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GREEN SUPPLY CHAIN PRACTICES FOR INTRACITY LOGISTICS AND ITS CONSEQUENCES

Master of Science Thesis

Examiner: Prof. Jussi Heikkilä
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ABSTRACT

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For more than two decades, humanity has been pointing out the rise in global pollution. First recognized in 1990's, the term Green Supply Chain Management (GSCM) has gained popularity amongst many companies and has become the pivotal point to address when it comes to supply chain management. More and more companies in contemporary world have now given the priority to green supply chain management, let it be green purchasing or green logistics. A sizable chunk of air pollution comes from logistics as last mile delivery. The other aspect is the rise in need of logistics in recent years. The blend of these two issues have made it utterly important for the companies to come up with such practices which would be a step towards solving them.

The aim is to draw the attention of the reader towards the question of what can be done to overcome or reduce the effects of these issues. Therefore, the objective of this research is to introduce the green practices concerning intracity logistics as last mile delivery. This study also draws the attention of the reader towards the implementation of newly born industry of electric vehicles for the purpose of logistics within the city, let it be a fast-moving consumer goods (FMCG) company or a mail and delivery industry. The idea is to study the company's existing strategies and measures in relation with green supply chain management and apply those strategies to the model designed in this thesis to see additional measures that can enhance the green supply chain further.

The result of the study is the introduction of practices and measures that is necessary to implement to resolve the issues related to intracity logistics. These measures presented in a model with some aims represents a feasible solution to each issue created with increased need of intracity logistics and green supply chain management. The overall result of the thesis is to figure out the imbalance between the green practices that a company implements. This imbalance is depicted in the model constructed throughout the thesis. With that, it can be made clear that which practices are needed to shift the balance and put efforts in all the issues pertaining intracity logistics. Lastly, it is essential to mention that different companies may require different set of practices due to varying supply chains.

PREFACE

I would take this opportunity and platform to pay my regards and express my gratitude towards people who helped me in the process of carrying out this study. Starting with the thesis supervisor, Prof. Jussi Heikkilä who provided me with the rudimentary elements for this thesis. Moreover, his constant support towards me proved to be invaluable for carrying out this thesis. I would also like to thank Tampere University of Technology for giving me the opportunity to carry out this study in my own fashion which would provide me with basic elements to improve in my personal and professional development.

This study would not have come to conclusion without data collection from the company's employee. I would like to thank Mr. Ahmer Zaidi who provided me with crucial information and data on this project. His support proved to be pivotal for the study. last but not the least, special thanks to my family who provided me love and affection which made my achievement a reality.

Tampere, 13.6.2017

Sohaib Ahmed Nasir

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LIST OF SYMBOLS AND ABBREVIATIONS

ACEA	Association des Constructeurs Européens d'Automobiles
GSCM	Green Supply Chain Management
IT	Information Technology
OECD	Organization for Economic Co-operation and Development

1. INTRODUCTION

1.1 Background

This study is an amalgamation of different concepts tied together to reach one common conclusion. To grasp the rudimentary concept behind this research, the study can be understood by breaking down the concept into three basic elements. These elements include the questions of why, how and what. First, the element "why" points out the need of green supply chain management practices and its sustainability. This is the direct consequence of rise in global pollution and surge in logistics (city logistics) related issues. Second, the element "how" implies that which management practices are there that can keep the earlier identified problem at bay. This particularly includes the organizational policies, technological advancements in the field of automobile industry and information technology. Integrating these advancements with intracity logistics would give rise to another element. This third element is "what", pointing the upshots of previously discussed elements. Therefore, understanding these three sequel elements would be the key to master the big picture of this study. Figure 1 below describe the above concept in a pictorial view.

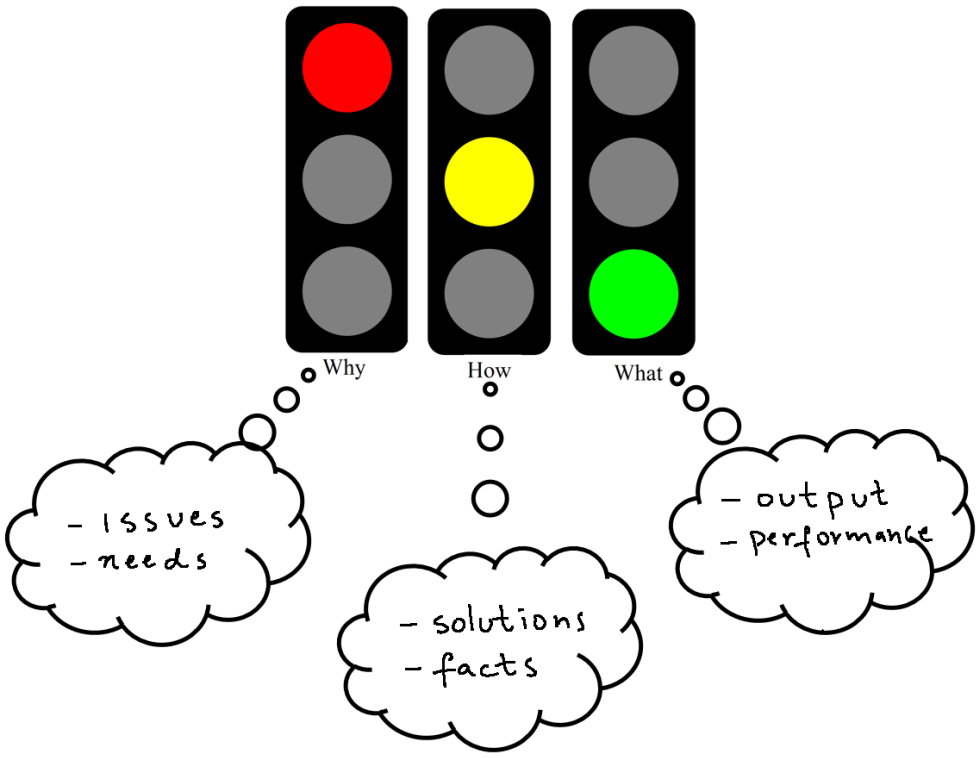

Figure 1. *The elements of why, how and what.*

By every passing day, companies are becoming aware of their surroundings, particularly the surrounding environment. Green supply chain management is a direct result of integrating the environmental issues into conventional supply chain management. Bringing down the environmental pollution by reducing the input energy and resources used is a step towards making the environment greener in addition to enhancing the supply chain by depleting the operational cost. (Mohanty & Deshmukh, 2001) A key factor recognized by the companies for improving the organization's performance is the increased awareness of environmental management (Diabata & Govindan, 2011).

The term "intracity logistics" is also attributed to the term "city logistics". The concept of freight movements within the cities and issues related to it has been the pioneer of the term intracity logistics. There has been a good amount of activity in the field of intracity logistics during early 1970's, concluding that it is not a recent field of study. Intracity logistics is responsible for enormous amount of activities for the inhabitants of a populated area such as delivering mails and goods to end customers, this has been difficult in a densely-populated area (Dablanc, 2007). Moreover, there have been issues in this field for the inhabitants of the city including emission, noise and congestion that ultimately becomes the problem of a company in addition to the efficiency of freight movement and number of empty vehicle-km (Benjelloun & Crainic, 2008).

In recent years, the last mile delivery has gained the popularity in the industry and by taking more than a quarter of the total cost of supply chain, it is considered less efficient. Even in an ideal scenario where the processes in logistics are efficient, in the last mile delivery there would be bottlenecks which must be removed by improving the last leg. The world population has shifted to urban areas with 54.5 percent of total population giving rise to above mentioned issues related to intracity logistics (Demographia, 2016). Therefore, the authorities must consider other paths/solutions to vanquish the issues. Number of measures have been considered in automobile industry including the introduction of hybrid electric vehicle and battery electric vehicle in addition to advancement of information technology. These technologies have built a platform for to companies to consider it as a last mile solution, reducing the noise and emission significantly (Duarte, et al., 2016).

1.2 Objective and questions

Rise in pollution has been a central attention for more than two decades now. Dealing with it has become the priority for many firms. The surge of pollution is affecting the life on earth in every way. A major source of pollution comes from the logistics. This is not the only issue to be addressed. Apart from pollution, safety and nuisance created also play a significant role towards deteriorating the environment and quality of life. One major development of the modern era is the introduction of electric vehicles to eliminate the emission into the atmosphere and advancement in information technology to minimize

the use of resources and time. This results in the rise of the quality of service provided by different organizations.

As pointed out in the preceding chapter that supply chain has a critical role in an organization, studies are being carried out to know how the supply chain management is affected and what are the factors affecting it. This thesis provides a comprehensive study on the factors affecting the intracity logistics and hence green supply chain. Moreover, the need of green supply chain practices has been discussed and issues concerning intracity logistics has been pointed out. This research focuses on developing on a model as a result of issues that have been deteriorating the efficiency of supply chain. Therefore, the model works in a way that it addresses the green practices in a balanced way in terms of environment, safety and quality in an urban area. Having said that, the objective of the research is…

> *…to carry out a study concerning the issues regarding intracity logistics and then designing a model to address the green supply chain practices that can be implemented in a balanced way for intracity logistics.*

To carry out this research and to fulfil the objective of this research, literature on green supply chain management, intracity logistics and technological advancement of the field is reviewed. The framework is built to help the reader to understand these concepts in relevance to each other. Relevant metrics on pollution are included to make the framework stronger.

Based on the objective, the study will address the following research questions:

- What is the need for green supply chain management and logistics in contemporary world?
- What are the alternate solutions for the addressed issue?
- How the use of alternate solutions is providing benefit to the companies and society?

In the next chapter, the structure of thesis is introduced along with the focus of the study. A module based system is introduced where each module is treated separately and the model is highlighted.

1.3 Structure of the thesis

The study is divided into total of six chapters. This study consists of introduction, research methodology, green supply chain management and logistics, green supply chain and the model, performance measurement and conclusions. The structure is presented in the figure 2 below, segregating the input on the left side from the output on the right. This means that in the figure below, the source of input of a chapter is described in the left box and

the output of a chapter is described in the right box. This would help the reader to understand the structure and the relevance of each chapter to each other.

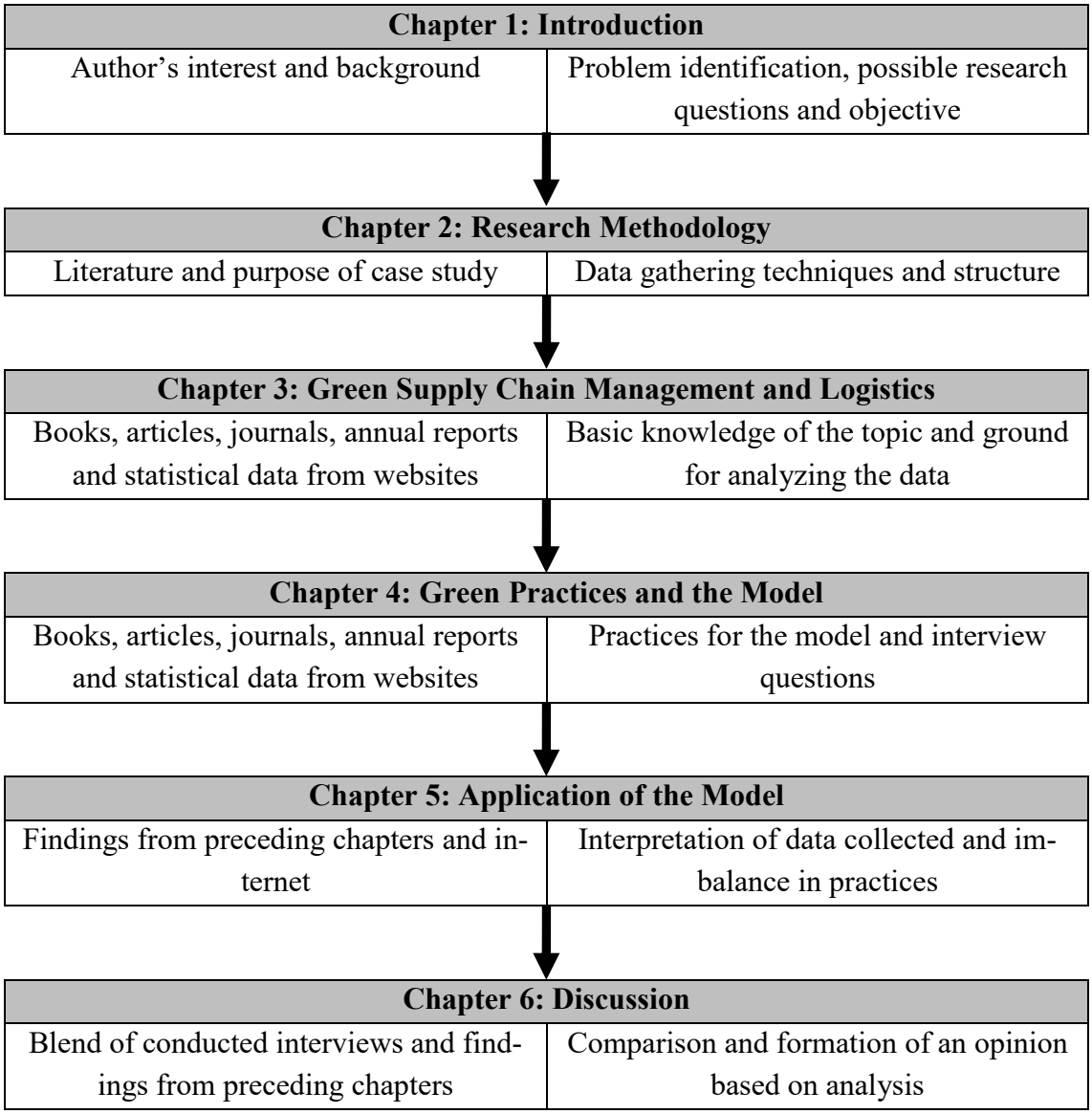

Figure 2. *Research structure.*

In the beginning, research questions are formulated based on personal interest of the author. Research methodology is described in the chapter 2 to make the reader follow the rest of the study easily. Basic rules of carrying out a research is explained in this chapter with different data gathering techniques. Moreover, this chapter makes it clear, why particular data gathering techniques have been chosen for the study.

Chapter 3 and chapter 4 basically concentrate on literature review of the chosen topic. Conventional practices have been summarized and the results are used in the next chapters, where it is discussed in the empirical setup.

Chapter 5 discuss the metrics and data is collected to analyze it. Different metrics are used to analyze the collected data and a point of view is presented based on the data. The data analyzed is of companies operating in Finland locally in addition to companies operating globally. Lastly, chapter 6 discuss the finding of the preceding chapters and present the view as a big picture.

Figure 2 above is one way of describing the structure of the thesis. Another way to understand the study is to break down the study into small modules and understand each module separately. This is done in this study where each concept has been broken down into smaller one and then the framework is built. Within the module, the focus of study is also highlighted where a model has been design.

Taking the example of Module A, where the concept of supply chain management, green supply chain management and intracity logistics has been explained. This module has some output which becomes the input of next module. Module B is the problem identification where issues have been put forward to base the model. Module C combines the model and the workable solutions. When the issues are passed through the model, the result is the solution to those problems. Lastly, Module D focuses on the application of model. By convoluting the existing green practices and policies of a company, it can be concluded that what is the focus of existing policies of the company in terms of environment, safety and quality of life in urban area and hence the model can provide a way to balance out green practices. Figure 3 below provides this type of structure.

