provides a summary of the findings of the cases study and consists of five paragraphs being, (1) set up and results of the case study, (2) GFSC leadership , (3) GFSC leadership criteria, (4) GFSCL strategies and drivers and (5)GFSCL barriers and tactics.

4.1 Case study set up and results

Desktop set up and results

For executing the conjunctive screening method that is elaborated in chapter two, firms were assessed on how well they scored on the four defined GFSCL criteria. This was done by evaluating their Company Environmental Reporting (CER) where a 5 points scale was used that varied from extremely good to extremely poor. This allowed to differentiate the firms that could be considered potential GFSC leaders from those that are clearly not candidates. As the scores of the firms varied significantly, three groups of GFSC leaders were identified, being (1) high level leaders, (2) medium level leaders and (3) emerging level leaders. High level leaders were considered to score extremely good on all four criteria, medium level leaders were considered to score higher than average on all criteria and emerging level leaders were considered to score higher than poor on all criteria. This is depicted in Table 14.

Table 14: scaling of the firms' scores

Score	Scale	Classification of leadership	Cut-off value	Elaboration
Extremely good	5	High level leader	4	Firm scores at all criterion higher than 4
Good	4	Medium level leader	3	Firm scores at all criterion higher than 3
Average	3	Emerging level leader	2	Firm scores at all criterion higher than 2
Poor	2	Non-leaders		
Extremely poor	1	Non-leaders		

As all firms have report differently, it is important to elaborate how the scores per criteria were determined. This will be elaborated per criterion after a brief explanation of the concepts of GHG, product footprint and corporate carbon footprint as they were key terms in understanding the reports.

GHG

An abbreviation for greenhouses gasses, this term refers to the gases that trap heat in the atmosphere and thus contribute to climate change. According to the Kyoto Protocol of the United Nations this includes carbon dioxide (C02), methane (Ch4), nitrous oxide (N2O), Hydro fluorocarbons (HFCs), per fluorocarbons (PFCs) and sulphur hexafluoride (SF6) (UN, 2014). Instead of mentioning each gas separately, a number of firms report their emissions in C02e, that stands for equivalent carbon dioxide, enabling the expression of all different greenhouse gases as a single number. C02e emissions are calculated according the greenhouse impact of each gas in proportion to the amount of C02 that would create the same amount of warming (EPA, 2014).

Product carbon footprint/Life Cycle Assessment (LCA)

The product carbon footprint provides a picture of the environmental impacts (in terms of carbon emissions/GHG) associated with a product, process or service and the LCA is a technique used to asses this (EPA, 2014). Here, different stages of a product can be taken into consideration that span from raw material acquisition, production, transportation, disposal to recycling/reuse (Wiedmann & Minx, 2008) (BU, 2014). Generally, firms focus on different stages and thus the scope of LCAs differ, producing the types of LCA elaborated in Table 15.

Table 15: different types of LCA

LCA type	Scope
Cradle to cradle	From resource extraction to recycling/reuse
Cradle to grave	From resource extraction to disposal
Cradle to gate	From resource extraction until factory gate, when product is ready to be transported to customer
Gate to gate	Concerns a value-added process in the production chain
Well to wheel (well to tank and tank to well)	From fuel production to vehicle fuel consumption
Economic input-output	Concerns the aggregated environmental impact of a sector and its links to other sectors
Ecologically based	Concerns a broader scope by including the indirect impacts to ecosystems and resources.

Corporate Carbon Footprint

The corporate carbon footprint provides a picture of the (GHG) emissions that a firm produces spanning from its own activities to the activities of other firms in the same supply chain (Wiedmann & Minx, 2008) (Hauschild, Jeswiet, & Alting, 2005). As with the product carbon footprint, firms have different scopes as they consider different activities. To increase harmonization in measuring and reporting of emissions, the Greenhouse Gas Protocol was developed and identifies the three categories elaborated in Table 16.

Table 16: Categorization according the Greenhouse Gas Protocol (WBCSD & WRI, 2014)

Category	Activities considered
Scope 1	The emissions produced as a result of firms direct activities
Scope 2	The emissions produced as a result of the purchased and consumed energy, e.g. electricity, gas etc.
Scope 3	Other emissions in the supply chain that are produced as a result of a firms demand to other firms, e.g. business travels and outsourced activities like transportation

In the context of this research, scope 3 emissions are naturally the relevant as they define all the transport related emissions for shippers and apart of the emissions for the LSPs. This is especially the case with shippers as most outsource the transportation of their goods. However, they will be the most difficult to set targets/strategies for, measure and reduce as they are produced by third parties given the obstacles and challenges elaborated in chapter 3.4. For this reason, only the firms that managed to achieve this to the full extent were considered to be potential high level leaders. Table 17 elaborates how the CERs were assessed through the four defined criteria.

Table 17:process of assessing cooperate environmental reports

	Scores on criteria		
Criterion	***5 (High level)***	***4 (Medium level)***	***3 (Emerging level)***
Targets set to reduce freight transport emissions	C02e targets covering the entire supply chain, i.e. cradle to cradle/grave-well to wheel; scope 3 emissions	C02 targets covering the major part of the supply chain	C02 targets covering a minor part of the supply chain
Strategies in place to achieve the targets	Strategies with a roadmap covering the entire supply chain	Strategies covering the major part of the supply chain	Strategies covering a minor part of the supply chain
Freight transport related emissions reduced	Reduced emissions over the entire supply chain reaching/surpassing previous targets	Reduced C02e emissions over the major part of the supply chain/previous targets not met	Reduced C02e emissions over a minor part of the supply chain/ previous targets not met
Reporting of freight transport emissions	Reports emissions of entire supply chain i.e. including all scope 3 emissions	Reports a major part of the freight transport emissions	Reports over a minor part of the freight transport emissions

Side notes here is that for LSPs also scope 1 and 2 emissions were taken into consideration as they also concern freight transport related emissions. Furthermore, a distinction was made whether a firm mentioned all freight transport related emissions of its supply chain i.e whether all regions, modes and sectors were covered. Here, “a major part of the supply chain” means that more than 50% of the freight transport was covered while “a minor part of the supply chains” implies that less than 50% was covered.

To give an impression of the execution of the conjunctive screening method, Table 18 contains a sample of the scores of four firms belonging in the categories of potential non-leaders, low level, medium level

and high level leaders. The full list of the scores and ranking can be found in the Excel file that comes as an attachment to this thesis.

Table 18: application of the conjunctive screening method

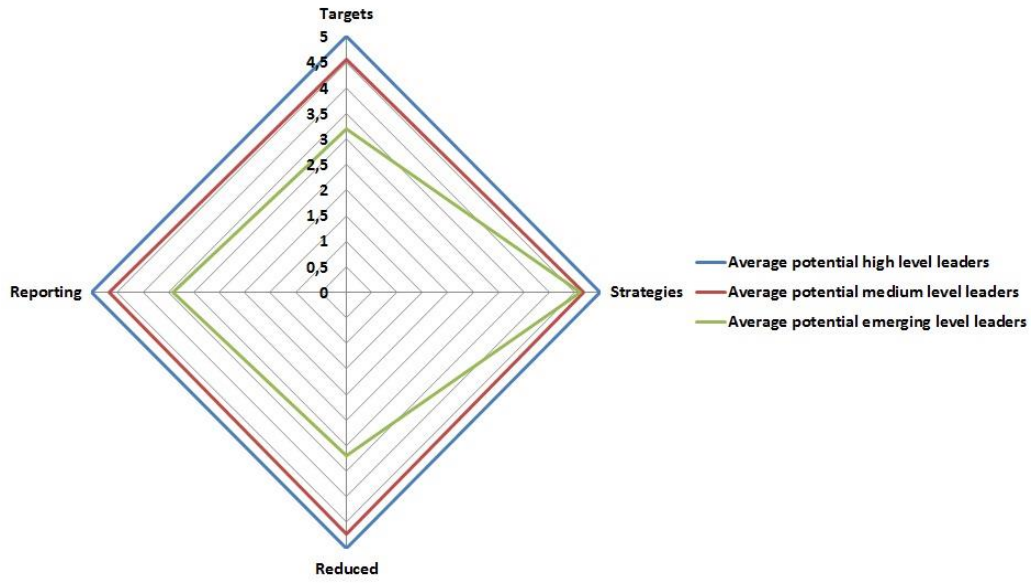
	Criteria				Potential GFSCL level		
Firm	Targets	Strategies	Reduced	Reporting	High	Medium	Emerging
Aviko	3	4	3	3	0	0	1
Ikea	5	5	5	5	1	0	0
Kuhne+Nagel	4	5	4	4	0	1	0
Ralp Lauren Corpor.	1	1	1	1	0	0	0
Average scores	**3,39**	**3,38**	**3,55**	**3,42**			

After applying the conjunctive screening method, 37 firms that were found to be potential leaders and were categorized in the three levels of GFSC leadership, providing 14 potential high level, 18 medium level and 5 emerging leaders, as illustrated in Table 19.

Table 19: list of potential high, medium and low level GFSC leaders

Potential high level leaders	Unilever	Kohl's
AkzoNobel	**Potential medium level leaders**	Kuehne+ Nagel
Deutsche Post DHL	Alcoa	The Coca-Cola Company
Epson	AT&T	The Procter & Gamble Company
Evonik Corporation	Ball Corporation	UPS
Heineken	BASF Corporation	Walmart
Hewlett-Packard (HP)	BDF Beiersdorf	**Potential emerging level leaders**
IKEA	Campbell's	Aviko (Royal Cosun)
Intel Corporation	DELL, Inc	Bacardi
Lenovo	DSV	Best Buy
NIKE, Inc.	Electrolux (major appliances)	DOW (Dow Chemical Company)
Philips	EMC Corporation	EMD Millipore Corporation
Schneider Electric	FedEx	
TNT	Heinz	

Table 20 and Graph 2 compare the three groups of firms on an aggregated level, showing the average scores. Here it is noticeable that the difference between the high level leaders and medium level leaders is significantly smaller than the difference between medium level leaders and emerging leaders. Looking only at the first two groups, it can be argued that the majority of the firms that do make significant effort to become GFSC leaders, lack a small step to succeed when their performance is assessed on the four criteria. Reflecting to the non-compensatory character of the conjunctive screening method elaborated in chapter 2, this means that most firms in the medium level leadership category score a 5 (meaning extremely good) at three criteria and score a 4 (meaning good) at one criterion. This is promising as these firms can thus become high level leaders with little improvement.



Graph 2: average scores of potential GFSC leader categories

Table 20: average scores on GFSC leadership criteria

	Criteria average scores			
GFSCL category	Targets	Strategies	Reduced	Reporting
Potential high level leaders	5	5	5	5
Potential medium level leaders	4,6	4,7	4,7	4,7
Potential emerging level leaders	3,2	4,6	3,2	3,4

Looking at the potential emerging leaders group, it is evident that the scores of this group, excluding the strategies criterion, are significantly lower than the scores of the other two groups. No obvious explanation can be found why the emerging level leaders score higher on the strategies criterion than on other criteria. The fact that this group only consists of five firms makes it more difficult to make general conclusions. The graphs that show firm's specific performances per category are included in Appendix 8.

Practical implications for desktop research

The practical implication of this desktop research can be that, since little difference exist in the potential high level and medium level leaders, firms from both groups will be qualified to in the interviews. This benefits the research as it increases the group of firms that can be approached to participate in the interviews. On this basis, all firms belonging in the high and medium potential leaders categories were approached for participating in the interviews. This was done through the commissioner's contacts and by online searching. In total the following seven companies were willing to provide a 1 hour interview: AkzoNobel;, Heineken; Intel; The Procter & Gamble Company; DHL; TNT and UPS. For confidentially

reasons, they will be referred to with the letters A-G. As all but one interviewee was in the Netherlands, the interviews took place via Skype. To maximize input, the questions to be asked and a summary of the literature review were sent beforehand to enable the interviewees to prepare. The findings and summary of the interviews can be found in Appendix 9.

Setup of interviews & validation

As elaborated in chapter 2.2, the direct rating method was used to conduct the interviews, as applied by Trochim & Cook (1992). Here, interviewees were asked to distinguish the relevant and irrelevant factors based on their firm's GFSC leadership experiences. The unstructured sorting procedure was used to process the results (Trochim, 1985; Rosenberg & Kim, 1975). As depicted in Table 21, An element received a value of 1 if it was considered relevant, a value of -1 if it was considered irrelevant and a value of 0 if no opinion was given. The total ratings constituted the score of the factors and the average score of all factors was taken as the cut-off value – the factors that scored higher than the average were considered relevant and the ones that scored the average or lower were considered irrelevant. The rational is that above average scores indicate that the majority of the interviewees agree with the relevance of a factor, while average and lower scores indicates the opposite or indecisiveness.

To validate the findings, the findings from the case study were compared with the theories explained in the literature review using the pattern matching technique since it is suitable for comparing empirical patterns with theoretical ones (Yin, 2014). The technique relies on the assumption that a theory is more confirmed when a theory is observed in empirical data (Yin, 2014). Here, the unstructured sorting procedure was also used where a factor is given: a value of 1 if case study findings confirmed the theory, a value of -1 if they contradicted theory, and a value of 0 if no opinion was given. Similarly, the total ratings constituted the score of the variable and the average score of all variables was taken as the cut-off value.

Table 21: application of the unstructured sorting procedure

Rating	Score	Threshold
Element is relevant/validates theory	1	Sum-Average > 0
No opinion	0	
Element is irrelevant/contradicts theory	-1	

4.2 First component: GFSC leadership

To generate input on the concept of GFSC leadership, interviewees were asked to elaborate the issue from their own perception. The interviewees were first asked to define the ideal GFSC leader in terms of behavior and characteristics. Subsequently, they were asked to reflect on the definition that this thesis adopted and the four complementary criteria that distinguish a GFSC leader. Table 22 summarizes the insights from the responses where it can be seen (in a green highlight) that the interviewees indicated that a GFSC leader needs to exercise leadership in the following three areas to effectively reduce transport related emissions: (1) internally/leading by example, (2) within the supply chain and (3)

outside the supply chain. Here, it is evident that the first two areas significantly score higher than the third option. The insights that the Table provide will be discussed further.

Table 22: interview ratings on GFSC leadership scope

Areas of GFCS leadership	Shipper				LSP			Times mentioned	Deviation from average
	A	B	C	D	E	F	G		
1. Lead by example	1	1	0	1	1	1	1	**6**	**3**
2. Lead within supply chain (LSPs/carriers)	1	1	1	1	1	1	1	**7**	**4**
2.1 Set targets beyond regulations	0	0	1	0	0	0	1	2	-1
2.2 Optimize the broader supply chain	0	0	0	1	0	0	1	2	-1
2.3 Engage with customers through LSPs/carriers	0	0	0	0	1	0	0	1	-2
3. Lead outside the supply chain	0	1	0	0	1	1	1	**4**	**1**
3.1 Collaborate with other shippers	0	0	0	1	0	0	0	1	-2
				Average				**3**	

1= area is relevant, 0 = no opinion given, -1 = area is not relevant

In addition to the four defined GFSC leadership criteria, the second areas was further specified by two firms arguing that a GFSC leader is a firm that sets environmental targets that go beyond governmental regulations. It was also suggested that a GFSC leader should optimize the entire supply chain to reduce transport emissions. This can for example be achieved by strategically placing manufacturing and distribution centers to minimize transportation or by applying best practices across the entire firm in all regions. Furthermore, only one firm argued that for an LSP to become a GFSC leader, it should pro-actively provide emission-efficient solutions to customers to incite green demands (highlighted in orange). Subsequently the LSP should fulfill these green demands. Here, the shipper would thus indirectly become the follower of the LSP.

On the area of leading by example, all but one of the firms remarked that the GFSC leader should lead by example by showing effort/commitment to reduce emissions and achieving visible emissions reduction within the own firm. This is deemed to be necessary to influence other organizations in a credible manner.

Concerning leading outside the supply chain, a small majority of the firms indicated that GFSC leaders should collaborate with other firms, NGO's and governmental organizations (like the E.U) outside the supply chain to achieve standardization and harmonization of emissions measuring methods and to promote the sharing of best practices. This can be done by setting up or joining green initiatives that bring the relevant stakeholders together. This is deemed to be necessary for being recognized as a leader and having the credibility to act as one. The argument here is thus that a leader should also influence other stakeholders outside the supply chain. For shippers, one firm argued that a GFSC leaders should collaborate more with other shippers, highlighted in orange. This can for example be achieved by shippers utilizing the same vehicles to ensure vehicle optimization or the double stacking of pallets. As

an argument for this case, the firm in question pointed out that about 20% of the truck miles in Europe are empty due to return trips.

Conclusions on leadership

The interviews revealed that a GFSC leader needs to exercise leadership in the following three areas to effectively reduce transport related emissions: (1) internally by leading by example, (2) within the supply chain and (3) outside the supply chain. Here, it is noteworthy that the first two areas score significantly higher than the third area.

4.3 Second component: GFSC leadership criteria

Interviewees were asked to review the list of criteria that a GFSC leader can use to evaluate or select transport suppliers. First they were asked whether the list was complete and whether additional criteria could be added. All interviewees found the list to be complete. Subsequently, the interviewees were asked to give an indication of which criteria they deemed relevant and which criteria they perceived as irrelevant, i.e which criteria are (not) suitable to evaluate transport suppliers. Table 23 provides a summary of the findings where the criteria that score above average are highlighted in green and the ones that score the lowest are highlighted in orange..

Table 23: interview ratings on GFSC leadership criteria

GFSC leadership criteria	Firm			LSP	Times mentioned	Deviation from average
	A	B	C	D		
1. Pollution production and reduction	1	1	1	1	4	3,5
2. Resource consumption	1	1	0	1	3	2,5
3. Green image	0	1	0	-1	0	-0,5
4. Environmental management system	1	1	0	1	3	2,5
5. Commitment of GSCM from managers	0	1	0	-1	0	-0,5
6. Use of eco- friendly technology	1	1	0	1	3	2,5
7. Management competencies (support, partners & training)	0	-1	0	-1	-2	-2,5
8. Public disclosure of environmental record	-1	-1	1	1	0	-0,5
9. Performance awards	-1	-1	1	-1	-2	-2,5
10. Reputation of LSPs/carriers	1	-1	0	-1	-1	-1,5
11. Willingness to share information	1	-1	1	1	2	1,5
12. Willingness to rely on each other	1	-1	-1	-1	-2	-2,5
13. Willingness to get involved in a long-term relationship	1	-1	-1	-1	-2	-2,5
	Average				**0,5**	

1= criterion is relevant, 0 = no opinion given, -1 = criterion is irrelevant

From Table 23, it can be argued that generally criteria are deemed to be relevant when they provide a picture of (a) the pollution production of the transport supplier (criteria 1 & 2), (b) the efforts/strategies of the transport supplier to increase environmental performance (criteria 4 & 6) and (c) the extent to which the transport supplier are willing to share information (11). This was also mentioned in an

interview as an interviewee remarked that “mostly important is the visibility of a firm’s current environmental status and their actual actions to improve”.

Here, the idea is created that the third aspect might be less relevant that the first two aspects as it has the lowest ranking. A noticeable criterion is number 8 “public disclosure of environmental record” as it is referred to as relevant and irrelevant. Looking at the interview reports, the reason given for public disclosure not being important was that using the track record/past history of transport suppliers is deemed to be a better alternative. Combined with criterion 11, this fact suggests that transparency in the environmental performance of transport suppliers is considered an important criterion for selecting and evaluating transport suppliers.

The Table also shows the criteria that were mostly referred to as irrelevant, highlighted in orange. Here it is noteworthy that this mainly concerns “intangible” criteria that are more difficult to measure. As can be seen from the interview reports in Appendix 9, criterion 12 and 13 were cited to be not relevant as they are considered to be common practice among large shippers since large volumes of goods are involved. While criterion 9, performance awards, was considered to be more an internal issue of transport suppliers and less of a criterion on which they can be assessed on.

Conclusion on leadership criteria

Criteria to select and evaluate transport suppliers are generally deemed to be important when they provide a picture of: (1) the pollution production of the transport suppliers, (2) the efforts and strategies of transport suppliers to increase environmental performance and (3) the transparency in the environmental performance of transport suppliers.

4.4 Third component: GFSC leadership strategies and drivers

This paragraph first discusses the practical findings on the GFSC leadership strategies and subsequently elaborates on the drivers.

4.4.1 GFSC leadership strategies

To determine the most deployed strategies, the desktop research and interviews mapped the strategies of the 14 firms that were identified as potential high GFSC leaders, as shown in Table 19. Five other firms (Heinz, P&G, FEDEX, K+N and UPS) were added to this list as they had a high likelihood of participating in the interviews and were classified as potential medium GFSC leaders. This resulted in a total of 19 firms of which their strategies reviewed in detail. For confidentially reasons, they will be referred to with the letters A-S.

During the interviews, correspondents were asked first asked which strategies they deployed on transport suppliers, which of these they deemed to be the most and ineffective, to what extent this was the case and how they measured this. Afterwards, the interviewees were asked to review the list of strategies from literature that a GFSC leader can deploy to develop transport suppliers and to indicate whether the list was complete and whether additional strategies could be added. All interviewees found the list to be complete. Subsequently, the interviewees were asked to give an indication of which strategies they deemed effective, which ones as ineffective and to what extent this was the case. This sub paragraph first presents the conclusions on the strategies that the firms deploy above average (Table 24 and Table 25) and subsequently the effectiveness of the strategies is discussed (Table 26). Again, the above average scores are highlighted in green and the lowest scores are in orange.

Frequency of deployed strategies

Table 24: deployed strategies

Category	Strategy (most applied)	Shipper														LSP						
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	Sum	Deviation from average
1. Green knowledge transfer and communication	1.1 Training LSP/carrier employees on environmental issues	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	4	1
	1.2 Train LSPs/carriers in stakeholder expectations	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	4	1
	1.3 Train users in environmental capabilities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3
	1.4 Train LSPs/carriers on environmental and cost controls	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	4	1
	1.5 Giving green technological advice to LSPs/carriers	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	0
	1.6 Conduct training and education programs for LSP/carrier personnel	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	4	1
	1.7 Supplier environmental evaluation and feedback	1	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	1	0	6	3
	1.8 Develop LSP/carrier environmental assessment programs	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-2
	1.9 Providing feedback about LSP/carrier environmental performance	1	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	1	0	6	3
	1.10 Strong formal LSP/carrier environmental evaluation	1	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	1	0	6	3
	1.11 Setting environmental improvement targets for LSPs/carriers	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	5	2
	1.12 Auditing LSPs/carriers	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	1	0	5	2
	1.13 Joint and team problem solving on environmental issues	0	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	15	12
	1.14 Information sharing on environmental topics	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	5	2
	1.15 On-going communication with LSP/carrier community via LSP/carrier environmental councils	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	-1
2. Investment and resource transfer	2.1 Invest in improvement of transaction processes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3
	2.2 Reduce LSP/carrier environmental costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	-2
	2.3 Solve LSP/carrier environmental technical problems	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	3	0
	2.4 Finance LSP/carrier major capital environmental expenditures	0	0	0	1	0	1	1	0	0	0	0	1	0	0	1	0	0	0	1	6	3
	2.5 Transferring LSP/carrier employees with environmental	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3

	expertise to buying firm																						
	2.6 Transferring employees with environmental expertise to LSP/carrier	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3
	2.7 Investment in LSP/carrier capacity building	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	-1
	2.8 LSP/carrier rewards and incentives for environmental performance	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	2	-1
3. Management and organizational practices	3.1 Requiring ISO 14000 certification for LSPs/carriers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3
	3.2 Long-term contracts with environmental dimensions incorporated	1	0	1	0	0	0	0	1	0	0	0	0	1	1	0	1	1	0	1	8	5
	3.3 Introduce a cross-functional supply chain team with environmental presence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3
	3.4 Building top management commitment/support within shipper/LSP organization for green supply practices	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	-2
	3.5 Building top management commitment/support for LSP/carrier organization for green supply practices	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3
	3.6 Organization management has formal long-term plans to improve LSP/carrier performance	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	1	4	1
	3.7 Formal process for LSP/carrier development	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	3	0
	3.8 Identification of critical LSPs/carriers for improvement opportunities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3
	3.9 Criteria established about when to enter into LSP/carrier development	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	3	0
	3.10 Formal process to identify LSP/carrier emission reduction targets	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	-1
	3.11 The participation level of LSP/carrier in the eco-design stage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3
														Average							**3**	

1= strategy is applied, 0 = strategy is not applied

Table 24 and Table 25 depict the strategies used by the 19 firms. The first observation is that the strategies in category 1 are deployed the most, accounting to 67% of all applied strategies, and category 2 strategies are applied the least.

