TO GREEN OR NOT TO GREEN?

EXPLORING THE ADOPTION OF GREEN INITIATIVES IN CANADIAN TRUCKING

by

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Author's Declaration

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Abstract

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The topic of environmental sustainability has become a central theme in recent years. To-date, ample scholarly literature has focused on the application of environmental sustainability in manufacturing, with scant attention on the logistics industry – particularly in Canada. Given the lack of research on the topic in Canada and the significant negative environmental impact of trucking transportation in the country, I use case study methodology to uncover: (1) the types of green initiatives that have been adopted by Canadian trucking companies, and (2) the drivers and barriers that can affect trucking companies' adoption of green initiatives. Moreover, I conduct semi-structured interviews with high-level employees from eight small-to-medium sized trucking companies in Ontario. The results illustrate that the implementation of green initiatives in trucking is at an early stage and that trucking companies in Ontario face a multitude of drivers and barriers when adopting green initiatives. Additionally, I reveal three *new* findings.

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My parents – your capacity to handle FIVE years of my school-related tantrums is absolutely *astonishing*! I do not know how you did it.

Хвала вам ☺

Toronto, Canada

July 12th, 2019

Dedication

To my baby brother, Igor

Table of Contents

Author's Declaration.....	ii
Abstract.....	iii
Acknowledgements.....	iv
Dedication.....	vi
Table of Contents.....	vii
List of Tables.....	xiii
List of Figures.....	xiv
List of Appendices.....	xv
1 Introduction.....	1
1.1 Need for “Green” Research in the Canadian Logistics Market.....	2
1.2 The Canadian Trucking Sector.....	6
1.3 Research Objectives, Aims, and Questions.....	9
1.4 Scope and Focus.....	10
1.5 Canada as Research Infrastructure.....	11
1.6 Outline of Thesis.....	12
2 Literature Review.....	14
2.1 The Development of Green Logistics.....	15
2.2 A Review of Green Initiatives Adopted in the Global Logistics Industry.....	17
2.2.1 North America.....	17
2.2.2 Europe – Italy.....	18
2.2.3 Europe – Germanic Countries.....	21
2.2.4 Asia.....	24
2.2.5 Africa.....	25
2.2.6 Framework of Green Initiatives.....	25
2.3 A Review of Drivers and Barriers Affecting the Adoption of Green Initiatives.....	28
2.3.1 Organization-Related Factors.....	30
2.3.2 Finance-Related Factors.....	32
2.3.3 Market-Related Factors.....	34
2.3.4 Government-Related Factors.....	38

2.3.5 Technology-Related Factors.....	40
2.3.6 Framework of Drivers and Barriers.....	41
2.4 Summary Insights.....	42
3 Methodology.....	45
3.1 Research Methodology.....	46
3.1.1 Multiple-Case Study Approach.....	46
3.1.2 Inductive Research.....	47
3.1.3 Philosophical Assumptions and Chosen Paradigm.....	48
3.1.4 Merriam’s Case Study Approach.....	49
3.2 Research Design.....	50
3.2.1 Units of Analysis.....	50
3.2.2 Sampling Strategies, Selection of Cases, and Recruitment of Companies.....	51
3.2.3 Interview Design and Protocol.....	55
3.2.4 Data Collection.....	55
3.3 Data Analysis.....	56
3.3.1 Analysis and Software.....	56
3.3.2 Strategies to Ensure a Reliable Analytic Procedure.....	59
3.4 Validity and Reliability.....	62
3.5 Summary Insights.....	64
4 Analysis.....	65
4.1 Alpha.....	66
4.1.2 Alpha’s Green Initiatives.....	66
4.1.2.1 Vehicle Technologies in Alpha.....	67
4.1.2.2 Operational Strategies in Alpha.....	67
4.1.2.3 Truck Replacements in Alpha.....	68
4.1.2.4 Other Initiatives in Alpha.....	68
4.1.3 Alpha’s Drivers and Barriers.....	69
4.1.3.1 Organization-Related Factors in Alpha.....	70
4.1.3.2 Finance-Related Factors in Alpha.....	71
4.1.3.3 Market-Related Factors in Alpha.....	71
4.1.3.4 Government-Related Factors in Alpha.....	73

4.2 Beta.....	74
4.2.1 Beta’s Green Initiatives.....	74
4.2.1.1 Alternative Fuels in Beta.....	75
4.2.1.2 Vehicle Technologies in Beta.....	76
4.2.1.3 Operational Strategies in Beta.....	76
4.2.1.4 Truck Replacements in Beta.....	77
4.2.1.5 Other Initiatives in Beta.....	78
4.2.2 Beta’s Drivers and Barriers.....	78
4.2.2.1 Organization-Related Factors in Beta.....	78
4.2.2.2 Finance-Related Factors in Beta.....	80
4.2.2.3 Market-Related Factors in Beta.....	81
4.2.2.4 Government-Related Factors in Beta.....	82
4.2.2.5 Technology-Related Factors in Beta.....	83
4.3 Gamma.....	85
4.3.1 Gamma’s Green Initiatives.....	85
4.3.1.1 Alternative Fuels in Gamma.....	85
4.3.1.2 Vehicle Technologies in Gamma.....	86
4.3.1.3 Operational Strategies in Gamma.....	86
4.3.1.4 Truck Replacements in Gamma.....	87
4.3.2 Gamma’s Drivers and Barriers.....	87
4.3.2.1 Organization-Related Factors in Gamma.....	87
4.3.2.2 Finance-Related Factors in Gamma.....	88
4.3.2.3 Market-Related Factors in Gamma.....	88
4.3.2.4 Government-Related Factors in Gamma.....	89
4.3.2.5 Technology-Related Factors in Gamma.....	90
4.4 Delta.....	91
4.4.1 Delta’s Green Initiatives.....	91
4.4.1.1 Vehicle Technologies in Delta.....	91
4.4.1.2 Operational Strategies in Delta.....	92
4.4.1.3 Truck Replacements in Delta.....	92
4.4.1.4 Other Initiatives in Delta.....	93

4.4.2 Delta's Drivers and Barriers.....	93
4.4.2.1 Finance-Related Factors in Delta.....	94
4.4.2.2 Market-Related Factors in Delta.....	94
4.4.2.3 Government-Related Factors in Delta.....	96
4.4.2.4 Technology-Related Factors in Delta.....	97
4.5 Epsilon.....	98
4.5.1 Epsilon's Green Initiatives.....	98
4.5.1.1 Vehicle Technologies in Epsilon.....	98
4.5.1.2 Operational Strategies in Epsilon.....	99
4.5.1.3 Truck Replacements in Epsilon.....	99
4.5.2 Epsilon's Drivers and Barriers.....	100
4.5.2.1 Organization-Related Factors in Epsilon.....	100
4.5.2.2 Finance-Related Factors in Epsilon.....	101
4.5.2.3 Market-Related Factors in Epsilon.....	102
4.5.2.4 Government-Related Factors in Epsilon.....	102
4.5.2.5 Technology-Related Factors in Epsilon.....	103
4.6 Zeta.....	105
4.6.1 Zeta's Green Initiatives.....	105
4.6.1.1 Operational Strategies in Zeta.....	106
4.6.1.2 Other Initiatives in Zeta.....	106
4.6.2 Zeta's Drivers and Barriers.....	107
4.6.2.1 Organization-Related Factors in Zeta.....	107
4.6.2.2 Finance-Related Factors in Zeta.....	108
4.6.2.3 Market-Related Factors in Zeta.....	108
4.6.2.4 Government-Related Factors in Zeta.....	109
4.6.2.5 Technology-Related Factors in Zeta.....	109
4.7 Eta.....	110
4.7.1 Eta's Green Initiatives.....	110
4.7.1.1 Vehicle Technologies in Eta.....	110
4.7.1.2 Operational Strategies in Eta.....	111
4.7.2 Eta's Drivers and Barriers.....	111

4.7.2.1 Organization-Related Factors in Eta.....	111
4.7.2.2 Finance-Related Factors in Eta.....	112
4.7.2.3 Market-Related Factors in Eta.....	113
4.7.2.4 Government-Related Factors in Eta.....	113
4.7.2.5 Technology-Related Factors in Eta.....	114
4.8 Theta.....	115
4.8.1 Theta’s Green Initiatives.....	115
4.8.1.1 Vehicle Technologies in Theta.....	115
4.8.1.2 Operational Strategies in Eta.....	116
4.8.1.3 Truck Replacements in Theta.....	117
4.8.2 Theta’s Drivers and Barriers.....	117
4.8.2.1 Finance-Related Factors in Theta.....	118
4.8.2.2 Market-Related Factors in Theta.....	119
4.8.2.3 Government-Related Factors in Theta.....	121
4.8.2.4 Technology-Related Factors in Theta.....	122
5 Discussion.....	124
5.1 An Overview of Green Initiatives Adopted by the Studied Companies.....	125
5.1.1 Alternative Fuels Adopted by the Studied Companies.....	125
5.1.2 Vehicle Technologies Adopted by the Studied Companies.....	129
5.1.3 Operational Strategies Adopted by the Studied Companies.....	131
5.1.4 Truck Replacements Adopted by the Studied Companies.....	134
5.1.5 Other Initiatives Adopted by the Studied Companies.....	135
5.2 An Overview of Drivers and Barriers in the Studied Companies.....	137
5.2.1 Organization-Related Factors in the Studied Companies.....	138
5.2.2 Finance-Related Factors in the Studied Companies.....	142
5.2.3 Market-Related Factors in the Studied Companies.....	144
5.2.4 Government-Related Factors in the Studied Companies.....	148
5.2.5 Technology-Related Factors in the Studied Companies.....	150
5.3 Summary Insights.....	151