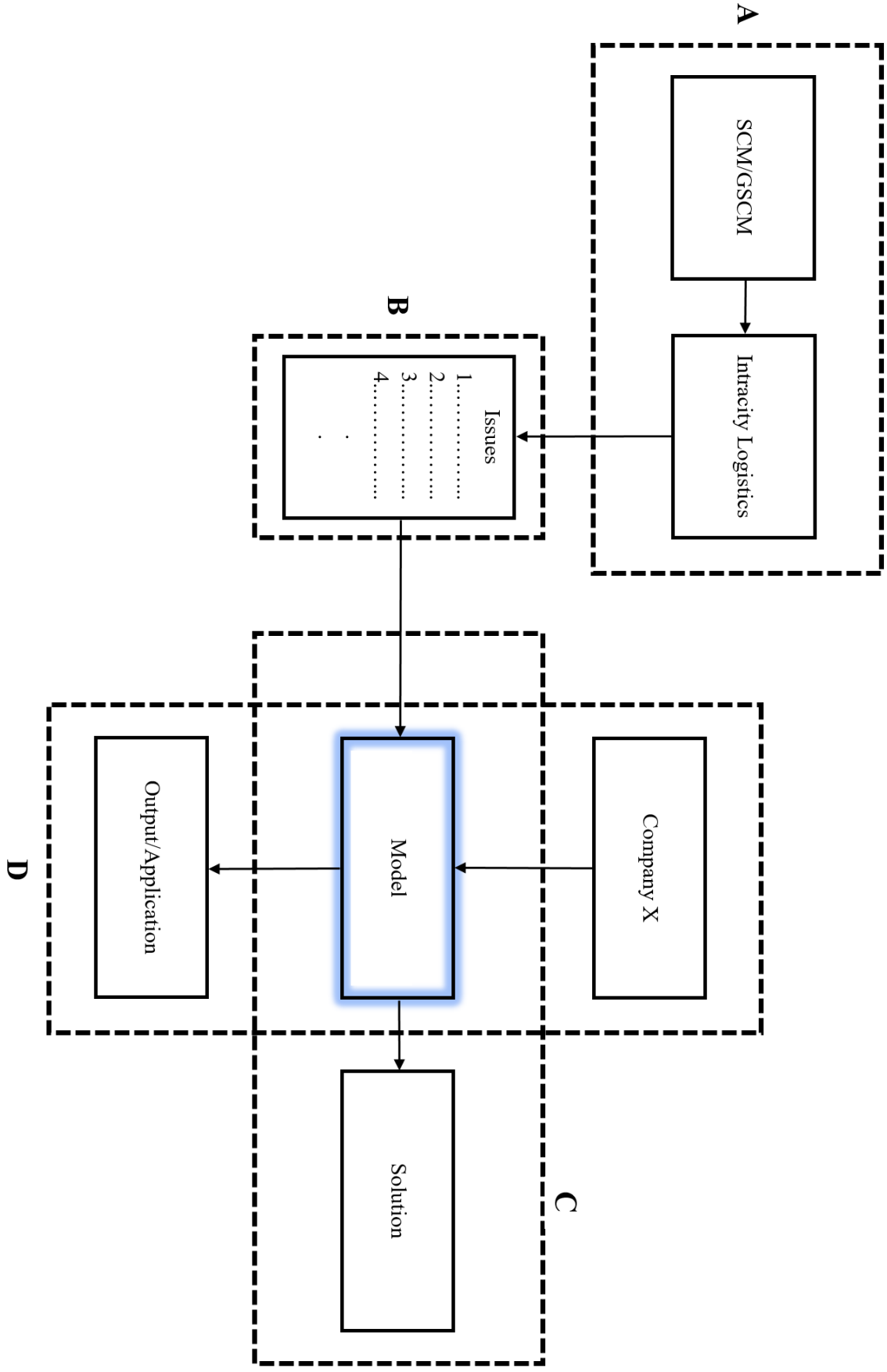

Figure 3. *Structure of the thesis and study modules.*

As mentioned earlier that the focus of the study is Module D and the model specifically. The model has some inputs with some outputs. The input of the model are the issues that has been identified using the literature of green supply chain management and intracity logistics combining with the green practices and policies of a company. Figure 4 below describes this part of structure in a pictorial view.

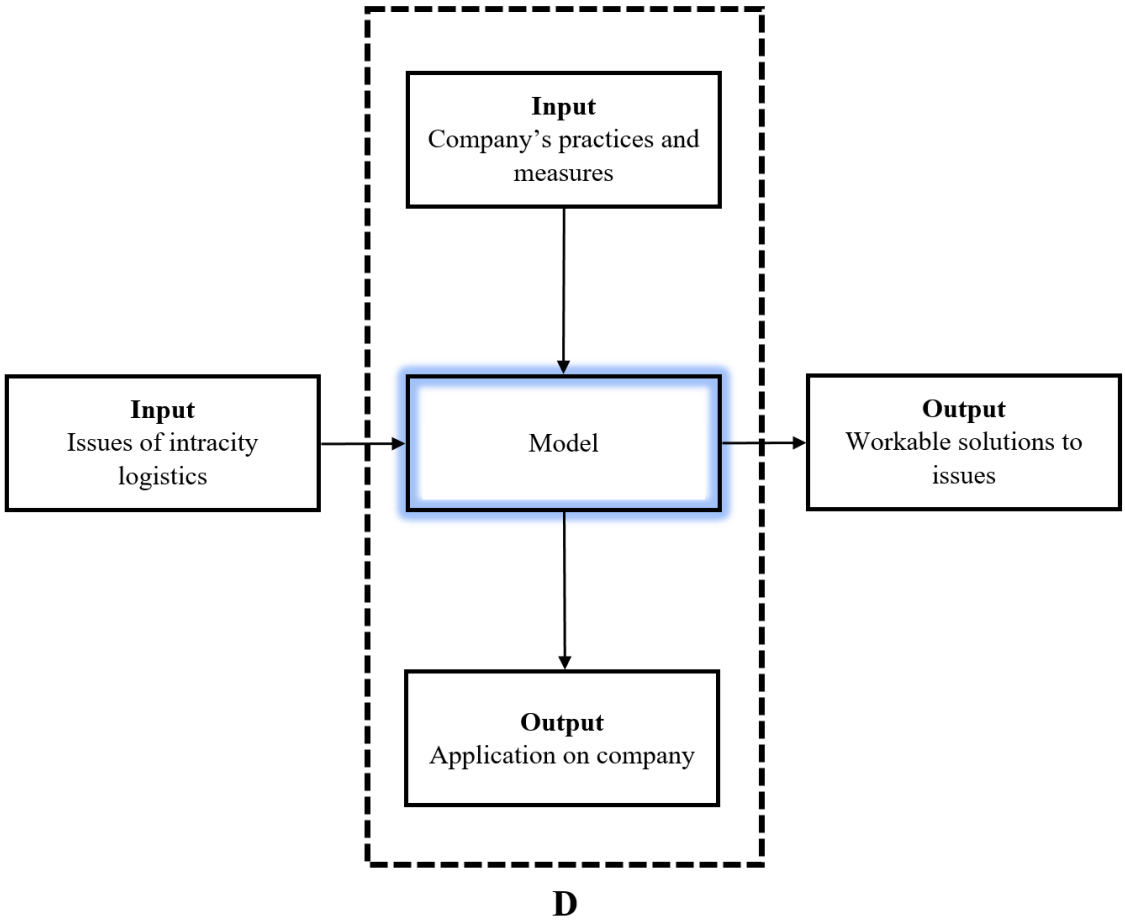

Figure 4. *Module D and the model.*

This input provides a base for the model which becomes the objective of the model in the later part. The output of the model in Module D is the application of the green practices and a direction for the company under study. This means that the output of the model in Module D would be a series of fruitful statements which shall provide the direction a company should take in terms of technology, planning or policy. This would be explored in forthcoming chapters.

2. RESEARCH METHODOLOGY

2.1 Research design

The research process was started in February 2017 when the author took interest in the selected topic. In the beginning, the literature was reviewed thoroughly and the necessary background knowledge was gathered. Throughout the study, the content was reviewed and refined according to the objectives and needs. The strategy taken for the study is in the form of case study.

According to Creswell (2009), a case study is a form of strategy in which a researcher investigates the insights of an event, activity, process or individual. A set of conclusions is developed to answer the research questions formed as a result of topic being investigated. A case study can be defined in diverse ways, table 1 below shows how different author see a case study in a distinct perspective.

Table 1. *Defining a case study.*

Author	Definition
Yin (2013)	The questions of "how" and "why" are asked in a case study about a subject which is not in control of the investigator.
Saunders et al. (2009)	It is an empirical investigation about a matter done by an investigator and it is based on facts and evidence from different sources.

As described by Yin (2013), this study also begins with the questions of "why", "how" and "what". According to Saunders et al. (2009), a research is a cross-sectional study on a specific phenomenon and at a specific time. The timeline reserved for this research is a little over four months, starting from reviewing the literature to presenting the findings. Breaking down the timeline into smaller segments gives an insight of time spent on each phase of the study.

2.2 Data gathering techniques

Choosing the data collection technique wisely and according to the needs of the research being carried out is of paramount importance. The core reason behind these case studies is to understand and explore the complex or hidden phenomenon in a better way

(Gummesson, 1993). Gummesson (1993) lists number of data collection methods described in table 2 below with characteristics that are associated with each type of method.

Table 2. *Data gathering techniques (Gummesson, 1993).*

Method	Description
Existing material	This type of technique is sometime referred to as secondary source. Existing material contains literature in many forms such as books, articles, journals, official websites, social media, databases and annual reports.
Questionnaire survey	The questionnaire survey is a good source of qualitative data gathering. This method focuses on the different types of surveys from the researcher.
Qualitative interview	Qualitative interview is an excellent method to gather data and to get to know different opinions. Although, this method might be time consuming but it is a reliable source of data.
Observation	Data gathered by observation is type of gathering techniques in which subject under study is observed carefully to extract information.
Action science	The action science is a data gathering method that is demanding to be used in relation to a case study. In this type of data gathering, the researcher becomes in change agent that influence the case study.

Similar to many case studies, data gathered in this case study is in the form of existing material, interviews and observation. Mono approach is avoided in this case study to gather data. Through semi-structured interviews and existing material in the form of annual reports, statistical data and official websites the data is analyzed with interpretation.

The first form of data collection in this study is the existing material in the form of books, journals and articles. As Modules A and B are totally based on existing literature, a thorough study has been made and relevant material is gathered in the study and presented. Secondly, the study is supported by some facts and figures as the nature of the study make it necessary to consider statistical data. For this form of data, official websites have been referred such as OECD, UNSTATS and statistics of Finland. Lastly, annual reports of the companies along with the interviews provide the base for the application of the study. The annual reports of the companies give the insight of the current performance and the areas to improve.

Gummesson (1993) has already provided a brief definition of existing material. The other major type of data collection technique in this research is semi-structured interviews. In

this type of interviews there is a theme of topic to be discussed during the interview. This theme is formed by formulating a series of related questions to be asked from interviewee during the interview. These questions are formulated based on current issues, research questions and existing literature. Semi-structured interviews are known to be commonly used for case studies for a specific topic (Saunders, et al., 2007).

3. GREEN SUPPLY CHAIN MANAGEMENT AND LOGISTICS

3.1 Green supply chain management

Green supply chain management is defined as same as supply chain management by just adding the element of green in the definition. There has been a lot of work in recent years in this field. Authors and researchers have been busy tracking the roots for the need of green supply chain management. Srivastava (2007) provides a state of the art literature review on green supply chain management. Srivastava (2007) uses current literature and concepts and bring it down to a single document to provide the findings and focus of work done by different authors in preceding years. Similarly, Porter & Linde (1995) brings the literature regarding rudimentary concepts of green supply chain management.

Similarly, Kumar & Chandrakar (2012) talks about the application of green supply chain management and argues about the waste and emission produced by the companies. Further, Kumar et al. (2012) talks about sustainability in green supply chain management and introduces a simple model to help understand the reader for improvement in supply chain sustainability. Then Bhattacharjee (2015) explains the differences between the conventional supply chain management and green supply chain management in addition to the necessity of green supply chain management in the modern era. Figure 5 below highlights the content of this chapter with respect to the structure of the thesis.

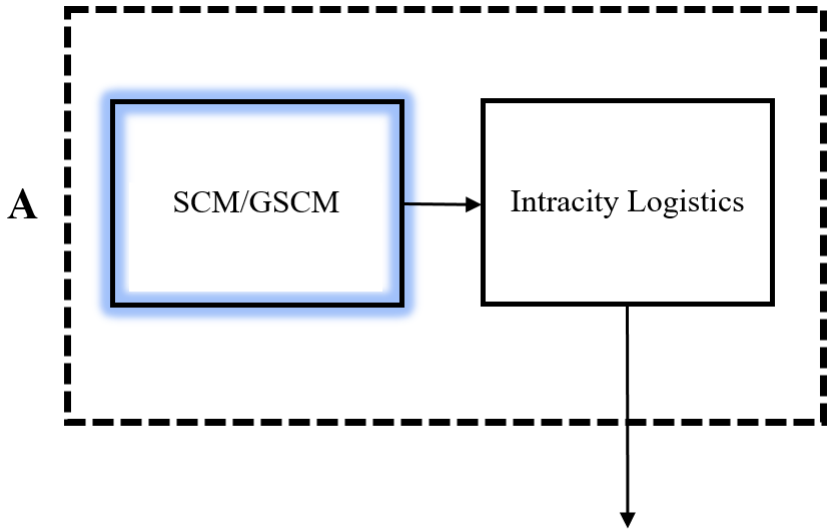

Figure 5. *Content of the chapter seen as a part of thesis.*

This chapter provides the insights of the above-mentioned authors and gather it under one umbrella. For the readability, the chapter will explain the root of the term “green supply chain management” and the background behind it. Further, the importance is highlighted

and it shown that the green supply chain management is a necessity of a company in the contemporary world.

3.1.1 The root and background

As a result of revolution in supply chain in 1990s, there has been a call for concatenating environmental management and operations. The term “green supply chain management” has the same roots and before 1990s, the environmental issues were handled in a different manner. The earliest frameworks and approaches towards environmental management were different from what the world is experiencing today. The environmental issues were secluded to some extend by the managers (Srivastava, 2007). An entirely different approach was taken where a different unit in an organization was responsible for the environmental issues in different departments such as operations, marketing, logistics and product development. Figure 6 below depicts this idea of the earliest approach.

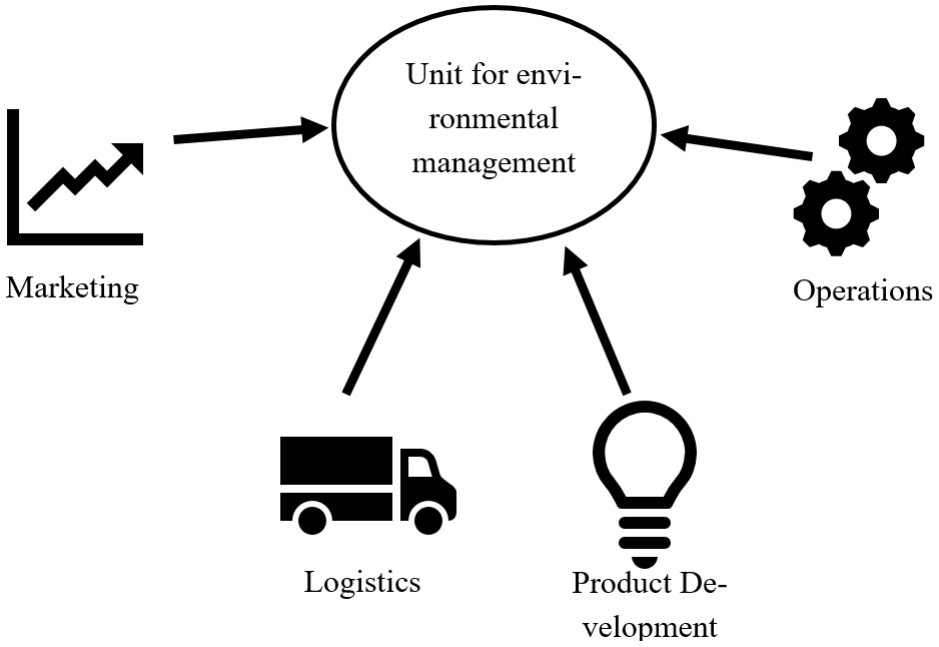

Figure 6. *A unit responsible for environmental management.*

Typically, in literature green supply chain management has been extensively referred to as green purchasing, industrial ecosystem, green designing, remanufacturing, reverse logistics, logistics network design and collaboration between companies in the value chain. For example, by green manufacturing, the aim is to take off the load from environment and use the appropriate material with appropriate quantity. On the other hand, remanufacturing aims to restore a product in its new condition through an industrial process.

Similar to many other research areas, literature emphasizing the fundamental concepts including scope and meaning of different terms comes in the beginning. Porter & Linde (1995) explains the fundamentals of green supply chain management as a competitive

advantage. Three basic elements have been identified by Porter & Linde (1995) in which a company can invest to attain greening. These elements are saving the resources, eliminating the waste and improving the productivity. Furthermore, there are three approaches for a company towards greening which includes: (Kopicki, 1993)

- Reactive approach
- Proactive approach
- Value-seeking

First, by acting on environmental regulations by lowering the input resources, companies mark the reactive approach. The production in a company start to use recycled material to lower the impacts on environment. Second, by proactive approach, companies take the lead and start to implement new environmental laws and take the initiative to recycle and reuse the products. Third, in value-seeking approach companies start to integrate the practices such as green purchasing and ISO into the environmental activities.