Table 25: number of times categories are deployed

Category	Number of times deployed	%
1. Green knowledge transfer and communication	70	67
2. Investment and resource transfer	14	13
3. Management and organizational practices	21	20
Total	**105**	**100**

It can be argued that this is because category 1 has got the most strategies and category 2 the least. However, looking at the individual strategies in Table 24, it is apparent that this is not the case, e.g. only one strategy in category 2 is green. This was also affirmed during the interviews where it was elaborated that category 1 strategies are considered to be more attractive as the firms give preference to strategies that are perceived to be cost-efficient i.e. reduce emissions while improving business. As can be seen read in the interviews in Appendix 9, most firms explained that the main reason of implementing the strategies is the expected cost reduction and/or competitive edge as "green transport" is considered a growing business aspect. This simultaneously explains why category 2 strategies are the least deployed as they would generally require more investments. On these strategies, the interviewees argued that they were too far going and not realistic for implementation from a costs-perspective. This confirmed a study by Bai and Sarkis which suggested that category 2 strategies do no lead to higher (business) performance (Bai & Sarkis, 2010).

Concerning the low implementation of category 3 strategies, it was mentioned that these strategies are considered to be more advanced and better suited for a later stage.

Looking at the individual strategies, strategy 1.13 "Joint and team problem solving on environmental issues" stands out as it is significantly deployed the most. The strategy was specified as follow:

- Reorganizing the supply chain to increase transportation efficiency by optimizing routes, return-trips, distribution-centers, frequencies, shifting transport-modes (from air/truck to sea/ral), packaging and loading.
- LSPs providing green transport and warehousing alternatives for the shippers
- Shippers collaborating with transport suppliers to ensure return-flows/reduce empty kilometers.

The unprecedented high deployment of this strategy underlines the argument that firms give preference to cost-efficient strategies as this strategy is mainly aimed at reducing costs. The next section will elaborate on the significance of these strategies in terms of emission reduction potential.

Most and ineffective strategies

Concerning the effectiveness of the strategies, only one of the interviewed firms was able to attach a concrete number in terms of the reduced emissions that can be accounted to a strategy. All other firms interviewed argued that it was impossible to determine due to the complexity of the supply chain and/or the lack of information. The complexity of the supply chain was explained by the thousands of LSPs/carriers involved in a firm's supply chain in different countries. Related to this, it was furthermore argued that since transport suppliers are influenced by more shippers/LSPs, it is not possible to determine which share of emission reduction can be attributed to a specific strategy.

With respect to lack of information, the main reason given, was that LSPs/carriers are reluctant to provide information on their fuel consumption as this can be used in price negotiations. This makes it difficult for shippers/LSPs to calculate emissions. These limitations made it challenging to quantitatively assess the effectiveness of strategies in terms their emissions reduction potential. To compare the effectiveness of strategies given these limitations, it was decided to assess strategies in the same manner as all other elements of the GFSC leadership model.

Table 26 shows that the strategies in category 3 category "management and organization practices" are perceived to be the effective while the ones in category 2 "Investment and resource transfer" are perceived to be the ineffective. Also here, this cannot be attributed to the fact that the categories have a different number of strategies as can be seen in Table 27 where the strategies that scored above average are in a green highlight and the strategies with the lowest scores are in an orange highlight.

Table 26: sum of category scores on effectiveness

Category	Sum
1. Green knowledge transfer and communication	4
2. Investment and resource transfer	-13
3. Management and organizational practices	14

Looking at Table 27, four notable observations can be made. First, all the strategies that are deemed to be effective belong to category 1 and 3 while all the strategies that are deemed to be the ineffective are in category 2. This is reflected in the interview reports in appendix 9, where the interviewed firms argued that the effective strategies enhance (1) management's commitment; (2) collaboration and information sharing between shippers, LSPs and carriers; (3) harmonize standards, methodologies and practices. Furthermore, it was argued that these strategies should have a long-term perspective, as in contracts, and should be included in formalized processes. With respect to category 2 strategies, also here the firms found them to be too far going and not realistic for implementation from a costs-perspective.

Table 27: strategies perceived to be (not) effective

Category	Strategy[3]	Shipper			LSP		Sum	Deviation from average
		A	B	C	D	E		
1. Green knowledge transfer and communication	1. Training LSP/carrier employees on environmental issues	-1	-1	1	0	1	0	0
	2. Train LSPs/carriers in stakeholder expectations	-1	0	0	0	0	-1	-1
	3. Train users in environmental capabilities	-1	0	0	0	0	-1	-1
	4. Train LSPs/carriers on environmental and cost controls	-1	0	0	0	0	-1	-1
	8. Develop LSP/carrier environmental assessment programs	**1**	0	**0**	**0**	**1**	2	2
	9. Providing feedback about LSP/carrier environmental performance	0	0	0	0	1	1	1
	10. Strong formal LSP/carrier environmental evaluation	0	0	0	0	-1	-1	-1
	11. Setting environmental improvement targets for LSPs/carriers	0	0	0	0	-1	-1	-1
	13. Joint and team problem solving on environmental issues	**0**	**1**	**1**	**1**	0	3	3
	14. Information sharing on environmental topics	0	0	1	0	0	1	1
	15. On-going communication with LSP/carrier community via LSP/carrier environmental councils	**1**	0	0	**0**	**1**	2	2
2. Investment and resource transfer	1. Invest in improvement of transaction processes	0	0	-1	0	-1	-2	-2
	2. Reduce LSP/carrier environmental costs	0	0	-1	0	0	-1	-1
	3. Solve LSP/carrier environmental technical problems	0	0	-1	0	-1	-2	-2
	4. Finance LSP/carrier major capital environmental expenditures	0	0	-1	0	-1	-2	-2
	5. Transferring LSP/carrier employees with environmental expertise to buying firm	-1	0	-1	0	0	-2	-2
	6. Transferring employees with environmental expertise to LSP/carrier	-1	0	-1	0	0	-2	-2
	7. Investment in LSP/carrier capacity building	0	0	-1	0	0	-1	-1
	8. LSP/carrier rewards and incentives for environmental performance	0	0	-1	0	0	-1	-1
3. Management and organizational practices	1. Requiring ISO 14000 certification for LSPs/carriers	**1**	-1	**1**	**0**	**1**	2	2
	2. Long-term contracts with environmental dimensions incorporated	**1**	**1**	**1**	**0**	**1**	4	4
	4. Building top management commitment/support within shipper/LSP organization for green supply practices	1	0	0	0	0	1	1
	5. Building top management commitment/support within LSP/carrier organization for green supply practices	**0**	**1**	**1**	0	0	2	2
	6. Organization management has formal long-term plans to improve LSP/carrier performance	0	0	0	0	1	1	1
	7. Formal process for LSP/carrier development	0	0	0	0	1	1	1
	8. Identification of critical LSPs/carriers for improvement opportunities	**0**	**0**	**1**	0	**1**	2	2
	10.Formal process to identify LSP/carrier emission reduction targets	0	1	0	0	0	1	1
		Average					0,2	

[3] Only the strategies cited were taken into account, since the inclusion of all the strategies would significantly reduce the average (increasing selected strategies) due to the large number of strategies.

1= strategy is effective, 0 = no opinion, -1 strategy is in effective

Secondly, another remarkable observation is that there seems to be less consensus on the effectiveness of strategy 1.1 and strategy 3.1 to a lesser extent as they are simultaneously cited to be effective and ineffective. Concerning strategy 1.1, "training of supplier employees on environmental issues", the firms that considered it to be ineffective were shippers that argued it to be the responsibility of transport suppliers, as can be seen in Appendix 9. Provided that the research by Bai and Sarkis found this strategy to be effective, the idea arises that this assessment was less on the potential of the strategy to reduce emissions and more on the suitability of the stakeholder that applies. I.e. shippers argued that the strategy would not be effective if they deployed it but it might be effective if transport suppliers implement it. With respect to strategy 3.1, requiring ISO 14000 certification, the firms that referred it to be not effective, argued that generally certifications tend to be a formality than real life implementation. As more firms considered it to be effective, it can be suggested that it has the potential to be effective only when implemented to the full extent.

Thirdly, as was elaborated in Chapter 3.2.2, the strategies can either be deployed to increase the willingness and/or capability of transport suppliers. To this end, the strategies that were cited to be the important from Table 27 were classified in these two dimensions through expert opinions as is elaborated in Appendix 7. The results can be seen in Figure 12.

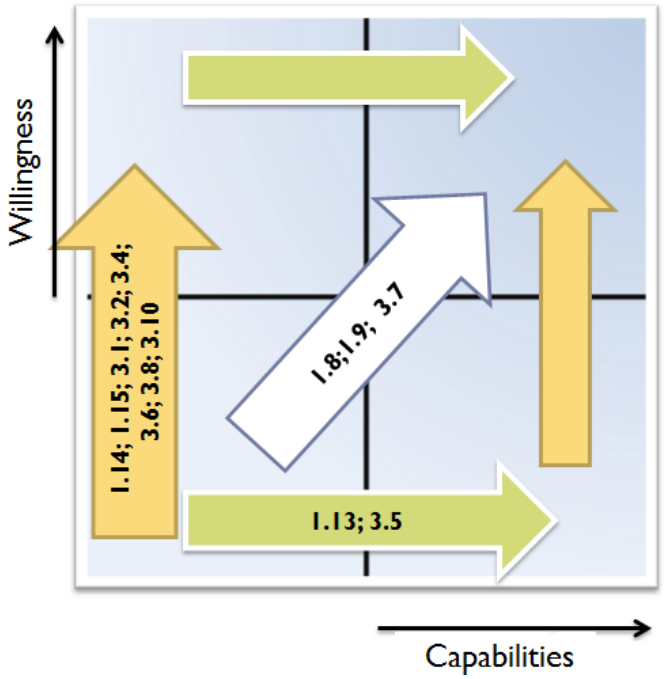


Figure 12: segmentation of important strategies on capabilities and willingness

Fourthly, the interviewees argued the effectiveness of strategies depends on other conditional organizational characteristics. This confirmed the study by Bai and Sarkis (2010) which suggested that profitability, firm size and industry type influence the effectiveness of a green strategy. For instance, it was suggested that providing long-term commitment via the strategies 3.6, 3.7 and 3.8 will most likely be effective on large transport suppliers. Additionally it was mentioned that regulations and willingness to cooperate can be conditional characteristics as they determine the feasibility of certain potentially effective strategies that include setting environmental targets and conducting evaluations on transport suppliers (strategy 1.10 and 1.11).

Conclusions on strategies

Six conclusions can be made when comparing the strategies. Firstly, it is evident that while the strategies in category 1 and 3 are considered to be effective, the most applied strategies belong in category 1. This is even more remarkable when considering the fact that category 3 strategies are perceived to be significantly more effective than category 1 strategies. This might be explained by the revealed "business approach to green transport" that prevails among firms as they indicated that strategies were implemented for the expected financial benefits. This is confirmed by the study of Bai and Sarkis that found that the most business performance enhancing strategies belong in category 1.

Secondly, it can be argued that category 1 strategies will generally provide short-term benefits as they are applied directly to the issues at hand i.e. the necessary knowledge needed to reduce emissions in day to day activities. While the benefits of category 3 strategies will be more structural and long-term as they are indirectly applied to the issues through a firm's management, i.e. increasing the management's commitment to environmental performance. This is also confirmed by the earlier mentioned interview observation where firms indicated that category 3 strategies were considered to be more advanced and suitable for a later stage. The fact that they were also perceived as effective measures further strengthens this argument.

From conclusion 1 and 2 the hypotheses can be made that although both category 1 and 3 strategies are considered to be effective, category 1 strategies are more preferred as they have more short-term benefits. Since category 3 strategies show a much higher effectiveness level and are considered to be more advanced and suitable for a later stage, future research should focus on how firms can make the transition from category 1 strategies to category 3 strategies.

Thirdly, the influence of conditional organizational characteristics of firms to the effectiveness of strategies was revealed as an important aspect. Here, the size of the transport suppliers size and their willingness to enhance environmental performance were pointed out as the main conditions that positively determine the effectiveness of applied strategies. This confirms the segmentation of strategies in the dimensions of transport suppliers willingness and capabilities.

Fourthly, it was found that firms could not quantitatively assess the effectiveness of strategies in terms their emissions reduction due to the complexity of the supply chain and the lack of information. It was argued that the shippers/LSPs have thousands of transport suppliers all over the world and all are

influenced by more shippers/LSPs. Thus it was not possible to determine which share of emission reduction could be attributed to a specific strategy. It was furthermore argued that the fear and reluctance of transport suppliers to provide fuel consumption information, makes it difficult to calculate emissions reduction of a strategy.

For instance, about six out of eleven of the above average deployed strategies are found to be ineffective in reducing emissions. While about half of the under average applied strategies were found to be effective. This indicates that, although the studied firms belonged in the group of potential GFSC leaders, they did not apply the effective strategies implying that the current resources used to reduce transport related emissions can be utilized more efficiently. For instance, strategy 2.4 was considered no to be effective by both the case study and Fu et al., (2012) yet it is in the strategies that are most applied.

The last conclusion is that the effective strategies were generally found to enhance (1) management's commitment and (2) collaboration and information sharing between shippers, LSPs and carriers. The ineffective strategies were found to be investing and transferring resources to transport suppliers as they were not realistic from a costs-perspective.

4.4.2 GFSC leadership drivers

Interviewees were asked to review the list of drivers that a GFSC leader can communicate to incentivize transport suppliers to comply with the strategies as this concerns benefits for both parties. First they were asked whether the list was complete and whether additional drivers could be added. All interviewees found the list to be complete. Subsequently, the interviewees were asked to give an indication of which drivers they deemed relevant and which drivers they perceived as irrelevant, i.e. which drivers would they communicate to support strategies and which ones not. Table 28 provides a summary of the findings where the drivers that scored above average are highlighted in green and the ones that scored the lowest are highlighted in orange.

Table 28: rating of GFSC leadership drivers on relevancy

Drivers	Shipper				LSP			Sum	Deviation from average
	A	B	C	D	E	F	G		
1. Cost reduction	1	1	0	1	1	1	1	6	4
2. Productivity improvement	1	0	0	-1	0	0	0	0	-2
3. Buyer performance improvement	0	0	0	-1	0	-1	0	-2	-4
4. Improvement in quality	1	0	0	-1	0	-1	0	-1	-3
5. Increased financial performance	0	0	0	-1	1	0	0	0	-2
6. Operations improvement	1	1	1	1	1	1	1	7	5
7. Collaboration between leader and follower	0	0	0	-1	0	0	0	-1	-3
8. Optimal resource utilization	1	1	1	-1	1	0	0	3	1
9. Competitive advantage	0	0	1	1	1	1	1	5	3
10. Follower performance	0	0	0	-1	0	0	0	-1	-3
11. Improved shipper/LSP-LSP/carrier relationships	0	0	0	1	1	1	0	3	1
	Average							**2**	

1=driver is relevant, 0 = no opinion given, -1 = driver is irrelevant

The Table shows that the interviewees stated that these drivers would incentivize transport suppliers the most: (1) operations improvement, (2) cost reduction and (3) gaining a competitive advantage. To a lesser extent, (4) optimal resource utilization and (5) improved leader-transport supplier relationship would also be effective drivers to communicate.

As the first four drivers are related to increased cost-efficiency and financial performance, the argument can be made that the interviewed firms, as the GFSC leaders, assume that the transport suppliers will have a business approach to green transport as well. Further research on the side of the transport suppliers need to be conducted to verify this hypothesis.

It is furthermore remarkable that "improvement in quality, follower performance and buyer performance" are considered as irrelevant drivers since emissions reductions falls in these categories. The explanation can be that "green performance" was not considered as an important element of a firm's performance or quality. Another reason can be that, since the firms primarily perceive green transport as a way to reduce costs and improve business, increasing environmental performance was considered a less of a benefit. Also here, further research should provide more clarity.

Conclusion on drivers

Drivers related to increased cost-efficiency/financial performance and improved leader-transport supplier relationship are considered relevant in incentivizing transport suppliers to comply with the strategies. It is remarkable that "improvement in quality, follower performance and buyer performance" are considered as irrelevant drivers since emissions reductions falls in these categories. It can be argued that both findings are related to the prevailing business approach to green transport, further research can clarify this.

4.5 Fourth component: GFSC leadership barriers and tactics

Also here, the difference was made between barriers and tactics that come from within the GFSC leader-follower relationship and the external challenges and measures that are caused by the global transport industry environment. These will be discussed in separate sub-paragraphs.

4.5.1 GFSC leadership barriers and tactics

Interviewees were asked to review the list of barriers and tactics. First they were asked whether the list was complete and whether additional barriers and/or tactics could be added. All interviewees found the list to be complete. Subsequently, the interviewees were asked to give an indication of which barriers and tactics they deemed relevant and which they perceived as irrelevant for GFSC leadership. Table 29 and 30 provide a summary of the findings where the barriers and tactics that scored above average are highlighted in green and the ones that scored the lowest are highlighted in orange. This paragraph first discusses the barriers and subsequently the tactics.

GFSC leadership barriers

Table 29: rating of GFSC leadership barriers on relevancy

Who barriers apply to	Barriers to the strategies	Shipper				LSP			Sum	Deviation from average
		A	B	C	D	E	F	G		
1. Leader (shipper/LSP)	1. Lack of leader top management commitment	-1	0	-1	-1	1	1	1	0	-0,5
	2. Too small purchases by the leader spread across too many followers	1	1	-1	1	1	1	0	4	3,5
	3. Follower not important enough to leader	1	0	-1	1	0	-1	0	0	-0,5
	4. Overly ambitious expectations that go unrealised	0	0	-1	-1	0	-1	0	-3	-3,5
2. Follower (LSP/carrier)	1. Lack of follower commitment	0	1	1	0	1	1	1	5	4,5
	2. Lack of leader's power creates follower reluctance to participate	0	0	-1	0	0	-1	0	-2	-2,5
	3. Insufficient follower human resources	1	1	-1	1	1	-1	1	3	2,5
	4. Insufficient follower technical capabilities	1	1	1	1	1	-1	1	5	4,5
3. Shippers, LSPs and carriers	1. Lack of mutual trust	-1	0	-1	0	0	-1	0	-3	-3,5
	2. Ineffective communication of potential benefits	0	0	-1	0	0	-1	0	-2	-2,5
	3. Insufficient inducements to the follower	0	0	-1	0	0	-1	0	-2	-2,5
	4. Follower is reluctant to share cost/process information	0	0	1	1	1	1	0	4	3,5
	5. Poor cultural alignment	0	0	-1	0	0	-1	0	-2	-2,5
			Average						0,5	

1= barrier is relevant, 0 = no opinion given, -1 = barrier is irrelevant

As depicted in Table 29, it is noteworthy that of all barriers that were cited to be relevant, all but one apply to transport suppliers. On the other side, all but one barrier that apply to shippers/LSPs were considered as not relevant. This might suggest that the interviewees were not self-critical enough to realize the problems that they might face and could only identify barriers for other parties. If this is the case, it will be a serious issue since acknowledging a problem is essential for accepting and implementing a solution. Further research, by e.g. interviewing transport suppliers, can provide more clarity on the issue.

From Table 29, four other conclusions can be made. Firstly, concerning the insufficient human and technical resources , it was argued that the transport industry consists mainly of small to medium transport suppliers that generally have small profit margins and thus cannot replace their equipment before it is fully utilized. It was furthermore pointed out that green equipment is costly in terms of resources and time to implement, and that transport suppliers lack the resources to make the necessary investments. This disability also reduces the commitment to engage in green collaborations with the aim of reducing emissions. The interviewees suggested that this mainly applies to the smaller transport suppliers as the larger LSPs/carriers often already have their own environmental programs, the necessary resources and are generally more prepared to collaborate.

Secondly, it was stated that transport suppliers are sceptic to disclose data, especially on fuel consumption, as they fear that such information will be used in price negotiations. As this applies to the majority of the transport supplier, it hinders shippers/LSPs to calculate transport related emissions. On this issue, other interviewees argued that this is a part of a behavioral shift as it takes time to convince carriers to collaborate.

Thirdly, concerning the barriers that are attributed to the GFSC leader, the interviewees pointed out that they operate in various countries around the globe and some collaborate with thousands of transport suppliers. The fact that most of the transport suppliers have different characteristics and are in different stages in terms of sustainability, makes it practically impossible to collaborate with all of them to reduce emissions.

Fourthly, although not scoring above average, the barrier " lack of leader's top management commitment" is remarkable as it was simultaneously cited to be among the relevant and irrelevant barriers. Looking at the type of firms that provided the assessment, it is evident that the LSPs argued this barrier to be relevant referring to lack of demand for green transport from shippers especially in economically developing regions like Asia and in Business to Business logistics. They further remarked that this hinders their efforts to provide green freight transportation as there is no demand for it. On their turn, shippers generally suggested that this barrier was not relevant as most large shippers and LSPs are committed to reduce emissions. This depicts a difference in the views of shippers and LSPs and also remains a contested issue that can be evaluated in further research.

Conclusion on GSC leadership barriers

The following barriers are considered significant: (1) insufficient human and technical resources , because the transport industry mainly consists of small to medium transport suppliers that have small profit margins and lack the resources to make the necessary investments. (2) This disability also reduces the commitment to engage in green collaborations with the GFSC leader. (3) Transport suppliers are sceptic to share data on fuel consumption, as they fear that such information will be used in price negotiations. (4) As the GFSC leaders have thousands of transport suppliers all over the world with different characteristics and at different stages in sustainability, it is practically impossible to collaborate with all of them. (5) Except for one, all barriers that were cited to be the relevant apply to transport suppliers and this suggests that Shippers/LSPs were not self-critical to acknowledge their problems. This is strengthened by the fact that LSPs argued that shippers' top management commitment to sustainability is lacking especially in developing regions and in Business to Business logistics. This might imply a serious issue, as no problem can be solved if it is not first acknowledged.

Tactics

Table 30 shows the tactics that were cited the most as effective and ineffective. Here, it is evident that emphasis lies on the tactics related to clear agreements and communication of benefits, being: (1) spelling it out by using written, well-defined agreements, (2)communicating the benefits and (3) to clarify current and future expectations with a roadmap. The other tactics are related to financials and business incentives being (1) offering financial incentives and (2) repeat business.