6 Conclusion.....	154
6.1 Final Remarks.....	155
6.2 Implications.....	157
6.3 Limitations.....	160
6.4 Future Research Avenues.....	160
Appendices.....	163
Reference List.....	171
Glossary.....	184

List of Tables

Table 1: Studies Dealing with Green Initiatives Adopted by LSPs (2010-2018).....	16
Table 2: Framework of Green Initiatives.....	27
Table 3: Studies Dealing with Drivers/Barriers Affecting the Adoption of Green Initiatives (2008-2018)28	
Table 4: Framework of Drivers and Barriers.....	42
Table 5: Components of Merriam’s Case Study Approach.....	50
Table 6: Summary of Eight Small-to-Medium Sized Trucking Companies Studied.....	54
Table 7: Intercooder Reliability Test Results for Three Coders.....	60
Table 8: Green Initiatives Adopted by Alpha.....	66
Table 9: Drivers and Barriers Influencing the Adoption of Green Initiatives by Alpha.....	69
Table 10: Green Initiatives Adopted by Beta.....	74
Table 11: Drivers and Barriers Influencing the Adoption of Green Initiatives by Beta.....	78
Table 12: Green Initiatives Adopted by Gamma.....	85
Table 13: Drivers and Barriers Influencing the Adoption of Green Initiatives by Gamma.....	87
Table 14: Green Initiatives Adopted by Delta.....	91
Table 15: Drivers and Barriers Influencing the Adoption of Green Initiatives by Delta.....	93
Table 16: Green Initiatives Adopted by Epsilon.....	98
Table 17: Drivers and Barriers Influencing the Adoption of Green Initiatives by Epsilon.....	100
Table 18: Green Initiatives Adopted by Zeta.....	105
Table 19: Drivers and Barriers Influencing the Adoption of Green Initiatives by Zeta.....	107
Table 20: Green Initiatives Adopted by Eta.....	110
Table 21: Drivers and Barriers Influencing the Adoption of Green Initiatives by Eta.....	111
Table 22: Green Initiatives Adopted by Theta.....	115
Table 23: Drivers and Barriers Influencing the Adoption of Green Initiatives by Theta.....	118
Table 24: A Summary of the Green Initiatives Adopted by the Studied Companies.....	125
Table 25: A Summary of the Drivers and Barriers Identified in the Studied Companies.....	138

List of Figures

Figure 1: Growth of Global Carbon Dioxide (CO ₂) Emissions from Fossil Fuels, 1900-2014.....	2
Figure 2: North American Freight Value by Mode (in Billions USD), 2017.....	5
Figure 3: Vehicle Technologies in Trucking and Estimated Fuel Savings %	27

List of Appendices

Appendix A: Ethics Approval of Current Study.....	163
Appendix B: Interview Guide.....	164
Appendix C: Coding of Types of Green Initiatives in NVivo.....	165
Appendix D: Coding of Organization-Related Drivers and Barriers in NVivo.....	166
Appendix E: Coding of Finance-Related Drivers and Barriers in NVivo.....	167
Appendix F: Coding of Market-Related Drivers and Barriers in NVivo.....	168
Appendix G: Coding of Government-Related Barriers in NVivo.....	169
Appendix H: Coding of Technology-Related Drivers and Barriers in NVivo.....	170

1 Introduction

This thesis is the study of the current state of environmental sustainability in the Canadian logistics market, with a main focus on the *trucking* sector. Hence, through the use of a *multiple*-case study approach, this thesis sets out to explore: (1) the types of “green” initiatives that have been adopted by small-to-medium sized Canadian trucking companies based in Ontario, and (2) the *main* drivers and the barriers that can affect such trucking companies’ adoption of green initiatives.

The purpose of this chapter is to provide a sufficient knowledge in order for the reader to gain an understanding of the *context* of the topic under investigation. As such, this chapter provides an overview of: (1) the need for “green” research in the Canadian logistics market, and (2) the significance of the trucking sector in Canada – both in terms of its economic contribution, as well as its negative environmental impact.

Furthermore, the market structure and current trends in the Canadian trucking sector are discussed. Additionally, the objectives and aims of the study (along with the main research questions) are outlined. Moreover, the uniqueness of Canada as research infrastructure is highlighted, and the scope and focus of the thesis are presented. Lastly, the chapter concludes with an outline of the structure of this thesis.

In order to provide the reader with a clear understanding of the main concepts and terminology used in this thesis, definitions of the central terms are provided (see Glossary). This is to ensure increased clarity for the reader and *consistent* meaning of terminology used in the thesis.

1.1 Need for “Green” Research in the Canadian Logistics Market

Environmental sustainability has become a trending topic worldwide – particularly in the last couple of decades (Centobelli et al., 2017). According to the United States Environmental Protection Agency (EPA) (2017), this increasing focus on environmental issues is attributed to the alarming growth of emissions worldwide since the 1990’s (see Figure 1).

Figure 1. Growth of Global Carbon Dioxide (CO₂) Emissions from Fossil Fuels, 1900-2014

(United States Environmental Protection Agency, 2017)

As shown in Figure 1, global CO₂ emissions from fossil fuels have significantly increased from 1990 to 2014. More alarmingly, since 1970, global CO₂ emissions have increased 90%, with emissions from fossil fuel combustion contributing to 78% of the total greenhouse gas (GHG) emissions increase from 1970 to 2011 (United States Environmental Protection Agency, 2017).

Evidently, the world is experiencing an emissions growth problem (Carrington, 2018). For such reason, governments have started to react more strongly – particularly in the 1990’s – by imposing more stringent environmental regulations to counteract the negative impact on the environment caused by society (Isaksson, 2012). For instance, in 1994, a number of countries across the globe ratified an international environmental treaty called the United Nations Framework Convention on Climate Change (UNFCCC). The aim of this international treaty was to circumvent the rise of global emissions – primarily by setting clear emissions reductions targets – with the expectation of developed countries (e.g., United States, Canada, United Kingdom, Australia, Germany, Japan, etc.) to lead the way in cutting emissions over a specified period of time (United Nations Climate Change, n.d.).

Additionally, following the establishment of the UNFCCC, several agreements on emissions reductions targets – that are binding under international law – have come into effect. These include the 1st Kyoto Protocol Agreement (with a commitment period from 2008 to 2012); the 2nd Kyoto Protocol Agreement (with a commitment period from 2013 to 2020); and, the most recent Paris Agreement, which entered into force in November 2016 (European Council, 2018).

Furthermore, in 2018, the United Nations Panel on Climate Change released a report emphasizing the need to *focus* on reducing emissions from the *transportation* sector, specifically (Bliss, 2018). According to the Panel, transportation is the *only* sector in which emissions are rapidly increasing, and in 2014, it accounted for almost one-fourth of the CO₂ emissions *worldwide* (Bliss, 2018). Thus, the logistics industry has lately started to receive increased attention with regards to reducing its environmental impact.

Traditionally, the logistics sector is viewed as separate from the wider supply chain – and is often described as the least integrated link – in which the primary focus is on reducing costs (Isaksson, 2012). However, in this industry, logistics service providers (LSPs) have consistently played an important role by *supporting* supply chain activities – that is, primarily by providing knowledge and transportation assets for members in the supply chain (Spens & Bask, 2002).

However, in recent years, the role of LSPs has started to change as increasing competition in global supply chains have caused supply chain members to recognize that the actions undertaken by LSPs can significantly influence the performance of the entire supply chain (Ju et al., 2019). This development of the role of LSPs puts these actors in an important position to improve the overall environmental sustainability of supply chain activities – primarily by “greening” their transportation operations.

Moreover, in the *academic* community, green practices in the *logistics* sector have only *recently* started to gain attention by international scholars as most of the studies in the last decade focused on the *manufacturing* industry (Centobelli et al., 2017). Furthermore, according to Evangelista et al. (2018), academic interest for environmental sustainability issues in the logistics industry was insignificant until the 2014 to 2016 time period, where researchers started to demonstrate increased interest for the topic. Additionally, Evangelista et al. (2018) highlighted that there is a lack of research on the topic in North America – particularly Canada.

Unfortunately, North America is the second largest contributor (after China) to global CO₂ emissions as of 2016 (Ritchie & Roser, 2017). Furthermore, in Canada and the United States, the transportation sector is one of the largest contributors to emissions growth (Plumptre, 2018; Irfan, 2019). Moreover, according to a study conducted by the University of Toronto’s Faculty of Applied Science & Engineering (2018), *trucking* is one of the biggest culprits of pollution. Additionally, according to the United States Department of Transportation (2018), “trucks continued to be the most heavily utilized mode for moving goods” (para. 3) in the region; thus, trucking is the dominant mode of transportation in North America in terms of both value and volume. For instance, trucking contributed to \$720.8 billion of the \$1.1 trillion USD in freight flows in North America in 2017 (see Figure 2). Additionally, trucks carried the largest share of total freight volume (57.7%) in the region in 2017.

Figure 2. North American Freight Value by Mode (in Billions USD), 2017

(United States Department of Transportation, 2018)

Furthermore, Canada – which along with the United States, is one of the developed countries who is expected to lead the way in reducing emissions under the UNFCCC – is currently exhibiting poor environmental performance (Gatehouse, 2018). In 2015, Canada committed to reduce its emissions by 30% by 2030 under the Paris Agreement; however, 2019 estimates show that Canada is not on track to meet its climate goals and that under even the most optimistic scenario, will only achieve 19% emissions reduction by 2030 (Lewis, 2019).