To emphasize the relationship between environmental management and supply chain management, the term "green" is added to supply chain management. The borderline of green supply chain management entirely depends on the investigating authority as in the case of supply chain management. (Srivastava, 2007) The department of supply chain management in an organization has many roles, similarly the scope and role of green supply chain management has a broad spectrum as well. This includes the green practices in entire value chain starting from supplier to manufacturer and then to the customer. The focus area of this study has already been defined which includes the logistics (last mile delivery to customers).

3.1.2 Importance and need

One of the serious environmental issues of the world is experiencing the global warming and acid rain in the present century. Kumar & Chandrakar (2012) argues that the main source of these problems is waste and emission that is caused by supply chain management. There has been a call for green practices and policies to take into action. In the 21st century, one of the challenges for logistics management is the concern of supply chain management and making greener. To begin with, the main concern to be addressed is the way of delivering environmental awareness in the logistics activities of the supply chain management (Kumar & Chandrakar, 2012).

Srivastava (2007) argues that green supply chain management has gained popularity amongst the companies and researchers in the field of supply chain management. This is reflected by the implementation of environmental management practices by the companies such as ISO14001. This acts as a subliminal message that the companies have been putting the efforts to minimize the environmental issues. Srivastava (2007) also argues

that the driving force behind the implementation of these practices and increased awareness of green supply chain management is the fact that environment is deteriorating over a period of time. This includes shrinking of resources i.e. raw material and surge in pollution and waste sites. This is described in figure 7 below.

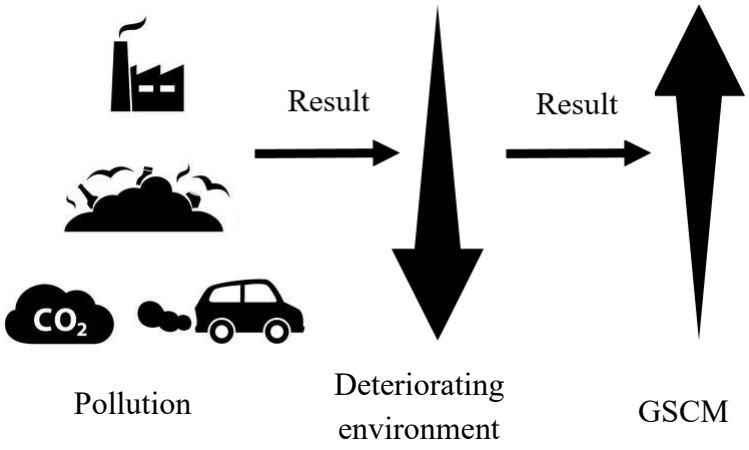

Figure 7. *Driving force behind GSCM.*

The above presented argument is only the one side of the coin. The flip side is the fact that it is not only the matter of being friendly to the environment but to make profits as well. Implementing green supply chain management and integrating the practices into the organization is not a cost center but on the other hand, it is a driver for business value (Wilkerson, 2005). Moreover, the stress from the higher bodies and society is forcing the companies towards green supply chain management.

Kumar et al. (2012) identifies the drivers for implementing the green supply chain management. The drivers are divided into external and internal. The external drivers result from competition between the organizations and stakeholders. For example, many companies collecting data on waste are influenced by the performance of supply chain management. Taking an example of a company that manages to get the media coverage for being the best in keeping the sustainability, this would significantly enhance the customer satisfaction, brand value and sales. Internal driver for implementing the green supply chain management comes from the thinking of top management, leading to reduce the emission, costs and waste. (Kumar, et al., 2012)

The importance of green supply chain management can also be gauged by the fact that the companies of contemporary world have now accepted the need of integrating sustainability into the supply chain management. Sustainability in this context means to carry out the desired needs without compromising the needs of future race. Sustainability in transportation can be attained by several different practices such as smart packaging, full truck load and hybrid/battery powered vehicles. By taking these practices into consideration, carbon footprint can be reduced and hence sustainability in logistics can be attained. (Sanders, 2011)

3.1.3 Conventional and green

One way to see green supply chain management is to understand the need of it and difference it carries from the conventional supply chain management. Organizations have different motivators to go for green supply chain management. One of main motivators is the sustainability. Apart from sustainability, organizations may also have cost reduction and profitability as primary motivator (Bhattacharjee, 2015). To understand the green supply chain management, difference with conventional supply chain management is shown in the following table 3.

Table 3. *Difference between conventional and green supply chain (Bhattacharjee, 2015)*

Characteristic	Conventional supply chain	Green supply chain
Output	Economic	Economic and ecological
Impact on environment	Could be positive or negative	Low negative impact
Supplier	Short-term relationship and focus on cost	Long-term relationship and focus on environment
Speed	High	Low

Another perspective of green supply chain management is that it allows an organization to optimize the material and information flow along the entire value chain. The priority is given to the effects on ecological and social aspects while decision making. Kumar et al. (2012) argues that for the companies to stay in the business, entire think tank should reconsider the process of doing the business. Sustainability also plays role of saving costs, finding new markets and increasing efficiency. Eventually, sustainability helps to gain profits for an organization. Therefore, an organization has to rethink and apply changes to entire value chain (upstream and downstream) of the supply chain.

The companies in the value chain today have been responsible for the environmental and social impacts on their immediate supplier or customer. Sanders (2011) explains that sustainability has been a main issue in the supply chain management and thus has been given high importance by the companies. By taking an example for two companies (Company A and Company B), this phenomenon can be explained. In the value chain, if company B is the supplier of company A and company B is not implementing green supply chain, then the company A becomes culpable for the damage done. Therefore, if a legal action against company B results in shutting down the supply, then company A will eventually disappear from the market if immediate substitute with the same quality is not available. This phenomenon is described in the figure 8 below.

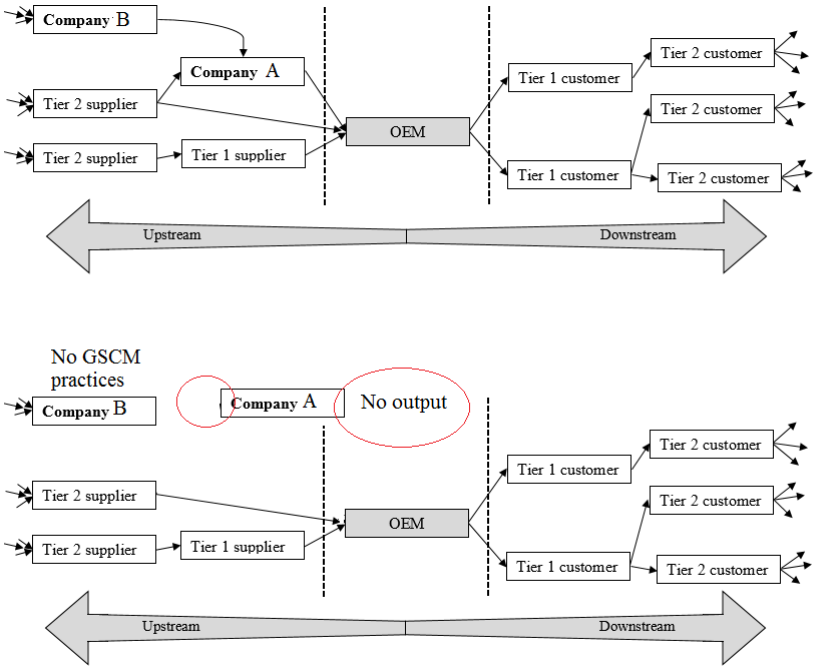

Figure 8. *GSCM as an interconnected phenomenon.*

The above figure is one way of seeing the interconnected phenomenon of value chain. A company can be aware of the need in improving the environment, the full potential of implementing the green supply chain management for an organization is only possible when working with immediate supplier and the suppliers of the supplier. In the same way, the full potential can only be reached when working with the immediate customers and the customers of customer (Kumar, et al., 2012).

Supply chain management is a long chain of interconnected activities with each stage having its own impact on the environment. Not different from conventional supply chain management processes, green supply chain management also must be an organization wide process. For a supply chain to be green, the impacts on the environment should be considered cumulative for all stages of the supply chain (Kumar & Chandrakar, 2012). For example, if a person buy a product or a service that has minimal negative effects on environment but during the manufacturing process it consumes extra energy, then the term “green” in supply chain has no meaning in it. This is described in the figure 9 below.

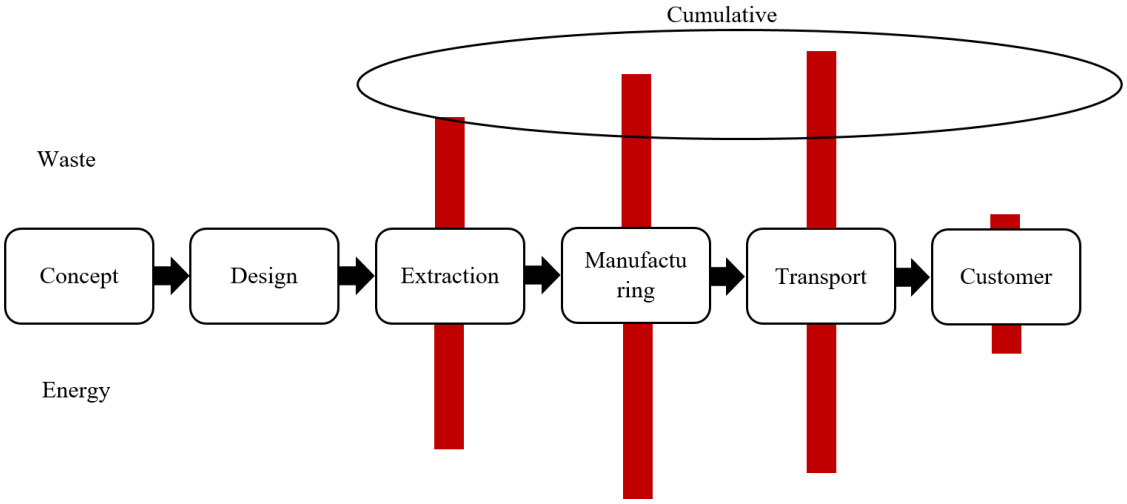

Figure 9. *Cumulative impact on supply chain (Adapted from Kumar & Chandrakar, 2012).*

Even if the companies have an idea about environmental concerns and the opportunities to overcome it in the designing and production phase, the impact on sustainability is low. Therefore, companies can use their purchasing power on suppliers to get them work in the same way to overcome or reduce the environmental issues (Kumar, et al., 2012). As this study is focused on transportation phase of the product life cycle, meaning to overcome the environmental issues by emission. Transportation is one of main source of waste. Therefore, every act that can reduce the harmful effects on environment must be considered. To name few activities, full truckload and using the energy efficient technologies can be a step towards reduction of waste through transportation. Following figure 10 shows the simple equation for transportation phase.

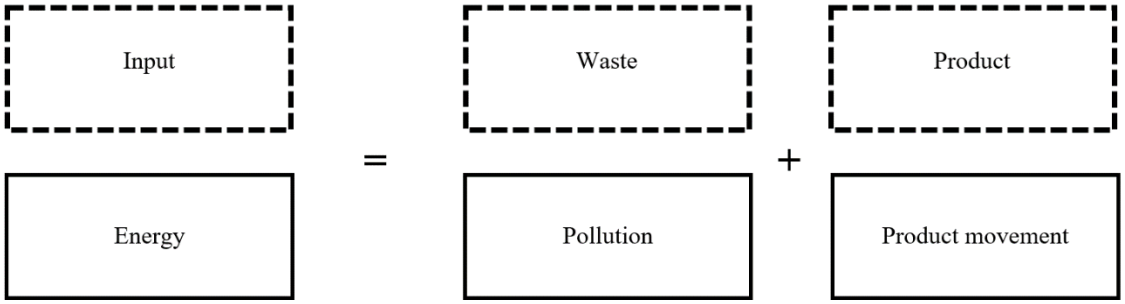

Figure 10. *Transportation and Shipping.*

Above figure is a depiction of simple phenomenon where input must be equal to output. In the intention of making a product, there must be energy in the input. However, a by-product in the process is waste. In this specific case, the waste is pollution and the product in movement of goods.

3.2 Intracity logistics

While previous chapter provided the base for green supply chain management, this chapter would be primarily about intracity logistics. Similar to green supply chain management, this subset of supply chain management has been talked about by many researchers and authors in recent years. Describing the works in intracity logistics, the foremost to be mentioned is Taniguchi & Van Der Heijden (2000) and Crainic et al. (2009).

Taniguchi & Van Der Heijden (2000) has a focus on the initiatives to overcome the issues in intracity logistics. The study by Taniguchi & Van Der Heijden (2000) provides with application of road network and rerouting. It is suggested that the initiatives taken are helpful towards the reduction of cost CO_2 emission. On the other hand, Crainic et al. (2009) provides the history and need of intracity logistics. The problem has been understood and in terms of modeling and planning.

Other works to be mentioned here are the works from Browne et al. (2007) and Anand et al., (2015). Browne et al. (2007) provides the literature on urban freight transport and several issues and opportunities has been identified. The author of this thesis has based the study on the model provided be Anand et al., (2015). However, the approach has been a little different. The base is the same, which is to design a model to overcome the issues with respect to an organization. Figure 11 below describe the part of thesis in the chapter.

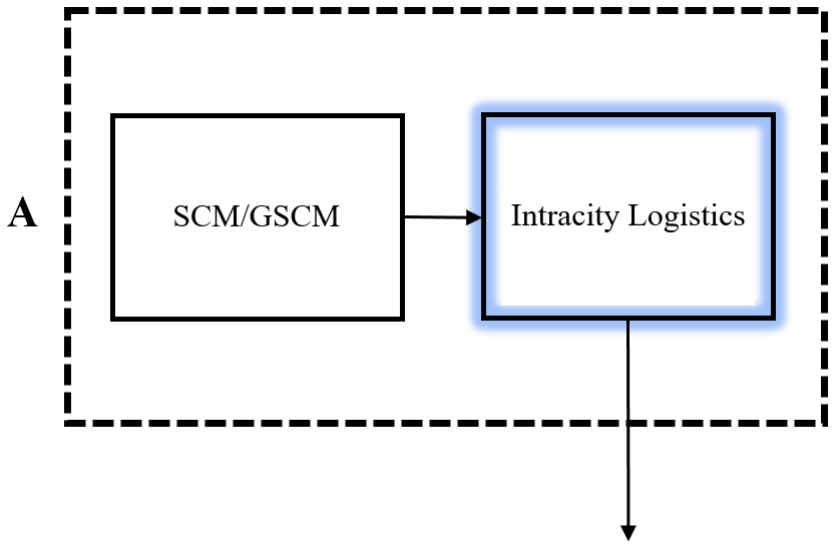

Figure 11. *Content of the chapter seen as a part of thesis.*

This chapter provides the works from above mentioned authors. Moreover, the importance, impacts and some initiatives have been discussed in the chapter.

3.2.1 The root and background

Intracity logistics is a concept started in 1970s when the issues with traffic within a city started to be discussed as a separate matter. These issues resulted in actions such as forbidding the heavy vehicles in a city and restricting the freight transportation. Intracity logistics has been mainstream since 1990s and this mark the era when the organizations started to have surveys and case studies on traffic within a city. The boost of study in this area resulted in collecting data and researches. The main target at the time was European Union. (Browne, et al., 2007)

Logistics in today's world has gained extremely crucial importance. When one thinks of logistics, the evolution of supply chain comes to the mind. In its simplest form, logistics can be defined as a process of moving goods from one place to another. The delivery of a product or a service to the customer must be made at the right time. The importance can be gauged by an example where a product or a service is pricey and is of excellent quality but if the delivery of that product or service is not made timely to the customer, it makes no sense. If the logistics department of an organization is not working appropriately and is insufficient, all efforts made by sales and marketing will fade away. Nevertheless, business in today's world is about the making the correct decisions at the correct time.

Within a city, freight transportation plays critical role in the activities happening such as movement of goods to several different locations without which life in an urban area would be meaningless. These important locations make up an urban area and includes restaurants, shops, manufacturing facilities, retailers, hospitals, schools, public places and domestic deliveries. Meyburg & Stopher (1974) identifies four different types of movement in an urban area including:

- Movement of goods into an urban area where the goods are consumed.
- Movement of goods out of an urban area where the goods are produced.
- Intracity movement of goods where pickup and delivery of goods take place within an urban area.
- Momentarily transit of goods in an urban area where goods are stored for some time before it is moved to another place.

The above-mentioned types of movement of goods depends on the urban area. The size, population density, traffic density and number of ports in an urban area decides how frequent is the movement taking place. Moreover, these movement take place by road because of short distance between the pickup and destination of the goods.