Table 30: rating of GFSC leadership tactics on relevancy

Area	Tactics to overcome barriers	Shipper				LSP			Sum	Deviation from average
		A	B	C	D	E	F	G		
Buyer-centric	1. Consolidate to fewer followers	-1	0	-1	1	0	-1	0	-2	-4
	2. Keep confidential information exclusive	0	0	0	-1	0	-1	0	-2	-4
	3. Spell it out	1	1	0	1	0	1	1	5	3
	4. Minimize legal involvement	0	0	0	-1	0	-1	0	-2	-4
	5. Adapt to local conditions	1	0	0	1	0	-1	1	2	0
	6. Create an expectations road map	1	1	1	1	0	-1	0	3	1
Supplier-centric	7. Clear communication of benefits	1	0	1	1	0	1	1	5	3
	8. Offer financial incentives	1	0	0	1	0	1	0	3	1
	9. "Design in" motivation	1	0	0	1	0	-1	0	1	-1
	10. Offer repeat business as an incentive	0	0	1	1	0	1	0	3	1

1=tactic is effective, 0 = no opinion given, -1 = tactic is ineffective

Another remarkable fact is that, with the exceptional of one, all the tactics that were referred to as ineffective belong to the buyer-centric category. This is in line with the findings on barriers which suggested that the interviewees focused on issues relating to transport suppliers ignoring their own issues. If this is the case, it would imply that the interviewed shippers/LSPs would be blind to solutions as they do not perceive to have problems. This is however merely a hypothesis to explain the findings

Conclusion to GFSC leadership tactics

Tactics cited to be the effective are related to (1) to clear agreements, communication of benefits and (2) to financial and business incentives. The tactics that were referred to as ineffective are generally related to solving shippers/LSPs issues and strengthens the idea that the interviewees were not self-critical to acknowledge their problems and solutions. These tactics match well with the barriers that were identified as relevant: There is however no tactic cited to be relevant that can solve the barrier of "too many transport suppliers in different regions" as the interviewees that the tactic of "consolidate to fewer followers" is often not possible. This underlines the significance of segmenting suppliers in the four categories elaborated in Chapter 3.2.2, as this would enable the deployment of strategies per segment instead of engaging individual firms.

4.5.2 GFSC leadership challenges and measures

Interviewees were asked to review the list of challenges and measures. First they were asked whether the list was complete and whether additional challenges and measures could be added. All interviewees found the list to be complete. Subsequently, the interviewees were asked to give an indication of which challenges and measures they deemed the relevant and which they perceived as irrelevant. Table 31 and 32 provide a summary of the findings where the barriers and tactics that scored above average are highlighted in green and the ones that scored the lowest are highlighted in orange. This paragraph first discusses the challenges and subsequently the measures.

Challenges

Four conclusions can be drawn from Table 31. Firstly, it is evident that complexity and mind-set and cultural changes were cited as relevant challenges. On complexity, the interviewees argued that the lack of transparency in transport emissions is one of the biggest challenges to reduce them. As elaborated in the previous paragraph, the lack of transparency was also the reason given for not being able to determine to which extent strategies are effective in reducing emissions and this generates operationalization challenges. The interviewees argued that the lack of transparency is caused by transport suppliers that often provide limited data that is not comparable and not standardized because transport suppliers use different methods/approaches generating different types of data. It was further suggested that the low level of knowledge of transport suppliers is an issue as some do not have data on their own emissions.

Table 31: rating of GFSC leadership challenges on relevancy

Green challenges	Shipper				LSP			Sum	Deviation from average
	A	B	C	D	E	F	G		
1. Costs	1	1	0	1	1	-1	1	4	0,6
2. Complexity	1	1	1	1	1	1	0	6	2,6
3. Operationalization	1	0	1	1	0	1	0	4	0,6
4. Mind-set and cultural changes	1	1	1	1	1	-1	1	5	1,6
5. Uncertainties	-1	0	-1	0	0	-1	1	-2	-5,4
						Average		**3,4**	

1= challenge is relevant, 0 = no opinion given, -1 = challenge is irrelevant

Secondly, referring to "the mind-set and cultural changes" challenge, it was argued that there is a low level of commitment and that little priority is given to sustainability in the transport industry. It was further suggested that this particularly applies to the fragmented road transport sector as it has many small to medium transport suppliers. Closely related to the mind-set and cultural changes challenge, is the earlier mentioned issue of trust where skeptic transport suppliers are not willing to share fuel data in fear of price negations. Another related issue mentioned in the interviews, is the notion that transport emissions are only a small part of a shippers footprint.

Thirdly, the costs barrier was cited as both relevant and irrelevant because it depends on the perspective taken. Shippers generally regarded costs as a driver to reduce the transport costs in their supply chain since emissions reductions are considered primarily to be achieved through efficiency. Also, it was suggested that shippers are willing to finance green transportation more in Business to Customer cases for marketing purposes. It was argued that costs would be a challenge from a transport supplier perspective, given the low profit margins in the industry and the involved high investments.

Fourthly, the least cited challenge is uncertainties where one LSP indicated that the lack of demand for green logistics from shippers, that leads to less supply of green logistics, is caused by the little demand from the market, NGO's and the government.

Measures

Table 32 shows the measures that were cited as effective and as ineffective. Here, it is evident that they all concern measures that cannot be taken by one shipper/LSP as the challenges they solve stem from the bigger "global supply chain system" as elaborated in chapter 3.4.2.

Table 32: rating of GFSC leadership measures on relevancy

Measures for challenges	Shipper				LSP			Sum	Deviation from average
	A	B	C	D	E	F	G		
1. Standardization & harmonization of methodologies	1	1	1	0	1	1	0	5	0,5
2. Industry wide sharing of best practices	1	1	0	1	1	0	1	5	0,5
3. Availability of transport suppliers emissions data	1	0	1	1	1	1	0	5	0,5
4. External pressure	0	0	1	0	1	0	1	3	-1,5
	Average							4,5	

1= measure is relevant, 0 = no opinion given

The main observation from the Table is that the interviewees argued for more and transparent data in the transport sector. This refers to (1) more standardization & harmonization of measuring methodologies, (2) best practices sharing and (3) availability emissions data of transport suppliers. Here, the suggestion was made that a third neutral party will mostly likely have the credibility to collect fuel consumption data from transport suppliers, translate that into emissions production and share the information with shippers/LSPs. Also it was suggested that such a third party can facilitate the standardization of methodologies, the sharing of best practices and help in making the necessary resources available for small and medium transport suppliers.

It was furthermore argued that external pressure from the market, NGO's and the government can increase demand for green logistics from shippers and that this will lead on its turn more green logistics.

Conclusion on challenges and measures

Four challenges are considered to be relevant. (1) Complexity: the lack of transparency in transport emissions caused by transport suppliers that provide limited data and unstandardized data since they use different methods/approaches. (2)For this reason, shippers/LSPs cannot determine which actions to take leading to operationalization challenges. (3) Mind-set and culture: there is a low level of commitment (little priority) in the transport industry, transport suppliers are not willing to share fuel data in fear of price negations and transport emissions are perceived to be only a small part of a shippers footprint. (4) Shippers regard costs as a driver to reduce transport costs while transport suppliers perceive it as a challenge given the low profit margins in the industry and the involved high investments.

The measures cited to be relevant concern industry wide, (1) standardization of measuring methodologies, (2) best practices sharing and (3) availability of emissions data of transport suppliers. It was suggested that a third neutral party will have the credibility from all stakeholders to implement these measures. Although cited as less relevant, the idea was raised that external pressure from the market, NGO's and the government can increase demand for green logistics from shippers and that this will lead on its turn more green logistics.

5 Comparison of literature & case study

To compare the findings from literature and from the case study, the methodology of pattern matching through the unstructured sorting procedure was used as elaborated in chapter 2.2 and in appendix 2. An element received a value of 1 if an interviewee confirmed theory findings, a value of -1 if an interviewee contradicted theory and a value of 0 if no opinion was given. The sum of the values per element was used as an indication of the extent to which the data matched theory. The line of reasoning is that a positive sum will indicate that the majority agree with theory, a negative sum will indicate that the majority disagrees and an even sum will be undeceive.

5.1 First component: GFSC leadership

Table 33 compares the insights from literature review and from the interviews on GFSC leadership. This Table and Table 34 show that all the interviewees found that the adopted definition and the four criteria for GFSC leadership were important elements. However, all corresponds argued that the defined scope was too narrow as it only focused on transport suppliers while other areas outside this scope were relevant to reduce transport emissions. As can be seen in the Tables 33 and 35, it was argued that a GFSC leader should show leadership in three areas, being (1) leading by example, (2) leading entire supply chain and (3) leading outside the supply chain to effectively reduce transport emissions. Details on how and why this is was argued have been extensively elaborated in Chapter 4.2

Table 33: comparison literature & case study GFSC leadership

Theories	Case study findings that validate theory	Case study findings that contradict theory	New elements from case study
(Defee C. , 2007) (Defee, Stank, & Esper, 2010) (Watts & Hahn, 1993)	The adopted definition of GFSC leadership (leading LSPs and carriers)	Scope is too narrow	Lead by example
	The four criteria for GFSC leadership		Leading entire supply chain
			Lead stakeholders outside the supply chain

Table 34: interview findings on the four criteria for GFSC leadership

Criteria for GFCS leadership	Shipper				LSP			Total
	A	B	C	D	E	F	G	
1. Set emission reduction targets through LSPs/carriers	1	1	1	1	1	1	1	7
2. Implement strategies to achieve targets through LSPs/carriers	1	1	1	1	1	1	1	7
3. Reduce supply chain emissions through LSPs/carriers	1	1	1	1	1	1	1	7
4. Report supply chain emissions including LSPs'/carriers emissions	1	1	1	1	1	1	1	7
Total times that all areas are mentioned	1	1	1	1	1	1	1	**28**

1= validates theory, 0 = no opinion given

Table 35: interview findings on the scope of a GFSC leader

Areas of GFCS leadership	Shipper				LSP			Total	Total in %
	A	B	C	D	E	F	G		
1. Lead by example	1	1	0	1	1	1	1	6	33
2. Lead the entire supply chain	1	1	1	1	1	1	1	7	39
3. Lead stakeholders outside the supply chain	0	1	0	1	1	1	1	5	28
Total times that all areas are mentioned								**18**	**100**

1= indicated as relevant, 0 = no opinion given

5.2 Second component: GFSC leadership criteria

Table 36 compares the results of the literature review and the interviews on GFSC leadership criteria. Here , it can be argued that the findings generally fit the conclusions of the research by Shen et al. Apart from criterion 7 literature and the case study argue on all other criteria that were referred to as important. These findings are depicted in Table 37. Table 36 also shows that two criteria were found to be important from the interviews, being (1) willingness to share information and (2) public disclosure of information. Detailed information and arguments for these findings have been extensively elaborated in Chapter 4.3

Table 36: comparison literature & case study GFSC leadership criteria

Theory	Case study findings that validate theory	Case study findings that contradict theory	New elements from case study
(Shen, Olfat, Govindan, Khodaverdi, & Diabat, 2013)	Strategies 1-6 are important (see Table 37)	Strategy 7 is not important (see Table 37)	Willingness to share information and public disclosure of environmental records are import criteria
	The list in chapter 4.3 was perceived to be complete		

Table 37: interview findings on the scope of GFSC criteria

GFSC leadership criteria	Firm			LSP	Sum
	A	B	C	D	
1. Pollution production and reduction	**1**	**1**	**1**	**1**	**4**
2. Resource consumption	**1**	**1**	0	**1**	**3**
3. Green image	**0**	**1**	0	-1	**0**
4. Environmental management system	**1**	**1**	0	**1**	**3**
5. Commitment of GSCM from managers	**0**	**1**	0	-1	**0**
6. Use of eco- friendly technology	**1**	**1**	0	**1**	**3**
7. Management competencies (support, partners & training)	0	-1	0	-1	**-2**

1= validates theory, 0 = no opinion given, -1 = falsifies theory

5.3 Third component: GFSC leadership strategies and drivers

5.3.1 GFSC leadership strategies

Table 38 compares the results of the literature review and of the case study on GFSC leadership strategies and drivers. Here, it can be argued that the case study findings generally fit the conclusions of the research of (Bai & Sarkis, 2010) and (Fu, Zhu, & Sarkis, 2012).

Most and least deployed strategies

A study by (Fu, Zhu, & Sarkis, 2012) found strategy 3.1 to be the most applied, while Table 39 shows that none of the 19 firms deployed this strategy. Here it must be noted that the study by Fu et al., focused on one case of a telecommunications systems provider and suggested that this finding was likely specific to the systems provider. In this research, the interviewees argued that certificates tend to be a formality than real-life implementation. As literature does not provide information on the least applied strategies or more information on the most applied strategies, all strategies mentioned in Table 38 are a new contribution to literature. Detailed information and arguments for these findings have been extensively elaborated in chapter 4.4.1.

Table 38: comparison of literature & case study GFSC leadership strategies and drivers

Theory	Case study findings that validate theory	Case study findings that contradict theory	New elements from case study
Deployment of strategies (see Table 39)			
(Bai & Sarkis, 2010) (Fu, Zhu, & Sarkis, 2012).		Strategy 3.1 is not in the most applied strategies	Most applied strategies: 1.1; 1.2; 1.4; 1.6; 1.7; 1.9; 1.10; 1.11; 1.12; 1.13; 1.14; 2.4; 3.2; 3.6
			Least applied strategies: 1.3; 2.1; 2.5; 2.6; 3.1; 3.3; 3.5; 3.8; 3.11
Effectiveness of strategies (see Table 40)			
(Bai & Sarkis, 2010) (Fu, Zhu, & Sarkis, 2012).	Effective strategies: 3.1; 3.2; 3.5. 1.10 is even	Strategy 1.10 is not in the effective strategies	Most effective strategies: 1.8; 1.9; 1.13-1.15; 3.4; 3.6-3.8; 3.10
	Not effective strategies: category 2 strategies		
	The list of strategies was perceived to be complete		

Table 39: interview findings on how often strategies are applied

Strategy	Shipper														LSP				
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
3.1 Requiring ISO 14000 certification for LSPs/carriers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1= validates theory, 0 = no opinion given, -1 = falsifies theory

Most and ineffective strategies

Table 40: : comparison of interview and literature findings of strategy effectiveness

Category	Strategy	Shipper			LSP		Sum
		A	B	C	D	E	
1. Green knowledge transfer and communication	1. Training LSP/carrier employees on environmental issues	-1	-1	1	0	1	0
	10. Strong formal LSP/carrier environmental evaluation	0	0	0	0	-1	-1
2. Investment and resource transfer	1. Invest in improvement of transaction processes	0	0	1	0	1	2
	2. Reduce LSP/carrier environmental costs	0	0	1	0	0	1
	3. Solve LSP/carrier environmental technical problems	0	0	1	0	1	2
	4. Finance LSP/carrier major capital environmental expenditures	0	0	1	0	1	2
	5. Transferring LSP/carrier employees with environmental expertise to buying firm	1	0	1	0	0	2
	6. Transferring employees with environmental expertise to LSP/carrier	1	0	1	0	0	2
	7. Investment in LSP/carrier capacity building	0	0	1	0	0	1
	8. LSP/carrier rewards and incentives for environmental performance	0	0	1	0	0	1
3. Management and organizational practices	1. Requiring ISO 14000 certification for LSPs/carriers	1	-1	1	0	1	2
	2. Long-term contracts with environmental dimensions incorporated	1	1	1	0	1	4
	5. Building top management commitment/support for LSP/carrier organization for green supply practices	0	1	1	0	0	2

1= validates theory, 0 = no opinion given, -1 = falsifies theory,

As can been seen from Tables 38 and 40, the interviews generally confirmed the literature concerning which strategies are effective and which ones are not. This concerns the strategies 3.1; 3.2 and 3.5 being effective and the strategies in category 2 not effective. This is in line with the findings of Fu et al., and Bai et al.,. These findings can be seen as contradicting to the research by Krause et al. which suggests that the "direct involvement" strategies lead to higher performance improvements although they might cost more effort (Krause, Scannel, & Calantone, 2000). However, the research by Krause et al,. concerned supplier development in general and might thus be less applicable to this case.

The evident contradiction lies in strategy 1.10 "strong formal evaluation" that was also found to be effective through the telecommunications systems provider study by (Fu, Zhu, & Sarkis, 2012). On this strategy, an interviewer indicated that it will not be realistic due to legal and willingness constraints. Strategy 1.1 was found to be effective by Bai et al., but scored even in the interviews as some found it the responsibility of transport suppliers. Detailed information and arguments for these findings have been extensively elaborated in chapter 4.4.1.

5.3.2 GFSC leadership drivers

Also here the case study findings generally fit the literature as the studies depicted in Table 41 argue that collaborating and developing suppliers leads to a competitive advantage and improved performance in the supply chain. This is also depicted in Table 42.

Table 41: comparison literature & case study GFSC leadership drivers

Theory	Case study findings that validate theory	Case study findings that contradict theory	New elements from case study
(Lammgård & Andersson, 2014) (Lintukangas, Hallikas, & Kähkönen, 2013) (Lai, Lun, Wong, & Cheng, 2011)	Operations improvement and competitive advantage are relevant drivers to stimulate transport suppliers		Relevant drivers: cost reduction, optimal resource utilization, improved buyer-supplier relationship
	The list of drivers was perceived to be complete		Not relevant drivers: buyer performance improvement, improvement in quality, collaboration between leader and follower and follower performance

Table 42: comparison of interview and literature findings on drivers

Drivers	Shipper				LSP			Sum
	A	B	C	D	E	F	G	
6. Operations improvement	1	1	1	1	1		1	7
9. Competitive advantage		0	1	1	1		1	5

1= validates theory, 0 = no opinion given, -1 = falsifies theory

As literature does not provide information on the irrelevant drivers or more information on the relevant drivers, all other drivers mentioned in Table 41 are a new contribution to literature. Detailed information and arguments for these findings have been extensively elaborated in Chapter 4.4.2.

5.4 Fourth component: GFSCL barriers and tactics

Table 43: comparison literature & case study GFSC leadership barriers & tactics

Theory	Case study findings that validate theory	Case study findings that contradict theory	New elements from case study
Barriers (see Table 44)			
(Watts & Hahn, 1993) (Lintukangas, Hallikas, & Kähkönen, 2013)	Relevant barriers: 2.1; 2.3; 2.4		Relevant barriers: 1.2 & 3.4
(McKinnon, 2014)	Least relevant barriers: 1.2		Least relevant barriers: 1.4; 3.1
	The list of barriers was perceived to be complete		
Tactics			
			Effective tactics: 3; 6-8; 10
	The list of tactics was perceived to be complete		Least effective tactics: 1; 2; 4

Table 44: comparison of interview and literature findings on barriers & tactics

Who barriers apply to	Barriers to the strategies	Shipper				LSP			Sum
		A	B	C	D	E	F	G	
2. Follower (LSP/carrier)	1. Lack of follower commitment	**0**	**1**	**1**	0	**1**	**1**	**1**	5
	2. Lack of leader's power creates follower reluctance to participate	0	0	1	0	0	1	0	2
	3. Insufficient follower human resources	**1**	**1**	-1	**1**	**1**	-1	**1**	3
	4. Insufficient follower technical capabilities	**1**	**1**	**1**	**1**	**1**	-1	**1**	5

1= validates theory, 0 = no opinion given, -1 = falsifies theory

Table 43 and 44 show that the case study findings on GFSC leadership barriers fit literature. This concerns studies by (Watts & Hahn, 1993) (Lintukangas, Hallikas, & Kähkönen, 2013) that argue that the lack of commitment and resources of transport suppliers can hinder a GFSC leader to develop them. This also concerns a study by McKinnon that suggests that shippers have the power to influence transport suppliers.

As literature does not provide information on the most and irrelevant tactics, all other tactics mentioned in Table 43 are a new contribution to literature. Detailed information and arguments for these findings have been extensively elaborated in Chapter 4.5.

5.5 GFSCL challenges and measures

Table 45: comparison literature & case study GFSC leadership challenges & measures

Theory	Case study findings that validate theory	Case study findings that contradict theory	New elements from case study
		Challenges	
(Abbasi & Nilsson, 2012) and (McKinnon, 2014)	Relevant challenges: 1-4	Challenge 5 "uncertainty" is less relevant	
	The list of challenges was perceived to be complete		
		Measures	
	Effective measures: 4		Effective measures: 1-3

Table 46: comparison of interview and literature findings on challenges

Green challenges	Shipper				LSP			Sum
	A	B	C	D	E	F	G	
1. Costs	1	1	0	1	1	-1	1	4
2. Complexity	1	1	1	1	1	1	0	6
3. Operationalization	1	0	1	1	0	1	0	4
4. Mind-set and cultural changes	1	1	1	1	1	-1	1	5
5. Uncertainties	-1	0	-1	0	0	-1	1	-2

1= validates theory, 0 = no opinion given, -1 = falsifies theory

Table 47: comparison of interview and literature findings on measures

Measures for challenges	Shipper				LSP			Sum
	A	B	C	D	E	F	G	
4. External pressure	0	0	1	0	1	0	1	3

1= validates theory, 0 = no opinion given, -1 = falsifies theory

Tables 45 and 46 show that the case study findings on the relevancy of challenges are in line with literature except for challenge 5. This concerns studies by (Abbasi & Nilsson, 2012) and (McKinnon, 2014). The reason for this can be that the interviewees found uncertainties from regulations and the market relatively less important than other barriers. Since all but one measures were attained from the interviews, Table 45 and 46 show that this measure confirms the literature by (Abbasi & Nilsson, 2012) and (McKinnon, 2014), while all other measures are new contribution to literature. Detailed information and arguments for these findings have been extensively elaborated in Chapter 4.5.

6 Final GFSC leadership model

The case study achieved the goal of reducing the amount of variables as it provided insights in the variables that were considered to be the relevant. Furthermore, it can be argued that the case study validated the theory as most findings from the literature review were confirmed by the interviews. The few exceptions could be explained by the setting of the interviews or are a subject for further research. Overall, the variables were reduced from the 88 variables from literature to 41 variables that were considered to be the most significant. This concerns, 5 criteria for selecting and evaluating transport suppliers, 18 strategies to develop transport suppliers, 5 drivers to support the strategies, 9 barriers/challenges and 9 tactics and measures. These are visualized in Figure 13.