Moreover, actions to reduce emissions in the *transportation* sector are inefficient and generally neglected in Canada as most governmental efforts are directed towards promoting fossil-fuel exploration and production (Lewis, 2019). As a result, in 2017, the transportation sector was the *second* largest source of emissions in Canada, accounting for 24% of the total GHG emissions in the country (Government of Canada, 2019). Moreover, since 1990, emissions from transportation have increased by 43% in Canada,

which was mainly driven by an increase of emissions from *freight* transportation activities – that is, *trucking* (Government of Canada, 2019). More alarmingly, by 2030, emissions from *freight* transportation are projected to surpass emissions from *passenger* transportation in Canada (Lee, 2019). Evidently, trucking is the *dirtiest* mode of freight transportation in Canada when compared to rail, air, and maritime transportation (Natural Resources Canada, 2018).

Furthermore, among the 10 provinces in Canada, Ontario and Alberta emit the most emissions in the country (Warzecha, 2015). Ontario, however, is the primary source of *transportation* emissions in the country, and currently, the transportation sector is responsible for the largest and fastest growing share of GHG emissions in the province (Environmental Commissioner of Ontario, 2016). Furthermore, in Ontario, emissions from transportation have increased by 28% since 1990, with the most dramatic emissions growth coming from *trucking*, which has seen a 108% increase in emissions since 1990 (Environmental Commissioner of Ontario, 2016).

Additionally, most of the trucking business in Canada is concentrated in Ontario. Out of 78,532 trucking companies in Canada, 36,819 of them – or roughly 47% – are based in Ontario (Government of Canada, 2018a). Moreover, in Ontario, only *five* trucking companies are considered “large-sized”, having more than 500 employees (Government of Canada, 2018a), with most of the trucking companies being small-to-medium sized businesses, having less than 150 employees (Kilcarr, 2017), as is generally the norm for the rest of Canada. Therefore, it can be said that *small-to-medium sized* trucking companies greatly contribute the province’s pollution and thus are most fruitful to study on the topic of greening transportation operations.

1.2 The Canadian Trucking Sector

Trucking is the main method of transportation in Canada as more than 90% of all goods in the country are transported by trucks (Canadian Trucking Alliance, 2019a). Moreover, trucking is a \$65-*billion* industry in Canada and the GDP generated by the trucking industry alone is three times that of rail,

maritime, and air transportation *combined* (Canadian Trucking Alliance, 2019a). Furthermore, demand for trucking services in Canada is expected to significantly grow post-2020, with freight volumes projected to increase 3.4% through 2023 (Canadian Trucking Alliance, 2017).

Additionally, Canadian trucking companies operate in a *hypercompetitive* market (Government of Canada, 2018a). As highlighted in Section 1.1, there are almost 79,000 trucking companies in the country of which almost all are *small-to-medium sized* businesses. Furthermore, in the trucking sector, companies compete on price and reliability of service. The primary aim of any trucking company is to lower its costs of doing business by reducing overall fuel consumption – this is because fuel is the single largest expense in trucking companies (Goddyn, 2018).

Moreover, there are four main trends presently affecting the Canadian trucking sector.

First, the Canadian trucking industry is plagued with a severe shortage of truck drivers, with most trucking companies not having enough drivers to operate their trucks. According to a study conducted by the Canadian Trucking Alliance (CTA) in 2011, analysts predicted that the trucking industry would be short 33,000 drivers by 2020 (Canadian Trucking Alliance, 2016). However, more recently, it has been found that the truck driver supply and demand gap is escalating more rapidly than analysts previously projected. For instance, according to study conducted by the CTA in 2016, analysts forecasted that the driver shortage would increase to 48,000 drivers by 2024 and would be highest in the provinces of Ontario and Québec (Canadian Trucking Alliance, 2016). The trucking industry is going as far as recruiting *ex-military* personnel to fill truck driver positions (Atchison, 2018). Additionally, fully automated trucks will not be operational before 2024 and thus cannot be counted on to resolve the truck driver shortage (Canadian Trucking Alliance, 2016). As a result, the Canadian trucking industry is currently scrambling to find a way to deal with this issue as, according to Stephen Laskowski, the President of the CTA, “*I would say the most dire consequence of the trucking industry not resolving the driver shortage is a chilling effect on investment in the Canadian economy*” (Atchison, 2018, para. 8).

Second, the driver shortage is closely linked with another issue presently affecting the trucking industry: the rapidly aging workforce. Currently, the trucking industry has one of the oldest workforces in the country, with an average age of 47 years and rising, and with a *third* of the drivers over 55 years (Canada Immigration, 2017). Many of these drivers are near retirement. Additionally, the industry is struggling to attract a younger generation of workers (Lowrie, 2016). Younger generations (i.e., aged 18 to 30 years) are not interested driving trucks nor in working in the trucking industry, as they seek careers that allow them better work-life balance and view jobs in the trucking sector as stressful (Atchison, 2018).

Third, on April 1, 2019, the Canadian government implemented a *nation-wide* carbon tax which taxes fossil fuels in order to reduce their overall consumption and thus help lower the country's emissions (Harrison, 2019). The federal and provincial governments originally agreed to establish a Canada-wide price on carbon pollution; however, with provinces having some flexibility to devise their own policies. Nonetheless, for those provinces that were unable to devise their own policies in accordance with federal regulations, they would be required to adopt the federal government's conditions of the carbon tax system. In 2018, all provinces in Canada satisfied the federal government's conditions except Ontario, Manitoba, New Brunswick, and Saskatchewan (Harrison, 2019). In 2019, however, these four provinces were required to adopt the policies outlined by the federal government in relation to the enactment of carbon taxes. The Canadian trucking industry, however, is not in favour of such enactment of carbon taxes (Canadian Trucking Alliance, 2019b). The industry, which is dominated by many small companies and competes on very tight margins, will face challenges in absorbing higher fuel costs resulting from the carbon tax. For instance, even if diesel fuel prices were to remain flat over the next four years, given the carbon tax alone, the cost of diesel fuel will increase by 18% by 2022 (Ontario Trucking Association, 2019).

Fourth, in addition to the rising costs of doing business as a result of the recently imposed carbon tax, the new Canadian Electronic Logging Device (ELD) mandate will provide yet another increase in the costs of doing business for the trucking sector. The ELD mandate, which is set to roll out in June 2019 in Canada, and with full implementation required by 2020, requires that trucking companies transition from

using paper logs to computerized logs to track their drivers' working hours (Truck News, 2019). Such computerized tracking of drivers' hours will be done through an ELD, which is a device that is hooked onto the truck's engine control module and stores information in a standardized format that cannot be altered. The primary purpose of implementing ELD's is to reduce the amount of errors occurring when drivers record their hours. However, the adoption of ELD's will significantly raise the costs of doing business in the trucking sector. For instance, ELD's range from \$300 to \$900 per unit; the associated installation cost is \$220 per device and the activation fee is \$15 per unit; the monthly monitoring service fee is approximately \$30; the driver training costs amount to an estimated \$48 per month; and, the inspector training is about \$457 per person (Ontario Trucking Association, 2016).

As a result of the four main trends – particularly the driver shortage – Canadian analysts claim that “*a crisis is looming in the transportation industry*” (Wilson, 2017, para. 1).

1.3 Research Objectives, Aims, and Questions

Given the following:

1. The scarcity of research on the topic of environmental sustainability in logistics – specifically in the trucking sector (Centobelli et al., 2017)
2. The lack of research focus on the topic in the *North American* region (Evangelista et al., 2018)
3. North America's *significant* contribution to *global* emissions
4. Canada's projected *failure* in meeting its 2030 emissions reduction target
5. And, the *alarming* growth of Canada's emissions from *trucking* transportation,

my main objectives are: (1) to fill a knowledge gap in the literature by exploring a region previously understudied on the topic of environmental sustainability in logistics (i.e., Canada), and (2) to investigate the current state of environmental sustainability in logistics in Canada so as to provide exploratory insights that can be of use in helping Canada reduce its emissions in light of the country's 2030 climate goals.

Furthermore, according to Isaksson (2012), there will be a need of guidance on the topic of environmental sustainability in logistics, as integrating green initiatives in an LSPs' business will require even more managerial attention in the future. Therefore, the two main aims of my research are to:

1. Discover the current *state* of adoption of green initiatives in the Canadian trucking sector by studying *small-to-medium sized* trucking companies in Ontario
2. Reveal *deeper* insights into the adoption of green initiatives by gaining an understanding of how different drivers can *initiate* the adoption of green initiatives, which could subsequently help clarify how trucking companies can progress further in greening their operations. Additionally, identifying the barriers that can impede the adoption of such initiatives can help expose the type of actions that need to be taken to help facilitate trucking companies' adoption of green initiatives in the future.

As such, the *two main research questions* this study sets out to answer are as follows:

1. What are the green initiatives that have been adopted by small-to-medium sized trucking companies in Ontario?
2. What are the drivers and barriers that can affect the adoption of green initiatives by small-to-medium sized trucking companies in Ontario?

As argued by Lin and Ho (2008), not all logistics companies are exposed to the same type of pressure or to the same extent. Thus, I intend to explore how the *perception* of drivers and barriers varies between *different* trucking companies when adopting green initiatives, hence my decision to conduct a *multiple-case study*.

1.4 Scope and Focus

The *main* focus of the current study concerns the *types of green initiatives* that have been adopted by small-to-medium sized trucking companies in Ontario as well as the *main drivers* and *barriers* than can affect their adoption of such initiatives. Given that there is a lack of research on this topic (and the fact the

LSPs are argued to be in the early stages of green logistics development), this limits the boundaries of the *scope* and *focus* of the current study.