In an urban area, movement of goods take place frequently for social activities and economic activities. To name few activities taking place in an urban area, the examples from routine activities can be taken. For example, social activities include movement of people from one place to another, delivery of products and services to homes and any kind of

transportation which involves movement of public or products related to inhabitants of a city. In a more professional and economical point of view, firms located within the cities use intracity logistics for the purpose of business. This mark a relationship between the organizations. For example, the movement of mail and packages from one point to another or movement of fast moving consumer goods to retailers. (Crainic, et al., 2009)

The last mile delivery concept is catching up in modern era. The term indicates the transportation of goods or service to the customers in a confined populated area. When a shipment arrives at a sea port, the delivery must be made to the end customer of that product. According to some stats, this last leg of the delivery consumes almost quarter of the total cost. Therefore, even if an organization's all processes are efficient, last mile delivery will have some bottlenecks in it which must be removed in order to improve the efficiency.

3.2.2 Impacts of freight transportation

A significant portion of air pollution comes from road freight transportation rather than normal operating vehicles such as personal cars in an urban area. This difference is merely the reason of higher fuel consumption of freight transport vehicles. According to a study carried out by Volvo, freight transportation vehicle using internal combustion engines cause more pollution than long distant vehicle such as personal cars. The study calculates the number of stops that a freight vehicle makes in an urban area. The results show that more number of stops make vehicle less environmental friendly and cause immense amount of CO_2 emission. Following figure 12 show the results of the study.

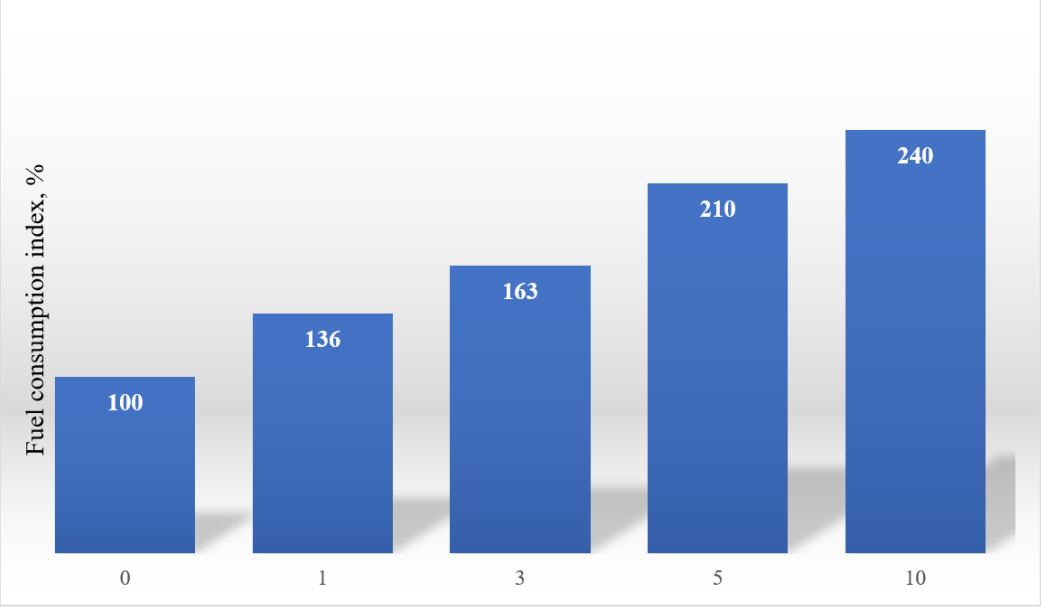

Figure 12. *Impact of number of stops (Mårtensson, 2015).*

Current transportation system creates several problems in an urban area affecting the economic, social and environmental impacts. These impacts or problem can be summarized in the table 4 below.

Table 4. *Impacts of transportation in an urban area.*

Impact	Description
Economic	Inefficiency Congestion Resource waste
Environmental	Air pollution Depletion of natural resources Danger to wild life
Social	Health Safety Noise Essence of making a journey

Urban population and life is mostly effected by the rising environmental issues. Attracted by most population, urban areas are in a danger by increasing level of traffic density. Environmental sustainability is defined by OECD as transportation that does not cause any danger to public health and ecosystem.

As described earlier that the freight transport vehicle is causing more pollution than any other type of vehicle mainly because of its low energy efficiency. With the increasing number of these types of vehicles in urban areas the impact on environment is extremely negative as they directly contribute towards air pollution and noise pollution. According to OECD stats in urban population, Finland has 52.2% of population living in metropolitan areas as compared to OECD's total of 21.9% as of 2014 (OECD, 2017d). This indicates that a relatively substantial number of population in Finland resides in urban areas. Moreover, according to a report by European Automobile Manufacturers Association (ACEA) total number of commercial vehicles have increased since February 2016 with growth of 2.7%. (ACEA, 2017)

Vehicle used for road transport emits several types of dangerous gases including carbon dioxide (CO_2), carbon monoxide (CO), nitrous oxides (NO_x) and hydrocarbons (HC). These pollutants significantly contribute towards global warming and acid rain. Moreover, these gases also have a negative effect on human health such as causing respiratory problems, heart problems and nervous system problems. (Plowden & Buchan, 1995) These gases emitted by the vehicles vary from one type of vehicle to another depending on type of carrier; heavy or light, type of engine, age of engine, road condition, load on the vehicle and distance travelled.

Noise pollution is another issue to discuss in the context of environment as well as society. Big trucks that carry goods are the main source of noise pollution in an urban area. In addition to noise pollution, freight vehicle cause nuisance to the residents of an urban area. This leads to the operations of freight vehicles under some restrictions such as operating in certain period of time and being prohibited in other to minimize the problems faced by residents.

One social aspect to discuss here is the safety of residents of an urban area. With increased number of urbanization and increased number freight vehicle, an individual is in more danger of being involved in a road accident than ever before. Apart from that, there are certain drawbacks that result in case of an accident such as accident cost, slow traffic and cleanup cost. Moreover, traffic congestion is also an issue which is a problem in urban areas. With the increased number freight vehicles, the road capacity should also be increased to accommodate the traffic. With the increase of this issue, the accessibility of a city is also disturbed. Due to certain factors such as loading/unloading, parking places and traffic jams, cities have become less assessable.

3.2.3 Initiatives to reduce the negative effects

Within a city, transportation for social purposes compete with freight transport and significantly contributes towards disturbances within a city, let it be congestion or environmental pollution (Crainic, et al., 2009). These issues are not going to fade away easily and cannot be resolved overnight. The intracity transportation is growing and is expected grow even faster in near future. One of the main reason for this fast growth is the worldwide urbanization, meaning population density within a city has increased and is expected to be 85% by 2020 (Demographia, 2016). Figure 13 below shows the population growth from total of 36 OECD countries from 1990 to 2014.

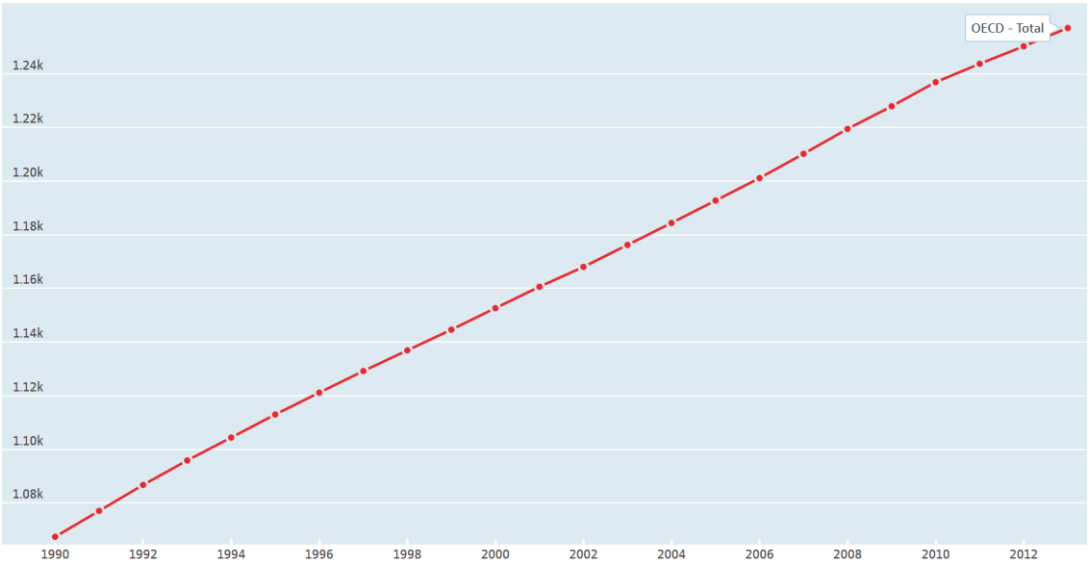

Figure 13. *Population growth of 36 OECD countries (OECD, 2017a).*

To better understand and control the intracity logistics, much work has been done and projects have been initiated. Generally, the goals set by organizations are of essence and includes: (Crainic, et al., 2009)

- Emission reduction
- Pollution reduction
- Congestion reduction

The above goals have been set while keeping the quality of social and economic activities same. Organizations can take several models with some priorities such as rerouting, reducing the dimensions of vehicle, full truck load and most importantly introducing the environmental friendly vehicle such as hybrid. Russo & Comi (2010) argues that in addition to congestion and air pollution, intracity logistics contributes towards many other issues as well including noise pollution, increased transportation cost and hence high products and services prices. Therefore, a careful and intelligent system or a model must be designed which incorporates above mentioned issues and bring them to minimal level. This would be a way to bring the quality of life to higher level in an urban area.

Once again sustainability plays its part and world-wide target has been developed to achieve the goals for healthy life style and quality. Moreover, for safety and efficiency, economic and social sustainability pops up. The environmental sustainability takes care of pollution. Russo & Comi (2010) also segregates two types of freight movement within a city. In a similar way described earlier in the chapter, two types of movement have been named “end-consumer” and “logistics”. The former contributes towards the transportation made by end customer, moving from the point of purchase to homes. The later mark the movement of goods from facilities to markets or retailers.

To overcome the issues, several models and initiatives have been taken which can be a solution to intracity logistics issues. One such model has been proposed by Taniguchi & Van Der Heijden (2000) and is summarized in the table 5 below.

Table 5. *Initiatives for intracity logistics (Taniguchi & Van Der Heijden, 2000).*

Initiative	Description
Information system (historical data)	Information system has been playing important part in every operation in logistics. One such use of information system is the use of historical data by storing the pickup/delivery operations within a city. Taniguchi & Van Der Heijden (2000) describes that according to a study carried out in Japan, historical data improved the organization’s performance by reducing the number of trucks used for

	pickup/delivery an increased load factor. This historical data can be used to change the routes and efficient scheduling.
Cooperative intracity transport	According to this initiative, a neutral vehicle is chosen by different organizations for their logistics operations. This allows an organization to reduce the number of transport vehicles. For example, more than two organization can arrange a common vehicle which can pickup/deliver the goods of these organizations within a city, reducing the travel time and eventually reducing the total cost on transportation.
Load factors	A relatively new initiative which is used to control the loading transport vehicle within a city. A special certificate is issued to different vehicle which can be used for the purposes of transportation within a city. For example, in city center of a city, the only vehicles allowed are with the certificates. This initiative ca accomplishes several goals including the reduction of emission and congestion with a city. The vehicles are to be inspected by an authority certain limitations are imposed such as high load factor, age of vehicle and emission by the vehicle.
Underground transport system	The underground transport system aims for the urban freight transport problems. This system allows the movement of goods between different checkpoints through underground. A study on this project states that if built, this system can be used to reduce the CO_2 emission as well as energy consumption by the transport vehicles. This would account to overall reduction in pollution within a city caused by the movement of goods. Another idea is to use electricity to power these transportation systems which would eradicate the pollution, congestion and noise with a city.

The model described in this study could be taken as having same structure as model described by Taniguchi & Van Der Heijden (2000). A difference comes in the approach where in this study it is designed by pointing out the aims first. After narrowing the aims,

some workable solutions/measure are introduced for fulfilment of each aim. In a specific way, it is done in an organized manner where each measure is associated with some issue. This is described in the coming chapters in details.

3.3 Challenges in green supply chain and intracity logistics

In the previous chapters, literature regarding green supply chain management and intracity logistics was reviewed. The root, importance, relevance to the study and some issues were put forward to build a framework. There is sufficient literature on green supply chain management and intracity logistics and the challenges it imposes on the implementation. This has been mainstream and a hot topic for almost four decades. This chapters specifically focus on the challenges and limitations of the on the implementation. Because of relevance of the study, not all problems will be discussed. However, the issues pertaining the subject matter of the study is streamed down and discussed as an issue. This chapter is focused on Module B of the thesis as shown in the figure 14 below.

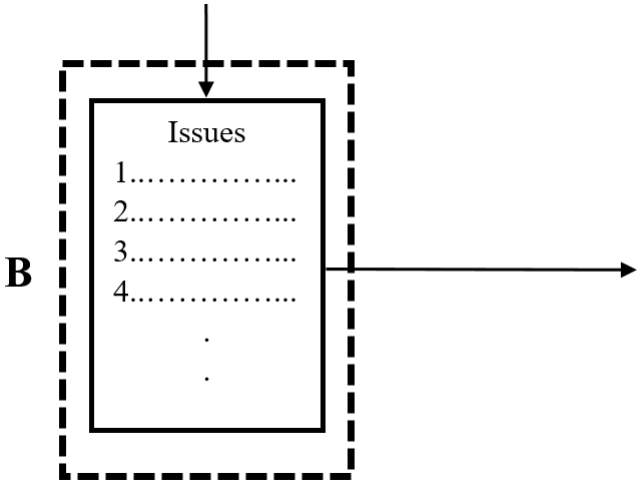

Figure 14. *Module B of the thesis.*

Today, the business environment is changing rapidly with increased globalization and internationalization. The competition between the companies has increased and to be successful, organizations must use the resources available in a best possible way in order to stay competitive. This growth in competition between the organizations has increased the intake of material and energy which directly contributes towards rising environmental issues. Apart from the issues regarding pollution, depletion of resources is a major concern to be addressed. This results in a scenario where organizations must put efforts to make a balance between economic and ecological point of view. (Bhattacharjee, 2015)

It is becoming inevitable that today the real competition is between the supply chains of the organizations rather than organizations. Therefore, organizations that have efficient supply chains will be the one gaining a competitive advantage in the market. Moreover,

to remain on top of it, organizations go through changes along with the changing environment and look constantly for any improvement.

Bhattacharjee (2015) argues that it is not only the organizations that contributes towards pollutions and depletion. It is a two traffic where the society is equally responsible for the damage. When protection of environment is discussed as an issue, everyone come under the bracket of culprit and must response to have some positive impact on the issue. According to Bhattacharjee (2015), in a study carried out by Environmental Protection Act 1994 (EPA), end customers put forward the reason of why their actions are considered damaging to the environment. This includes:

- Unavailability of the alternatives.
- Cheap products.
- Inconvenient to go for greener products.
- Laziness towards protecting the environment.
- Unable to understand the real issue.

Additionally, the implementation of green supply chain management has been different from different organizations. Depending on the type of business, the main focus is developed. For some organization, the focus is on the suppliers without putting any effort in organization's own process and this mark a reactive approach.

Another issue to be addressed here is the question of uncertainty. Implementation of green supply chain management in most cases of not all brings improvement to environment. However, the concern for the top managers is the uncertainty of the improvement in economic performance. Decision making in such cases does not happen overnight and it involves a lot of thinking and efforts by the organization.

With the main focus on the supplier side, an organization has to look into the manufacturing process of the supplier. Not all suppliers would be willing to open the manufacturing process and secrets which can become a major issue between the organizations. One reason for this would be the transparency towards the manufacturing process and hence towards pricing of the product or service.

There would be some costs initially for an organization to kick start the green practices and integrate then in the organization. Wilkerson (2005) argues that green supply chain management is not a cost center but a driver for the business value. However, initially there would be some costs for integrating the green practices and the profits might be low at the beginning as the customer would not be willing to pay a higher price (Bhattacharjee, 2015).

Perhaps the most difficult challenge to overcome is the thinking process of people. There must exist enough motivation for people to make them create a difference in a positive way towards environmental protection.

To discuss the issues related to intracity logistics, one must understand the standing of logistics in supply chain management. Logistics can be thought of as a part of supply chain management. Supply chain management is the integration of activities from a point of demand to a point of consumption. This includes huge amount activities and transporting goods and services is one of them. Figure 15 below shows logistics as a subset of supply chain management.