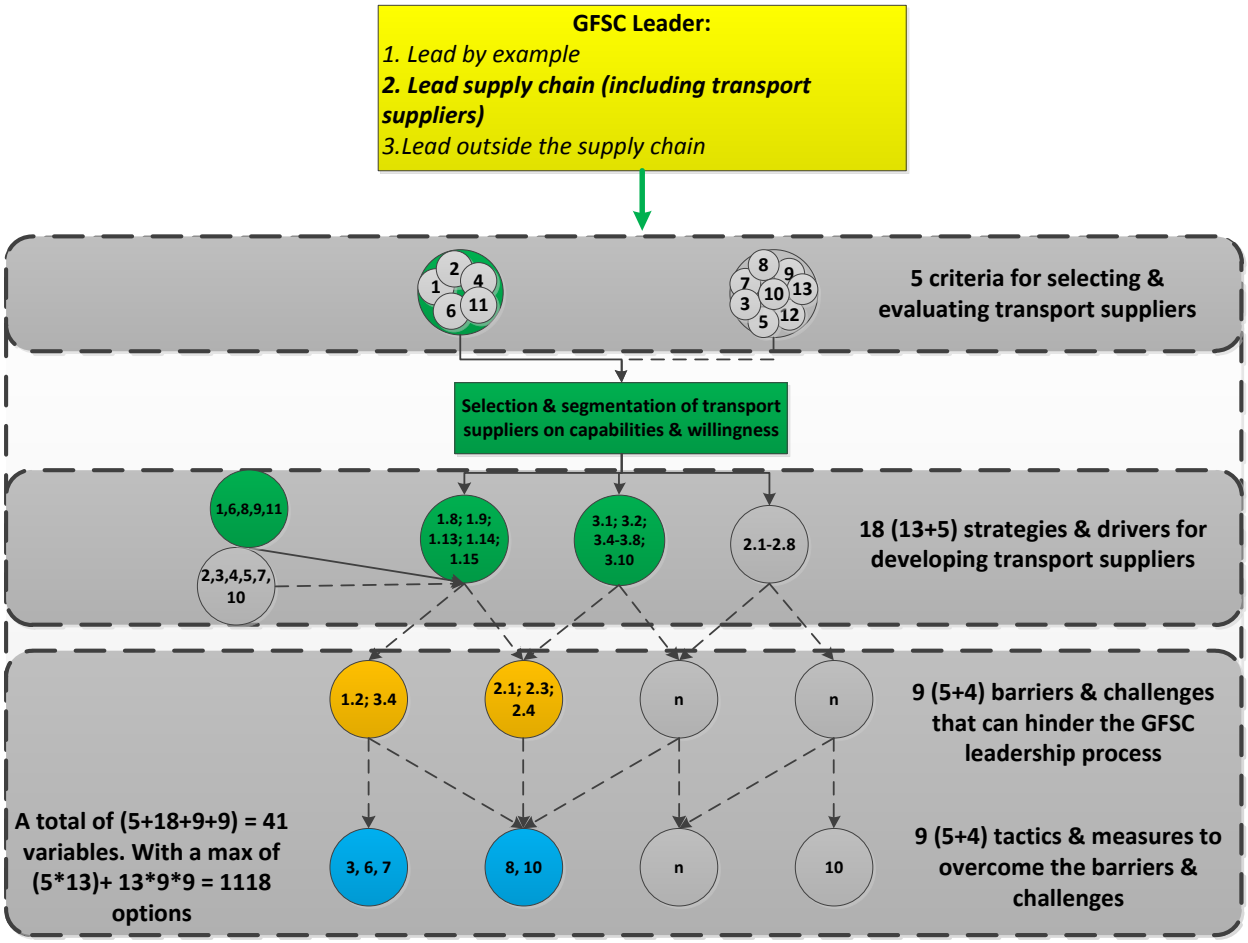


Figure 13: final GFSC leadership model

Logically, drivers would have to be connected to strategies, strategies to barriers and challenges, barriers to tactics and challenges to measures. Considering the number of variables involved, the initial GFSC leadership model would provide a maximum of 7718 different options which have been reduced to 1118 options in the final GFSC leadership model. This chapter provides an overview of these connections, with Chapter 6.1 connecting drivers to strategies, 6.2 connecting strategies to

barriers/challenges and 6.3 connecting barriers/challenges to tactics/measures. From these connections it can be seen that the actual total number of options is (65+91+11+8) 175.

6.1 Connecting drivers to strategies

Table 48 shows that each strategy to develop transport suppliers can be supported by each driver, providing a total of 65 options. The drivers are ranked in the order of effectiveness and the strategies to which the numbers refer to can be found in Table 49. Because of how literature formulated the strategies, it was necessary to make a distinction between the act of having a strategy (marked with a -) and the act of implementing a strategy (marked with a x). An example is strategy "3.6 Organization management has formal long-term plans to improve LSP/carrier performance" that would only be supported by drivers if it is implemented.

Table 48 can allow a shipper/LSP to choose which drivers to communicate to incentivize compliance of transport suppliers, taking their effectiveness into account. Here, a recommendation can be to emphasize on the first 3 drivers as they ranked significantly higher in the case study as elaborated in Chapter 4.4.2.

Table 48: connecting drivers to strategies

		Strategies													
Rank	**Green suppliers development drivers**	**1.13**	**1.8**	**1.9**	**1.14**	**1.15**	**3.1**	**3.2**	**3.4**	**3.5**	**3.6**	**3.7**	**3.8**	**3.10**	**Total**
1	6. Operations improvement	x	x	x	x	x	x	x	x	x	-	-	-	-	**13**
2	1. Cost reduction	x	x	x	x	x	x	x	x	x	-	-	-	-	**13**
3	9. Competitive advantage	x	x	x	x	x	x	x	x	x	-	-	-	-	**13**
4	8. Optimal resource utilization	x	x	x	x	x	x	x	x	x	-	-	-	-	**13**
4	11.Improved shipper/LSP-LSP/carrier relationships	x	x	x	x	x	x	x	x	x	-	-	-	-	**13**
Number of times that all drivers can support strategies															**65**

6.2 Connecting strategies to barriers/challenges

Table 49 shows which barriers and challenges can hinder which strategies, providing a total of providing a total of 91 options. The strategies are ranked in the order of effectiveness and the barriers and challenges to which the numbers refer to can be found in Table 50 and 51. As there are there are strategies that a GFSC leader can independently take, it was again necessary to make a distinction between strategies/challenges that can hinder the making of a strategy (marked with a -) and ones that can hinder the implementation of a strategy (marked with a x). An example is that the strategy "3.2

incorporating environmental dimensions in long term contracts" can be deployed but be hindered in the implementation phase by the barrier "2.1 lack of transport suppliers commitment". Table 49 also depicts which strategies will face the most barriers/challenges and which one the least. This can allow a shipper/LSP to determine which strategies will face less resistance than other, taking their effectiveness into account. Here, a recommendation can be to consider the strategies 3.2; 1.15 and 3.1 since they were considered to be highly effective, as elaborated in chapter 4.4.1, but are connected to a relatively low number of barriers and challenges.

Table 49: connecting strategies to barriers and challenges

Rank	Strategies	Barriers					Challenges				Total times hindered
		1.2	2.1	2.3	2.4	3.4	1	2	3	4	
1	3.2 Long-term contracts with environmental dimensions incorporated		-	-	-	x -		x			5
2	1.13 Joint and team problem solving on environmental issues	x	x -	x -	x -	x -	x -	x -	x -	x -	9
3	1.8 Develop LSP/carrier environmental assessment programs	x	-	-	-	x -	x -	x -	x -	x -	9
3	1.15 On-going communication with LSP/carrier community via LSP/carrier environmental councils		x -	-	-						3
3	3.1 Requiring ISO 14000 certification for LSPs/carriers		-	-	-						3
3	3.5 Building top management commitment/support within LSP/carrier organization for green supply practices	x	x	x -	x -		x	x			6
3	3.8 Identification of critical LSPs/carriers for improvement opportunities	x	-	-	-	x -	x -	x -		x -	8
4	1.14 Information sharing on environmental topics		-	-	-			x -			4
4	1.9 Providing feedback about LSP/carrier environmental performance	x	-	-	-	x	x	x	x	x -	9
4	3.4 Building top management commitment/support within shipper/LSP organization for green supply practices	x -	-	-	-	x -	x -	x -	x -	x -	9
4	3.6 Organization management has formal long-term plans to improve LSP/carrier performance	x -	-	-	-	x -	x -	x -	x -	x -	9
4	3.7 Formal process for LSP/carrier development	x	-	-	-	x -	x -	x -	x -	x -	9
4	3.10 Formal process to identify LSP/carrier emission reduction targets	x	-	-	-	x -	x -	x -		x -	8
Total number of times that all strategies can be hindered by barriers and challenges											91

6.3 Connecting barriers/challenges to tactics/measures

Table 50 shows which tactics can be used on which barriers while Table 51 depicts which measures can used on which challenges, providing a total of 11 and respectively 8 options. The barriers and challenges are ranked in the order of relevance. The tactics and measures to which the numbers refer to can be found in Table 52 where they are also ranked in order of effectiveness. The Tables 51 and 52 depict which tactics and measures can be considered as the most attractive as they can solve the most tactics and challenges. Here it can be seen that tactic number 8 and 10 (offering business and financial incentives) are cited to tackle the most challenges while tactic number 3 (spell it out) is cited to tackle the least. Concerning the challenges, best practice sharing (measure 2) tackles the most challenges while external pressure (measure 4) tackles the least challenges.

Table 50: connecting barriers to tactics

Rank	Barriers	Tactics					Total
		3	6	7	8	10	
1	2.1 Lack of transport supplier commitment	x	x	x	x	x	
1	2.4 Insufficient transport supplier technical capabilities				x	x	
2	1.2 Too small purchases by the leader spread across too many followers						
2	3.4 Transport supplier is reluctant to share cost/process information	x		x			
3	2.3 Insufficient transport supplier human resources				x	x	
	Total number of times that all tactics are linked to barriers	**2**	**1**	**2**	**3**	**3**	**11**

An important side note here is that no tactics and measures were cited to be as the most significant for the barrier 1.2 (too many followers) and challenge 1 (costs for transport suppliers). The first barrier underlines the essence of transport supplier segmentation as this can help to deal with the many different suppliers.

Table 51: connecting challenges to measures

Rank	Challenges	Measures				Total
		1	2	3	4	
1	2. Complexity	x	x	x		
2	4. Mind-set and cultural changes		x	x	x	
3	1. Costs for transport suppliers					
3	3. Operationalization	x	x			
	Total	**2**	**3**	**2**	**1**	**8**

Table 52: tactics and measures cited to be effective

Rank	Tactics to overcome barriers	Rank	Measures
1	3. Spell it out (clear formal agreements)	**1**	1. Standardization & harmonization of methodologies
1	7. Clear communication of benefits	**1**	2. Best practices sharing
2	6. Create an expectations road map	**1**	3. Data sharing
2	8. Offer financial incentives	**2**	4. External pressure
2	10. Offer repeat business as an incentive		

7 Conclusions and recommendations

This chapter provides the conclusions and recommendations of this study. First the research questions are answered by discussing the current GFSC system followed by a discussion of the identified faults that cause the system not to function. The chapter ends with recommendations to improve the system and a reflection on the study.

7.1 Conclusions: the current GFSC system

The following research question was formulated in the introduction and was the purpose of this study:

" How can shippers and LSPs, as green freight supply chain leaders, influence their green freight supply chain followers, that consist of LSPs and carriers, to reduce freight related emissions? "

Summarizing all the insights from the study, Figure 14 provides an overview of how a GFSC leader can influence transport suppliers by depicting how the actions of all elements within the chosen scope relate to each other. The important element here is the feedback loop that consists of a variable that eventually influences itself through other variables and thus can strengthen or weakens a certain effect. Three positive feedback loops will be discussed by describing how a GFSC leader can influence transport suppliers to reduce freight related emissions.

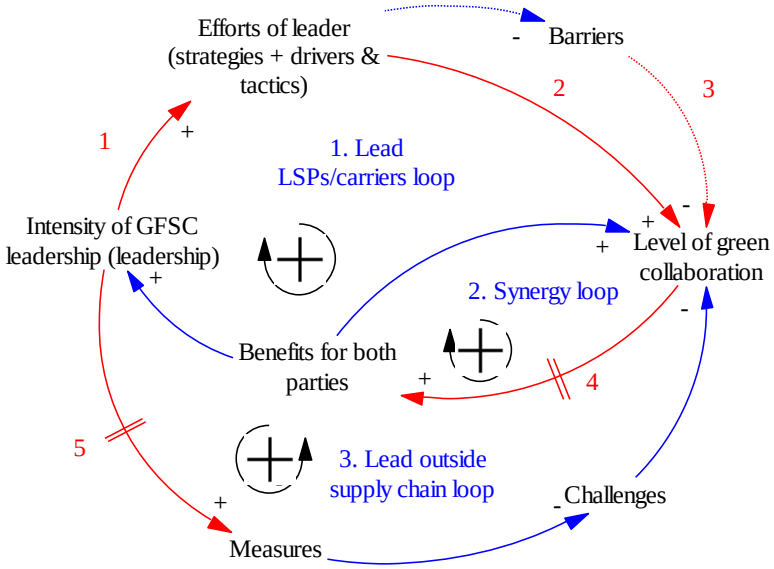


Figure 14: visualization of the current GFSC system

The answer to the first research question "What is green freight supply chain leadership and followship and to what extent do these concepts apply? I.e. What is the appropriate scope of these concepts?" can be seen in the variable "level & intensity of GFSC leadership" in Figure 14. This research found that *"GFSC leadership is a relational concept involving a collaboration between a GFSC leader and GFSC followers where the GFSC leader is a shipper/LSP that exercises leadership at the three levels of GFSC leadership. GFSC followship refers to followers taking action as a reaction to the leader's efforts to achieve transport-emissions reduction objectives of the leader"*. The following three levels of GFSC leadership were identified where in a shippers/LSP needs to exercise leadership to effectively reduce transport related emissions:

(1) Leading by example by showing commitment to reduce own emissions as this is deemed to be necessary to influence other organizations in a credible manner. (2) Leading firms within the supply chain by strategically designing and optimizing the entire supply chain to reduce transport emissions. This thus includes developing transport suppliers. (3) Leading outside the supply chain by collaborating with other shippers/LSPs, NGO's and governmental organizations to create standardized emissions measuring methods, platforms that bring all relevant stakeholders together and promote the sharing of best practices. As the first level concerns a firm's internal processes and this study focused on collaborations between a GFSC leader and transport suppliers, the rest of the diagram illustrates the leadership process at the second and third level.

Lead LSPs/carriers feedback loop

The second level of leadership can be perceived as a positive feedback loop where a higher intensity of leadership leads to increased efforts by the GFSC leader to develop suppliers. Efforts can take the form of deployed strategies + drivers and of deployed tactics. The first form consists of strategies implemented to develop transport suppliers and are supported by drivers. Drivers are the potential benefits for both parties that a GFSC leader can communicate to incentivize transport suppliers to comply with the strategies. The second form of efforts refers to tactics that can be used to overcome barriers that can hinder the success of the strategies (indicated in Figure 14 with dotted lines). Higher intensity of these two forms of efforts will lead to higher levels of green collaborations that will increase the benefits for both parties, thus turning the communicated drivers into real benefits. Closing the first feedback loop, higher benefits intensify GFSC leadership. The second feedback loop **"synergic partnership"** concerns to "increased levels of green collaborations" leading to "higher benefits for both parties". This increases green collaborations and thus closes the second feedback loop.

Efforts in the form of strategies and drivers provide the answer to the second research question "What strategies and drivers can shippers/LSPs use, as green freight supply chain leaders, to reduce freight related emissions through LSPs/carriers?" This study assumed that the deployment of strategies occurs in three subsequent phases, that are (1) selecting and evaluating transport suppliers with criteria, (2) segmenting them on willingness to cooperate and their capacity to reduce emissions and (3) developing them through strategies and drivers. The literature review provided a comprehensive list of, 13 criteria, 34 green supplier development strategies and 11 potential drivers. Table 53 depicts the variables that were cited as relevant.

Table 53: criteria, drivers and strategies cited to be relevant for GFSC leadership

Criteria for selecting/evaluating transport suppliers	Drivers for incentivize transport suppliers	Strategies to develop transport suppliers
Transport suppliers pollution production	Increased cost-efficiency	Green knowledge transfer and communication
Transport suppliers efforts to reduce emissions	Increased financial performance	Develop transport suppliers management and organizational practices
Transport suppliers transparency of environmental performance	Improved leader-transport supplier relationship	

The barriers for green collaborations and the tactics to overcome them provided the answer to the third and fourth research questions "What barriers can hinder the success of these strategies?" and "What tactics can shippers/LSPs use to overcome these barriers?" The literature review provided a list of 18 barriers and 10 tactics. Table 54 depicts the variables that were cited as rlevant.

Table 54: barriers and drivers cited to be relevant

Barriers	Tactics
Transport suppliers have in insufficient resources	Financial and business incentives
Transport suppliers have low commitment to engage in green collaborations	Make clear and formal agreements
Transport suppliers are reluctant to share fuel consumption information in fear for price negotiations	Communicate the benefits
Shippers'LSPs have too many transport suppliers with different characteristics in different regions	

Lead LSPs/carriers feedback loop

The third feedback loop involves external challenges from the global transport industry that hinder green collaborations. As the challenges are industry wide, the measures to tackle them cannot be implemented by an individual firm but a GFSC leader can contribute to the realization of a measure. Such measures can increase green collaborations, which increase the involved benefits, the benefits increase the intensity of GFSC leadership and thus closes the third feedback loop. The literature review and case study provided the challenges and measures that are summarized in Table 55.

Table 55: challenges and measures cited to be relevant

Challenges	Measures
Different emissions measuring methodologies that cause unstandardized and limited data	Standardization of measuring methodologies
Prevailing idea that transport emissions represent only a small part of shippers footprint	Making transport emissions data available for shippers/LSPs
Little priority for sustainability in transport industry	External pressure from the market, NGO's and governments to increase the demand for green transport
High green investment costs vs low profit margins in transport industry	Sharing of best practices

7.2 Discussions: faults in the GFSC system

Three main faults have been identified in the current system that hinder shippers/LSPs to effectively reduce emissions, being (1) a lack of the bigger picture, (2) lack of self-critique by shippers and (3) the prevailing business approach to green transportation. Their effects in the system are visualized by the red numbered arrows in Figure 14 and will be elaborate further.

The first fault can be found in the first and second red arrow and concerns the making and deployment of strategies to develop transport suppliers. Here it was found that the shippers/LSPs did not have a clear picture of the effectiveness strategies as only one of the interviewees could provide a concrete number on the reduced emissions that could be accounted to their deployed strategies. The other firms argued that it was impossible to determine numbers because they lacked fuel consumption data as transport suppliers are reluctant to provide this due fear of price negotiations. Other reasons given were that their transport suppliers are influenced by more shippers/LSPs and that there have too many transport suppliers in service.

This issue hinders the deployment of the effective strategies as the case study illustrated a significant mismatch between the effectiveness of strategies and the rate in which they are deployed. For instance, about 6/11 of the mostly applied strategies were cited to be in the ineffective category while about half of the least applied strategies belonged in the mostly effective category. This indicates that, although the studied firms belonged in the group of potential GFSC leaders, they lacked the full picture in terms of what strategies should best be applied. This also implies that the current resources used to reduce transport related emissions can be utilized in a more efficient manner.

Another issue that can be attributed to this fault is the lack of a long-term perspective to see past the delays involved in the fourth and fifth red arrow. On this issue, it was found that the benefits from green collaborations mostly come in the long-term and that it take takes time to realize the measures that can tackle the industry wide measures.

The second fault was has also its effect in the first and second red arrows and concerns the prevailing business approach to green transportation. The interviews namely showed that green strategies were mostly implemented for costs savings and improving business and not for their long-term emissions reduction potential. This was also reflected in the drivers that were cited to be the effective in incentivizing transport suppliers to cooperate as they all were business-oriented. As a consequence, strategies that were referred to as the most cost-effective but with a lower emission reduction potential were deployed more often than strategies that are considered to have a higher emission reduction potential.

The third fault can be found in the third red arrow and concerns the barriers that were cited to be the relevant in hindering green collaborations. Here, it was remarkable that all but one applies to transport suppliers while all but one barriers that apply to shippers/LSPs were cited to be as irrelevant. As all their interviewees were shippers/LSPs, it might suggest that they are not-self-critical enough to recognise their own issues but rather identify problems that are caused by other parties. This was also reflected in the tactics that were cited as the most significant, since all concerned transport suppliers. Here, no tactic that could tackle the only shippers/LSPs related barrier was cited as being effective. If this fault

proves to be relevant, it might be a serious issue as solving shippers/LSPs related problems would be problematic if they are first not acknowledged.

7.3 Recommendations: improvements

With respect to the insights gained from this research, recommendations can be made for shippers/LSPs that aim at becoming GFSC leaders, i.e. reducing their freight transport emissions. Furthermore, recommendations can be made for SFC as the commissioner of this study that regard the global transport industry.

Recommendations for shippers/LSPs

For shippers/LSPs aspiring to effectively reduce their transport related emissions, the current GFSC leadership model provides a process that starts with the selection/evaluation of transport suppliers and ends with developing them. This process provides a means overcoming the first identified fault (a lack of the bigger picture) by providing an overview of the different strategies that can be taken with the corresponding drivers, barriers, tactics, challenges and measures. Given the identified positive feedback loops in the system, it can be argued that firms using this model can achieve long-term benefits. The GFSC leadership model also provides a solution for the only barrier for which no tactic was found as the "too many" transport suppliers are segmented according their willingness and capabilities.

Another recommendation for shippers/LSPs is to take a long-term perspective when engaging into green practices as this is necessary to achieve the related benefits. Also a more critical view on their own behaviours is necessary as this study was only able to identify barriers for green collaborations that are mostly caused by transport suppliers, giving the impression of a low level of self-criticism.

Furthermore, the recommendation can be given to shippers/LSPs that currently do not have green programs to consider implementing the strategies that fall under the category of "Green knowledge sharing and communication" as they seem to have a lower threshold and are considered to be more cost effective. The more experienced firms can look into the strategies that fall in the "management and organizational practices" category as they are considered more advanced and effective.

Recommendations for SFC and the global transport industry

For SFC the recommendation can be given to facilitate in the realization of the measures to address the industry wide challenges. The interviewees namely suggested that a neutral party will mostly likely have the credibility to collect fuel consumption data from transport suppliers, translate that into emissions production and share the information with shippers/LSPs. Also it was suggested that such a third party can facilitate the standardization of methodologies and the sharing of best practices.

Furthermore SFC can help the transport industry to tackle the identified "faults in the GFSC system" by providing an overview of the current system, studying whether other shipper/LSPs related barriers are relevant and providing a roadmap of how shippers/LSPs can eventually deploy strategies that fall into the "management and organizational practices" category since they are considered to be more advanced and effective.

8 Reflection

This chapter reflects on how this thesis was conducted and provides proposals for future research.

8.1 The use of research methodologies

The study was performed by means of a literature review, a desktop research and semi-structured interviews with experts from firms that showed a high potential of being GFSC leaders.

Regarding the literature review, as no studies were found on green supply chain leadership, literature on green supply chain management and on supply chain leadership were used to build the initial GFSC leadership model. These findings were expanded and validated by the desktop research and interviews and this minimized the risk of excluding relevant variables. Regarding the performed desktop research, notable drawbacks were present.

Desktop research

The information on the applied strategies and the data that was used to select the potential GFSC leaders was attained from documents on the firm's websites. As this concerns information that firms provide on their own environmental performance and efforts, it is sensitive to strategic behavior as some firms may portray themselves better for PR purposes.

Furthermore, since the desktop research started with a total of 373 firms a huge amount of data was involved that was often not easily accessible. This generated the chance that not all relevant documents were not found and used for the purposes of this research. Also, as only a part of the firms were found to publically make their environmental reports available, there is a probability that well performing firms that did not make their report publically available were not included in the research.

Concerning the data that was found, there is a high likelihood that interpretability issues occurred since a number of firms that provided their strategies to influence their suppliers did not specify whether this also concerned transport suppliers. In such cases, it was assumed that the strategies were also applied to transport suppliers. Also, it was found that certain firms utilize their own fleet of trucks in combination with other carriers/LSPs. These firms were often found not to provide a clear distinction on whether their green strategies reflected their own fleet, the LSPs/carriers or both. In such cases, it was assumed that the strategies were applied to both groups.

Semi-structured Interviews

To validate and expand the findings of the literature review and desktop research, seven semi-structured interviews were held. Although this significantly improved the initial GFSC leadership model, some nuances have to be made.

Firstly, there is a likelihood that strategic or social appropriate answers were given. This is because the interviewees often concerned firm's representatives that are responsible for sustainability or freight transportation of their firm.

Secondly, as the availability of most of the interviewed was limited and they were in different locations, most interviews were conducted via the phone or Skype limiting the possibilities of asking more details on certain aspects. For instance, when reviewing the findings of the literature review, the interviewees were asked to indicate which variables they found most and irrelevant. In an ideal situation and with more time, weights could be given to each variable to determine the relative relevancy of each variable..

Thirdly, it is noteworthy that the interviewees indicated not being able to provide specific data on the effectiveness of strategies but were able to indicate which strategies were the effective and which ones were the ineffective. This implies that the findings of this research are based on more on tacit knowledge and experiences of the interviewees than on hard facts.