First, I do *not* aim to provide a *comprehensive* picture of Ontarian trucking companies' green situation. Rather, I intend to offer a *current* "snapshot" of the types of green initiatives that have been adopted by the companies and the associated drivers and barriers *as of the day* a company was studied.

Second, my intention is *not* to provide a comprehensive spectrum of *all* the drivers and barriers that can affect the adoption of green initiatives. Instead, by using a selection of commonly cited drivers and barriers in the literature, as well as welcoming new drivers and barriers emphasized by the studied companies, my aim is to offer *exploratory* (i.e., preliminary) insights, given that Canada is a region that has not yet been examined.

Third, in studying the types of green initiatives that have been adopted, note that: (1) I do *not* intend to focus on the technological aspects of green initiatives (i.e., how, for instance, certain vehicle technologies *technically* work); rather the focus is more on "have or have not" companies adopted green initiatives and if so, which ones; and (2) I do *not* intend to focus on assessing whether the adoption of green initiatives led to a decreased environmental *impact* (i.e., by *how much*, for instance, were CO₂ emissions reduced as a result of implementing a particular type of green initiative).

1.5 Canada as Research Infrastructure

Canada is an interesting region to conduct research on the adoption of green initiatives in road freight transportation (i.e., trucking) for two main reasons.

First, with a land area of almost 10 million km² (i.e., the second largest country in the world), Canada has both a *vast* and *varying* geography across different provinces and territories, as well as harsh climates that make it a very difficult and expensive environment in which to conduct transportation (Government of Canada, 2018b). With such an extensive territory, road transportation in Canada is characterized by *long distance* travel and through *varying topographies*. In addition, temperatures can fall

as low as 40 degrees below zero in Canada (Olawale, 2019). The country is also prone to heavy snowfall, having more than six months of snow-covered grounds per year. As such, variable weather characterized by continuous freeze-thaw cycles significantly disrupt transportation flow in the country as roads require constant repairs. However, the construction of *all-season* roads to support variable weather is very expensive. For instance, it costs roughly \$600,000 to build only 1.5 kilometres of all-season road in Canada (Levin, 2017).

Second, though Canada is the second largest country, its road network is *significantly* underdeveloped for its land size and constitutes as only the seventh largest road network in the world, after that of the U.S, China, India, Brazil, Russia, and Japan (Road Traffic Technology, 2014). While there are about 1.13 million kilometres of roads in Canada, approximately 60% of the road network is *unpaved* (Government of Canada, 2018b). This makes road transportation – which is the *dominant* mode of transportation in the country – particularly challenging. In fact, only four provinces (i.e., Ontario, Québec, Saskatchewan, and Alberta) account for more than 75% of the total road length in which most of the roads are concentrated in the southernmost areas of the country, close to the U.S. border (Government of Canada, 2018b).

Given such realities in terms of vast land size and harsh climates, it is also interesting to investigate how such conditions *unique to Canada* might affect the adoption of green initiatives in logistics.

1.6 Outline of Thesis

In order to provide the reader with an overview of the structure of this thesis, this section presents a summary of the six chapters included in this thesis, along with a brief discussion of each chapter's main contents.

- **Chapter 1 – Introduction:** This chapter presents a discussion on the background of environmental sustainability in logistics in order to highlight the lack of academic research on the topic – particularly in Canada. The chapter also offers an introduction to the growth of emissions in

Canada, as well as an overview of the Canadian trucking sector and its environmental impact, which forms the basis of the study's focus. Such background is provided to situate the main objectives, aims, and research questions that form the foundation of the work.

- **Chapter 2 – Literature Review:** This chapter begins by providing a brief account of the development of green logistics over time. Additionally, the global academic literature is reviewed in order to offer summary insights into: (1) the types of green initiatives that have been adopted in other regions in the world, and (2) the prevalent drivers and barriers affecting the adoption of such initiatives. The purpose of the literature review is to establish the theoretical foundation of the work, which will serve as a guide for the study.
- **Chapter 3 – Methodology:** This chapter presents the qualitative research approach (i.e., multiple-case study of eight small-to-medium sized trucking companies in Ontario) used in the thesis and consists of sections that discuss components of the research design process (e.g., assumptions, semi-structured interview design, validity and reliability of analytic procedure and research findings, etc.). Additionally, an explanation of the data analysis procedure is provided.
- **Chapter 4 – Analysis:** This chapter presents the main findings from each of the eight trucking companies studied via detailed individual case reports.
- **Chapter 5 – Discussion:** The purpose of this chapter is to summarize the main research findings from each individual case (i.e., presented in Chapter 4), and to provide a supporting discussion on the reasoning behind the findings and how they compare to the results uncovered by other studies in the reviewed literature.
- **Chapter 6 – Conclusion:** This chapter offers the concluding remarks for the study. Additionally, the implications and limitations of the work are discussed, and suggestions for future research avenues are offered.

2 Literature Review

This chapter presents the reviewed academic literature, which led to the development of the theoretical framework of the study.

The chapter begins by providing a brief overview of the development of green logistics over time. Following, in-depth discussions on: (1) the *types of green initiatives* that have been adopted by LSPs, and (2) the *main drivers* and *barriers* that can affect LSPs' adoption of such initiatives – that have been identified from the literature – are provided in order to highlight the current state of research with regards to the two main topic areas of the current work.

Studies conducted in different regions in the world (e.g., North America, Europe, Asia-Pacific, and Africa) were examined in order to provide a synthesized account of the two topics under consideration. As such, the purpose of this chapter is to position the current study against the extant literature. Hence, the chapter concludes with a summary discussion that highlights the novelty of the work.

2.1 The Development of Green Logistics

As a result of increased globalization over the last few decades, the requirements of LSPs have grown significantly. The principal goal of logistics companies in the 21st century is to introduce *service* innovations to the market at a faster rate (Isaksson, 2012). Thus, at the beginning of the century, many LSPs started implementing measures to broaden the scope of their services (Murphy & Daley, 2001). Such efforts have mainly been undertaken to improve customer service levels as customers have started to increasingly demand more *extensive* provisions of LSPs, such as value-added and technologically-sophisticated services (as cited in Evangelista, 2014). As such, the transformation of the scope of logistics service offerings has necessitated that LSPs develop new service strategies, some of which include providing customized services while ensuring greater flexibility to accommodate for the constantly changing requirements of both customers and the wider society. One of these prevalent demands of modern-day is the provision of more environmentally-friendly logistics services (Isaksson, 2012).

The work of Wu and Dunn (1995) pioneered research in the field of green logistics. Over the years, several other authors extended this work (see, e.g., Wee et al., 2005; McKinnon & Piecyk, 2009). Nowadays, actions to decarbonize the road freight sector primarily involve focusing on reducing fuel consumption, running a more environmentally-friendly fleet of vehicles, and consolidating goods (Tacken et al., 2014). However, specific examples of such actions and their respective classification greatly vary in the literature.

As shown in Table 1, I have identified 15 relevant studies, spanning the 2010 to 2018 time period, that specifically address the types and/or classification of green initiatives implemented by LSPs. To conduct the literature review search, I have primarily used the Ryerson University Library and Archives database along with Google Scholar. My initial search string comprised of the following keywords: “sustainability”, “green initiatives”, “environmental” in combination with “logistics” or “logistics service provider”, with the filter of only peer-reviewed papers used in the search process. As a limited amount of papers were found initially, the search string was revised to include additional keywords that were used in the papers that were originally identified. Thus, the keywords of: “CO₂ emissions”, “decarbonization”, and

“carbon footprint” in combination with “LSP”, “third party logistics”, “3PL”, “TPL”, “freight transportation”, and “trucking” were added to the initial search string.

Table 1

Studies Dealing with Green Initiatives Adopted by LSPs (2010-2018)

Author(s) and Year	Method	Location	Area of Focus	
			Types of Green Initiatives	Classification of Green Initiatives
Lieb and Lieb (2010a)	Survey	North America	●	
Lieb and Lieb (2010b)	Survey	North America Europe Asia-Pacific		●
Jumadi and Zailani (2010)	Conceptual	Malaysia		●
Perotti et al. (2012)	Case Study	Italy		●
Pieters et al. (2012)	Survey	Netherlands	●	●
Liimatainen et al. (2012)	Survey	Finland	●	
Colicchia et al. (2013)	Case Study	Italy	●	●
Tacke et al. (2014)	Case Study	Germany	●	●
Zhang et al. (2014)	Survey	China	●	●
Evangelista (2014)	Case Study	Italy	●	●
Liimatainen et al. (2014)	Survey	Scandinavia	●	
Pålsson and Johansson (2016)	Survey	Sweden	●	●
El Baz and Laguir (2017)	Case Study	Morocco	●	●
Evangelista et al. (2017)	Case Study	Italy & U.K.	●	●
Sureeyatanapas et al. (2018)	Survey	Thailand	●	●
Current Study	Case Study	Canada	●	●

It is interesting to note that an increasing number of papers have been published from 2013 onwards (refer to Table 1). Perhaps this can be explained by the emergence of more stringent environmental regulatory pressure worldwide as 2013 marked the start of the second Kyoto Protocol commitment period (i.e., active from 2013 to 2020) under the United Nations Framework Convention on Climate Change (Evangelista et al., 2018). As a result, greater focus worldwide on environmental compliance may have stimulated interest in research related to green logistics in the last five to six years.