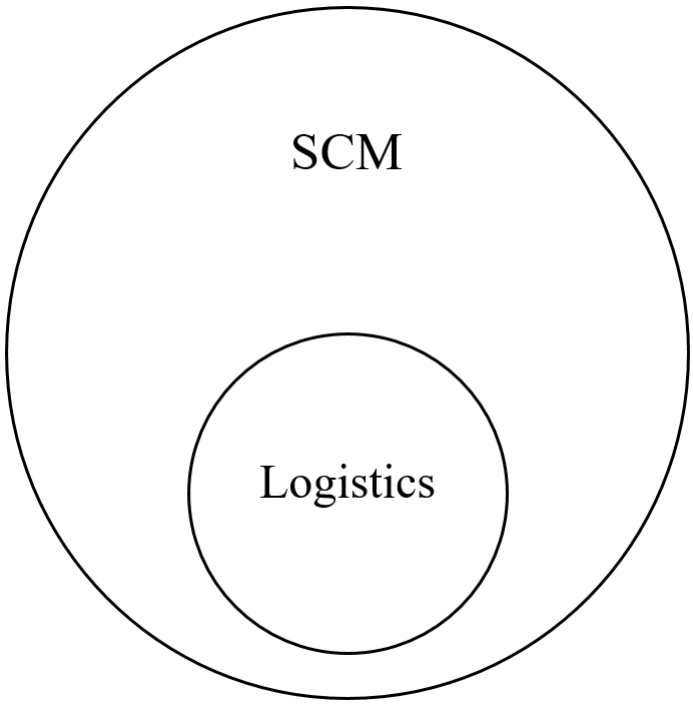

Figure 15. *Logistics as a subset of supply chain management.*

After going through the literature, some issues that are particularly related to green supply chain management can be listed down. The issues presented here covers whole green supply chain regardless of the focus of the study. These issues act as a base to design a model for the implementation of green practices. Table 6 below provides the description of each issue. Table 6 below also summarizes how these issues serve as a base to build a greener environment.

Table 6. *Issues in green supply chain management and intracity logistics.*

Issue	Description
Emission	When one thinks of emission in supply chain management, gasses such as carbon dioxide (CO_2), carbon monoxide (CO) and nitrous oxides (NO_x) are of essence. It has been discussed earlier that freight vehicles emits more pollutant gasses than a normal personal car. Emission of these types of dangerous gasses is one of the

	problem that has become mainstream of this study. these emissions significantly contribute in a negative way to environment in the form of global warming and health issues, making life in an urban area difficult. It is inevitable that there is a need of a proper solution of rising emissions, however other initiatives such as restrictions on the use of vehicle and rerouting can be other solutions. (Browne, et al., 2007)
Noise pollution	Similar to the problem of emission, noise pollution causes immense nuisance to the residents of an urban area. This type of pollution is mainly caused by heavy vehicle that are used as freight transporter. There are many factors that influence the extend of noise pollution. For example, a vehicle used by an organization to move goods to end consumer may be affect the noise pollution in many ways such as speed, traffic density, vehicle type and time window for the delivery. Another example would be the loading and unloading of goods at shops. While this directly influence the path and the surrounding of the shop causing trouble for the people. (Browne, et al., 2007) This is one the issue that has been based to develop he model.
Congestion	One severe problem that companies have been tackling is the congestion. Congestion in simple words mean that the number of vehicle are increasing with the limitation of road capacity. With the increase in the number of vehicles in an urban area, there is a need to increase the road capacity as well. Failing to do so, would result in collapse of traffic system. This eventually leads towards poor organizational performance in terms of delivery, increased cost of delivery, unreliability of the service, increase in fuel consumption and increased pollution. Other issues pertaining the increase of congestion would be the safety of the residents at stake in addition to parking. This can become as the base for the road accidents, traffic jams and breaching the traffic rules. (Browne, et al., 2007)

Economy	A balance is desired when economy is talked about in this subject matter. Companies cannot put the focus only on environment as there would be no point left in the existence of the organizations. With the increase of population density in an urban area, there is an increase in need of goods and services provided by the organizations. This result in increased need of intracity logistics for which organizations must invest massive amounts. There have been different models proposed to overcome the issue. This issue is talked here keeping in view of the organization's economy. (Savelsbergh & Van Woensel, 2016)
Safety	A rather unattended issue but important in every way, safety of the inhabitants of an urban area is of essence. Organizations must consider it as a separate issue to address. According to OECD stats, there has been an increase in road accidents for which one of the reason is the increased traffic density in urban areas.

The above issues make up the base for the model. Each issue has its own importance and the negative effect can be minimized by taking some actions. These actions are comprised of measures and practices depending on the issue. However, it must be noted that not every measure can be applied to every organization as their supply chain may differ substantially.

4. GREEN PRACTICES AND THE MODEL

4.1 The initiatives for the issues

Based on preceding chapters where the issues have been identified using the literature, this chapter provides the initiatives that could be taken. This chapter is comprised of Module C of the thesis where the solutions have been presented. Green practices correspond to each solution presented which would complete the model for its application on an organization. Figure 16 below shows how the model fits into the thesis.

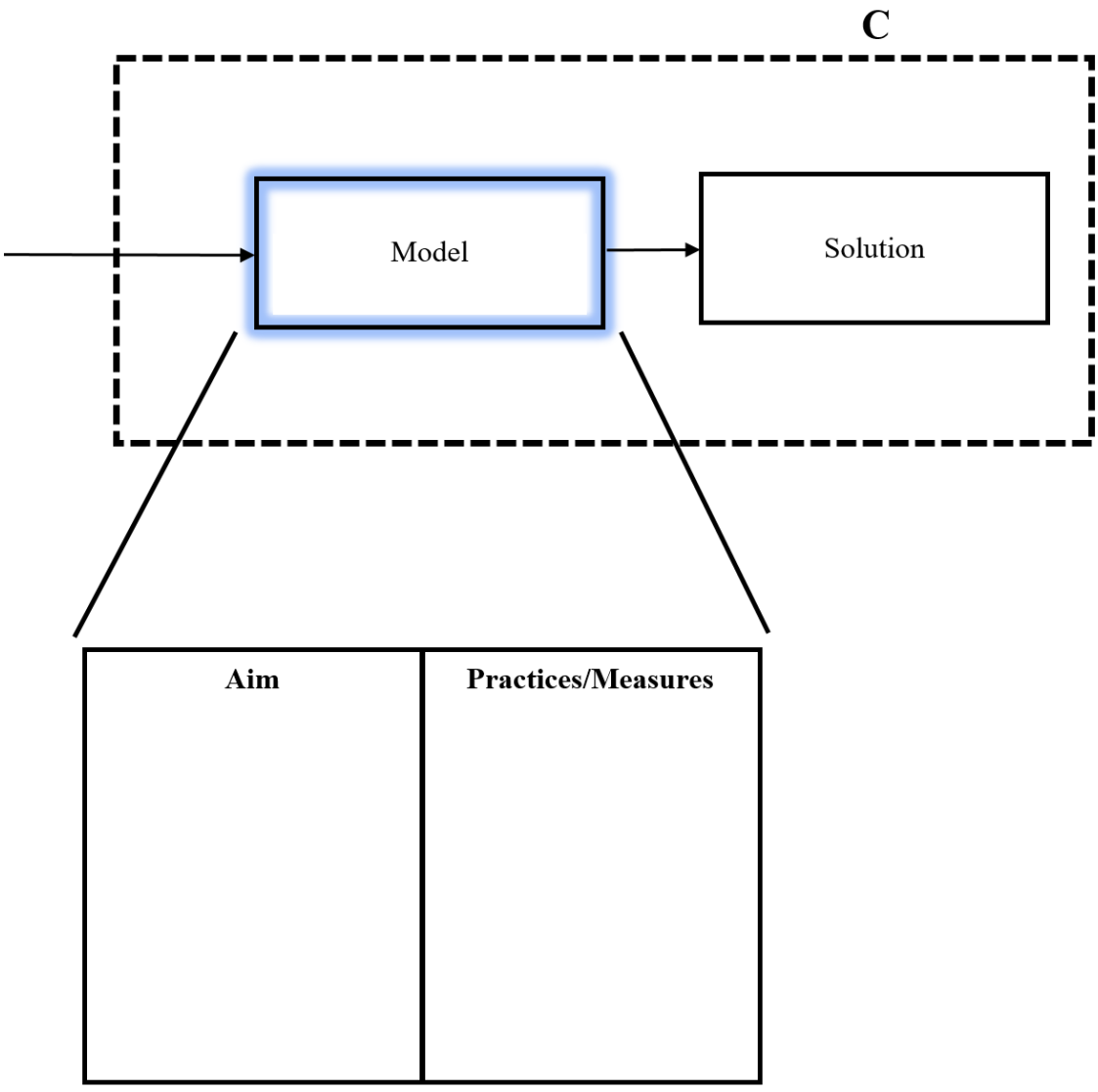

Figure 16. *Module C of the thesis.*

The above figure depicts that each green practice would introduce an initiative or a solution representing each issue that has been identified. However, to get into the details of the model, the reader must understand that how it works. In the table 7 below, an example

has been created to represent the working of the model. In this table, works from different authors has been shortlisted. Each issue has its significance and different authors signifies different issues. A check has been made for each issue that has been put into attention by different authors. This would result in identifying that whether the author has provided the solution that is more technology driven or policy/planning driven.

Table 7. *Example of the application of the model.*

		Author		
Issue	Emission	X P	X T	X T
	Noise pollution	X T		X T
	Congestion	X P	X T	X T
	Economy	X P		X P
	Safety	X P		X T, P
Solution	Technology driven **(T)**		X	X
	Policy/planning driven **(P)**	X		

The above table helps to understand the model. For example, the first author (Anand et al. (2015)) emphasizes issues of emission, noise pollution, congestion, economy and safety. The initiatives suggested by the author are more policy/planning driven rather than technology driven. However, the author does introduce the green practices, let it be technology driven or policy/planning driven. Taking this as an analogy, this suggest that the output must contain some technology driven practices in order to improve the efficiency.

Concentrating on policies alone might not be as fruitful as introducing the new technology to minimize the issues.

4.1.1 Emission

The first issue that has been highlighted is the emission of dangerous gasses in logistics. The meaning of emission and the main source of it has already been defined earlier. To ensure the sustainability, there must be measures to minimize the negative impacts of increased freight transportation. This would keep the beauty and attraction of urban areas intact. Savelsbergh & Van Woensel (2016) argues that in Europe, the most problematic issue is the transport sector with increasing trends. There is a constant need for improvement in air quality. Road transport has been responsible for the biggest amount of emission of CO_2 (73% in 2000) (Demir, et al., 2011).

The emission has numerous factors to depend on. Each factor contributes towards air pollution in its own unique way. All the factors when added up, intensify the issue that might be beyond control. These factors have been studied thoroughly by the authors and researchers. By combining the works of different authors such as Anand et al. (2015), Anand (2015), Savelsbergh & Van Woensel (2016) and Browne et al. (2007), factors can be listed down. These factors are listed below.

- Vehicle size
- Vehicle weight
- Internal combustion engines/conventional engines
- Route planning

Vehicle size and weight directly affect the emission of gasses into the air. The heavier the vehicle is, more amount of gasses it will produce. On the other hand, the size of the packages and goods transported also have an impact on emission. This can be understood by a simple phenomenon where the larger size of package would result in occupying larger spaces. As a result, volume/mass ratio would be increased and eventually company would have to use more number of vehicle to accommodate the services and goods. Browne et al. (2007) argue with the same reasoning and puts forward some stats that correspond to the type of vehicle contributing in polluting the air. The stats shown here comprised of study done in London alone. However, this can be taken as an analogy to understand the effect of vehicle size and weight. Table 8 below shows the results.

Table 8. *Emission for road vehicle depending on the type of vehicle (Browne, et al., 2007).*

	CO	**HC**	**NO_x**	**CO_2**
Petrol car	5	1	4	89
Diesel car	1	3	33	82

Petrol light goods vehicle	4	1	7	136
Diesel light goods vehicle	3	7	45	131
Rigid goods vehicle	8	23	261	361
Articulated goods vehicle	22	61	560	483
Bus	15	35	416	433

As shown in the table above that as the size and weight of the vehicle increases, the emission of CO_2 also increases. The difference is noticeable and can be brought down with the introduction of green practices such as reducing the size of vehicle, weight of vehicle and using full truck load (FTL) instead of less than load (LTL).

The internal combustion engines or conventional engines have long been talked about. There have been attempts to bring the emission of gasses down. Perhaps the most intrigued solution for this problem is the introduction of modern technology. The introduction of battery electric vehicles (BEVs) and hybrid engines could provide a viable solution to the listed issue. The decarbonization of intracity logistics could be achieved if the battery electric vehicle uses renewable energy source (Browne, et al., 2011). The consequence of using battery electric vehicles would be the elimination of emission of gasses and better air quality (Soret, et al., 2014). However, the sale of battery electric vehicles has been limited and is mostly attracted by personal and passenger cars. There is a need of extending this innovation to urban intracity logistics.

Lebeau et al. (2016) argues different benefits of using battery electric vehicle instead of conventional. First, the drivers have been reluctant to switch towards battery electric vehicle, however, after having a test with battery electric vehicles, there has been a change representing better comfort with driving. The key point regarding the performance of a battery electric vehicle for an organization is its environmental effects. In addition to the reduction in CO_2, these vehicles can be used as a marketing tool by introducing the environmental rewards.

The choice of battery electric vehicle is a difficult choice to make organizations. There are certain factors that must not be ignored while choosing these vehicle for urban freight transport. These factors include:

- Environmental performance
- Purchase cost
- Operating cost
- Range
- Charging time
- Capacity

These factors would decide for a company what whether it is worth to have battery electric vehicle for urban freight transport or otherwise. According to OECDb (2017) stats shown below in figure 17, the CO_2 emission has been on the rise for last one decade.

Figure 17. *CO_2 emission for the one decade (OECD, 2017b).*

The drop in the above figure in year 2009 could be because of several reasons. One probable reason of the drop is the economic crisis in many countries in year 2009. An analysis done by the international team of scientist also suggest that an overall drop in GDP can make the CO_2 emission fall than the previous year. (Jha, 2010)

Another factor that affects the emission rate of the urban freight transportation is the poor routing of the vehicles. The distance travel from the pickup point to the delivery point should be minimized in order to minimize the emission of gasses. This can be done with proper routing and planning. It has already been shown in the preceding chapters that how the number of stops affect the fuel consumption and hence the emission. To summarize the argument presented in this section, figure 18 below introduces some practices pertaining emission. These practices could be technology driven or policy/planning driven.

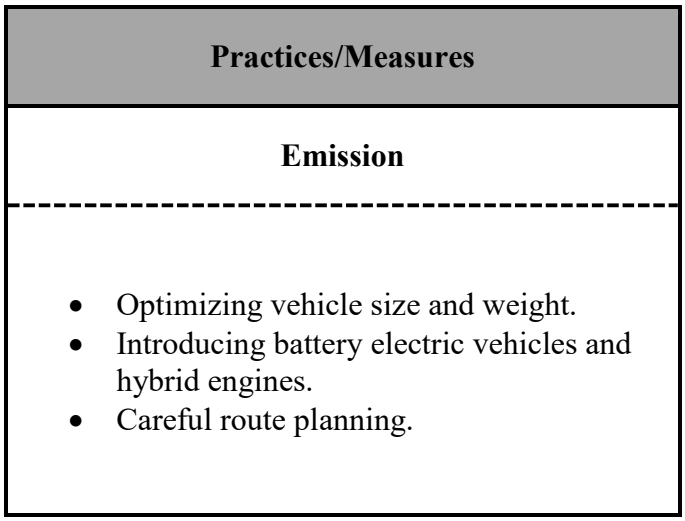

Figure 18. *Green practices to tackle emission.*

The above figure includes the practices that has already been integrated into the companies or could be integrated in the future. These practices would later form a part of model through which an organization's green practices would be convoluted to give the output.

4.1.2 Noise pollution

Similar to emission of gasses, noise pollution is another issue that has immense impact of urban life style. The source of this type of pollution is the same as emission, which is urban freight transport vehicles. Good transport vehicles in an urban area are usually big in size and usually have larger operating engines. This is merely because of the reason that these types of vehicles need to accommodate humungous amount of weights. To accomplish this, a bigger engine is needed to drag the good container behind.

Within an urban area, the frequency of travel and size of freight vehicles create too much of noise and nuisance for the inhabitants, let it be a running vehicle or a parked vehicle. This adds to safety issues as well for the people living nearby. Noise produced by these vehicles intensify the nuisance when they are operating at night time. During the night time quite surroundings, these vehicles produce so much of noise that it could affect the sleeping people. With the increase of urbanization, organizations must think on reducing the effects of noise and must plan the operation of freight vehicles without compromising the needs of urban citizens. Alone in Europe, over 40 million people are facing the problems related to noise pollution in urban cities (Savelsbergh & Van Woensel, 2016).