8.2 Further research

Concerning scientific literature, the aim of this research was to add the "green" element" to the current literature on (freight) supply chain leadership. For this, the research took the case of the global freight transport sector and did not take all other aspects of supply chains into account. As a rule, it is thus not possible to generalize the findings of this study to other parts of the supply chain. However, this thesis provided insights that future research can use to develop general theories on green freight supply chain leadership. To this end, the following recommendations are proposed for future research in the field of green freight supply chain leadership.

- A validation of the current final GFSC leadership model with a second round of interviews to verify the connections made between the drivers, strategies, barriers, tactics, challenges and measures. Also transport suppliers can be included to verify whether the model also applies from their perspective. An interesting topic would here would be whether there are more shipper/LSP related barriers that hinder green collaborations as all are now related to transport suppliers.
- A correlation test to check on the extent to which the different variables measure the same aspects of the "latent" variables.
- A study on the other two identified fields of GFSC leadership, being leading by example and leading outside the supply chain.
- A deeper study on how leading within the supply chain can incorporate other parties than LSPs/carriers, to reduce transport related emissions. Examples that were mentioned were the strategically placing of manufacturing and distribution centres.
- The role of conditional characteristics of the followers on the effectiveness of GFSC strategies. This research found that the a firm's size and willingness to cooperate determines the feasibility of certain strategies but did not determine the extent to what this applies.

In addition, future research can expand the findings of this report to the general field of green supply chain leadership by providing a model that not only applies to freight transport but to other aspects of the global supply chain, that for example include manufacturing.

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Appendix I: Influence of shippers on transport choices

Attained from a research by McKinnon, on the influence of shippers on carbon emissions from deep-sea container supply chains, Table 18 shows the degree of control that which shippers indicated to have over decisions relating to the choice of mode, carrier, and port. The Table uses a 5 point scale where 0 refers to no influence and 4 to full influence. The Table provides the mean scores and the percentage of responses that stated to have no influence or full influence.

Overall, it is obvious that shippers have a considerable influence on transport choices. According to McKinnon, the fact that importers have higher scores is related to factors like the heavy reliance of exporters on freight forwarders and the relative smaller volumes of container traffic they generate.

Table 56: Amount of influence exerted by shippers over key transport choices (McKinnon, 2014)

	Mean score (0–4)	*% Full control*	*% No influence*
Exporters: choice of			
transport mode for container movement to port of export	2.59	53	24
outbound port	2.38	31	19
foreign entry port	2.24	41	24
transport mode for delivery from foreign port to destination	2.17	33	17
deep-sea shipping line	2.06	29	24
carrier for movement to port of export	1.80	27	27
feeder (short-sea) shipping line	1.71	24	35
Importers: choice of			
transport mode from port of entry to destination	3.40	68	8
deep-sea shipping line	3.30	68	4
carrier for movement from port of entry to destination	3.10	60	12
port of entry	3.00	48	8
feeder (short-sea) shipping line	2.20	32	16
transport mode for delivery to port in country of origin	2.10	24	20

Appendix 2: Research methodology and process

Methodology for case study

According to Yin, there are four (2x2) types of case study designs that are distinguishable by two variables. These are the number of units to be analyzed (singular vs multiple-case designs) and their setting (holistic vs embedded case designs). Single -case designs refer to cases where only 1 "experiment" is conducted while multiple-case designs refer to cases with more experiments. Embedded-designs refer to studies that involve multiple units of analyses (multiple topics) while holistic-designs refer to cases that have a single unit of analysis. As single-case studies have the weakness of providing unreliable/non-generalizable results and this study is focused on one topic, the choice was made for a multiple-case (hollistic) design. The main disadvantage of this design is that it is time-consuming but it enhances the reliability.

Collecting the data through the desktop research and interviews was guided by Yin's recommendations for collecting sound case study data. This refers to being a good listener, being adaptive/flexible, having a good understanding of the issues being studied, remaining unbiased, asking the right questions and giving meaningful interpretation to the answers (Yin, 2014). Furthermore effort was done to follow Yin's principles on collecting data through interviews and archival records. This includes using multiple sources of evidence, maintaining a case study database and ensuring logical links between the questions asked, the data collected and the conclusions drawn. This can be seen throughout the report and specifically in Appendix 9.

Analyzing data and drawing conclusions

Yin provides five techniques for case studies that enable the drawing of empirically based conclusions from data analysis, being:

1. Pattern matching: considered as one of the most desirable techniques, it compares an empirically based pattern with a predicted one. If the pattern coincide, the results can help a case study to strengthen its internal validity.
2. Explanation building: a special type of pattern matching where data is analyzed by building explanation about a case, i.e to explain a phenomenon by elaborating a presumed set of causal link on "how/why" something happened.
3. Time-series analysis: to conduct analysis directly analogous to the time-series analysis conducted in experiments, i.e. analyze the data by tracing changes over time.
4. Logic models: analyzing data by looking at sequential stages, events are staged in a repeated cause-effect-cause-effect pattern, thus where a dependent variable at an earlier stage becomes the independent variable.
5. Cross-case synthesis: When analyzing multiple independently executed studies on the same subject i.e. word tables that enable cross-case conclusions .

Concerning the techniques for analyzing data, pattern matching was chosen as the aim of the case study is to expand and validate the GFSC leadership framework from literature with insights from the industry. The other techniques are less qualified to reach this end or would require a large amount of data that cannot be gathered within the time-frame of this research or would fall out of the scope of the research.

Pattern matching

The pattern matching technique has been extensively researched by Trochim and relies on the idea that patterns link theory and data as they connect what is believed to structurally happen (theory) and what is actually happening (data) (Trochim & Cook, 1992). The rationale behind the technique is that a theory will be more confirmed if a predicted pattern from theory is observed in the data. The main issue of this technique is that there might be other reasons, other than the theory, that are responsible for the pattern. To deal with this issue, Trochim & Cook suggest increasing the complexity of theories as this enhances the uniqueness in theoretical patterns and decreases other competing theories. Akin to this line of thinking, it can be argued that the GFSC leadership framework has a certain level of complexity caused by the various factors involved and will thus leave little room for alternative explanations.

In this study pattern matching was conducted by comparing each component of the framework to the results of the desktop research and interviews. This concerns, (1) the scope of GFSC leadership, (2) GFSC leadership criteria, (3) GFSC leadership drivers and strategies, (4) GFSC leadership barriers and tactics. For instance, a comparison was made whether GFSC leadership strategies that literature argues to be more effective or most applied are also considered to be so by the industry.

For the interviews and desktop research, the direct rating method was used which implies that interviewees rate the expected effects and that the total ratings constitute the pattern (Trochim & Cook, 1992). As this method does not elaborate on "why" a pattern is expected, Trochim & Cook argue that it is essential to let the stakeholders elaborate on the rationale behind their predictions. Also this point was included in the interview questions as can be seen in Appendix 9.

Because of the aggregated level of this research and the infancy level of the theory on GFCS leadership, it was not possible to quantify the GFSC leadership framework. Also it was found that the interviewees had limited time and could give little to no quantitative information on their green programs. For these reasons it was not possible to quantifiably assess the degree to which the theory patterns match the data patterns using statistical work, e.g. correlational tests. Given these limitations, partner matching was executed through an unstructured sorting procedure as applied by (Trochim W. M., 1985) (Rosenberg & Park Kim, 1975). Here, data and theory were analyzed and compared where joint occurrences were given values in tables according the following rule:

X = 1 if an interviewee validates theory
0 if a interviewee provides no opinion
- 1 if an interviewee falsifies theory

For instance, if an interviewee provided a statement that validates an aspect of the theory, then that aspect gets a value of 1. The new aspects that were provided by the interviewees, and thus expanded the GFSC leadership framework, were also given values in the same manner. As mentioned earlier, the significance of each aspect was determined by the total sum, meaning that contradicting opinions of experts can nullify each other. An argument for the latter is that the same amount of value is attached to interviewee's opinions.

Phase one of selection process

Table 57: sectors within which firms were classified

Abbreviation	Sector	Elaboration
F&B	Food & Beverages	Perishable food and drinks
I&M	Industry & manufacturing	
IT	Information Technology (IT)	
U	Utilities	Water, electricity & sewage
CG	Consumer goods	Everyday use products
HC	Health Care	
T	Transportation & Logistics	

Phase two of selection process

As for the second phase, a conjunctive screening method was chosen in which suppliers were evaluated against the green leadership criteria defined by the literature review. This method thus considers all criteria to be of equal importance and is represented by the Equation 1:

$$\prod_j I(C_{ij} > \gamma_j) = 1$$

Equation 1: Conjunctive rule (Gilbride & Allenby, 2004)

Here, the variable C_{ij} represents the score of a firm ***i*** on a particular criterion ***j***. As 64 firms were screened by means of 4 criteria, the ***n*** set of firms was ***i*** *= 1,2,…64* and the ***m*** set of criteria was ***j*** *= 1,2,3,4*. The variable γ_j represents the cut-off value that is the minimum score that a firm needs to attain on each criterion in order to be considered a green leader. This is shown by the indicator function I ($C_{ij} > \gamma_j$), which equals to 1 if a firm ***i*** scores on a criterion **j** higher than cut-off value γ_j . The variable $\prod j$ means that for each firm the indicator functions must be multiplied with respect to all criteria. This means, that for a firm to be considered as a GFSC leader, the indicator function must be 1 for all ***m*** criteria, i.e. a firm that does not meet a minimum score for all leadership criteria will be considered a non-leader.

Motivation for choosing the conjunctive screening method

Due to the multiplication of the indicator functions, the conjunctive screening method is non-compensatory as it does not allow a low score on one criterion to be compensated by a higher score on

another criterion. The disjunctive screening method does allow compensatory effects as the indicator functions are added as shown by Equation 2:

$$\sum_{m} \mathrm{I}(x_{jm} > \gamma_m) \geq 1$$

Equation 2: Disjunctive rule

This thus means that a firm that does not meet the threshold on one criterion can compensate this with a high score on another criterion. The explicit choice was made for the conjunctive screening method as leadership is considered to be a reflective and not a formative construct (Podsakoff, MacKenzie, Podsakoff, & Lee, 2003). By viewing leadership as reflective construct, the assumption is made that leadership is the latent variable and that the criteria (that represent the indicators) are used to measure it. Thus the defined criteria act as the measurable functions that reflect the changes in the less measurable latent variable, i.e. the degree of green leadership (Diamantopoulos & Siguaw, 2006). This assumption thus leaves no room for compensatory effects as each fulfilled criterion merely demonstrates a part of green leadership.

In the case that a disjunctive screening method would be used, the opposite causal assumption would be adopted, thus considering leadership as a formative construct. This would imply that the criteria should be viewed as causing green leadership (the latent variable) instead of being caused by green leadership (Coltman, Devinney, Midgley, & Venaik, 2008). Thus causality would flow from the indicators to the latent variable (green leadership) leaving room for compensatory effects between indicators as the latent variable would demonstrate the combined indicators. This is obviously not considered to be the case for leadership as a latent variable.

Appendix 3: Model for supply chain partnerships

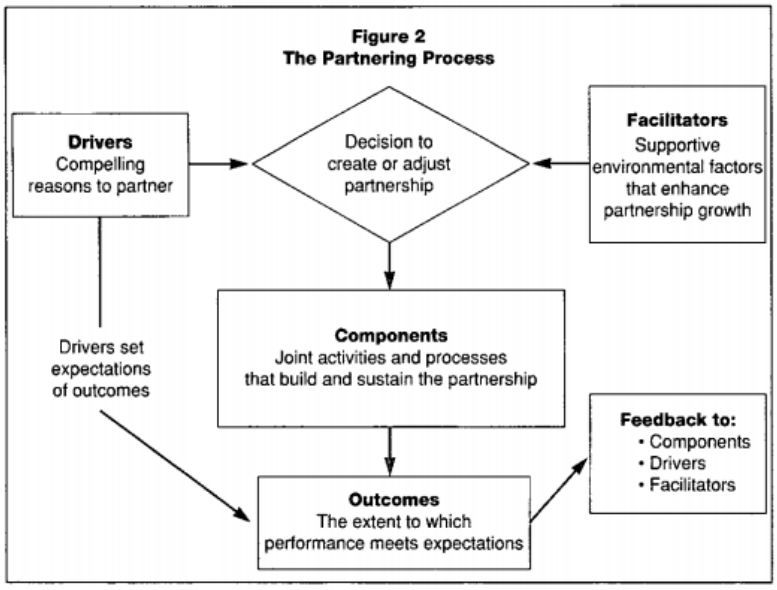


Figure 15: model for supply chain partnerships (Lambert et al., 1996)

The GFSC leadership model adopts an already existing model by Lambert et al., that assesses new and existing supply chain partnerships between buyers and suppliers. By providing a process of developing, implementing and improving relationships between a firm and its suppliers, the model by Lambert et al., enables firms to determine which partnerships are worthy of investments as they will create the desired result (Lambert, Emmelhainz, & Gardner, 1996). The line of reasoning is that, since a firm's investment capabilities (in terms of time and resources) to develop its suppliers are limited, a firm should only invest in those relationships that will truly benefit from the partnership. This is pre-eminently applicable to green supplier development as literature argues that costs, in terms of resources and time, is the most frequently highlighted factor that hinders sustainable supply chains as firms are primarily cost driven (Abbasi & Nilsson, 2012) (Tongzon, 2009) (McKinnon, 2014). For this reason, the model created by Lambert et al., that also consists of four elements, is deemed to be suitable for describing how relationships between green supply chain leaders (shippers/LSPs) and their followers (LSPs and carriers) can be established and sustained with the aim of reducing emissions.

These four elements are defined as the drivers, facilitators, components and feedback (Lambert, Emmelhainz, & Gardner, 1996). Drivers are described as the benefits that a partnership brings for both firms that include increased profits and improvements in areas like competitive advantage or marketing. Facilitators refer to the corporate environmental factors that if present strengthen and if absent weaken a buyer-supplier relationship. This concerns issues like the cultures and values of both firms; operating procedures and principles; willingness to develop joint goals and share sensitive information with a long-term perspective; similarity of firms in terms of size, market share, image, strength etc. Components

are the joint activities that both firms take to build and sustain the partnership. This includes activities like planning, communication, controlling etc. Feedback relates to the evaluation of how the previous elements facilitate the realization of the expectations.

In contrast with the model of Lambert et al., that generally describes the relationship between a buying firm and its suppliers, the green supply chain leadership model has a narrower scope and aims at describing the relationship between a green supply chain leader (i.e. the buying firm) and its followers (i.e. its transport suppliers). Comparing the two models, drivers would have the same definition, facilitators would be the barriers or drivers and the components would be represented by the strategies and tactics.

Appendix 4: Defining supply chain leadership

The 7 habits of highly effective people (Covey, 1989):

The first 3 habits are on independency. They state that the basis of effective leadership is primarily an internal issue → from dependence to independence → self-mastery. The fourth, fifth and sixth habit are on interdependency. They elaborate that effective leadership can only occur in collaboration with other parties. The seventh habit is dedicated on maintaining a sustainable growth of effectiveness. This is accomplished by balancing efforts with resources and continuously renewing these resources.

The seven habits of highly effective people (Covey, 1989)

Habit	**Principle**
Independence: conquering yourself	
1. Be pro-active in decision making understanding that your decisions determine your effectiveness	Principles of personal understanding
2. Begin with the end in mind and specify the important values, goals, roles and relationships	Principles of personal leadership
3. Prioritize and put important things first, thus by executing activities to reach the goals identified in habit 2	Principles of personal management
Interdependence: conquering with the environment	
4. Think in win-win and mutually beneficial solutions and agreements as they are better for long-term relations than winner takes all practices.	Principles of interpersonal leadership
5. Seek first to understand, then to be understood by first listening to others and allowing to become influenced by them. This will lead them to become more open-minded and to be influenced by you.	Principles of empathetic communication
6. Aim for synergy with teamwork so that the delivered work is more than the individual contributions	Principles of creative collaboration
Renewal: continues and balanced improvement of the self and environment improvement	
7. Balancing and renewing your resources, energy and health for a long-term effective life style.	Principle of balanced self-renewal

Appendix 5: Criteria for green supplier selection and evaluation

Table 58 elaborates on all the criteria identified for green supplier selection from a literature review by (Shen, Olfat, Govindan, Khodaverdi, & Diabat, 2013).

Table 58: Criteria for green supplier selection (Shen et al., 2013)

Criteria for green supplier selection and evaluation	References
Physical performance (e.g. air emissions and energy consumption) and economic performance (e.g. incremental revenues and environmental taxation)	Noci (1995)
Design for the environment, life cycle analysis, total quality environmental management, green supply chain and ISO 14000 environmental management system requirements	Sarkis (1998)
External environmental effectiveness, environmental efficiency, green image and environmental flexibility	Azzone and Noci (1996)
Green competencies, current environmental efficiency, suppliers 'green image and net life cycle cost	Noci (1997)
Environmental system management, suppliers process, product (recycling, packaging and production spill), transportation (return loads, choice of transportation, supplier's geographical location and optimizing loads)	Enarsson (1998)
Eco design, environmental certification, development of clean technologies, the use of environmentally friendly materials, return and reuse of packaging, the use of life cycle assessment (LCA) or waste management, reduction in environmental emissions	Sarkis (2001) and Zhu et al. (2007a)
ISO 14000 certified, Ozone depleting substances, recyclable content, volatile organic compounds content, on EPA (Environmental Protection Agency) 17 hazardous material list, remanufacturing/reuse activity, returnable or reduced packaging, take back or reverse logistics, participation in voluntary EPA programs, public disclosure of environmental record	Handfield et al. (2002)
Environmental costs (pollutant and improvement), management competencies, green image, green design, environmental management system, and environmental competencies.	Humphreys et al. (2003a)
Conventional pollutants released to water, ambient air releases, hazardous/non-hazardous waste, chemical releases, global warming gases, ozone depleting chemicals, bio accumulative pollutants, indoor environmental releases, resource consumption (material, energy, water), non-renewable resource consumption, recycled content, product disassembly potential, product durability, component reusability	Huang and Keskar (2007)
Eco-design, environmental performance, positive economic performance, ISO 14000 certificate, commitment of GSCM from senior and mid-level managers	Zhu et al. (2007b)
Environmental product design, reduction of material and energy usage, environmental management procedures for internal use, use of advanced prevention and safety systems at work, filters and controls for emissions and discharges	Gonzalez et al. (2008)
Requirement of green purchasing, green materials coding and recording, capability of green design, inventory of hazardous substances, management for hazardous substances, legal-compliance competency, environmental management system, hazardous substance management system	Hsu and Hu (2009)
Green process management, green product, green image, environment and legislative management, pollution control, environmental costs	Tuzkaya et al. (2009)

Total product life cycle cost, green image, pollution control, environment management, green product, green packaging, green competencies	Lee et al. (2009)
Eco-design requirements for energy using products, ozone depleting chemicals, restriction of hazardous substance, certified requirement of environmental management system	Kuo et al. (2010)
Use of environment friendly technology, use of environment friendly materials, green market share, partnership with green organizations, management commitment, adherence to environmental policies, green R & D projects, staff Training, lean process planning, design for environment, environmental certification, pollution control initiatives	Awasthi et al. (2010)
Pollution controls, pollution prevention, environmental management system, resource consumption, pollution production	Bai and Sarkis (2010)
Green image, product recycling, green design, green supply chain management, pollution treatment cost, environment performance assessment	Yeh and Chuang (2011)
Design for the environment, life cycle analysis, total quality environmental management, environment related certificates such as ISO 14000, cleaner production, internal green production plan, green purchasing, environmentally preferable bidding, knowledge-based environmental management systems, degree of innovativeness of R&D green products, reduce to use of hazardous products in production process	Tseng and Chiu (in press)

Appendix 6: Approaches of supplier segmentation

Table 59 elaborates on all the approaches of supplier segmentation from a literature review by (Day, Magnan, & Moeller, 2010). An important remark here is that, although earlier tools existed to segment markets and customers, (Parasuraman, 1980) was the first to apply this concept on the supply side of the supply chain distinguishing vendor characteristics. In the proposed 4-step procedure, that identified supplier segments in line with customer segments, Parasuraman however merely described the process but did not elaborate on the variables that could be used to make the segments. This was improved by the approaches that followed.

Table 59: Approaches of supplier segmentation (Day et al., 2010)

Author(s)	Predominant theoretical basis	Object of categorization and assessor(s)	Classification schema and output model format	Rationale behind supplier categorization
1. Kraljic (1983)	No disclosed theoretical basis, but limited connections to industry analysis	Buyer assessment of purchased products and services	Two, four category taxonomies (portfolio matrices of activities to focus procurement effort)	Organisations should realise the complexity of global supply markets and should develop a comprehensive plans to manage supply risks.
2. Hadeler and Evans (1994)	No disclosed theoretical basis, but limited connections to industry analysis	Buyer assessment of purchased products and services	Four category taxonomy (portfolio matrix of relationship types)	Forming a strategy for different types of relationship is critical for managing suppliers based on cost control and risk reduction.
3. Steele and Court (1996)	No disclosed theoretical basis, but limited connections to industry analysis	Buyer assessment of purchased products and services; buyer assessment of individual suppliers	Four category taxonomy (portfolio matrix of relationship types)	Time and effort should be devoted to those items deemed 'strategic critical' or 'strategic security' in order to manage risk and leverage opportunities with suppliers who provide these high risk/high cost products.
4. Olsen and Ellram (1997)	Resource dependency theory, inter-organisational theory, industry analysis	Buyer assessment of purchased products and services (matrix 1); buyer assessment of individual suppliers (matrix 2)	Two, four category taxonomies (portfolio matrices of relationship	Forming a supply strategy is critical for the effective management of the entire portfolio of relationships. This

			types)	should be based on analysing the company's purchases, analysing relationships, then developing action plans.
5. Dyer et al. (1998)	Transaction cost economics	Buyer assessment of purchased products	Two category typology based on arm's length versus partner relationships with rows showing different relationship facets	Each supplier should be analysed to determine the extent to which their product(s) contribute(s) to the core competence of the firm. Strategic suppliers are defined by asset specificity and component value-add.
6. Bensaou (1999)	Transaction cost economics, inter-organisational theory	Buyer assessment of individual supplier relationships	Two, Four category taxonomies (portfolio matrix of relationship types), (portfolio matrix of managerial profiles)	Portfolios of relationships are determined by the level of tangible and intangible buyer and supplier specific investments. Different relationship profiles are needed to avoid poor returns from investing in the wrong suppliers.
7. Tang (1999)	Transaction cost economics, industry analysis	Buyer assessment of products	Four category taxonomy (portfolio matrix of relationship types)	Two determining forces shape supplier relationships (strategic importance of the part; buyer's bargaining power). These are mapped to position and manage suppliers on a differentiated basis. Relationships are dynamic thus can move around the matrix.
8. Moeller et al. (2000)	Transaction cost economics, industrial networks, resource-based view	Buyer assessment of purchased products/services or individual supplier relationships	Four category typology (portfolio matrix of relationship types)	Segmentation is based on knowledge contributions, not just on asset specificity or criticality of spend. The value of supplier competences should be assessed in relation to the firm's strategic direction.