Additionally, following the start of the second Kyoto Protocol commitment period in 2013, Tacke et al. (2014) initiated research in the field of carbon-reducing initiatives in the German logistics sector. Their results confirmed the findings previously described in the literature on the topic of green initiatives in logistics as well the influencing factors affecting their adoption. As a result, the authors stressed that

more information about green initiatives and the related drivers and barriers is needed in order to extend research in this domain and thus support climate commitments leading up to 2020. As a result, Tacke et al. (2014) called for new studies in previously unexplored geographical regions, such as Canada, in order to gain broader insights. Hence, the significance and contribution of the current study.

2.2 A Review of Green Initiatives Adopted in the Global Logistics Industry

2.2.1 North America

The work of Lieb and Lieb (2010a) was the first to investigate specific green initiatives implemented in logistics. Since 1994, the authors have provided insights into the logistics industry from the LSPs' perspective by conducting annual surveys of CEOs of some of the largest logistics and supply chain companies in the world such as DHL, UPS, Kuehne + Nagel, Ceva, Penske, Ryder, Panalpina, and DB Schenker. Their 2008 survey was the first to examine LSPs involvement in environmental sustainability issues. This was primarily because during this period, the 2008-2009 recession was well underway – particularly in North America. Moreover, this was a time that was marked by increasing fuel prices and a greater focus on branding efforts by global logistics companies operating in North America. As a result, the authors decided to survey CEOs of large LSPs operating in North America (with headquarters primarily in the U.S.) on the topic of green initiatives. They discovered that the most frequently mentioned initiative was participation in the SmartWay compliance program (Lieb & Lieb, 2010a), which is a public/private partnership between the EPA of the U.S., Natural Resources Canada, and the North American logistics industry. The primary aim of this partnership is to help logistics companies pursue more environmentally-friendly operations by tracking and monitoring their fuel efficiency, benchmarking their results against companies with similar fleets, reducing operating costs and emissions, and attracting business from SmartWay shippers (Kuzeljevich, 2012).

Additionally, the authors highlighted several other initiatives mentioned by CEOs such as retrofitting the company's fleet with more fuel-efficient vehicles, investing in routing software, consolidating

shipments, developing formal environmental strategies, establishing specific units within the company to drive environmental changes, recycling office supplies, and reducing printed materials produced by the company (Lieb & Lieb, 2010a).

In order to further extend their research, the authors conducted another survey in 2010 to examine whether the 2008-2009 recession had an impact on LSPs commitment to environmental sustainability. However, this time, they widened the geographical scope of their study to include Europe and Asia-Pacific. Interestingly, the authors discovered that LSPs involvement in green issues *grew* following the recession. In fact, the green initiatives that logistics companies implemented increased in *breadth*.

As a result, the work of Lieb and Lieb (2010b) was the first to offer an overarching *classification* of green initiatives. As such, the authors divided green initiatives into the following four categories: (1) *administrative activities* (such as setting specific environmental metrics, establishing departments to oversee sustainability efforts, etc.); (2) *analytical activities* (such as purchasing evaluation software, monitoring a company's carbon footprint, etc.); (3) *transportation-related activities* (such as experimenting with biodiesel, hydrogen, natural gas, shifting freight to more fuel-efficient modes, limiting the speeds at which vehicles are operated, reducing idling times, sharing vehicles, purchasing newer vehicles, etc.); and (4) *"other" activities* (such as recycling materials, installing solar panels in facilities, pursuing green certifications, etc.). They discovered that most of the surveyed logistics companies adopted initiatives from the *analytical* category.

Overall, the North American region is understudied in the literature with regards to green initiatives in logistics. This is particularly the case with Canada, as this country has not been previously investigated. This is in line with the recent findings of Evangelista et al. (2018).

2.2.2 Europe – Italy

As a result of the development of an increased need for more *integrated* logistics solutions over time, several studies distinguished between green initiatives implemented by LSPs *in-house* and those that

require *collaboration* among various stakeholders *external* to the company. Most of these studies focused on the European context – particularly on Italian LSPs. For instance, Colicchia et al. (2013) differentiated between *intra-organizational* and *inter-organizational* environmental logistics practices, respectively. According to their study, *intra-organizational* activities involve initiatives as part of five categories: (1) *transportation execution* (such as using alternative fuels, purchasing latest-model equipment, vehicle speed reduction to save fuel and reduce emissions, routing systems to minimize travel distances, utilizing maximum vehicle capacity, etc.); (2) *warehousing and green building* (such as using energy-efficient heating in buildings, green material handling equipment, etc.); (3) *reverse logistics* (such as waste reduction and proper material disposal, recycling materials, etc.); (4) *packaging management* (such as using ecological materials for primary packaging); and (5) *internal management* (such as employee training, providing incentives for green-behaviour practices within the company, establishing sustainability-dedicated groups, etc.). On the other hand, *inter-organizational* activities involve initiatives as part of two categories: (1) *collaboration with customers* (such as cooperating with customers on recycling programs, helping customers attain their green goals, etc.), and (2) *external collaboration* (such as collaborative partnerships with other LSPs, membership in environmental programs, etc.). Following their case study of 10 medium and large-sized Italian LSPs, it was found that *intra-organizational* initiatives in the area of *transportation execution* are most commonly implemented (Colicchia et al., 2013).

Similarly, Evangelista (2014) and Evangelista et al. (2017) studied the Italian logistics market and distinguished between *point* and *supply chain* initiatives – that is, measures implemented within the boundaries of the company and those that imply greater collaboration with various supply chain parties, respectively. Both studies grouped *point initiatives* into six categories: (1) *vehicle use* (such as reducing empty running, improving vehicle loading, etc.); (2) *transport modes* (such as using lower energy transport modes, greater use of intermodal transportation, etc.); (3) *energy efficiency* (such as using alternative and renewable energy, etc.); (4) *recycling materials and packaging* (such as reducing packaging, etc.); (5) *warehousing and green building* (such as efficient land use, eco-friendly building design, etc.); and (6)

environmental training (e.g. training for eco-driving and tire pressure monitoring, etc.). On the other hand, *supply chain initiatives* were grouped into three categories: (1) *supply chain re-organization* (such as transport planning, route optimization, etc.); (2) *supply chain collaboration on shared green targets* (such as with customers, with other LSPs, etc.); and (3) *collaborative planning and environmental control* (such as setting lower GHG emissions targets, pursuing Environmental Management Systems such as ISO 14001, etc.). The study of Evangelista (2014) uncovered three different environmental profiles of small and medium-sized Italian LSPs. For the first group of LSPs, cost savings were the main priority, hence this group of LSPs adopted a limited breadth of green initiatives and primarily focused on point initiatives. The second group of LSPs, however, adopted a mix of point and supply chain initiatives and thus showed a greater environmental sensitivity than the previous group. Lastly, the third group – which was a minority – demonstrated an increasing environmental awareness as they started to focus more on supply chain initiatives. As such, it was concluded that LSPs operating in the Italian logistics market are poorly engaged in green initiatives (Evangelista, 2014).

Evangelista and colleagues extended their study in 2017 to incorporate a *cross-country* comparison of medium-sized Italian and British LSPs. However, similar findings were uncovered to the previous study (see, Evangelista, 2014) as supply chain initiatives were still found to be underrepresented in both sub-samples (Evangelista et al., 2017). Interestingly, earlier case studies of Italian LSPs – such as the work of Perotti et al. (2012) – uncovered similar results. Though all sizes of LSPs were studied, *point initiatives* that focused on the *transportation execution* function (such as route optimization, the use of more environmentally-friendly fleets, etc.) were most widely adopted. In fact, Perotti et al. (2012) emphasized that supply chain initiatives requiring collaboration are underdeveloped and that, interestingly, these practices “are not among the *prospective* practices towards which companies have shown a *potential* interest” (p. 660). Thus, it can be concluded that from 2012 to 2017, Italian LSPs have not made a significant improvement to the environmental sustainability of their operations.

2.2.3 Europe – Germanic Countries

Countries such as the Netherlands, Germany, and especially Sweden, Finland, Norway, and Denmark have extensively been studied by scholars over the years. In fact, in their systematic review of the literature from 1960 to 2014 on the topic of environmental sustainability in logistics, Centobelli et al. (2017) highlighted that the “most *prolific* authors” belong to these countries (p. 458).

The Netherlands has been a leader in Europe in integrating environmental sustainability into the logistics sector (Pieters et al., 2012). The country has consistently been ranked as one of the top five countries in the World Logistics Performance Index from 2007 to 2016 (Baida, 2018). However, in 2018, the Netherlands dropped to sixth place, as it was surpassed by Germany, Sweden, Belgium, Austria, and Japan (Baida, 2018). Nonetheless, the Dutch government expressed that its aim is for the Netherlands to lead Europe by 2020 in environmentally responsible logistics. As such, the country is spearheading the trend towards greener mobility in Europe through its Lean and Green program first implemented by Connekt, a public-private Dutch network for more environmentally-friendly transportation. This program was first initiated by the Dutch Ministry of Infrastructure and the Environment in 2008 with a specific goal in mind: to reduce CO₂ emissions by at least 20% over a five-year period (Connekt, n.d.).