Browne et al. (2007) argues that there are numerous factors which affect the noise pollution in an urban area. These factors contribute towards the rising level of noise generated. Factors includes:

- Speed of the vehicle
- Flow of the traffic

- Condition of the road
- Weather
- Type of vehicle

The above factors become the reason that the operation of heavy vehicle creates problems for the people. Russo & Comi (2010) put forward a couple of arguments related to noise pollution. The author argues the two sides of noise pollution. First, it is said that a good strategy would be to reduce the number of trucks and good transport vehicle in the day time which contributes towards noise pollution. Second, the freight transport vehicles should be banned to operate in the night time. These arguments have positives and negatives with them and a balance would be needed to tackle the issue.

Although, the freight transport vehicles are not the only reason for noise pollution but the effects noise pollution might be devastating. The inhabitants of urban area where noise is an issue might become problematic with hearing capabilities. Unnecessary, sound that hit he ears might be irritating and damaging. This is because of the reason that human ears can only take certain level of sound with getting damaged. Prolong exposure to the noise pollution can result in decreased sensitivity of hearing.

Another side effect of noise would be the sleep disorders of the inhabitants where noise pollution prevails. The vehicles operating at night can result in situations where people become sleep deprived. Without a good night sleep, health of a person is directly influenced. Issues such as fatigue and performance would be the result. To tackle this issue, there are green practices that could be taken into consideration. The figure 19 below shows these practices.

Practices/Measures
Noise pollution
• Specific time zone operations. • Vehicle optimization.

Figure 19. *Green practices to tackle noise pollution.*

First, the specific time zone operation means that vehicle that carry goods within an urban area must operate in a specific time zone. The time zone specified by law would be only

time that a facility in an urban area can receive a delivery. Banning the night time deliveries would be a way to reduce the night time production of noise.

Second, vehicle optimization corresponds to the design of vehicle and technology used in the vehicle. The engines noise and vibrations can be reduced with introducing the hybrid engines. Moreover, to reduce the noise produced compressed air, brake silencers could be used.

4.1.3 Congestion

One of the factors that cities depend on is its efficiency of logistics system. The advancement of the cities therefore depends on the further development of the logistics system such as expanding and enhancing logistics activities. It is practically extremely difficult to reduce the freight transport and traffic density in urban areas and not affecting the needs of the city and its inhabitants. Therefore, congestion in urban areas is a big issue to be addressed. (Tadić, et al., 2015)

Two primary reasons for the congestion to occur are breaching the capacity of facility as demand level are raised or under low demand, the time required to use the facility increases above average (de Dios Ortuzar & Willumsen, 2001). One of the direct effect of congestion on the urban areas is the decreased accessibility of parts of urban areas. This adds to other issues as well such poor road condition and access restriction which leads to urban areas to be less accessible. Anand (2015) argues that one of the main factor in traffic congestion is goods delivery. Because of the enormous size of these types of vehicles, they contribute significantly greater than other types of vehicle despite of their small number (Anand, 2015).

The major part of solving the issues related to city logistics should be controlled by the city administration. But the flip side of the coin is that the private sector also has some role in the process without which it would be difficult to control the logistic process (Stathopoulos, et al., 2012). Reliable and flexible deliveries become higher in demand when the warehouse space is reduced which leads to just in time (JIT) strategy for urban transport (Rodrigue, 2006). Tadić et al. (2015) argues that partial transfer of inventories to transport system increases the traffic congestion issues in urban areas. This phenomenon is studied in the United Kingdom where 87 companies under investigation had decreased storage capacity by 39%, while 33% of the companies had increased volume of on road traffic (McKinnon, 1998).

Some of the goods that comes in the warehouse are not stored. Those goods are immediately put into the transport vehicles and send for deliveries. This decreases the inventory and increases the on-road transportation. (Bowen, 2008)

Another phenomenon associated with the traffic congestion is the increased costs and risk. Traffic congestion in the urban areas may lead to increased delivery/travel time. This lead to delay in the delivery of the goods and increased costs. While traffic congestion in a particular area of the road may lead to reroute the vehicle from another route. This also leads to increased time in delivering the goods and increased risks because unknown conditions. These factors are passed on to the supply chain and eventually the end user is obliged to pay. (Tadić, et al., 2015)

Summarizing the above arguments, the possible outcome from the traffic congestion can be listed down. Figure 20 below describes some practices to tackle the issues of congestion. The outcome from traffic congestion are:

- Traffic jams
- Increased costs and risk
- Delay in deliveries

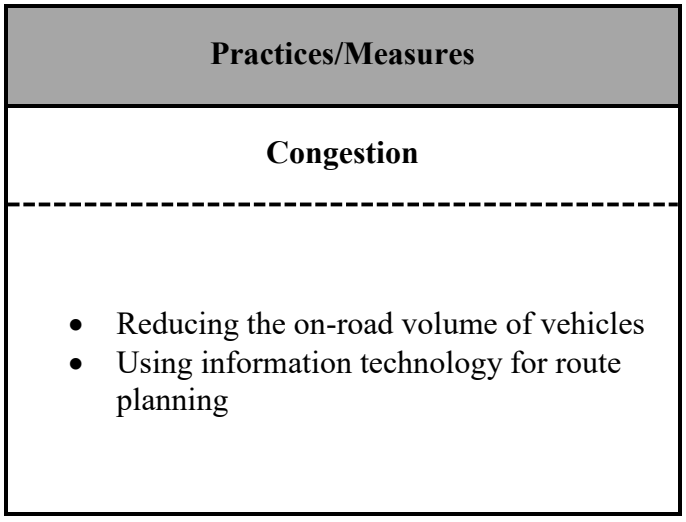

Figure 20. *Green practices to tackle congestion.*

The above figure describes that using less vehicle volume on-road can lead to less traffic congestion. This can also explain that when there is less amount of transport vehicles on-road, there would be continuous flow of traffic and which would result in timely deliveries. As a result, the end user would not be obliged to pay extra added costs because of the discussed phenomenon. Apart from that, using information technology, a company can predict the condition in urban areas and can figure out other plausible route and time of delivery. This would result in decreases risk.

4.1.4 Economy

One of the most important aspect of green supply chain management is maintaining a balance between environment consciousness and the economy. With favouring one over the other and hence disturbing the balance would bring insecurities to the business made

by an organization. There are times when one should be favoured over another because of certain reasons. Simchi-Levi (2010) in his book list down several examples of different scenarios where the motive of the companies was different depending on situations.

It is also essential to mention here that society in general also shows the environmental concerns. For example, a company based in New Zealand faced immense pressure and competition when another company in the United Kingdom claimed that product made thousands of kilometres away contributes towards environmental pollution than the product made locally. This was an attempt to raise the environmental concern in the society which resulted in immense competition for New Zealander company. (Patton, 2006)

The reaction of New Zealander company is worth mentioning here. The company took a scientific approach to the situation and proved that most of the greenhouse gasses produced in the process of making the products of the company generates in the farming steps. Then the company proved that it consumes 50% less energy in the making of the products as compared to its rival. This argument shows that the public is conscious about the environmental concern and sometimes (if not always) favours the more environmental friendly company.

When economy is talked about, it is worth mentioning that corporate social responsibility also plays its part. It can be understood as company's way of managing its business in order to positively affect the society in terms of social and environmental concern (Kaufmann & Carter, 2009). Simchi-Levi (2010) argues that corporate social responsibility is more than a company's brand. It stretches as far as business value created by the company. A two-dimensional framework is developed which represents the effects of a company on society and business. By dividing the framework, it can be easily differentiated between an approach towards business of the company and hence economy and an approach towards society and hence environment. Figure 21 below shows this framework.

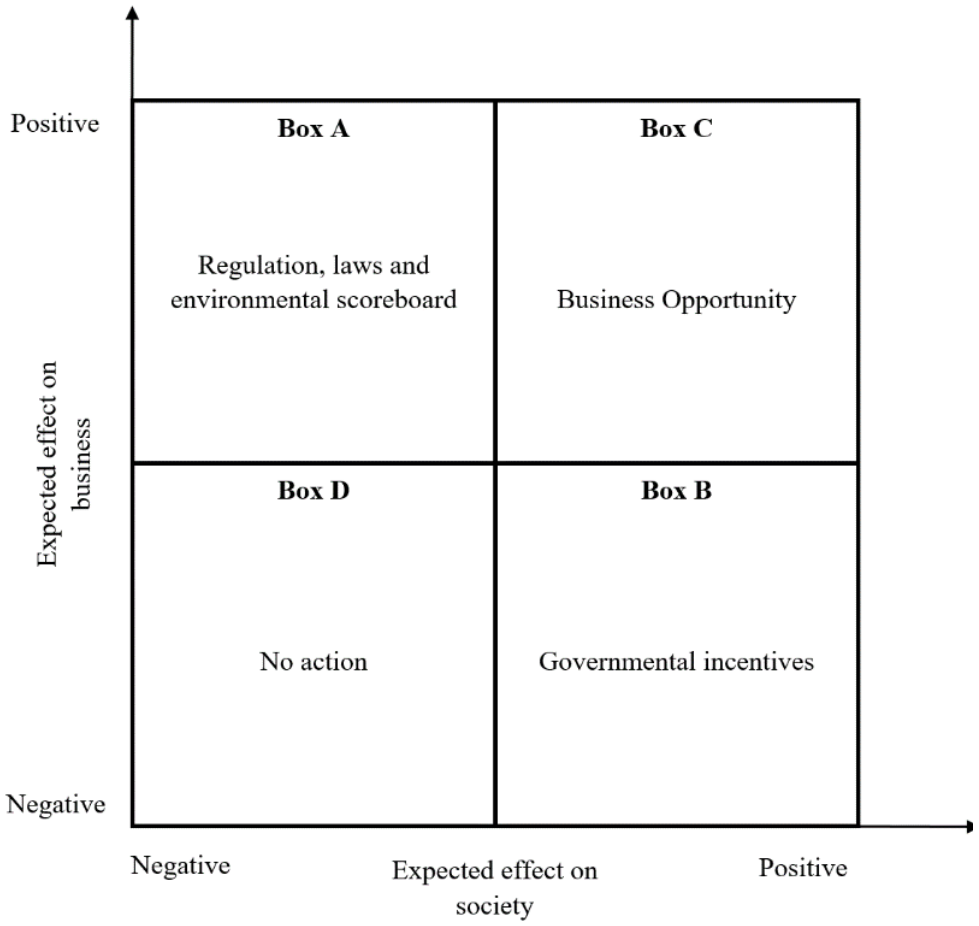

Figure 21. *The corporate social responsibility framework (Simchi-Levi, 2010).*

The box A of the matrix represents an imbalance between the good for the company and good for society. This means that the business might flourish with the cost of some negative effects on the society. The prime example of this phenomenon is the operations of the company associated with supply chain management such as transportation which could lead to increased carbon footprints and traffic congestion. As a result, it would create a nuisance for the inhabitants of the city and hence society.

On the other hand, box B represent the imbalance of the other side where something is beneficial for the society but not for the organization itself. This is the phenomenon that explains the effort to bring about the change in the environment. Typically, government take the charge and sets the objective of reducing the environmental concern. It comes at a cost of jeopardizing the organization's own benefit. This trigger the behavior of other organizations to step up in the area of protecting the environment.

Box C represents a neat balance between the two where business opportunity lies. There are economic benefits for the organizations in the investment and at the same time, there are massive benefits for the society as well. In the context of green supply chain management, this is where a firm needs to be. As a matter of fact, organizations are there to make

profit. However, at the same time it should not come by jeopardizing the environment and the society.

Now in relation to the topic of the thesis, it depends on the type of business a company makes to what extent an organization can stretch its balance. As an example, a company that deals in logistics mainly would find it rather difficult to neatly balance the operation in favor of both i.e. economy and society. However, efforts could be made in order to make it possible.

4.1.5 Safety

Many of the above-mentioned issues when combined give rise to another significant issue of safety in urban areas. By safety, the meaning is the safety of every individual, let it be a pedestrian or the driver of the vehicle itself. In terms of resources, safety of vehicles and infrastructure should also be intact. According to Russo & Comi (2010b), there could be numerous factors involved which give rise to safety issues in an urban area. These factors are identified as following.

- Congestion
- Large traffic density
- Limited parking
- Frequent movement of large vehicles
- Loading/unloading of goods to destination

Within the above-mentioned factors, there could be many reason for each of the factor to play its part in safety issue. For example, the large traffic density may be a result of high rate of urbanization in big cities and population growth. This mean that some of the factors are directly related to each other and resolving one may result in resolution of other issue.

The classical example would be the population growth and urbanization. While this issue has been talked about in many contexts, one possible outcome of the issue would be high traffic density in urban areas. This is a direct result from meeting the requirements of the inhabitants of the city to provide high quality services and goods. However, it comes at a cost, which is increased risks and safety issues in addition to many others. One viable way out would be to expand the cities into mega cities. Of course, this cannot be done by the private companies. The point here is to show the relationship between numerous factors and the outcome.

According to OECD (2017c), the general trend is the decrease in road accidents over the past years. However, it can still be taken further down if the factors that mentioned above are carefully examined. In some of the European countries the death rate per 1000000 inhabitants is relatively low than the United States of America. For example, Finland has

49 deaths per 1000000 inhabitants, Germany has 42.5 deaths per 1000000 inhabitants which is way lower than United States of America featuring 110 deaths per 1000000 inhabitants (OECD, 2017c).

On the other hand, the organizations can focus on their delivery method and style to minimize the safety issues. Many of the accidents happen because of small mistakes of amateur drivers. This can be neutralized by policy making where the company can standardise the process of hiring drivers by scrutinizing the process of hiring and recruiting professional drivers. This can affect the outcome and can bring the safety issue to normalise in the organization.

At company's end, there could also be other measures that affect the safety. These measures have already been talked about in the preceding chapters. For example, standardizing the vehicle design and size for delivery purposes can be taken into consideration. This can lead to drivers driving the similar kind of vehicle every time instead changing between several types of vehicles. Then specific time zone operation could also lead to reduction in road accidents. Figure 22 below show the practices pertaining safety.

Practices/Measures
Safety
• Scrutinizing the recruitment process of drivers • Standardization of vehicle • Specific time zone operation

Figure 22. *Green practices to tackle safety.*

The above figure list down some practices by a company to neutralize the safety issues. The next chapter would describe how these practices forms a model.

4.2 Integrating the green practices into the model

There are numerous factors which give rise to above issues and have been identified throughout the thesis. As a refresher, some of them are frequency of delivery, improper vehicle use, inefficient planning of routes, improper infrastructure (road conditions) and poor engines. Although there are measures to reduce the current identified issues, the logistics policy making is in its immature phase. Until the recent past, most of the policy

making in logistics activities include the restrictions on vehicle carrying goods and specific zone operations. A balance is absolutely required to neutralize the effect and encourage the urban transport with enhanced supply chain management and logistics.

After scanning the literature thoroughly and streaming down the issues related to green supply chain management, previous chapter provided a firm base for the model. The core component of the model is the practices involved in each of the listed issue and these practices helps to achieve the desired aim of the model. In this chapter, all the practices identified earlier can be integrated into the model to see the shape of it. This is done in the following diagram.