9. Nellore and Söderquist (2000)	Transaction cost economics	Buyer assessment of products	Four category taxonomy (portfolio matrix of relationship types)	Suppliers should be categorized according to relationship strength and market attractiveness. Linking portfolio models to purchasing specifications improves relations, and reduces risk.
10. Kaufman et al. (2000)	Transaction cost economics, networks of innovators	Buyer assessment of individual suppliers	Four category typology (portfolio matrix of supplier types)	Categorization is based on degree of technological integration and the nature collaborative linkages in manufacturing and strategy. Companies can improve their competitiveness by managing suppliers according to one of four relationship choices.
11. Cox et al. (2002)	Resource dependency theory, transaction cost economics, resource-based view, industry analysis	Buyer assessment of individual supplier relationships	Eight category typology with a nested three construct *x* axis and single construct *y* axis	Relationships should be managed with different strategies based on the power regimes that apply to their network positioning. Companies that do not do this will risk of value loss from supplier appropriation.
12. Svensson (2004)	Industrial networks	Buyer and supplier assessment of joint relationships	Four category typology (portfolio matrix of relationship vulnerability types)	Vulnerability in relationships (based on power, conflict, risk, uncertainty, reliability, availability and stock-outs) is dynamic over time. Vulnerability should be managed to avoid risk.
13. Van Weele (2005)	No disclosed theoretical basis, but limited connections to industry analysis	Buyer assessment of purchased products	Four category taxonomy (portfolio matrix of relationship types based on (Kraljic, 1983)	Purchasing managers should follow differentiated strategies with their suppliers, based on an assessment of supply risk and a product's purchased

				value.
14. Hallikas et al. (2005)	Transaction cost economics, risk management	Buyer assessment of individual supplier relationships	Four category typology (portfolio matrix of relationship types)	Risks and its management vary across relationship types. Collaborative learning is a key to managing risk in supplier relationships.
15. Caniëls and Gelderman (2007)	Resource dependency theory, transaction cost economics, industry analysis	Buyer assessment of products/services, then of individual relationships	Four category typology (portfolio matrix of relationship types based on Kraljic, 1983)	Power and interdependence need to be considered in portfolio matrices; the strategic quadrant may not be supplier dominant which will impact on the ability to control supplier opportunism.

Zhu et al. extended the work on green supplier segmentation by providing a segmentation framework that was specified for buyers that aimed to achieve a green supply chain. Like in previous frameworks, four segments were identified with two dimensions, being " supplier's relative power" (referring to the buyer's dependence) and "supplier's overall performance" as can be seen in Table 60.

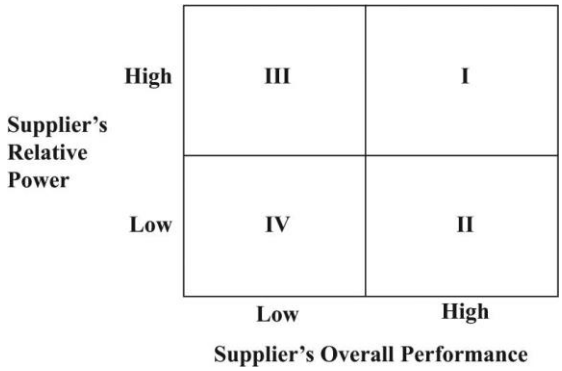


Table 60: Green framework for segmenting suppliers (Zhu et al., 2010)

Appendix 7: Classifying strategies in capabilities and willingness dimensions

The classification of the strategies in the dimensions of capabilities and willingness is based on the segmentation theory developed by Rezaei et al. According to this theory, the long-term green potential of a firm can be described through the dimensions of capabilities and willingness to reduce freight transport emissions. Supplier's capabilities and willingness that are specified as follow:

"supplier's capabilities are the complex bundles of skills and accumulated knowledge, exercised through organizational processes that enable firms to co-ordinate activities and make use of their assets in different business functions that are important for the buyer"

"supplier's willingness is confidence, commitment and motivation to engage in a (long-term) relationship with the buyer" (Rezaei, 2012)

For LSPs/carriers, as supply chain followers, the capability of a firm refers to the extent to which the firm can successfully reduce its own freight transport emissions, (mostly) guided by strategies of the supply chain leader. The willingness refers to the confidence, commitment and motivation of a supply chain follower to engage in a collaboration/relationship with the leader to reduce its own freight emissions. Thus overall, capability concerns "*the skills, knowledge and assets to achieve the emission reduction*" while willingness is more about "*confidence, commitment and motivation for collaboration*" to reduce emissions . In this line of reasoning, the strategies identified by (Bai & Sarkis, 2010) were classified in strategies to develop strategies to develop LSPs' /carriers' capabilities and/or willingness.

As this process can cause confusion, due to the fact that certain strategies can influence both capabilities and willingness, five experts in the field were asked to verify the classification according their professional opinion. This concerned the following experts with the following remarks:

Table 61: Opinions of experts on classification of strategies

Name	Function	Opinion of expert
Lori Tavasszy	Professor Freight Transport and Logistics	A shipper has instruments (money, power) to exercise influence over certain carrier attributes, or points of intervention. The primer is shipper specific, the latter related to the C&W criteria.
Jafar Rezaei	Assistant professor of operations and supply chain management	Found no difference
Pieter Bots	Assistant professor in multi-actor systems and policy analysis	Auditing affects capabilities, rewards effects both (1.12 & 2.8)
Sophie Punte	Executive director at Smart Freight Centre	Training, assessment, evaluation and audit affect both willingness and capabilities (1 to 10 and 12)
Erica Marcos	Global Freight Initiatives Coordinator at Smart Freight Centre	Auditing and rewards affects both capabilities and willingness

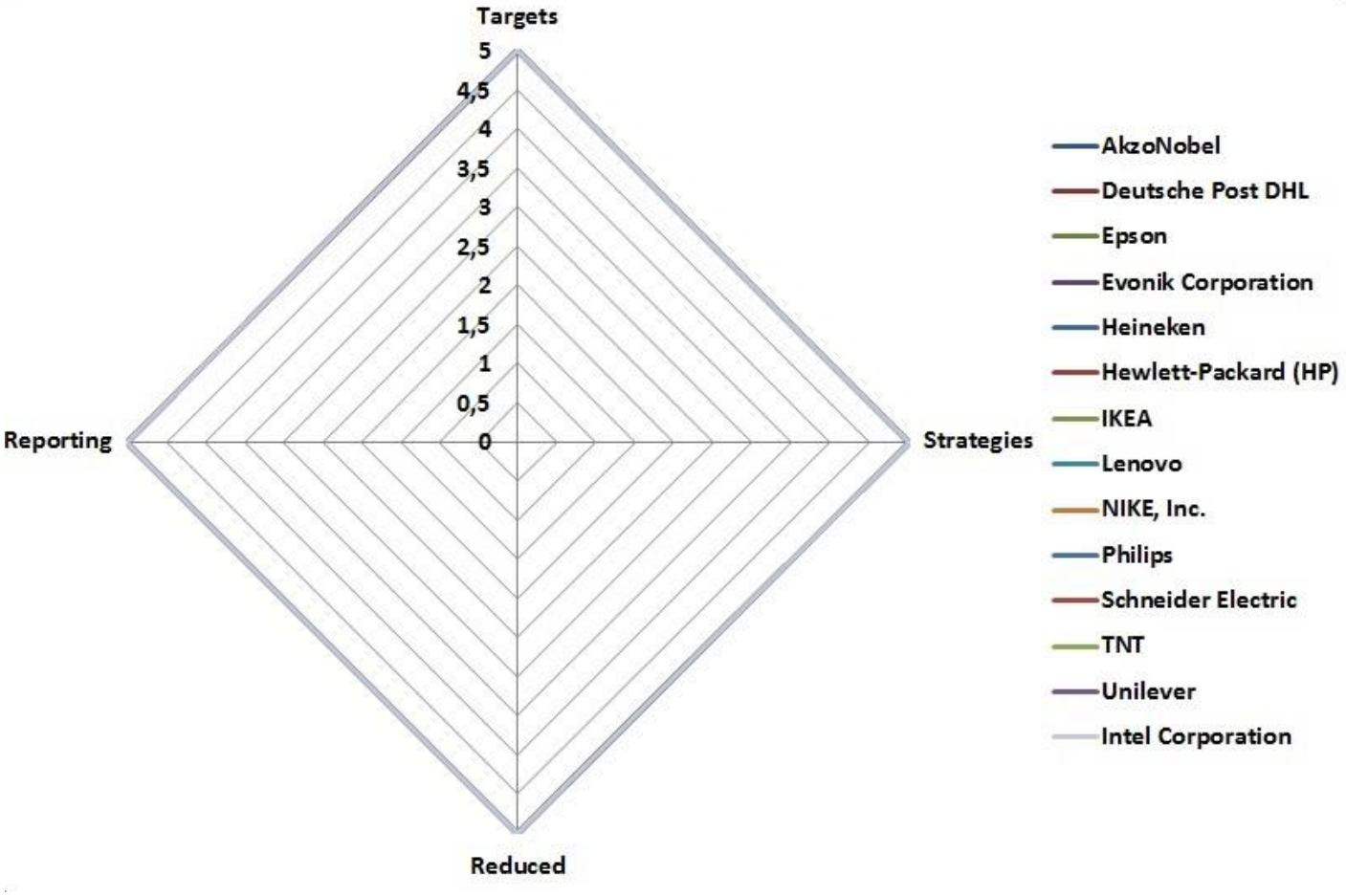
Looking at Table 61, the only strategy that the experts slightly disagreed on whether auditing only affects capabilities or both dimensions. As only one expert suggested that it only affected capabilities, the decision was made that it affected both the dimensions. The full categorization of the strategies can be found in Table 62.

Table 62: categorization of strategies in the dimensions of willingness and capability

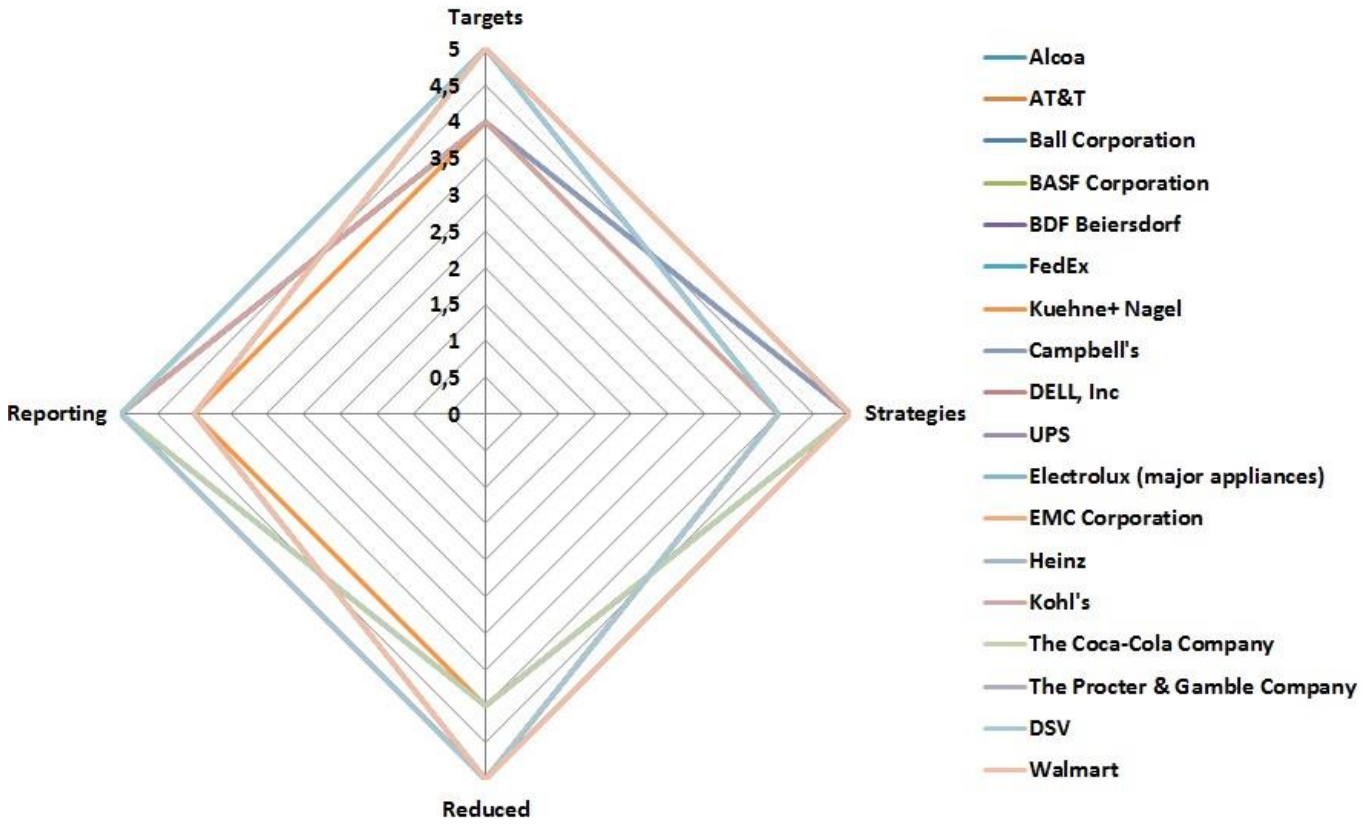
Strategy category	Strategy	Capabilities	Willingness
1. Green knowledge transfer and communication	1. Training LSP/carrier employees on environmental issues	x	x
	2. Train LSPs/carriers in stakeholder expectations		x
	3. Train users in environmental capabilities	x	x
	4. Train LSPs/carriers on environmental and cost controls	x	x
	5. Giving green technological advice to LSPs/carriers	x	x
	6. Conduct training and education programs for LSP/carrier personnel	x	x
	7. Supplier environmental evaluation and feedback	x	x
	8. Develop LSP/carrier environmental assessment programs	x	x
	9. Providing feedback about LSP/carrier environmental performance	x	x
	10. Strong formal LSP/carrier environmental evaluation	x	x
	11. Setting environmental improvement targets for LSPs/carriers		x
	12. Auditing LSPs/carriers	x	x
	13. Joint and team problem solving on environmental issues	x	
	14. Information sharing on environmental topics		x
	15. On-going communication with LSP/carrier community via LSP/carrier environmental councils		x
2. Investment and resource transfer	1. Invest in improvement of transaction processes	x	
	2. Reduce LSP/carrier environmental costs	x	
	3. Solve LSP/carrier environmental technical problems	x	
	4. Finance LSP/carrier major capital environmental expenditures	x	
	5. Transferring LSP/carrier employees with environmental expertise to buying firm	x	
	6. Transferring employees with environmental expertise to LSP/carrier	x	
	7. Investment in LSP/carrier capacity building	x	
	8. LSP/carrier rewards and incentives for environmental performance	x	x
3. Management and organizational practices	1. Requiring ISO 14000 certification for LSPs/carriers		x
	2. Long-term contracts with environmental dimensions		x

	incorporated		
	3. Introduce a cross-functional supply chain team with environmental presence	x	
	4. Building top management commitment/support within shipper/LSP organization for green supply practices		x
	5. Building top management commitment/support for LSP/carrier organization for green supply practices	x	
	6. Organization management has formal long-term plans to improve LSP/carrier performance		x
	7. Formal process for LSP/carrier development	x	x
	8. Identification of critical LSPs/carriers for improvement opportunities		x
	9. Criteria established about when to enter into LSP/carrier development		
	10. Formal process to identify LSP/carrier emission reduction targets		x
	11. The participation level of LSP/carrier in the eco-design stage	x	

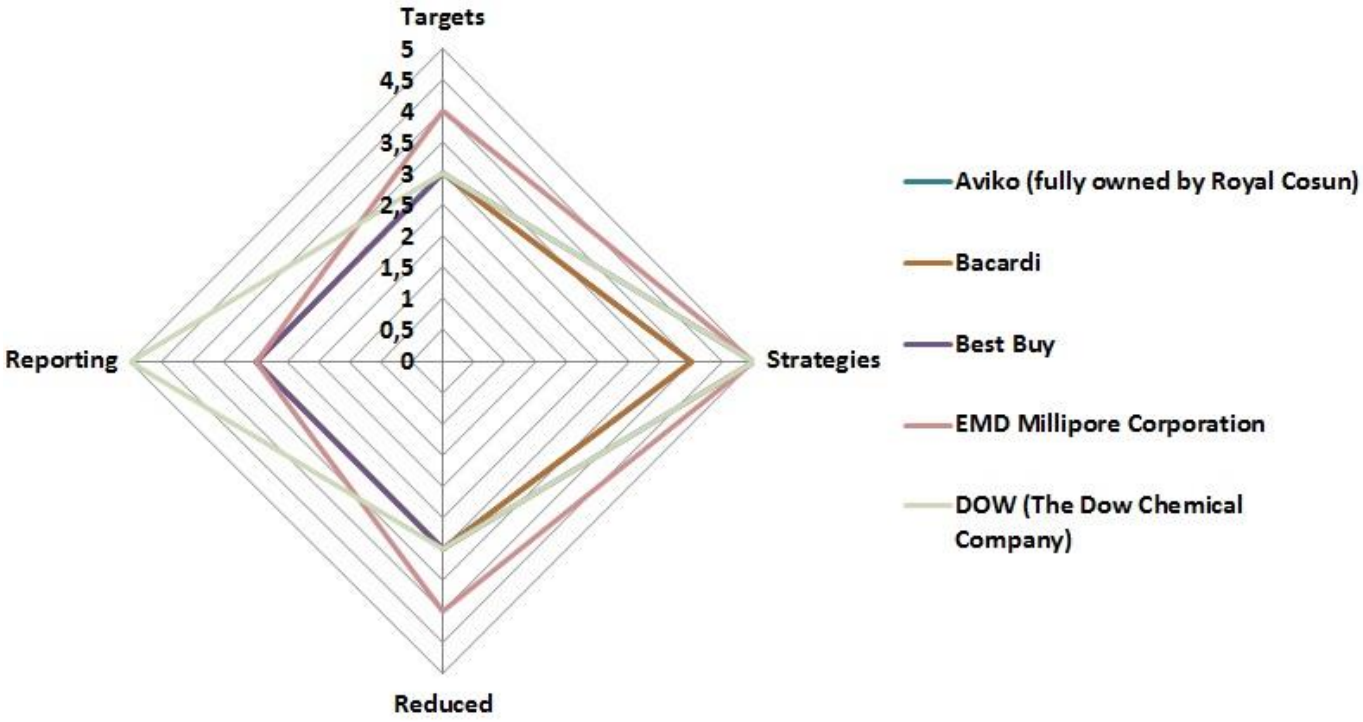
Appendix 8: Firms performances per GFSC leadership category



Graph 3: performance of potential high level GFSC leaders



Graph 4: performance of potential medium level GFSC leaders



Graph 5: performance of potential emerging level GFSC leaders

Appendix 9: Interview reports

List of interviewees

Firm	Interviewee	Function
AkzoNobel	Eric Majoor	Sourcing manager, Sea containers EMEA
Heineken	Ana Davila Martinez	Manager transport & green logistics, Global Logistics
Intel corporation	Vladimir Poppel	Corporate commodity manager, supply chain analyst
Protector and Gamble	Georgios Yiannakou	Project Leader, Europe transport operations
Deutsche Post DHL	Björn Hannappel	Senior Expert, Go Green
TNT	Bjorn Sawilla	Manager C02 services, Business development & revenue management
UPS	Curt Rousseau	Vice President Information Technology, Asia Pacific Region

Interview A

Date: 17 November 2014

Time: 16.30-17.30

Location: not applicable/telephone

Interviewee:

Left out for confidentiality reasons

Interviewer:

Jean Charles Nyabusore (Student Systems Engineering Policy Analysis & Management at Delft University of Technology, Intern at the Smart Freight Centre)

Subject:

This report summarizes the conclusions and insights attained through an interview with A. These conclusions and insights will provide input for a Master's Thesis concerning the concept of "Green Freight Supply Chain Leadership" conducted at the Delft University of Technology, Faculty of Technology, Policy and Management.

Goal of the interview

Commissioned by the Smart Freight Centre, Jean Charles Nyabusore is conducting a research on how the concept of green supply chain management can be utilized to achieve a more sustainable global freight sector. This is a knowledge gap that was derived from scientific literature. To fill this gap, a case study was used regarding how shippers/Logistics Services Providers (LSPs), as green supply chain leaders, can influence their freight supply chain followers, that consist of LSPs and carriers, to reduce transport related emissions and increase fuel efficiency.

The interview had the following goals:

1. Expand the green freight supply chain framework built from literature and desktop research
2. Validate the green freight supply chain framework
3. Gain information on the relative significance of the identified LSPs'/carriers' selection criteria, LSPs'/carriers' development strategies, barriers for these strategies, tactics to overcome these barriers, obstacles and drivers for green supply chains.

1. **Why did you decide to become a member of one the following initiatives: Green Freight Asia, Green Freight Europe, SmartWay, Clean Cargo Working Group and/or Lean & Green?**
   - *Firm A wanted to generate transparency in the market and get a picture of the current environmental status of carriers. This basis would allow the firm to determine the subsequent steps to enhance environmental performance .*

2. **In our desktop research you were recognised as a green freight supply chain leader -- you use your influence to stimulate your transport suppliers to become more sustainable by reducing their emissions and increasing their fuel efficiency. What would your definition be of a true green freight supply chain leader in terms of behaviour or characteristics?**
   - *A leader should have sustainability high on the agenda (leading by example), be a role model and make agreements with its LSPs/carriers to reduce emissions and increase fuel efficiency. In this process the leader should understand and solve the specific issues that are related to each different mode, being air, road, sea and rail.*

3. **Which strategies do you deploy to make your transport suppliers, being LSPs/carriers, more sustainable?**
   - *On the cooperate level, Firm A joined other firms to audit its LSPs/carriers through the Ecovadis platform. This platform conducts extensive audits, shares the outcomes and Firm A can discuss these with the relevant LSP's/carriers.*
   - *Firm A also conducts its own LSPs/carriers audits. But this is only restricted to the smaller firms that are not audited by Ecovadis.*
   - *Environmental performances from the audits are further used as selection and evaluation criteria for LSPs/carriers.*
   - *In comparison with other (goods) suppliers, the strategies to enhance sustainability in the logistics sector are less developed and defined. This is because the logistics sector only accounts for only a small portion of emissions (an estimated 2-4%). Currently, Firm A knows which aspects they want to tackle per transport mode, but the firm does not yet have the full picture of its cooperate footprint.*

   a. Why did you choose these?
   - *Costs-efficiency: auditing via Ecovadis is efficient as it is done and financed by 5 large chemical companies and all use the outcome. This requires less resources than if each firm would do it separately.*

   b. How did your transport suppliers react to these?
   - *This differs on the size of the firms. Large LSPs/carriers often already have their own environmental programs, have got the financial means and cooperate more easily through auditing and agreements. While the smaller carriers do not have the financial means and therefore do not give environmental performance much attention.*

   c. Which of these do you deem effective? Which ones least?
   - *This is difficult to answer as a carriers have got agreements with more shippers. Thus Firm A cannot clearly determine which share of emissions reductions can be attributed to its strategy. However, the firm recognizes that the environmental performance of carriers is increasing over time and that the agreements made with its carriers are implemented.*

4. **Which barriers did you encounter in the process and how would you look to see these being dealt with?**
    - *Especially in the sea transport mode, there is a lack of transparency in the sea emissions. This can be solved by merging the "Clean Shipping Index" and "Clean Cargo Working Group". This will lead to one standardized system being used to calculate emissions.*
    - *The transparency issue applies to all the transportation modes. Solving this issue will enable to measure the effectiveness of certain strategies.*
    - *Shippers and carriers are meeting the same challenges but are not sufficiently learning from each other. Increasing the sharing of best practices can help to solve this problem.*

5. **What do you think that it would take for other multinational shippers/LSPs to do the same as you did? What would you recommend to scale up your efforts to the entire freight and logistics sector?**
    - *Shippers and logistics services providers should communicate more to ensure that they speak to the carriers as "one voice" using the same approach. This will decrease the work of shippers/LSPs and increase the likelihood of carriers meeting their demands.*

6. **How can industry programs help multinationals to become green freight supply chain leaders?**
    - *The initiatives can show what is possible by facilitating the sharing of best practices through for example workshops that aim at acquiring and implementing knowledge.*

7. **Do you have comments/suggestions on the green freight supply chain leadership framework?**

Framework section	Comments
Green supply chain leadership criteria (criteria that are considered to be the relevant for distinguishing green supply chain leaders from non-leaders)	**Remarks:** the criteria of intra-firm initiatives/leading by example is affirmed to be important. Furthermore, the criteria are all good and evenly relevant
LSPs/carriers selection and evaluation criteria (criteria that are considered to be relevant for evaluating/selecting LSPs/carriers)	**Most important criteria:** 1, 2, 4, 6, 10, 11, 12, 13 **Least important criteria:** 8, 9 (more for the carriers themselves and it's better to use the track record/past history for this)
Strategies to develop LSPs/carriers (effectiveness in terms of a strategies potential to reduce C02 emissions)	**Remarks:** management commitment, exchanging information, and standards are important while training is considered the responsibility of LSPs. Category 2 strategies are considered too much. **Most effective strategies:** 1.8; 1.15; 3.1; 3.2; 3.4 **Least effective strategies:** 1.1; 1.2; 1.3; 1.4; 2.5; 2.6
Green challenges and barriers for implementing the strategies (challenges and barriers that are most applicable and generate most hinder)	Remarks: most shippers/LSPs have got commitment and trust is not an issue **Most important challenges and barriers:** 1.2; 1.3; 2.3 The important challenges being (1) costs, (2) complexity and (4) mind-set and cultural changes. Other challenges are less relevant **Least important challenges and barriers:** 1.1; 3.1
Tactics for overcoming the barriers (effectiveness in terms of a tactics potential to overcome barriers)	**Most effective tactics:** 3; 5; 6; 7; 8; 9 **Least effective tactics:** 1 (not always possible)
Drivers for realizing green supply chains (drivers that are most applicable and generate most incentive/motivation)	**Remarks:** all are relevant but are not well comparable as they overlap, e.g cost reductions leads to competitive advantage. But important is cost reduction and efficiency. **Most important drivers:** 1, 2, 4 en 8 **Least important drivers:** None

Interview B

Date: 5 November 2014

Time: 12.00-13.15

Location: not applicable/telephone

Interviewee:

Left out for confidentiality reasons

Interviewer:

Jean Charles Nyabusore (Student Systems Engineering Policy Analysis & Management at Delft University of Technology, Intern at the Smart Freight Centre)

Subject:

This report summarizes the conclusions and insights attained through an interview with B. These conclusions and insights will provide input for a Master's Thesis concerning the concept of "Green Freight Supply Chain Leadership" conducted at the Delft University of Technology, Faculty of Technology, Policy and Management.