In assessing the effectiveness of Lean and Green, Pieters et al. (2012) investigated large Dutch LSPs who are frontrunners of the program. They discovered that 608 transport-related measures were implemented by Dutch LSPs, some of which included buying electric vehicles, formally training truck drivers on efficiently operating equipment, using more biofuels, and alternative modes of transportation. Given that a wide variety of green initiatives were found to be adopted by Dutch LSPs, the authors then classified the measures into four categories: (1) *internal measures* which are personally organized by LSPs; (2) *external measures* which require cooperation with other parties; (3) *innovating measures* which include measures that are previously unknown to the LSP; and (4) *optimizing measures* which deal with improving the efficiency of logistics operations. It is interesting to note that the first two categories of green initiatives (i.e., internal and external measures) suggested in the work of Pieters et al. (2012) are in line with the

classifications used in the previously discussed four studies of the Italian logistics market (see, e.g., Perotti et al., 2012; Colicchia et al., 2013; Evangelista, 2014; Evangelista et al., 2017). However, the work of Pieters et al. (2012) was the first to extend this two-category classification to acknowledge the presence of more *advanced* measures – such as those that deal with *innovative* and *optimizing* aspects of green logistics. In fact, Pieters et al. (2012) was the first to develop a “sustainability activity matrix” (p. 120) for logistics activities based on the four-category classification of green initiatives. For instance, some measures can be both internal and innovative such as implementing new software applications, or both external and innovative such as cooperating with *competitors*. Overall, the authors found that Dutch LSPs preferred solutions which involved cooperative strategies, which sharply contrasts the findings from the Italian logistics market, as previously discussed. They also concluded that for Dutch LSPs “sustainability is not a unique selling point anymore, it has become a common feature” (p. 119).

Similarly, in the German logistics sector, Tacke et al. (2014) more extensively classified green logistics initiatives when compared to the works of authors focusing on the Italian logistics market. In addition to proposing six categories of green logistics initiatives such as (1) *modal split* (e.g., modal shift); (2) *average handling factor* (e.g., network optimization); (3) *average length of haul* (e.g., route optimization); (4) *vehicle utilization* (e.g., consolidating goods, inter-company collaboration, increased backhaulage, etc.); (5) *vehicle fuel efficiency* (e.g., driver training, reducing vehicle weight, aerodynamic applications, effective vehicle maintenance, fleet management, improved tire performance, etc.); and (6) *carbon intensity of fuel used* (e.g., alternative fuel sources), the authors also distinguished between the decision-making level(s) of each initiative (such as tactical, operational, or strategic). Though most of the LSPs had implemented *operational* initiatives, it was also found that considerable importance was given to *collaborative* logistics practices in Germany (Tacke et al., 2014).

Furthermore, three other studies focused on the Scandinavian region. Liimatainen et al. (2012) and Liimatainen et al. (2014) have not provided classifications of green initiatives per se, but have identified a wide variety of measures implemented by Finnish, Danish, Swedish, and Norwegian LSPs. In 2012,

Liimatainen et al. (2012) surveyed Finnish LSPs to determine their implementation of 16 different green initiatives ranging from auxiliary power units for idle reduction, speed limits, driver training, low-rolling resistance tires, and aerodynamic add-ons to route optimization, truck replacements, and hybrid vehicles. They discovered that Finnish LSPs have mainly adopted route optimization. Though a large variety of actions were not implemented by *each* LSP, the authors found that about 10-20% of Finnish LSPs were in the process of implementing more sustainable initiatives from 2012 onwards. Likewise, they replicated the survey in 2014 to compare Finland against Sweden, Denmark, and Norway in terms of their level of implementation of green initiatives. In their study, however, Liimatainen et al. (2014) found that Finland was less engaged in the implementation of green initiatives compared to the other three Scandinavian countries. In fact, Norway had the widest variety of green initiatives implemented, while Denmark made the greatest use of route optimization when compared to other Scandinavian countries. Sweden, however, was most focused on *technical* initiatives that were related to vehicle technologies, such as aerodynamic add-ons and low-rolling resistance tires. However, the monitoring of fuel consumption was found to be rather similar among the four countries, with all of them having set *specific* fuel consumption targets (Liimatainen et al., 2014). The authors also reported that the type of industry an LSP serviced played a role in the adoption of green initiatives. For instance, LSPs transporting liquid products implemented more energy efficient measures than those carrying general cargo or dry bulk products.

Interestingly, the recent work of Pålsson and Johansson (2016) uncovered contrasting findings to that of Liimatainen et al. (2014) for the *Swedish* context. The authors found that Swedish LSPs are most likely to reduce emissions from *operational* changes, such as improved transport planning, driver training, and increasing load capacity.

According to the preceding literature review, it has been observed that Germanic countries – particularly those in the Scandinavian region – exhibit a strong focus on promoting environmental sustainability in their logistics sectors. This is in line with the findings of Isaksson and Huge-Brodin (2013)

who confirmed that “LSPs operating in the Scandinavian countries are perceived to have an established level of maturity in and sensitivity towards environmental issues” (p. 234).

2.2.4 Asia

A total of three studies conducted between 2010 and 2018 in Asian countries were uncovered from the review of literature. For instance, in their study of Malaysian LSPs, Jumadi and Zailani (2010) distinguished between five general categories of environmentally-friendly logistics initiatives, such as: (1) *green transportation*; (2) *green storage*; (3) *green packing*; (4) *reverse logistics*; and (5) *green innovation*. The authors, however, did not provide specific examples of initiatives implemented in the Malaysian logistics context.

Zhang et al. (2014) provided a more extensive classification than that of Jumadi and Zailani (2010) in their study of Chinese LSPs. They distinguished between six categories of green initiatives such as: (1) *environmental management* (e.g., establishing environmental strategies, pursuing green certifications, employee training on environmental aspects, etc.); (2) *low carbon storage* (e.g., optimizing storage space, recycling materials, etc.); (3) *low-carbon transportation* (e.g., route optimization, integrated transportation, etc.); (4) *fleet management* (e.g., establishing a vehicle repair and maintenance strategy, monitoring fuel consumption, etc.); (5) *alternative energy* (e.g., use of alternative fuels such as natural gas, hydrogen, biofuels, electric vehicles, etc.); and (6) *logistics innovation* (e.g., improving innovative handling systems, etc.). Additionally, the authors concluded that the most influential green logistics practices were part of the *environmental management* and *fleet management* categories.

More recently, in studying the adoption of green initiatives in Thailand, Sureeyatanapas et al. (2018) proposed the following seven categories: (1) *modal shift* (e.g., intermodal transport, supply chain collaboration, etc.); (2) *eco-driving* (e.g., driver training, assessing each drivers’ performance, vehicle maintenance, etc.); (3) *reverse logistics* (e.g., recycling materials, collaborating with customers on recycling programs, etc.); (4) *green packaging* (e.g., using reusable containers, etc.); (5) *alternative energy and*

vehicle technology (e.g., using biofuels, upgrading vehicles to latest-models, using hybrid or electric vehicles, etc.); (6) *vehicle routing* (e.g., route optimization, improving load distribution, etc.); and (7) *green administration* (e.g., developing formal environmental goals, selecting partner carriers based on environmental performance, employee training on sustainability efforts, etc.). The authors found that activities implemented within the *eco-driving* category are most widely implemented by Thai LSPs.

Overall, as illustrated in the preceding review of the literature, the Asian region is understudied on the topic of green logistics initiatives. Additionally, most of the green initiatives implemented in Asian countries are *internal* measures as opposed to more *collaborative* practices. Nonetheless, Evangelista et al. (2018) emphasized that there is an increasing number of studies on the topic of green logistics in *China*.

2.2.5 Africa

Only one study has been identified that focused on the African continent. The recent work of El Baz and Laguir (2017), who examined the Moroccan logistics sector, used a similar classification to the previously discussed work of Evangelista (2014). They studied green initiatives adopted by Moroccan LSPs as part of four categories: (1) *transport and vehicle use* (e.g., fleet modernization, alternative fuels, modal shift, etc.); (2) *warehousing and handling* (e.g., recycling materials, eco-packaging, etc.); (3) *environmental training and control* (e.g., employee training on eco-driving, partner training, etc.); and (4) *supply chain collaboration* (e.g., with customers and with other LSPs). Additionally, the authors found that the scope of green initiatives implemented by Moroccan LSPs is generally limited, with most LSPs implementing initiatives in the *transport and vehicle use* and *warehousing and handling* categories.

2.2.6 Framework of Green Initiatives

As shown in the preceding review of the literature on the types of green initiatives adopted by LSPs, a *plethora* of unique classifications of such initiatives emerged. Additionally, numerous examples of specific types of green initiatives implemented by LSPs have been provided by various scholars.

As such, it became very difficult to choose a framework to use for the current study. Moreover, this issue is further complicated by the fact that the topic of green initiatives adopted by LSPs has not been previously studied in Canada and thus there are no previous Canadian frameworks established. Hence, I decided to employ a suitable strategy in choosing a framework to use as the foundation for my analysis of the types of green initiatives that have been adopted by Canadian trucking companies.

In choosing a foundation for the analysis of green initiatives in the current study, my primary aim was to use a framework that was more relevant to *Canada*. I assumed that choosing such a framework would lead to increased understanding by the interviewees as they would be more familiar with the initiatives outlined. Given such assumption, I have chosen to adapt a framework that was proposed in a 2011 study conducted by the Commission for Environmental Cooperation (Commission for Environmental Cooperation, 2011). This framework is shown in Table 2. Note that this commission is a collaboration between *Canada*, the U.S., and Mexico on environmental issues.

Given that the current study is of *exploratory* nature, the analysis of the green initiatives is *not* limited to the initiatives outlined in Table 2. Additionally, for the purpose of increasing the reader's understanding of more *technical* initiatives, an illustration of some of the initiatives from the "Vehicle Technologies" category outlined in Table 2 – along with their estimated fuel savings – is shown in Figure 3.