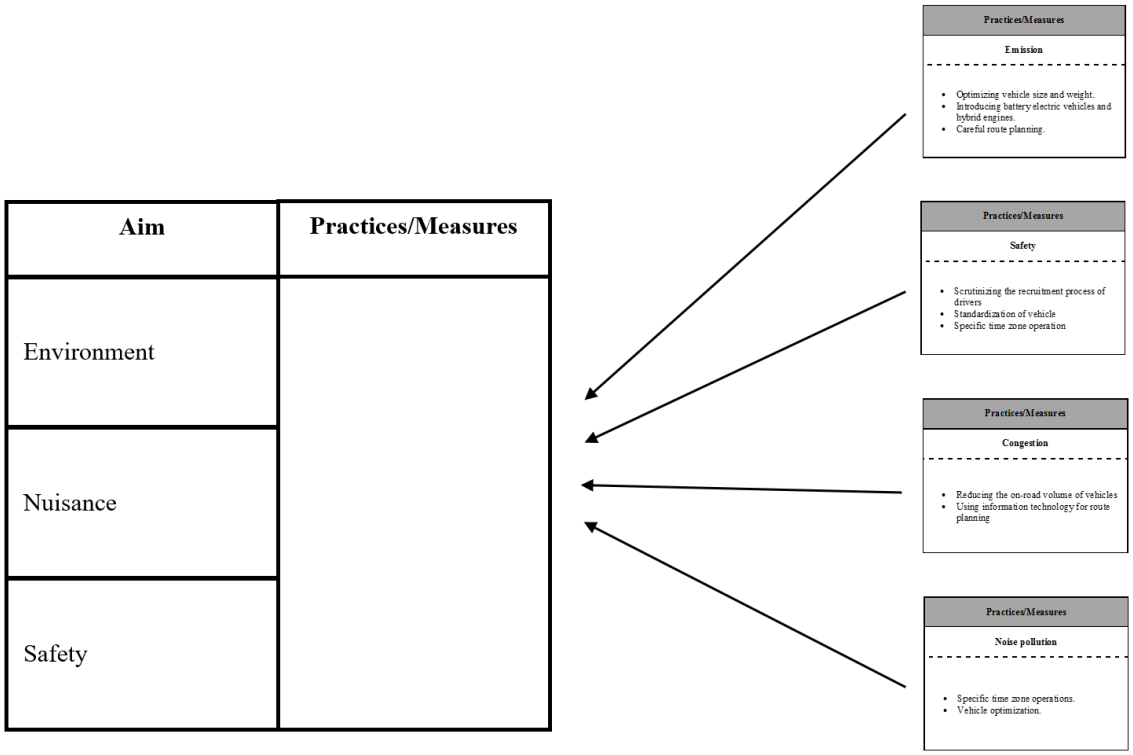

Figure 23. *The model containing the practices.*

The figure 23 above depicts the model with its aim and green practices associated with each aim. This is to be used in relation to a company's strategies for green supply chain management. As an example, a company might be investing its revenue and time in effort to make the environment green. However, there could be a lot of efforts in a particular area, for example investment in buying new battery vehicle engines and hybrid engines to reduce the carbon emission. This would create an imbalance and might end up in the ignorance of other issues such as safety issues. While investing most of allocated budget in one stream i.e. buying new battery electric vehicles can leave no place and investment for safety issues. This model addresses these issues in a balanced manner and let the reader know what a company is lacking in terms of aims of the model.

In addition, the model can also be used to let the reader get an idea whether a company has more technology driven practices or planning/policy driven practices. For example, buying new vehicles that have battery electric engines involves both technology and planning. A company might carefully plan the issue before procuring the new vehicles. In this case planning is seen as policy driven act and buying the battery electric vehicles is seen as technology driven act. On the other hand, a company might only involve one the two phenomena i.e. either it would be technology driven or planning/policy driven. An example of this would be a company eliminating its freight vehicle for last mile delivery in an urban and introducing bicycles. This is seen as a planning/policy driven act where to reduce the carbon the emission, a company has taken a step without involving any technology in the process.

The reader of this thesis might think for second that not every company is same and has needs for such efficient supply chain. While this is true that not every company needs to be addressed in this thesis. Some companies might have extremely efficient supply chain management and might not need to enhance their supply chain. In that case, these green practices do not carry much value to those companies. However, for companies that deal in logistics as core business, those companies need a balance chart like this model in order to introduce balanced practices in their supply chain.

As of the model is concerned, to find out the balance and the extend of technology and planning/policy driven, company's current strategy must be studied and understood. It was described earlier that how this model can be used to find out the extend of technology and planning/policy driven based on the framework developed by Anand (2015). A similar framework can be used to find out the balance between the current strategy of a company. This could be done by gathering data associated with a particular company and carrying out interviews. A reliable source where the information can be found is the annual reports of the company in addition to official statistic shared by the company in the form of reports and documents.

As an analogy, this could be thought as a company's vision and measures that a company takes to fulfil that vision. The aims in the model could be thought as representing the vision of a company. These vision statements are set by company based on their needs. In a similar fashion, these aims are based on the needs of a company and the society. Following figure 24 represents this in a pictorial view.

Vision by 2100	Practices/Measures
• ……. • ……. • …….	…… …… …… ……

Figure 24. *Aims as vision.*

The above figure displays that to achieve the vision, a company must take a set of measures to ensure that the vision is fulfilled. In a similar manner, this model presents some practices in a balanced way that may be helpful for company when designing the strategies related to above identified issues.

5. APPLICATION OF THE MODEL

5.1 Case: DHL

This chapter provides a comprehensive detailed study of distinct aspects of Deutsche Post DHL Group. It would be wise to understand the company in terms of its vision and measures to keep the environment safe and green. The protection of the environment and the success of the business that a company makes are tied together in a catch 22 situation where one cannot proceed without other. In addition, sustainability has been a major one of the main issue in contemporary world. DHL has been targeted its logistics related emission to help sustain the environment. This chapter is comprised of module D as shown in figure 25 below.

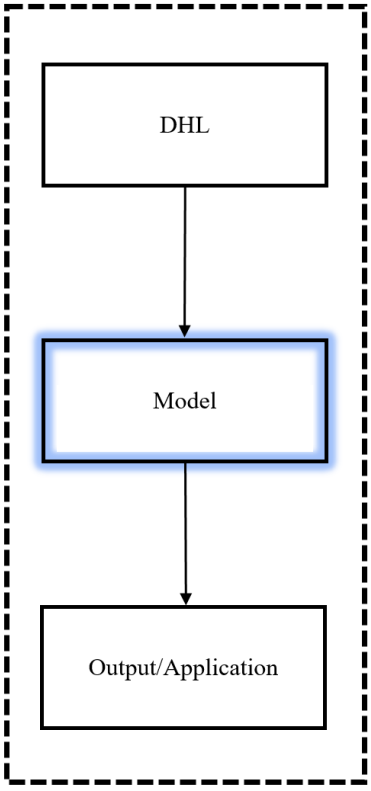

Figure 25. *Module D of the thesis.*

In DHL, a project called GOGREEN has been related to reduce the emission significantly. The green solution that the company provides is more or less same as described in the previous chapters by identifying the issues in intracity logistics. These solutions are route optimization and alternative engines for convention combustion engines. It is important to state here that these solutions are related to reducing the carbon emission specifically.

Apart from this, DHL also mentions that there are also many other ways to reduce the carbon emission. (DHL, 2017a) However, this study is only related to logistics related activities.

To reduce the emissions and logistics related issues, one must come up with a sharp vision. DHL also clarifies its vision for the environment to go green. DHL puts forward its vision by the year 2025. The vision is listed below in table 9.

Table 9. *DHL vision by the year 2025 (DHL, 2017b).*

Vision	Description
Carbon efficiency	Increasing the carbon efficiency to 50% by 2025 as compared to levels measured in 2007.
Last mile delivery	Clean delivery vehicles for last mile delivery and reducing the air pollution.
Employee certification	Certifying the employees as GOGREEN specialists and involving them in the activities of environmental protection.

To attain this vision by 2025, there are several measures that are initiated by DHL. These measures to go green includes distinct aspects covering the issues identified from the literature. Following discussion will expand these measures in relation to the issues and later integrated into the model.

5.1.1 Emission

Before stating any of the DHL's initiative towards emission, it is crucial to mention the practices that were identified earlier. These practices include:

- Optimizing vehicle size and weight.
- Introducing battery electric vehicles and hybrid engines.
- Careful route planning.

DHL measures its carbon emission with carbon efficiency index (CEX). It is claimed that in 2016, DHL improved its carbon efficiency index by one. By 2016, DHL's carbon efficiency achieved was 30%. However, this efficiency was calculated by combining the efficiency of individual division within DHL. In addition, a sizable chunk of the improvement came from ocean transport. (DHL, 2016) Following figure 26 describes this efficiency gain by DHL.

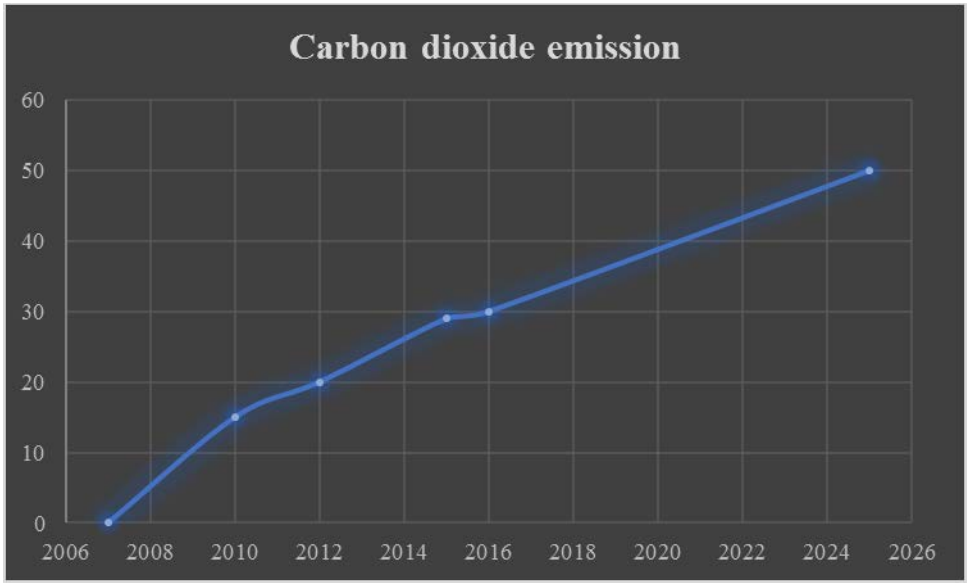

Figure 26. *DHL's carbon efficiency (DHL, 2016).*

Despite the improvement in carbon efficiency index, it cannot be broken down into simpler modules to see the exact emission caused by urban transport system. However, it possible to see the contribution of road transport by DHL in air pollution. Since it was mentioned that a sizable chunk came from ocean transport, it is useful to see how much air pollution does ocean transport accounts for. This is shown in the figure 27 below.

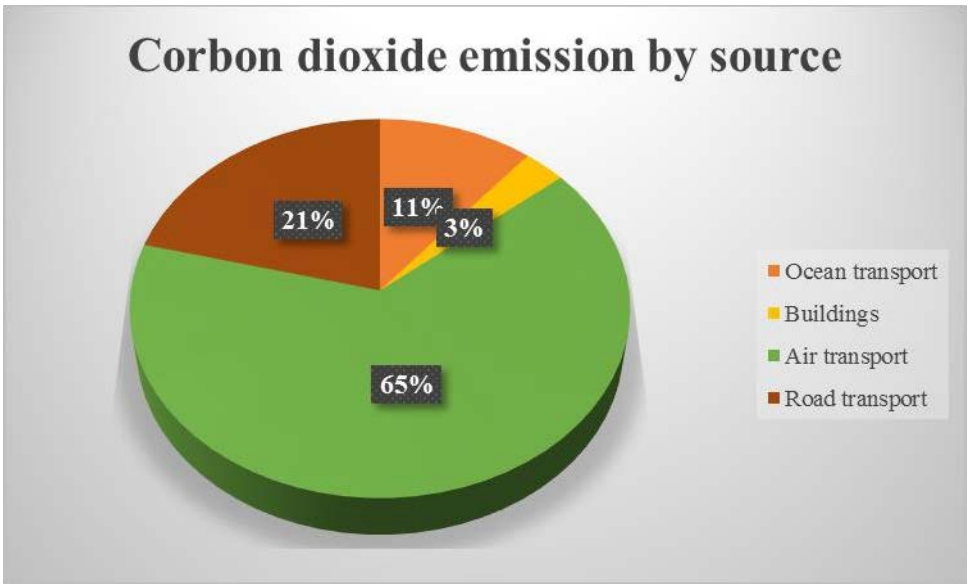

Figure 27. *Division of different modes of transport (DHL, 2016).*

It can be noticed from the figure above that road transport accounts 21% of air pollution which means a further improvement in this mode of transport would account for greater gains in carbon efficiency index. Apart from carbon emission, there are also other pollutants that accounts for air pollution. According to DHL, 48% of nitrogen oxides (NO_X) in

the air comes from road transport and 31% of sulfur dioxide (SO_2) in the air comes from road transport (DHL emission) (DHL, 2016).

One way to response to this emission is the strategic decisions made by DHL management. The target of reducing this emission could be achieved by using most of their own road vehicles as last mile delivery. This is done by changing the last mile delivery from conventional vehicles to bicycles and e-mobility. While this practice is already in the implementation and more than 6000 e bikes have been issued to be used as last mile delivery vehicle in Bonn, Germany (DHL, 2013). Apart from e-bikes, electric vehicles are also used in this process as a last mile delivery vehicle.

In DHL, the efficiency measures are guided through principals of "burn less" and "burn clean". First, burn less accounts for reduction in the consumption of fuel in the operations. Second, burn clean accounts using the alternative sources as fuel. This approach can be applied to any type of mode within DHL. However, following table 10 only includes road transport system.

Table 10. *Burn less and burn clean approaches (road transport) (DHL, 2016).*

Measures for burn less	Measures for burn clean
Vehicle optimization	Using alternative sources as fuel
Using hybrid engines	Using battery electric vehicles
Using telematic systems	

The above table describes some measure that have been a part of DHL strategy to reduce the emission of carbon and other pollutants into the air. Apart from these measures, DHL has improvised its network planning by optimizing the routes taken by their vehicles and carefully study them (DHL, 2016).

There are some measures that only dedicated to road transport system in DHL. Measures to improve carbon efficiency includes optimization of aerodynamics of vehicle (optimization of vehicle), light weight vehicle, low resisting tires and telematics. These measures are tested in a demonstration first and put into practices. As a result, the efficiency of road transport has increased and carbon emission has decreased by 2016. (DHL, 2016)

There is another tool that DHL is using to track the CO_2 emission by the customers. This tool is called carbon dashboard in GO GREEN project. However, the tool is only accounted for the emission seen over whole supply chain. Nevertheless, the tool could be used in future to see the emission caused by last mile delivery.

5.1.2 Noise pollution

The measures that were put forward by the author in the previous chapter related to noise pollution were specific time zone operations and vehicle optimization. Both measures play its part in minimizing the noise pollution caused by the transport system in urban areas.

From company's profile and reports, there has not been much attention given to this issue in particular. This could be because of the reason that DHL do not emphasize this issue to such a level where emission has been discussed and brought down. However, the issue cannot be left alone as it has been identified as one of the major trouble creator in intracity logistics for the inhabitants of an urban area.

Nevertheless, there could be some measures that are related to minimizing emission and concurrently providing the antidote for noise pollution. One such example is use of bicycles for last mile delivery. It was mentioned in the preceding chapter that DHL has a policy of using their own road fleet as last mile delivery which would made through bicycles and electric vehicles. Perhaps, this could also provide a minimization in noise pollution as delivery by bicycles would create minimal nuisance for the inhabitants. On the other hand, the feasibility of this measure should also be taken into consideration. The driver/deliverer using these vehicles should also be at ease with the vehicles and bicycles. In addition to bicycles, street scooters are also made available for last mile delivery. These scooters are electric scooters producing minimal noise and pollution (DHL, 2016).

These bicycles are made with a standardized container for the parcels. Operating in the main land city such as city centers, these bicycles can be attached to a vehicle for carrying to specific point and thereafter delivering the parcels using the bicycles. This significantly reduces the emission and noise created. However, this measure has been applied to a limited extend i.e. only two cities in Europe.

There are some other policies in DHL related to time zone operation but these policies do not specifically put in for minimizing the noise pollution. DHL has a term called end of day delivery which would mean that all the deliveries for a day should be made before some specific time, for example before 1900. However, this would not minimize the noise pollution to much extend.

There have been many measures that DHL has been taking for reducing the carbon footprints. However, when it comes to noise pollution, there seem to have few efforts made to reduce it. The interviewee also agreed to the fact that there have not been many efforts made in this area. When asked the question of other measures that company has taken to minimize the issues associated with city logistics, the interviewee barely mentioned any measure associated with noise pollution particularly.

5.1.3 Congestion

When it comes to congestion, the measures that could bring the congestion to a lower level would be to reduce the on-road fleet and using a proper information technology system. According to DHL (2016), the total number of road vehicle operating worldwide is more than 92,000. This is a substantial number and could be a reason to have some impacts on congestions in urban areas.

Congestion as seen in the literature has been left alone and there is not much attention given to this issue. Although, DHL has grown up as logistics giant, it is still difficult find what are the measures taken by the company to resolve the issue or bring it to minimal level. However, for temporary basis there has been some policies put in by DHL to tackle the congestion issue. One such occasion was enlisting some employees as jogging courier who would deliver the parcels in the areas where congestion has been a problem.