Goal of the interview

Commissioned by the Smart Freight Centre, Jean Charles Nyabusore is conducting a research on how the concept of green supply chain management can be utilized to achieve a more sustainable global freight sector. This is a knowledge gap that was derived from scientific literature. To fill this gap, a case study was used regarding how shippers/Logistics Services Providers (LSPs), as green supply chain leaders, can influence their freight supply chain followers, that consist of LSPs and carriers, to reduce transport related emissions and increase fuel efficiency.

The interview had the following goals:

4. Expand the green freight supply chain framework built from literature and desktop research
5. Validate the green freight supply chain framework
6. Gain information on the relative significance of the identified LSPs'/carriers' selection criteria, LSPs'/carriers' development strategies, barriers for these strategies, tactics to overcome these barriers, obstacles and drivers for green supply chains.

1. **Why did you decide to become a member of one the following initiatives: Green Freight Asia, Green Freight Europe, SmartWay, Clean Cargo Working Group and/or Lean & Green?**
   - *Sustainability logistics program started in 2010/2011, at the start there was a lack of knowledge of how Firm B measures it's freight C02 emissions.*
   - *There was no common standard within the transport industry in measuring emissions. There was also a lack in transparency and consistency among carriers.*
   - *Firm B joined to gain knowledge: on the different methodologies, standards, measurements and on what others were doing.*

   2011-2014:
   - *The programs allow Firm B to know on which areas to focus in respect to C02 reduction. Also they enable to understand and apply best practices with carriers. As in 2011-2014, Firm B sets targets and through the initiatives, it shares best practices and understands that there is a drive towards a common approach for measurement.*
   - *Carriers are also a part of the initiatives and this helps them in understanding the topic.*

2. **In our desktop research you were recognised as a green freight supply chain leader -- you use your influence to stimulate your LSPs/carriers to become more sustainable by reducing their emissions and increasing their fuel efficiency. What would your definition be of a true green freight supply chain leader in terms of behaviour or characteristics?**
   - *Externally: a firm that externally works towards unification of measurements/standard of measuring emissions, so that all other shippers and carriers are "talking the same language".*
   - *Internally: a firm that has targets to reduce its own and carriers' emissions and works with carriers to achieve this → thus leading carriers but also leading by example.*
   - *A firm that is ready to share best practices→ leading other firms outside the supply chain.*

3. **Which strategies do you deploy to make your transport suppliers , being LSPs/carriers, more sustainable?**
   - *There is a methodology developed within Firm B and consists of the following four components: (1) transport efficiency → reduction of kilometres (e.g. network optimization, increasing utilization, planning, better location) (2) fuel efficiency → decreasing fuel consumption (e.g. drivers training, truck designs, energy improvements, rolling resistant) (3) mode shift → cleaner ways of moving product (e.g. road/rail/ocean and barge trade-offs), (4) strategic collaboration → collaborating with carriers and other companies to reduce emissions by for example sharing transportation (e.g. joint supply chain planning and contract/carrier management).*

   a. **Why did you choose these?**
   - *They tackle each aspect of the formula that drives C02: distance, fuel consumption. But Firm B also looks at alternative fuels and alternative transportation modes.*

   b. **How did your transport suppliers react to these?**
   - *Firm B is working together with them: both parties are on board. Firm B aims at working with carriers that are serious on the topic and are willing to reduce emissions. Some carriers are less developed in this area than others but the program just entered in the phase of C02 reduction and it will take time to develop its full potential.*

c. **Which of these do you deem effective? Which ones least?**

- *You can't classify them in effective/ineffective terms but more in a roadmap of development. This starts with the easiest initiatives to implement but that have the biggest impact. With time more complex initiatives are implemented that have a bigger impact.*
- *Firm B identifies with its carriers, out of its total strategies in its methodology, what initiative each carrier can implement. Here, Firm B wants to always have the basics in place with the main priority being the reduction of fuel consumption. This happens through eco-drivers training, and lightweight trucks and use of other lightweight materials.*
- *Strategy definition: initiatives of a firm that have actual results in terms of reducing C02 → training carriers is considered to be more of an enabler (a component of the strategy) and less of a strategy.*

4. **Which barriers did you encounter in the process and how would you look to see these being dealt with?**
   - *The level of knowledge of the carriers and the industry.*
   - *To have the commitment and the low priority of sustainability. Firm B is overcoming that by putting more sustainability requirements in the tendering process and setting up collaborations with carriers.*
   - *Firm B has got many carriers and most are at different stages of knowledge, starting points and progress.*
   - *Barrier for the industry: green technologies require time and money. The industry has small margins and thus equipment cannot just be replaced before it is fully utilized. This is to maintain the profitability of the carriers.*

5. **What do you think that it would take for other multinational shippers/LSPs to do the same as you did? What would you recommend to scale up your efforts to the entire freight and logistics sector?**
   - *It takes commitment and management's ability to take the long-term vision and see the involved long-term benefits. As there are little quick short-term benefits involved.*
   - *A unified methodology and standards for big shippers towards carriers (so that each of the carriers get the same message)*
   - *Collaboration programs with carriers to do the process together.*

6. **How can industry programs help multinationals to become green freight supply chain leaders?**
   - *Work together and create the same approach as they currently do not have the same way of working.*
   - *More support from regional authorities, e.g E.U.*
   - *Focus from only measuring emissions to also reducing emissions. This can be facilitated by for example sharing best practices, through the platforms and the green initiatives.*

7. **Do you have comments/suggestions on the green freight supply chain leadership framework?**
   - *Feedback not provided*

Interview C

Date: 10 November 2014

Time: 18.00-19.00

Location: not applicable/telephone

Interviewee:

Left out for confidentiality reasons

Interviewer:

Jean Charles Nyabusore (Student Systems Engineering Policy Analysis & Management at Delft University of Technology, Intern at the Smart Freight Centre)

Subject:

This report summarizes the conclusions and insights attained through an interview with C. These conclusions and insights will provide input for a Master's Thesis concerning the concept of "Green Freight Supply Chain Leadership" conducted at the Delft University of Technology, Faculty of Technology, Policy and Management.

Goal of the interview

Commissioned by the Smart Freight Centre, Jean Charles Nyabusore is conducting a research on how the concept of green supply chain management can be utilized to achieve a more sustainable global freight sector. This is a knowledge gap that was derived from scientific literature. To fill this gap, a case study was used regarding how shippers/Logistics Services Providers (LSPs), as green supply chain leaders, can influence their freight supply chain followers, that consist of LSPs and carriers, to reduce transport related emissions and increase fuel efficiency.

The interview had the following goals:

7. Expand the green freight supply chain framework built from literature and desktop research
8. Validate the green freight supply chain framework
9. Gain information on the relative significance of the identified LSPs'/carriers' selection criteria, LSPs'/carriers' development strategies, barriers for these strategies, tactics to overcome these barriers, obstacles and drivers for green supply chains.

8. **Why did you decide to become a member of one the following initiatives: Green Freight Asia, Green Freight Europe, SmartWay, Clean Cargo Working Group and/or Lean & Green?**

- *Get an opportunity to drive the supply chain and industry to enhance sustainability with a focus on C02 reduction*
- *To get data transparency within the supply chain → the visibility of the firm's carbon footprint.*
- *Access to C02 reduction methodologies and best practices from other companies.*

9. **In our desktop research you were recognised as a green freight supply chain leader -- you use your influence to stimulate your transport suppliers to become more sustainable by reducing their emissions and increasing their fuel efficiency. What would your definition be of a true green freight supply chain leader in terms of behaviour or characteristics?**
   - *Transparency of carbon footprint: a firm that shares publically its emissions data*
   - *Environmental goals: having aggressive environmental goals for carriers*
   - *Having strategies to support the goals, e.g. green technologies.*

10. **Which strategies do you deploy to make your transport suppliers, being LSPs/carriers, more sustainable?**

- *Incorporating green criteria/components in the LSPs/carrier selection process: procurement process ensures that greener carriers have a higher chance of being selected. For this emissions data of LSPs/carrier is collected.*
- *Mode conversion: from air to truck and from air to ocean*
- *Reducing packing weight and dimensions*

   a. **Why did you choose these?**

It is the effective strategy to influence suppliers and provide an incentive to focus on emissions reduction.

   b. **How did you transport suppliers react to these?**

Skepticism was at the beginning as carriers did not want to disclose data, but this issue was devolved with time. If one carrier complies the others will follow due to the competition/incentive effect.

   c. **Which of these do you deem effective? Which ones least?**

- *The strategy has been applied for two years now and it is becoming more a priority for carriers. Most effective strategy is mode conversion and accounts for about 75% of the reduced emissions, but has got a max limit.*
- *In 2 years, a carbon footprint reduction of 20% was realized (2011-2013).*
- *Green procurement process is the second effective strategy in terms of emissions reduction.*

11. **Which barriers did you encounter in the process and how would you look to see these being dealt with?**

- *The biggest challenge is data and transparency: not enough carrier data is present*
- *The data that is present is not standardized and thus not comparable. Carriers use different approaches, methods and deliver different types of data etc.*
- *A solution is a standardized platform through the industry that would apply for all carriers.*
- *Behaviour shift → it takes time to convince carriers to share data but this issue is less critical.*

12. **What do you think that it would take for other multinational shippers/LSPs to do the same as you did? What would you recommend to scale up your efforts to the entire freight and logistics sector?**

- *Willingness: firms should just start measuring their footprints, see how they are performing and this can give an incentive to take action to reduce emissions.*
- *The current "green development" comes from consumers/end customer pressures.*

13. **How can industry programs help multinationals to become green freight supply chain leaders?**
    - *Share best known methods and technologies to measure and reduce emissions. Currently, much emphasis is on measuring C02 emissions but the reduction of C02 gets neglected.*
    - *Provide standards and singular approach for data, measuring and reporting C02 emissions*

14. **Do you have comments/suggestions on the green freight supply chain leadership framework?**

Framework section	**Comments**
Green supply chain leadership criteria (criteria that are considered to be the relevant for distinguishing green supply chain leaders from non-leaders)	**Remarks:** all criteria are applicable but should be specified to measurable units/contain thresholds e.g. the targets and reductions should elaborate on the amount of emissions that need to be reduced.
LSPs/carriers selection and evaluation criteria (criteria that are considered to be relevant for evaluating/selecting LSPs/carriers)	**Remarks:** LSPs/carriers are evaluated according their regional performance and not their global performance **Most important criteria:** 1, 8, 9, 11 **Least important criteria:** 12 and 13 are considered to be common practice with large shippers and thus not necessary to take into account.
Strategies to develop LSPs/carriers (effectiveness in terms of a strategies potential to reduce C02 emissions)	**Remarks:** Carriers can have better knowledge of reducing transport emissions and it is thus important to collaborate and share information. The strategies 3.1; 3.2; and 3.5 are more advanced strategies and not applicable for the firm at the moment but should become more relevant going forward. **Most effective strategies:** 1.1; 1.13; 1.14; 3.8 **Least effective strategies:** 2.1-2.8
Green challenges and barriers for implementing the strategies (challenges and barriers that are most applicable and generate most hinder)	**Remarks:** complexity and operationalization are considered to be the most applicable challenges and cultural changes the least applicable. **Most important challenges and barriers**: 2.1 & 2.4 **Least important challenges and barriers:** the rest is less relevant
Tactics for overcoming the barriers (effectiveness in terms of a tactics potential to overcome barriers)	**Most effective tactics:** 6, 7 and 10 **Least effective tactics:** 1
Drivers for realizing green supply chains (drivers that are most applicable and generate most incentive/motivation)	**Most important drivers:** 6, 8 and 9. **Least important drivers:** also the rest is relevant but the above 3 are the relevant

Interview D

Date: 5 November 2014

Time: 15.00-16.30

Location: not applicable/telephone

Interviewee:

Left out for confidentiality reasons

Interviewer:

Jean Charles Nyabusore (Student Systems Engineering Policy Analysis & Management at Delft University of Technology, Intern at the Smart Freight Centre)

Subject:

This report summarizes the conclusions and insights attained through an interview with D. These conclusions and insights will provide input for a Master's Thesis concerning the concept of "Green Freight Supply Chain Leadership" conducted at the Delft University of Technology, Faculty of Technology, Policy and Management.

Goal of the interview

Commissioned by the Smart Freight Centre, Jean Charles Nyabusore is conducting a research on how the concept of green supply chain management can be utilized to achieve a more sustainable global freight sector. This is a knowledge gap that was derived from scientific literature. To fill this gap, a case study was used regarding how shippers/Logistics Services Providers (LSPs), as green supply chain leaders, can influence their freight supply chain followers, that consist of LSPs and carriers, to reduce transport related emissions and increase fuel efficiency.

The interview had the following goals:

10. Expand the green freight supply chain framework built from literature and desktop research
11. Validate the green freight supply chain framework
12. Gain information on the relative significance of the identified LSPs'/carriers' selection criteria, LSPs'/carriers' development strategies, barriers for these strategies, tactics to overcome these barriers, obstacles and drivers for green supply chains.

8. **Why did you decide to become a member of one the following initiatives: Green Freight Asia, Green Freight Europe, SmartWay, Clean Cargo Working Group and/or Lean & Green?**

- *To enable more accurate emissions calculations as Firm D outsources all of its transportation to carriers.*
- *Calculation of C02 need to be based on fuel consumption as it is the source of emissions. Firm D does not have the data on fuel consumption.*
- *As Firm D only knows the distance and weight transported (Tonne Kilometres), they only can make assumptions of the emitted C02. GFE collects data from carriers on fuel consumption and from Firm D on kilometres and tons of goods transported. This allows a more precise calculation of emissions .*
- *Experience shows that carriers are reluctant in providing their fuel consumption data as this is considered sensitive information (due to price negotiations). But carriers are willing and do give the information to a third party and the third party only communicates the results to Firm D. This is the role that Green Freight Europe plays.*

9. **In our desktop research you were recognised as a green freight supply chain leader-- you use your influence to stimulate your transport suppliers to become more sustainable by reducing their emissions and increasing their fuel efficiency. What would your definition be of a true green freight supply chain leader in terms of behaviour or characteristics?**

- *The defined scope is too narrow as it should include a bigger part of the supply chain and not only focus on LSP's/carriers. Freight emissions are just a part of the overall carbon footprint of a product and thus it is not the only area of focus for Firm D.*
- *A leader should aim for a broader scope that includes the whole supply chain:*
    - *Supply chain optimization: e.g. placing manufacturing & distribution centres strategically to minimize transportation.*
    - *Mode optimization: use different modes for efficient transportation.*
    - *Vehicle optimization: According to EU data 20% of truck miles in Europe are empty (due to return trips). A leading firm should work with other shippers and carriers to create round trips. But also load optimization: e.g. double stacking of pallets.*
- *The key motivation for Firm D to work with the carrier to reduce emissions is because they also expect a cost saving on that aspect. The aim is to namely: (1) to reduce work more efficiently, reduce fuel consumption, better loading etc.*
- *The 4 criteria are deemed to be good and applicable.*

10. **Which strategies do you deploy to make your transport suppliers, being LSPs/carriers, more sustainable?**

- *Procurement process: in negations, options are discussed for the carriers to invest in "green" equipment (e.g cleaner engines, aerodynamic vehicles). Here, Firm D proposes long-duration contracts (1-2 years) as a means of enabling carriers to make the necessary investments.*
- *Work with carrier & other shippers to ensure return-flows and reduce carriers empty miles.*
- *Firm D has got no specific freight transport C02 emission reduction targets because accurate CO2 calculation using fuel consumption data is not yet readily available. But they have clear targets on vehicle utilization and this reduces miles and emissions.*

    a. **Why did you choose these?**

- *Procurement: long term contracts enable the building of a better shipper-carrier relationship and lower costs. Also long-term contracts enable the carrier to invest in more efficient equipment, thus that creates a win-win situation.*
- *Return trips: buy ensuring full return trips, Firm D wants to share the costs reductions with the carrier.*

b. How did your LSPs/carriers react to these?

- *No negative reactions as they see the benefit*

c. Which of these do you deem effective? Which ones least?

- *Ensuring full return trips is the effective strategy in C02 reduction terms. While in terms of costs reduction the first strategy is effective as that is where the costs are defined.*
- *First strategy is applied to all contractors as all of them have long-term contracts. Second strategy depends on specific locations and whether the opportunity is present, is applied to less than 10%..*
- *Measuring effectiveness: the effectiveness cannot be measured due to the lack of fuel consumption information. However, assumptions and simulations allow estimations which happen on a project basis. No overall figures are available considering the general effectiveness.*

11. Which barriers did you encounter in the process and how would you look to see these being dealt with?

Main barrier is sharing information in a secure way:

- *Availability of data: carrier is not willing to provide primary fuel consumption data. The way to manage this is by having a neutral party (like GFE) that calculates the emissions and provide it to Firm D.*
- *The willingness of other shippers to engage in horizontal collaborations, where they use the same carriers to ensure full return trip. Other shippers may use their own carriers and not willing to change to another carrier. Here also trust issues are involved. Also here, a neutral party/trustee can provide a solution that collects the data and only shares information on the savings.*

12. What do you think that it would take for other multinational shippers/LSPs to do the same as you did? What would you recommend to scale up your efforts to the entire freight and logistics sector?

- *A trusted third-party that ensures the secure sharing of information that enables the optimization of supply chains. This can scale up to the whole logistics sector.*
- *The main problems are namely: trust and availability of information → no transparency of emissions, vehicle utilization and empty miles. Sharing information will enable collaborations.*
- *Legal requirements are deemed not to be the best way of pushing the industry → it is better to show/share case studies that reducing emissions reduces costs and increases services.*

13. How can industry programs help multinationals to become green freight supply chain leaders?

- *Act as a neutral party to collect the information that can issue certified C02 reports.*
- *Share and spread best practices of successful firms.*
- *Through incentive programs, e.g. labels of L&G, GFE for "green carriers".*

14. Do you have comments/suggestions on the green freight supply chain leadership framework?

Framework section	Comments
Green supply chain leadership criteria	Adjust criteria 3 to " validate" reduction of supply chain freight emissions and adjust criteria 2 to set and execute "the right" strategies. Broaden up the scope: include other firms outside the supply chain of a firm (return trips) and consider other aspects of the supply chain that influences transport emissions (strategically positioning of distribution centers and warehouses to reduce transport distance).
LSPs/carriers selection and evaluation criteria (criteria that are considered to be relevant for evaluating/selecting LSPs/carriers)	Firm D does not have the actual numbers on the fuel consumption and pollution production. So they evaluate the strategies/plans/efforts that the carrier has to reduce emissions and consult information from initiatives like GFE on the pollution of carriers. **Most important criteria:** In a perfect scenario case (with all information), the following selection/evaluation criteria would be used: (1, 2)- (3,4,6)- (5). This is: pollution production, reduction plans/strategies and manager commitment. **Least important criteria:** all other criteria are less relevant
Strategies to develop LSPs/carriers (effectiveness in terms of a strategies potential to reduce C02 emissions)	Strategies with a focus on long-term contracts, building management commitment and formalizing the process of reducing emissions are considered to be important. **Most effective strategies:** 3.2; 3.5 & 3.10. **Least effective strategies:** 3.1 as certifications tend to be more a "formality/nice to have" than real life implementation. 1.1 as training is considered to be the responsibility of LSPs/carriers and not of the shipper.
Green challenges and barriers for implementing the strategies (challenges and barriers that are most applicable and generate most hinder)	Generally, the transportation industry consists of small to medium carriers with a lack in human & technical resources to invest in sustainability. This does not apply to Firm D as they cooperate with large carriers. Therefore, important **barriers:** 2.3; 2.4 for smaller carriers and 3.4; 1.2; 1.3 for the overall industry. The underlying challenges are complexity, costs, operationalization and mindset cultural changes. **Least important barriers:** 1.1 and 1.4 as most top management of big companies want to reduce emissions and got realistic expectations. It was noted that costs is perceived as a benefit and not a challenge by big firms.
Tactics for overcoming the barriers (effectiveness in terms of a tactics potential to overcome barriers)	**Most effective tactics:** 1 as more resources can be spent to the critical LSP/carriers. Also, the rest of the tactics are good. **Least effective tactics:** 2 and 4 (keeping confidential information exclusive and minimizing legal involvement)
Drivers for realizing green supply chains (drivers that are most applicable and generate most incentive/motivation for both parties)	**Most important drivers:** (1) cost reduction, (6) operations improvement, (11) improved leader-follower relationships and (9) competitive advantage. **Least important drivers:** the rest is less relevant

Interview E

Date: 14 November 2014

Time: 14.00-15.00

Location: not applicable/via telephone

Interviewee:

Left out for confidentiality reasons

Interviewer:

Jean Charles Nyabusore (Student Systems Engineering Policy Analysis & Management at Delft University of Technology, Intern at the Smart Freight Centre)

Subject:

This report summarizes the conclusions and insights attained through an interview with E. These conclusions and insights will provide input for a Master's Thesis concerning the concept of "Green Freight Supply Chain Leadership" conducted at the Delft University of Technology, Faculty of Technology, Policy and Management.

Goal of the interview

Commissioned by the Smart Freight Centre, Jean Charles Nyabusore is conducting a research on how the concept of green supply chain management can be utilized to achieve a more sustainable global freight sector. This is a knowledge gap that was derived from scientific literature. To fill this gap, a case study was used regarding how shippers/Logistics Services Providers (LSPs), as green supply chain leaders, can influence their freight supply chain followers, that consist of LSPs and carriers, to reduce transport related emissions and increase fuel efficiency.