Table 2

Framework of Green Initiatives

Category of Green Initiatives	Some Examples of Initiatives
Alternative Fuels	<ul style="list-style-type: none"> ▪ Biofuels ▪ Hydrogen ▪ Natural gas ▪ Electric
Vehicle Technologies	<ul style="list-style-type: none"> ▪ Auxiliary power units for idle reduction ▪ Aerodynamic improvements ▪ Tire improvements ▪ Lighter tractors and trailers
Operational Strategies	<ul style="list-style-type: none"> ▪ Training drivers ▪ Limiting truck speeds ▪ Setting fuel efficiency goals ▪ Optimizing routes ▪ Pursuing intermodal transportation ▪ Pursuing supply chain collaboration
Truck Replacements	<ul style="list-style-type: none"> ▪ Modernizing fleets ▪ Purchasing more fuel-efficient trucks
Other Initiatives	<ul style="list-style-type: none"> ▪ Vehicle maintenance and repairs ▪ Recycling materials ▪ Obtaining green certifications

Adapted from: Commission for Environmental Cooperation (2011)

Figure 3. Vehicle Technologies in Trucking and Estimated Fuel Savings % (Ogburn & Ramroth, 2007)

It is worth noting that the fuel savings obtained from the vehicle technologies depicted in Figure 3 (i.e., from a 2007 study) fall within a similar range nowadays. For instance, in the North American Council

for Freight Efficiency's 2018 study, fuel savings from trailer skirts are currently in the range of 3% to 4% (Berg, 2018).

2.3 A Review of Drivers and Barriers Affecting the Adoption of Green Initiatives

In the review of the literature on the topic of *drivers and barriers* affecting the adoption of green initiatives in LSPs, I have identified a total of 17 papers spanning the 2008-2018 decade (see Table 3).

Table 3

Studies Dealing with Drivers/Barriers Affecting the Adoption of Green Initiatives by LSPs (2008-2018)

Author(s) and Year	Method	Location	DRIVERS					BARRIERS				
			ORG	FIN	MKT	GOV	TEC	ORG	FIN	MKT	GOV	TEC
Lin and Ho (2008)	Survey	Taiwan	●		●	●	●					
Ho et al. (2009)	Survey	China	●									
Beškovnik and Jakomin (2010)	Conceptual	Southern Europe							●	●		
Lieb and Lieb (2010b)	Survey	North America Europe Asia	●		●	●						
Lin and Ho (2011)	Survey	China	●		●	●	●					●
Ho and Lin (2012)	Survey	Taiwan	●		●	●	●					●
Rossi et al. (2013)	Case Study	Europe	●	●	●	●			●	●	●	
Oberhofer and Fürst (2013)	Survey	Austria	●									
Evangelista (2014)	Case Study	Italy	●		●	●		●	●	●	●	
Tacke et al. (2014)	Case Study	Germany	●	●	●	●			●	●	●	
Oberhofer and Dieplinger (2014)	Case Study	Austria	●	●	●	●				●		
Pålsson and Kovacs (2014)	Survey	Sweden	●	●	●	●						
Zhang et al. (2014)	Survey	China	●		●	●						
Pålsson and Johansson (2016)	Survey	Sweden	●					●	●	●		●
El Baz and Laguir (2017)	Case Study	Morocco	●		●	●			●	●	●	
Evangelista et al. (2017)	Case Study	Italy & U.K.	●	●	●	●		●	●	●	●	
Sureeyatanapas et al. (2018)	Survey	Thailand	●	●	●						●	
TOTAL (17)			16	6	13	12	3	3	7	8	6	3
Current Study	Case Study	Canada	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Note: ✓ Novelty of current study

As highlighted in Section 2.1, an increasing number of papers were published from 2013 onwards on the topic of green logistics initiatives, which was previously suggested to be linked to the start of the second Kyoto Protocol commitment period (i.e., active from 2013 to 2020). Likewise, a similar conclusion can be drawn for the analysis of papers published on the topic of influencing factors (i.e., drivers and barriers) affecting the adoption of green initiatives by LSPs (refer to Table 3), thus marking a growing need to study the topic in recent years.

Furthermore, it is interesting to note that case study methodology started to be increasingly used to investigate the topic from 2013 onwards (refer to Table 3). In fact, to the best of my knowledge, the very first case study on the topic of drivers and barriers affecting the adoption of green initiatives in LSPs was published in 2013 (refer to Table 3). Perhaps, this can be explained by a greater need to gain *deeper* insights on the intricacies involved with adopting green initiatives in logistics as a result of more stringent environmental requirements arising from the start of the second Kyoto Protocol commitment period in 2013. Such intricacies can consist of more *subtle* drivers and barriers, which can best be uncovered through in-depth case studies (Kvale, 1996).

Moreover, an extensive set of drivers and barriers emerged, ranging from *internal* (i.e., within the company) factors to *external* ones (outside the company). Thus, in simplifying the analysis of the drivers and barriers in the current study, these factors are categorized based on a comprehensive framework recently proposed by Evangelista et al. (2018), which grouped the drivers and barriers into the following five categories: (1) *organization-related* factors; (2) *finance-related* factors; (3) *market-related* factors; (4) *government-related* factors; and (5) *technology-related* factors. Note that these factors have been abbreviated as “ORG”, “FIN”, “MKT”, “GOV” and “TEC”, respectively, in Table 3. Discussions on the specific types of drivers and barriers are provided in the subsequent paragraphs.

2.3.1 Organization-Related Factors

With regards to internal *drivers*, organization-related aspects have been most widely investigated in the literature (refer to Table 3). A total of 16 papers examined and confirmed the presence of certain intra-company aspects that can act as strong driving forces in motivating LSPs to implement green initiatives (refer to Table 3). Such influencing organization-related aspects have arisen from a wide variety of perspectives in the literature, discussed in turn.

A vast majority of studies found that **management support** for adopting green logistics initiatives acts a strong influential factor (Lin & Ho, 2008; Ho et al., 2009; Lin & Ho, 2011; Ho & Lin, 2012; Evangelista, 2014; Evangelista et al., 2017; El Baz & Laguir, 2017; Sureeyatanapas et al., 2018). Implementing environmental practices is argued to be a complex process that requires much intra-company coordination and significant changes to existing operations as well as the proper allocation of financial and technical resources (as cited in Ho & Lin, 2012). As such, most of these studies found that top management plays a crucial role in promoting the adoption of green initiatives within the company and thus acts as a driving force. However, several other studies highlighted more *subtle* drivers that influence management to take such a supportive stance in promoting green initiatives. These include aspects such as: (1) having a **knowledgeable management team** (Ho et al., 2009; Pålsson & Johansson, 2016); (2) having a **clear business strategy** set by management (Pålsson & Kovacs, 2014); and (3) having a strong **environmental culture** present in the attitudes of managers (Lieb & Lieb, 2010b; Rossi et al., 2013; Oberhofer & Fürst, 2013; Tacke et al., 2014).

For instance, in relation to the first aspect, in their study of Swedish LSPs, Pålsson and Johansson (2016) found that a **knowledgeable management team** that can perceive the potential benefits of adopting a particular green initiative increased the likelihood of its adoption. Moreover, other studies have argued that another closely linked aspect – i.e., a company's overarching business strategy – can motivate LSPs to implement more sustainable logistics. For instance, Pålsson and Kovacs (2014) found that the presence of a company strategy set on improving corporate image and obtaining a long-term competitive advantage

was the strongest motive for Swedish LSPs to implement green initiatives. As such, the authors were able to show that Swedish LSPs adopt more environmentally-friendly actions because they expect that such actions will positively affect their performance in the *long-term*. Furthermore, other studies – most notably the work of Lieb and Lieb (2010a) who studied the North American logistics sector – identified that the presence of a more altruistic and pro-environmental attitude in the managers of LSPs (which forms the basis of a company's strategy) acted a significant driver in motivating LSPs to adopt green initiatives. However, Zhang et al. (2014) found contrasting results for the Chinese trucking context.

Several other studies stressed the importance of support from management as it encourages **employee support**, which in turn influences the adoption of green initiatives. Employee support is a common driver in the extant literature (see, e.g., Lin & Ho, 2008; Ho et al., 2009; Lin & Ho, 2011; Ho & Lin, 2012; El Baz & Laguir, 2017). These studies argued that the green initiatives adoption process is employee-intensive as it heavily depends on the employee's skills and involvement. Hence, if employees have competent learning capabilities involved with adopting green initiatives, they will be able to ensure that the implementation of such initiatives is smoother within the organization. Additionally, employees that demand more sustainable behaviour from their organizations act as a strong driver. In fact, to further emphasize the importance of having strong employee support, Pålsson and Kovacs (2014) cited that one of the strongest motives for Swedish LSPs to implement green initiatives is to be seen as an environmental employer – that is, one who shows corporate social responsibility by voluntarily deciding to contribute to a cleaner environment.

Moreover, some studies highlighted the influence of other organizational aspects such as a **company's size** (Lin & Ho, 2011; Ho & Lin, 2012), and its **degree of internationalization** (Oberhofer & Dieplinger, 2014) in motivating logistics firms to adopt more sustainable practices. These studies found that larger LSPs are in a better position than smaller LSPs in adopting green initiatives due to having sufficient resources and stronger infrastructures. As a result, they develop more environmental attitudes that promote the adoption of green initiatives. Such findings were also present in the studies of Chinese and

Taiwanese LSPs (see, e.g., Lin & Ho, 2011; Ho & Lin, 2012). Interestingly, Oberhofer and Fürst (2013) uncovered contrasting findings for the Austrian logistics context. They detected the presence of similar attitudes towards sustainability between small and large LSPs; however, they claimed that smaller LSPs are less involved in environmental initiatives because of a lack of opportunities when compared to larger LSPs rather than a disproportionately poorer environmental attitude. Furthermore, Oberhofer and Dieplinger (2014) confirmed the significance of an LSPs' degree of internationalization as an influencing factor in studying the Austrian transport sector. For instance, they uncovered that logistics firms that operate globally have more environmentally sustainable operations, while companies who focus solely on the Austrian market do not.