This happened in London in 2012 when the number of visitors increased to five million due to an international event. These people were specialist and had a specific task of delivering the parcel on foot. However, on a long-term basis, it would be difficult to manage these kinds of measures. (Daily Mail Reporter, 2012)

Another measure that DHL has taken in the past was introducing the floating distribution center. As a result of congestion in Amsterdam, DHL responded to introduce their first floating distribution center. This replaced many vehicles on-road and reduced the amount of traffic in the city center. Conventional vehicles were only used as part of delivering the heavy packages to their destination. According to calculations, one delivery boat was meant to be used in replace for 10 on-road vehicles. DHL showed that it could save immense amount of fuel with this measure.

However, the above listed measures are limited to either time period or geography. In order to improve congestion issue globally, there has not much work done. In the interview, the interviewee responded to the question and informed these decisions are made strategically and depends on region to region. In some region, there could be some necessary measures that must be implemented in order to keep the raised issues at bay. On the other hand, it is wise not to implement such measures where there is no need.

5.1.4 Safety

Safety of inhabitants is of extreme importance and must be given significant attention to reduce the risk of fatal injuries and in some cases deaths. DHL claims that it has worked together with governmental authorities to overcome the safety issue (DHL, 2016). These safety issues mostly include operational safety at facilities. However, it must be taken into consideration that the safety that is being talked about here is in terms of road safety.

In the area of road safety and occupational health & safety, DHL has taken some measures in the past. To review the causes of road accidents, European Road Safety Charter membership helped the company improve the knowledge of reason for road accidents. Moreover, this membership also helps to design some measure for the prevention of road accidents. DHL also designed an internal body to develop and manage occupational safety KPIs. The top priority of DHL has been to avoid the road accidents to promote safety for people.

Although, there has been few measures by DHL to help reduce the accidents, there has not been much work done in this regard. The interviewee agreed that there have been accidents in the past with casualties. The interviewee also mentioned that this issue is not only limited to a specific region or a place but worldwide.

One of the recent accident that took place was in Coventry when a DHL employee was killed and three persons were injured. The accident occurred as a result of carelessness and one man had to give his life as a result. Another example of road accident was DHL driver crashed the vehicle into the church and killed the church minister. The driver was eating his lunch and telephoning when the incident happened. These types of incidents are the one which need to be controlled by the company.

The measures identified earlier to help reduce the safety issue includes specific time zone operation, and scrutiny of recruitment system. Scrutiny of recruitment system is something that could really help to maintain a safety standard in the company. However, there has not much work done in this regard. Moreover, operating under certain time zone could also help to reduce the security and safety issues. This way a common person would be aware of risks in the areas of high traffic volume and possible accident could be avoided in such situations.

5.2 Interview results

To know some more details about the policies of the company and current scenario, an employee of the company was interviewed during the thesis. The interviewee gave some insights of the company. However, with the limitation of contacts and time, only one person was interviewed. The interview was based on the same topic of green supply chain management and intracity logistics and questions were formulated keeping in view of research topic. The whole interview is attached in the appendix at the end.

The findings from the interview are not different from the literature and findings of this report. The interviewee stated that as a part of DHL policy, the waste produced in any part of the supply chain is minimized. Since, DHL is not a manufacturing firm, it is easily understood that there is not much waste in this regard. However, the scrap is handled in an appropriate manner in order to minimize the waste and hence harmful effects of it on environment.

One crucial point that interviewee mentioned was that the company lays much importance on emission and environmental pollution. This can be seen in the measures and policies that are formulated to tackle these issues. Other issues such as congestion safety and noise pollution do catch the eye of the company but the emphasis is not too much. Although, the company tries to minimize the other issues by implementing few strategies but if it does not come at the cost of profit loss.

In the answer to the question of practicing green supply chain management in DHL, the interviewee said there are number of factors which governs the practicing of green supply chain management. First, to minimize the environmental pollution, there are vans that dedicated to specific tasks. These dedicated vans are kept in supreme condition all the time. For example, as a general policy of the company, these dedicated vans are of latest model and no earlier than 2013 model. Specifically, Volvo vans are never older than 2013 model. Moreover, these vans are ecofriendly and produce lower emission than the conventional trucks and vans. However, the introduction of electric vans is limited to some cities and region and not yet implemented all around the world.

The primary goal set by the company in regard to green supply chain management is also described by the region. However, DHL express emphasize on promotions. Promotions in this sense means the promotion of green supply chain to encourage others and the employees to adopt the practices. Apart from that, there are some goals set each year for the improvements. The goals are defined by their KPIs and an improvement is expected each year. Despite all that, the primary goal of the company is the profit maximization. DHL would not be involved in any activity that would decrease the profit substantially. Therefore, all the policies, goal and measures are done in the view of profit maximization.

The integration of technology is also limited in the company and depends up on the region of operation. To enhance green supply chain management there is no particular technology used that can be used as enhancing factor such as information technology to tackle traffic and congestion. These policies come directly from government and company cannot dictate its own rule in any sense. Therefore, before introducing any measure or technology, the company has to review the policies and law that allow it. One example given by the interviewee was from the last year when employees at DHL started to plant trees in order to promote green supply chain management. About 1000 trees were planted that year but next when the same practice was carried out, government did not allow it as a part of law. This example gives a clear view that DHL cannot make decision on its own but must take governmental policies into consideration.

Interviewee also talked about city logistics in DHL. He mentioned that in some regions, DHL outsource the city logistics and does not take part in any way to handle the logistics inside a city. Therefore, it is not the responsibility of DHL alone to take care of the issues with in the cities in some regions. Mostly, the warehouses of DHL are located around the city to avoid any nuisance for the inhabitants of the city. The routes are also planned in a

way that would minimize the nuisance created. He also mentioned that noise pollution is taken seriously at DHL and this is one the main reason that the warehouses are around the city instead if inside the city.

According to the interviewee, the major waste of DHL is its scrap and emissions. For both types of wastes, DHL has taken considerable measures to minimize it. The scrap is given out to different vendors where it used for recycling. DHL avoids burning any type of scrap in the process. Secondly, it has been mentioned several times that DHL has been putting efforts to bring down the emission levels.

A significant factor in deciding the policy formulation and implementing the measures regarding green supply chain management is the region of operation. The interviewee said in a country where the society itself does not pay much attention to the environment is the one where companies usually do not implement such practices. An example of this would be third world countries where the pollution is on elevated levels and yet the society and the government lack the power of implementing these practices. In such cases, there is no point to stand out. DHL alone cannot resolve all the issues in such regions. It is only a collaborative effort of the company, government and the society to work together and sort out these issues. In developed countries of Europe, there has been implementation of several measures that were necessary for the betterment of environment and the company. One such example has been seen in cities such as Amsterdam, Bonn and London.

5.3 Summary

Previous chapter provided an insight of the measures and strategies that DHL has taken over the past to overcome the mentioned issues. The information collected in previous chapter came directly from DHL sources and partly from an interviewee. Hence the information collected can be considered authentic and up to date. In order to understand what the author originally meant, a list of measures that DHL has implemented must be shortlisted. These measures are listed below.

- Introduction of e-bikes and electric vehicles
- Vehicle optimization
- Telematic system for vehicles
- Route planning
- Light weight vehicles
- Standardizing the delivery containers
- Reducing the number of on-road vehicles

The above measures taken by DHL suggest a slight lean towards emission problem and neglecting the others. The negation in this sense does not mean a complete boycott of resolving the other. Rather it shows that less concentration is given to a particular issue

over other. These measures can be arranged in model to view which aim is currently being achieved with these measures. Following table 11 shows these measures in relation to the model designed.

Table 11. *Measures by DHL in relation to model.*

Aim	Measures/Practices
Environment	E-bikes and electric vehicles
	Vehicle optimization
	Telematic system for vehicles
	Light weight vehicles
Nuisances	Reducing on road vehicles
	Route planning
	Standardizing the delivery container
Safety	

From the table above, it can be easily understood that the company has more emphasize on environmental issue. This is a sign where there has been less importance given to issues like congestion, safety and noise pollution. Another point to be noted here is focus on corporate social responsibility framework by Simchi-Levi (2010). It would be wise to make a conclusion that the company's goal is to maximize the profit and hence resides in box A. However, it would be logical to make a conclusion that in regard to issues such as safety and congestion, the company lies in box D where there is no action from the company. Moreover, there has not been much business opportunity as well.

To represent the measures and see them side by side, table 12 below provides a fruitful comparison. Table 12 below shows a balanced model and practices by DHL.

Table 12. *Comparison with the model.*

Aim	DHL	Balanced measures
Environment	E-bikes and electric vehicles	Battery electric vehicles
	Vehicle optimization	Vehicle size
	Telematic system for vehicle	Vehicle weight
	Light weight vehicles	Hybrid engines
Nuisance	Reducing on-road vehicles	Reducing on-road vehicles
	Route planning	Route planning
	Standardizing the delivery container	Use of information technology

		Optimization of container
		Specific time zone operation
Safety		Scrutinizing the process of recruitment for drivers
		Specific time zone operation

According to literature and interview, the above table gives a spot-on result that there is a lack of measures and policies excluding the issue of emission. Whatever the reason may be, whether it is regional preference or lack of interest in the area, there is a need of improvement in order to resolve the issues. Since, the 21st century has seen a lot of innovation in the information technology sector. It is utterly important that the integration information technology should be done to resolve the issues. It has already been seen that according to the framework developed by Anand (2015), DHL's solution to intracity logistics resides mostly in emission control. These solutions are blend of technology based solution and policy based solution such as introducing hybrid engines (technology) and using dedicated vans no older than 2013 model (policy).

Another principal factor governing the resolution of the issues is the identification of decision maker. It has been seen that despite the effort of one party to make the environment green or resolve the intracity logistics issues, the other party's interference as a decision maker interrupts and spoils all the efforts made by first party. A classic example was given earlier when DHL made the effort of planting the trees but the company was interrupted by government due to some policies. After identification of decision maker, it becomes clear that who is responsible for what. However, it does not end here. As it was described earlier that in some regions DHL outsource its intracity logistics to other companies. In a case of accident made by outsourced company, brand value of DHL is also affected. This should also be kept in mind that it is important to know what are the duties of each party.

5.4 Added value

The model does not only show an imbalance between the aims but also can be used as identifier of the decision maker. In the above scenario, the target of the model is safety of the inhabitants. Of course, it is easy to understand even without model that safety is something that should be given importance. However, with the model, it is easy to compare how much weightage is given to such issue. The nest question is the identification of the decision maker. In this case it could be noted by the measure that could make a positive impact on the environment. For example, specific time zone operation is a measure that

could be implemented by the company alone. However, it would not be possible to solve the issue of safety by just implementing it by one company. Therefore, the decision maker in this regard should be government to implement specific time zone operation. This would bring the safety of inhabitants to a better level if not the best.

Another example of this scenario can be seen in the resolution of congestion issue in a Spanish city, Barcelona. When the congestion and pollution levels were on the high in Barcelona, there was a need of doing something out of the box to control it. Therefore, the government put out a new plan of superblocks to restrict the traffic to specific roads and area. The decision maker in this scenario was again the government. As a result, the city was able to reduce its emission level, congestion, noise pollution and increased safety of the inhabitants.

6. DISCUSSION

6.1 Overview of the framework

The project was started with an aim of identifying the issues of intracity logistics and addressing them in the form of model. The research questions formulated in the beginning were

- What is the need for green supply chain management and logistics in contemporary world?
- What are the alternate solutions for the addressed issue?
- How the use of alternate solutions is providing benefit to the companies and society?

The first research question was answered in the opening chapters of the thesis where it was discussed that the green supply chain management has become a need of a company in contemporary world. Many authors and researchers of this field now regard it as brand value for their company. Without which the company may lose the added value. Therefore, the answer to this question was provided with literature and in details.

The second research question of the thesis was to look for the solutions. The issues were identified as a result of first research question. Again, after searching through literature, there were many solutions put forward. However, the solutions that best suited the ideology of thesis were mentioned. In this process, a model was also designed to answer the question in a best conceivable way.

The third research question was basically designed to present the results and a way that could benefit the society as well as the company. This was answered through reading down the company's profile and finding out what is necessary to do. However, when the author made a study of the company's profile, distinct aspects came forward. These aspects were in the form company's operative policy and regional preferences.

The research was divided into different modules where each module had its distinct feature and nature. From literature, the concept of green supply chain management and intracity logistics were understood, which constituted module A. The issues were identified and a model was designed to accommodate those issues to present the solutions in a balanced way. This was necessary as it made it easier to identify the necessary efforts that should made to resolve the issues. This was done in module B, Module C and module D.

As described earlier, the model provided a platform for solutions and value for the company. This can be used to overcome what is needed in the company. However, this solution may differ from a real-life situation. It has already been seen that regional operation

becomes a significant factor when deciding a policy. These solutions just act like a plan neglecting the laws governing them.

6.2 Analysis of the results

It would be unjust to stream down the results in a single sentence. There was information from various sources that was accumulated in this study. Even though the practices presented in the model seemed to be applicable, the real use of these practices would be governed by number of other factors as well. These factors combined together to give an overall effect of a single practice on the company. However, the practices could be used to create value for the company and hence an competitive edge. In addition, this study provides the details of the main subject matter in the field of green supply chain management.

In a similar fashion to all studies made, this study also has limitations. Since, the application of the model is made in only one industry due to time restriction, it would be better to see how the results look like when the application is made on several industries. Secondly, the model made was based on the issue of intracity logistics. While these issues could turn out to be nothing in another company, it would be difficult to separate these accordingly. Some firms have efficient supply chain that it would not need any kind of measure to further minimize the issue. However, on the other hand, some firms may even need more drastic measures to overcome the issues in order to compete in the market with other companies.

7. CONCLUSIONS

Green supply chain management is a necessity in the contemporary world. This necessity is the result of global rise in pollution from manufacturing to consumption. The pollution is spread across the spectrum of supply chain management. The logistics part of supply chain management is also equally responsible for environmental and societal degradation. Most of the companies are focused on profit maximization as their sole purpose of existence. As a result, someone must pay the cost and in this case, it is environment in the shape of pollution or society in the shape of nuisance and safety. To be more precise, the last mile delivery (intracity logistics) creates elevated level of pollution and is a major cause of nuisance in urban areas. To be able to tackle the issues in an organized manner, companies ought to seek help from technology. Technological advancement coupled with policy and practices in the companies go on to resolve the issues raised by intracity logistics. More often these practices of the companies to bring the solution for the issues are driven by business opportunity, it is inevitable that in a company there must be paucity of workable solutions to all issues.

The objective of this study was to study the above-mentioned issues and design a model to address these issues to be presented in a balanced way for intracity logistics. For this reason, literature was referred and the concepts of green supply chain management and intracity logistics were brought forward. After identification of genuine issues in intracity logistics, workable solutions blended with technology were presented. These solutions were already being implemented according to regional preferences or were in the making. Upon the completion of looking for the workable solutions, the company's profile was studied and practices/measures were put forward to see what kind of work has been done by the company to resolve the issues.

Lastly, the results show that the company under study in this thesis has an imbalance in the implementation of solutions and policies. A major lacking is in the issues related to congestion, noise pollution and safety. These issues come in the bracket of nuisance and safety of the inhabitants of an urban area. The application is shown in this study only concerning one company. The limitation of the study is its application on only one type of industry as different industries having varying supply chain management needs would have different sort of issues. A manufacturing firm has more emphasis on bringing down the pollution in manufacturing phase rather than logistics. Hence a different study would have to be carried concerning other set of issues.

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APPENDICES

Appendix A. Interview

Interviewer: Sohaib Ahmed Nasir

Interviewee: Ahmer Zaidi

Designation of interviewee: Program Coordinator, DHL Global Forwarding

Date of interview: 08/06/2017

Company: DHL

Purpose: Measures/Policies/Practices of DHL in green supply chain management and intracity logistics

Total number of questions: 10

1. **What is the core business of the company?**

2. **What do you understand about the concept of Green supply chain? Have you practiced it in your firm?**

3. **What is the company's primary goal when it comes to green supply chain management?**

4. **A sizeable chunk of air pollution comes from last mile delivery. What types of vehicles your company uses for city logistics?**

5. **What type of technology your company uses to enhance the green aspect of green supply chain management?**

6. **What other measures does the company has taken to minimize the issues associated with city logistics?**

7. **What are the major wastes of your company in concern with environment?**

8. **How does the company minimize the effects of these wastes?**

9. **To which of the following parameters does the company gives foremost importance? Rank them in order of importance where 1 being least important and 5 being most important?**

Factor	1	2	3	4	5
Emission					
Noise Pollution					
Congestion					
Safety (Inhabitants)					
Economy (Profit vs Environment)					

10. **What is the limitation of implementing the strategies associated with green supply chain management? For example, inadequate information, high cost or governmental policies?**