The interview had the following goals:

13. Expand the green freight supply chain framework built from literature and desktop research
14. Validate the green freight supply chain framework
15. Gain information on the relative significance of the identified LSPs'/carriers' selection criteria, LSPs'/carriers' development strategies, barriers for these strategies, tactics to overcome these barriers, obstacles and drivers for green supply chains.

15. **Why did you decide to become a member of one the following initiatives: Green Freight Asia, Green Freight Europe, SmartWay, Clean Cargo Working Group and/or Lean & Green?**

- *Firm E was asked by its customers to join SmartWay and it was also a logic thing to do. The program is well known and recognised in the US and all major companies that want to depict a green image are a member of the initiative.*
- *Firm E co-started Green Freight Asia and Europe to increase transparency in sub-contractors emissions-efficiency and help them to reduce emissions. Sub-contractors emissions are namely included in Firm E's scope 3 emissions and need to be reduced. Also, GFA and GFE helps Firm E to engage better with the fragmented (road) carriers and thus does not have to engage on a 1 by 1 basis.*
- *Clean Cargo Working Group and Lean & Green: the reasons for joining are not known.*

16. **In our desktop research you were recognised as a green freight supply chain leader -- you use your influence to stimulate your transport suppliers to become more sustainable by reducing their emissions and increasing their fuel efficiency. What would your definition be of a true green freight supply chain leader in terms of behaviour or characteristics?**
    It goes beyond sub-contractors and emissions e.g. clients and internal operations are involved. There are internal and external factors:

- *Internally: leading by example by achieving emissions efficiency and reduction. This is for example done through a clean fleet of trucks and clean operations. This also means to become a first mover in the field and stay years ahead of other competitors, e.g. Firm E's "Project X" program that pioneered the neutral emission transportation concept. 80% of Firm E's transport is done via sub-contractors and 20% is internally.*
- *Externally:*
    - *Within the supply chain by cooperating with carriers and pro-actively providing carbon-efficient solutions to customers and fulfilling their "green" demands.*
    - *Outside the supply chain by collaborating with other stakeholders that include governments and institutions like the EU to actively build, share and apply knowledge to reduce emissions. E.g. Firm E helped in writing the greenhouse protocol.*

17. **Which strategies do you deploy to make your transport suppliers, being LSPs/carriers, more sustainable?**

- *First Firm E built an emissions measuring system (carbon accounting and controlling system) to have a clear picture of all its emissions. On this basis, the firm defined strategies to increase efficiency and reduce fuel consumption.*
- *The current strategies are too many to list and include checks, auditing, working with truck manufactures to get electric trucks, developed with a partner an e-delivery vehicle, driver training, aerodynamic etc.*

    a. **Why did you choose these?**

- *In 2006 the company wanted to reduce emissions, logically the first step was measuring fuel consumption/ emissions production and continue on this basis.*

    b. **How did you transport suppliers react to these?**

- *First focused on its own fleet and this was the easiest. Initial talks with sub-contracted carriers were more difficult as they involved convincing them and finding ways to finance green technologies (trucks, fuel, etc.). Firm E started GFE and GFA to facilitate a good cooperation with sub-contracted carriers.*
- *Concerning shippers, "Project X" service was the first C02 transport neutral product on the market. It was well received and the demand still has a double digit growth per year.*

- *Looking at each separate mode, rail is only 0,1% of the emissions and thus not of interest. For air, Firm E uses score cards for environmental performance measurement and defining strategies. For ships, the Clean Cargo Working Group Group facilitates the reduction of sea emissions. The road mode is the most difficult as it involves the most challenges. The market is fragmented, carriers have little interest in the topic and the industry has a low profit margin.*
- *Carriers that are interested are approached directly and the ones that are not interested are approached via the initiatives. The least interested carriers namely feel more "safer" providing data to these initiatives.*

c. Which of these do you deem effective? Which ones least?

- *Generally, the best strategies are considered to be the ones that are cost-effective, i.e.to reduce emissions while improving business. As an example, the go-green target aims at saving 30% of emissions and fuel costs by 2020. The aim is to achieve the most carbon reduction through cost savings. This can increase profits and generate new customers.*
- *Most effective strategies are the intra-firm strategies as Firm E controls its own assets. The ineffective strategies are the ones that involve road carriers as a part of them are not interested in the topic.*
- *No information is available on the effectiveness of specific strategies in terms of reduced emissions that can be accounted to a strategy.*

18. Which barriers did you encounter in the process and how would you look to see these being dealt with?

- *For shippers, the barriers are mainly related to financial aspects i.e. which party pays for the investments. This more the case for Business to Business cases than Business to Customer cases due to shippers marketing purposes.*
- *Carriers are hesitent want to share information on fuel consumption as they fear that Firm E can use the information for cost/rate discussions. Also, there is little interest in the topic and sometimes carriers do not know their own fuel consumption. Furthermore, there is a lack ins in terms of time and finances.*
- *The solution for these problems are the industry initiatives as they can facilitate: education, sharing best practices, giving access to technologies/finances, creating trust etc.*

19. What do you think that it would take for other multinational shippers/LSPs to do the same as you did? What would you recommend to scale up your efforts to the entire freight and logistics sector?

- *Shippers need to understand more the benefit of green freight supply chains and what LSPs can provide to achieve this. This is a challenge as transport is only a minor part of the total product, often accounting to 5-10% of the carbon emissions.*
- *Concerning other LSP's (competitors) it is not in Firm E's best interest for them to also become leaders as carbon reduction knowledge is considered a competitive advantage, differentiator and an extra service/selling point that Firm E can offer to its clients. Reducing emissions is mainly primarily seen as a competition strategy since it involves reducing fuel costs, increasing efficiency and a service that can be sold to the customer.*

20. How can industry programs help multinationals to become green freight supply chain leaders?

- *The initiatives can help by building awareness on the side of shippers. More interest/sense of urgency should be created for the topic so that shippers can be more pro-active and drive the movement. Currently it is driven by the LSPs but should be done by the shippers as they are the customers and should demand a more "green supply chain". It would then make it easier for LSPs to fulfil this demand.*

- Concerning the sub-contracted carriers, the initiatives should provide solutions that Firm E cannot provide via bilateral relations (due to earlier mentioned barriers). This involves creating trust, sharing knowledge, giving access to finances, insurances etc. This will be mainly to help the smaller carriers to become more efficient and green.

21. Do you have comments/suggestions on the green freight supply chain leadership framework?

Interview F

Date: 17 November 2014

Time: 11.00-12.00

Location: not applicable/telephone

Interviewee:

Left out for confidentiality reasons

Interviewer:

Jean Charles Nyabusore (Student Systems Engineering Policy Analysis & Management at Delft University of Technology, Intern at the Smart Freight Centre)

Subject:

This report summarizes the conclusions and insights attained through an interview with F. These conclusions and insights will provide input for a Master's Thesis concerning the concept of "Green Freight Supply Chain Leadership" conducted at the Delft University of Technology, Faculty of Technology, Policy and Management.

Goal of the interview

Commissioned by the Smart Freight Centre, Jean Charles Nyabusore is conducting a research on how the concept of green supply chain management can be utilized to achieve a more sustainable global freight sector. This is a knowledge gap that was derived from scientific literature. To fill this gap, a case study was used regarding how shippers/Logistics Services Providers (LSPs), as green supply chain leaders, can influence their freight supply chain followers, that consist of LSPs and carriers, to reduce transport related emissions and increase fuel efficiency.

The interview had the following goals:

16. Expand the green freight supply chain framework built from literature and desktop research
17. Validate the green freight supply chain framework
18. Gain information on the relative significance of the identified LSPs'/carriers' selection criteria, LSPs'/carriers' development strategies, barriers for these strategies, tactics to overcome these barriers, obstacles and drivers for green supply chains.

22. **Why did you decide to become a member of one the following initiatives: Green Freight Asia, Green Freight Europe, SmartWay, Clean Cargo Working Group and/or Lean & Green?**

- *Firm F is a member of GFA and GFE (initiated by Firm F with other firms) to deal with the issues that a single firm cannot solve by itself. This mainly concerns the creation of a harmonized approach and standards for subcontracted carriers. The major LSPs that include Firm E, Firm G and Firm F use the same carriers and desire information and certain (sustainability) actions from the carriers. Thus an individual firms perspective or approach is not feasible. GFE and GFA are considered as the independent parties that are situated between shippers, LSPs and carriers to facilitate a harmonized approach and sector wide standards.*

23. **In our desktop research you were recognised as a green freight supply chain leader -- you use your influence to stimulate your transport suppliers and shippers to become more sustainable by reducing emissions and increasing their fuel efficiency. What would your definition be of a true green freight supply chain leader in terms of behaviour or characteristics?**

- *There are two aspects, firstly a leader needs to be pro-active in the stakeholders initiatives by joining forces with other firms, conceptualize, set up and support green freight initiatives that bring all relevant stakeholders together to reduce emissions. Stakeholders are within and outside the supply chain, being shippers, carriers and governments etc. This enables a leader that is recognised, has got credibility and can influence other stakeholders.*
- *A leader needs to lead other firms by example, by commitment and taking action to achieve tangible and visible results in the own firm. This is necessary to "sell" the demands of the firm to its sub-contractors in a credible manner.*

24. **Which strategies do you deploy to make your transport suppliers and shippers more sustainable?**

- *On the one hand, as a LSP Firm F has got its own fleet of trucks and planes which they directly influence (intra-firm strategies) and on the other hand they have sub-contractors (inter-firm strategies). The ratio of own fleet vs sub-contracted fleet is classified information.*
- *But it in terms of emissions the ratio is 50/50 with most air deliveries being internally handled and most road deliveries being sub-contracted.*
- *The intra-firm strategies are a matter of commitment and easy to implement while the inter-firm strategies are more difficult to implement and take more time.*
- *Concerning the inter-firm strategies, Firm F aims at getting a picture of its subcontracted carriers emissions through asking information on their fuel/emission efficiency.*
- *Furthermore, Firm F aims at having direct influence through formalized ways via code of conducts, contracts and procurement criteria e.g. environmental standards of vehicles. There is also a driver's training in the form of a competition between carriers regarding the most efficient driver.*
- *Through the green freight initiatives, Firm F aims at selecting sustainable subcontracted carriers. This also drives the environmental performance of carriers as they know that enhancing their environmental performance will increase their likelihood of being selected.*

    a. **Why did you choose these?**

    - *The same bilateral strategies are applied to Firm F by its customers (shippers), as they collect information on its performance and use that in contracts/procurement process. Furthermore, influencing the carriers indirectly via the initiatives seems like the most logical thing to do.*

b. How did you transport suppliers/shippers react to these?

- *Requesting environmental performance without providing benefits for the carriers would by definition lead to resistance. GFE and GFA are also looking for all sorts of benefits to offer carriers.*
- *Overall, Firm F uses the sticks and carrots approach. Firm F asks for fuel efficiency but simultaneously uses its buying power to provide benefits like board computers which increases fuel savings of carriers.*
- *Other "carrots" that the firm uses involve providing other kinds of equipment, increasing business volumes and having deeper relations.*
- *It is not possible to state how carriers generally react as this varies by country and individual sub-contracted carriers (which differ from small to large). Also there is no one size fits all "carrot".*

c. Which of these do you deem effective? Which ones least?

- *It is not black and white because of the complexity caused by the different stakeholders situated in multiple countries. Thus no clear cut can be given. But generally, going through the green freight initiatives is considered to be the effective strategy in the long-term.*
- *This is because the initiatives approach is more harmonised, aligns all the parties involved and creates less work for each stakeholder. However, the initiatives need to be effective and efficient to actually deliver by ensuring that the right resources are available and that the parties are wiling.*
- *Bilateral agreements/contracts are considered to be a short-term strategy and less effective in the long-term.*
- *Initiatives and bilateral agreements are not exclusive as having the initiatives also facilitates the bilateral agreements. Firm F can for example only select the carriers that have a certain rank in the initiatives.*
- *Through the complexity of the issue, it is almost impossible to give an indication of the effectiveness of a strategy in terms of emission reductions. But it is argued that effective initiatives are the effective.*

25. Which barriers did you encounter in the process and how would you look to see these being dealt with?

- *Complexity in terms of scope: as Firm F is involved in a global supply chain with many countries and different specifics involved. There is a dilemma between a pragmatic approach of narrowing the scope but ignoring relevant issues or a wide approach but getting lost in the complexity. Also* each country has got different rules and directly exerting influence via formal ways is sometimes not feasible given the laws of a country.
- *For the freight sector as a whole, there is a discrepancy/disconnect between the needed high level strategic perspective and the detailed technical level. Currently, complexity causes the challenge to have an overall strategy that is filled with sound (technical) content.*
- The green initiatives take a long time to become efficient and realize their goals but they are essential to get information from the carriers.
- *The solution is to have a good alignment between the regions (EU, US and China) and a sound resourceful structure that can effectively guide the process, reduce complexity and stir the different parties.*

26. What do you think that it would take for other multinational shippers/LSPs to do the same as you did? What would you recommend to scale up your efforts to the entire freight and logistics sector?

- *Firms need to have a clear picture of their environmental performance and a clear vision/target on the area on which they want to focus on.*
- *Firms need to get support from the internal and external stakeholders with the right financial and legal means.*

27. How can industry programs help multinationals to become green freight supply chain leaders?

- *Solving the alignment issues that cannot be solved from a single company perspective as the supply chain is interlinked through various stakeholders. This includes aspects like providing visibility on the environmental performance of carriers.*

28. Do you have comments/suggestions on the green freight supply chain draft framework?

Framework section	Comments
Green supply chain leadership criteria (criteria that are considered to be the relevant for distinguishing green supply chain leaders from non-leaders)	**Remarks:** all criteria are evenly important and relevant
LSPs/carriers selection and evaluation criteria (criteria that are considered to be relevant for evaluating/selecting LSPs/carriers)	**Remarks:** two significant elements are the visibility of the company's current environmental status and their actual actions to improve. **Most important criteria:** 1, 2, 4, 6, 8 and 11 **Least important criteria:** 3 and all other criteria
Strategies to develop LSPs/carriers (effectiveness in terms of a strategies potential to reduce C02 emissions)	**Remarks:** the effectiveness of strategies differ per type of case e.g. long-term commitment will be effective on larger carriers. **Most effective strategies:** 1.1; 1.8; 1.9; 3.1; 3.2. Furthermore the strategies 3.6; 3.7; and 3;8 will only be effective on larger carriers. **Least effective strategies:** 1.10; 1.11; 2.1; 2.3; 2.4→can be effective if set up properly but are not realistic due to (legal, financial and willingness) constraints.
Green challenges and barriers for implementing the strategies (challenges and barriers that are most applicable and generate most hinder)	**Most important challenges and barriers:** 1.1; 2.1 and 3.4 With complexity and operationalization being the important green challenges **Least important challenges and barriers:** all others challenges and barriers
Tactics for overcoming the barriers (effectiveness in terms of a tactics potential to overcome barriers)	**Most effective tactics:** 7, 10 **Least effective tactics:** all other tactics
Drivers for realizing green supply chains (drivers that are most applicable and generate most incentive/motivation)	**Most important drivers:** 1, 6, 9 and 11 **Least important drivers:** 3 and 4

Interview G

Date: 29 October 2014

Time: 17.00-18.00

Location: not applicable/telephone

Interviewee:

Left out for confidentiality reasons

Interviewer:

Sophie Punte (Executive Director, Smart Freight Centre)

Subject:

This report summarizes the conclusions and insights attained through an interview with G. These conclusions and insights will provide input for a Master's Thesis concerning the concept of "Green Freight Supply Chain Leadership" conducted at the Delft University of Technology, Faculty of Technology, Policy and Management.

Goal of the interview

Commissioned by the Smart Freight Centre, Jean Charles Nyabusore is conducting a research on how the concept of green supply chain management can be utilized to achieve a more sustainable global freight sector. This is a knowledge gap that was derived from scientific literature. To fill this gap, a case study was used regarding how shippers/Logistics Services Providers (LSPs), as green supply chain leaders, can influence their freight supply chain followers, that consist of LSPs and carriers, to reduce transport related emissions and increase fuel efficiency.

The interview had the following goals:

19. Expand the green freight supply chain framework built from literature and desktop research
20. Validate the green freight supply chain framework
21. Gain information on the relative significance of the identified LSPs'/carriers' selection criteria, LSPs'/carriers' development strategies, barriers for these strategies, tactics to overcome these barriers, obstacles and drivers for green supply chains.

29. **Why did you decide to become a member of one the following initiatives: Green Freight Asia, Green Freight Europe, SmartWay, Clean Cargo Working Group and/or Lean & Green?**

- *Firm G has a strong position in Asia and in Europe/US. In Europe/US, Firm G is a dominant player and so it had to be a part of the green initiatives. In Asia the firm is less dominant but it detected the need for GFA in Asia and wanted to see it realized.*
- *As an LSP, Firm G would like to see shippers taking a leading role to make the freight sector more sustainable and GFA should facilitate this.*
- *Firm G participates in the programs to identify how it can generate more revenue from shippers and has a less focus on attaining carriers. Thus Firm G mainly aims at getting carriers to improve their performance so that the firm gets in a better position with shippers.*
- *Because supporting carriers costs significant amount of time, Firm G focuses on in-house and direct sub-contracted carriers but not on sub-sub-contractors. This is in line with the GFA label as it only considers a firm's own fleet and thus sub-contracted carriers scores are not taken into account.*

30. In our desktop research you were recognised as a green freight supply chain leader -- you use your influence to stimulate your transport suppliers and shippers to become more sustainable by reducing emissions and increasing their fuel efficiency. What would your definition be of a true green freight supply chain leader in terms of behaviour or characteristics?

The following 4 features can distinguish leaders:

- *Having a program to reduce freight supply chain emissions*
- *Creating standards where they are none*
- *Taking best practices across the company*
- *Getting subcontracted carriers to improve beyond governmental regulations*

31. Which strategies do you deploy to make your transport suppliers and shippers more sustainable?

- *Firm G can increase revenues through sustainability. The strategies that would be deployed would depend and vary on the regions. In Asia the firm would use the " Direct involvement" strategies. While in Europe and US it would use more the " competitive pressure" strategies because of the developed economies.*
- *Furthermore, Firm G would start with a small share of sub-contracted carriers to experiment how far Firm G can go in terms of implementing the strategies. Subsequently, these case studies would be used to decide on what approach to take across the supply chain and "turn green into gold".*
- *Firm G will also identify shippers that are leaders on sustainability.*
- *Firm G did a sustainability study (by BSR) to determine what is important to their customers (shippers) and then determine what Firm G can do. The study showed that customers in Asia are not yet asking for sustainability (in terms of fuel and efficiency) but only about the price*
- *Firm G is trying to educate its customers (shippers), i.e. leadership upside down and is trying to use this basis.*

a. Why did you choose these?

- *Answer was not provided*

b. How did you transport suppliers/shippers react to these?

- *Answer not provided*

c. Which of these do you deem effective? Which ones least?

- *Firm G sets global targets but they are achieved better in the US/Europe and to a lesser extent in Asia.*
- *This has several reasons: (1) the firm is a smaller player in Asia, (2) in the US/EU the market is further developed so sustainability is a potential distinguishing factor, (3) the market in Asia is still in the growth phase and the demand for sustainability is low.*

32. Which barriers did you encounter in the process and how would you look to see these being dealt with?

- *There is no market demand, especially in Asia. The prevailing line of reasoning is that "why throw away money on the environment when no one asks you to". The exceptions are the strategies that do not cost significant financial resources e.g. driver training.*
- *Customers (shippers) do not care.*
- *No NGOs holding firms accountable.*

33. What do you think that it would take for other multinational shippers/LSPs to do the same as you did? What would you recommend to scale up your efforts to the entire freight and logistics sector?

- *GFA is critical to achieve momentum and scale because right now there is no legislation. Only NGOs and customers are currently active in this area, thus shippers need to drive this more through.*
- *Pressure from NGO's*
- *Green brands*
- *Government legislation or the threat of it.*

34. How can industry programs help multinationals to become green freight supply chain leaders?

- *GFA needs a strong label and then raise the bar*
- *The label must be credible and have integrity*

35. Do you have comments/suggestions on the green freight supply chain leadership framework?

- *The model should consider regional differences, Europe/US vs Asia. This concerns the aspects like cooperate pressure of a firm with a head office in Europe/US to transport suppliers in Asia.*
- *The regional weakness of firms that take action in the EU + US but not in developing regions should be included.*
- *The goal of the model should also be to identify knowledge gaps, i.e. how third parties and organizations of shippers/carriers/suppliers of carriers can be used by shippers to influence their carriers.*

Appendix 10: Comparing effective to strategy deployment rate

Table 63: effectiveness of above average applied strategies

Rank	Strategy (applied above average)	Eff.	Ineff.
1	1.13 Joint and team problem solving on environmental issues	1	
2	3.2 Long-term contracts with environmental dimensions incorporated	1	
3	1.7 Supplier environmental evaluation and feedback	0	0
3	1.9 Providing feedback about LSP/carrier environmental performance	1	
3	1.10 Strong formal LSP/carrier environmental evaluation		1
3	2.4 Finance LSP/carrier major capital environmental expenditures		1
4	1.11 Setting environmental improvement targets for LSPs/carriers		1
4	1.12 Auditing LSPs/carriers	0	0
4	1.14 Information sharing on environmental topics	1	
5	1.1 Training LSP/carrier employees on environmental issues		1
5	1.2 Train LSPs/carriers in stakeholder expectations		1
5	1.4 Train LSPs/carriers on environmental and cost controls		1
5	1.6 Conduct training and education programs for LSP/carrier personnel	0	0
5	3.6 Organization management has formal long-term plans to improve LSP/carrier performance	1	
	Total number of mostly applied strategies that are (most/least) effective	**5**	**6**

1= (in)effective strategy, 0 = was not rated as (in)effective, green = good match, orange= mismatch

Table 64: effectiveness of under average applied strategies

Rank	Strategies (applied under average)	Eff.	Ineff.
1	1.3 Train users in environmental capabilities		1
1	2.1 Invest in improvement of transaction processes		1
1	2.5 Transferring LSP/carrier employees with environmental expertise to buying firm		1
1	2.6 Transferring employees with environmental expertise to LSP/carrier		1
1	3.1 Requiring ISO 14000 certification for LSPs/carriers	1	
1	3.3 Introduce a cross-functional supply chain team with environmental presence	0	0
1	3.5 Building top management commitment/support for LSP/carrier organization for green supply practices	1	
1	3.8 Identification of critical LSPs/carriers for improvement opportunities	1	
1	3.11 The participation level of LSP/carrier in the eco-design stage	0	0
2	1.8 Develop LSP/carrier environmental assessment programs	1	
2	2.2 Reduce LSP/carrier environmental costs		1
2	3.4 Building top management commitment/support within shipper/LSP organization for green supply practices	1	
3	1.15 On-going communication with LSP/carrier community via LSP/carrier environmental councils	1	
3	2.7 Investment in LSP/carrier capacity building		1
3	2.8 LSP/carrier rewards and incentives for environmental performance		1
3	3.10 Formal process to identify LSP/carrier emission reduction targets	1	
4	1.5 Giving green technological advice to LSPs/carriers	0	0
4	2.3 Solve LSP/carrier environmental technical problems		1
4	3.7 Formal process for LSP/carrier development	1	
4	3.9 Criteria established about when to enter into LSP/carrier development	0	0
	Total number of least applied strategies that are (most/least) effective	**8**	**8**

1= belongs to the group of above average cited as (most/least) effective, 0 = was not rated as (most/least) effective, green = good match, orange= mismatch