When compared to organization-related *drivers*, organization-related *barriers* have not been studied as extensively. For instance, only three papers discussing organization-related *barriers* have been found in the literature (refer to Table 3). While the works of Evangelista (2014) and Evangelista et al. (2017) cited a **lack of employees** devoted to managing green initiatives as a barrier to adopting more sustainable practices by Italian and British LSPs, Pålsson and Johansson (2016) did not find this to be the case for Swedish LSPs. However, they did highlight that for the adoption of more *technical* actions such as green vehicle technologies and alternative fuels, a **lack of knowledge on behalf of management** can inhibit the adoption of such initiatives.

2.3.2 Finance-Related Factors

Two of the most common finance-related *drivers* in the literature are **cost savings** resulting from the implementation of certain sustainable initiatives and **the ability to achieve a return on investment (ROI)** on the implemented initiatives. In general, only a few papers analyzed finance-related *drivers* in the literature. As was shown in Table 3, only six papers have investigated these aspects.

Rossi et al. (2013) were the first to mention **cost savings** as an internal driving force in the adoption of green initiatives by LSPs. In studying European LSPs, they discovered that when a logistics firm's desire

to cut operational costs is high, the company can strongly be motivated to adopt greener measures if it believes that such measures will help the company save costs in the *long-run*. These companies, however, are even more motivated to implement green initiatives if in addition to wanting to save costs, their environmental culture is particularly strong. Likewise, Pålsson and Kovacs (2014) uncovered similar findings for the Swedish context. The authors identified that LSPs who had a strategy to adopt green initiatives in hopes of cost savings or improving company image showed similar intent to reduce transportation emissions; however, LSPs that combined these motives showed the strongest desire to green their operations. Interestingly, the work of Sureeyatanapas et al. (2018) uncovered contrasting findings for the Thai context. The authors argued that logistics firms with significant financial resources are more driven to implement initiatives to improve their environmental performance rather than firms with lower profits whose main priority is to save costs.

Many other studies cited **cost savings** as a driver for adopting green initiatives (see, e.g., Tacke et al., 2014; Oberhofer & Dieplinger, 2014; Evangelista et al., 2017). In general, cost savings are one of the main drivers motivating LSPs to adopt green initiatives. In their study of ten German LSPs, however, Tacke et al. (2014) found that this was the case for only one of the ten companies they examined. Most of the companies had different perspectives on cost reduction. For instance, some were willing to accept additional costs in the case of innovation (Tacke et al., 2014). Furthermore, the work of Oberhofer and Dieplinger (2014) highlighted that both cost savings and the ability to achieve an ROI on the initiatives were driving forces in some Austrian transport firms. Interestingly, in their cross-case comparison of Italian and British LSPs, Evangelista et al. (2017) found that only *British* LSPs were motivated by cost savings resulting from the adoption of more environmentally-friendly measures in logistics. When compared to Italian LSPs, British LSPs place more emphasis on risk reduction and therefore see cost savings as an opportunity to better cope with any risks that might threaten their businesses.

On the other hand, finance-related *barriers* have also been understudied in the literature. As was shown in Table 3, only seven papers have investigated finance-related *barriers*. Two of the most common

finance-related barriers are **high costs** and **uncertain payback time** on the implemented green initiatives. For instance, in their study of countries such as Slovenia, Croatia, Macedonia, Bulgaria, Romania, and Greece, Beškovnik and Jakomin (2010) uncovered that the Southeastern European logistics industry is not willing to absorb the additional costs needed to implement green logistics in the region. The authors stated that there have been an increasing number of transport activities and logistics operations in the region and as a result, logistics firms do not aspire to absorb additional costs in order to be more cost-effective in the market. As a result, the authors suggested that long-term contracts are very important for LSPs in Southeastern Europe as it would enable them to absorb some of the start-up costs associated with implementing green logistics. Moreover, both Rossi et al. (2013) and Pålsson and Johansson (2016) cited high costs as a main barrier inhibiting the adoption of green initiatives; however, Pålsson and Johansson (2016) outlined that high costs are not a particularly strong barrier in the Swedish logistics market.

Furthermore, in addition to high costs, several other studies pointed out **uncertain ROI** as a barrier (see, e.g., Evangelista, 2014; El Baz & Laguir, 2017; Evangelista et al., 2017). This was the case for Italian, Moroccan, and British LSPs, respectively. Likewise, in studying the German logistics sector, Tacke et al. (2014) found that additional costs with regards to new green logistics investments is widely agreed as a strong barrier by German LSPs. Interestingly, however, almost all of the ten LSPs studied noted that their companies can obtain a return on many of their investments in this area in the long-run. More specifically, some companies reported that additional costs are not problematic if the firm conducts a proper cost-benefit analysis of green investments in logistics.

2.3.3 Market-Related Factors

Market-related factors mainly deal with aspects *external* to the LSP such as: (1) its relationship with various stakeholders outside of the company, and (2) the general industry and/or market situation in which the LSP operates. Market-related *drivers* have extensively been studied in the literature. As was shown in Table 3, a total of 13 papers have confirmed the presence of certain market-related *drivers*.

In terms of external stakeholders, the most common market-related *driver* in the literature is **customer demand** for green initiatives (see, e.g., Lieb & Lieb, 2010b; Rossi et al., 2013; Evangelista, 2014; Tacke et al., 2014; Oberhofer & Dieplinger, 2014; Pålsson & Kovacs, 2014). As was shown in Table 3, these authors studied the North American, European, Italian, German, Austrian, and Swedish transport sectors. In particular, Tacke et al. (2014) found customer demand to be a significant driver in motivating German LSPs to adopt green initiatives. In fact, the authors highlighted that for their study of ten German LSPs, seven of them confirmed that customers are increasingly demanding green services as well as statements reporting their environmental performance. The influence of the customer is not universally felt, however. Similar findings were reported by Rossi et al. (2013) who discovered that although some European LSPs confirmed the presence of strong customer demands for green service provisions, others complained about a lack of real commitment from them. Interestingly, customer demand was not found to be a significant driver in the studies of LSPs in China and Taiwan (see, Lin & Ho, 2011; Ho & Lin, 2012).

Several other studies highlighted **competitors** as a driving force (see, e.g., Lieb & Lieb, 2010b; Evangelista, 2014; Tacke et al., 2014; El Baz & Laguir, 2017). For instance, in their study of large North American LSPs, Lieb and Lieb (2010b) emphasized that competitive pressures were among the top five reasons for establishing sustainability programs. Evangelista (2014), however, found that only for Italian logistics firms who had the greatest environmental performance were actions undertaken by competitors considered as an incentive to adopt further green initiatives. Similarly, Tacke et al. (2014) acknowledged that competitive pressures are perceived in different ways by German LSPs. Though some logistics companies commented that their competitors are not driving them to implement more sustainable actions, others expressed that they go as far as benchmarking environmental practices against their competitors and thus see them as strong driving forces for adopting green initiatives. The latter is true for the study of Moroccan LSPs (see, El Baz & Laguir, 2017).

Furthermore, some studies cited that **partner collaboration** acts as a driver in motivating LSPs to adopt green practices. For instance, in their investigation of some of the largest North American LSPs, Lieb

and Lieb (2010b) acknowledged that an LSPs' partnerships with other transportation companies, trade organizations, consultants, and non-governmental organizations were instrumental in helping them achieve their sustainability efforts. Similarly, Zhang et al. (2014) found that pressures from transportation and logistics associations in China as well as from supply chain partners were important driving forces for the implementation of low-carbon logistics. Additionally, El Baz and Laguir (2017) reported that support from industry associations and partner LSPs are important enablers for Moroccan LSPs' adoption of more sustainable practices.

Apart from various external stakeholders, other market-related *drivers* such as those in relation to the general industry situation have also been studied in the literature. One of the main industry-related drivers is **environmental uncertainty**. For instance, in their study of Taiwanese LSPs, Lin and Ho (2008) found environmental uncertainty to be one of the driving forces in motivating LSPs to adopt green initiatives. Interestingly, the authors' further studies such as that of Lin and Ho (2011) and Ho and Lin (2012) who focused on the Chinese and Taiwanese logistics contexts, respectively, found contrasting findings. In general, however, environmental uncertainty has been defined by these authors as, "...frequent and unpredictable changes in customer preferences, technological development, and competitive behaviour perceived by the managers" (Ho & Lin, 2012, p. 229). Furthermore, Tacke et al. (2014) uncovered a different type of environmental uncertainty that motivated German LSPs to implement more sustainable measures. According to the findings, the rise and volatility of oil prices in the market encouraged several German LSPs to investigate and implement alternative fuels. Similarly, the more recent work of Evangelista et al. (2017), who compared Italian and British logistics firms, acknowledged that some British firms see the adoption of green initiatives as a lever for reducing company risk in an effort to cope with unexpected changes in the marketplace. Evidently, some LSPs implement green initiatives in order to combat some of the uncertainties associated with changes in the market and/or industry.

Market-related *barriers*, however, have less widely been confirmed. As was shown in Table 3, a total of eight papers confirmed the presence of certain market-related *barriers*. The most common market-

related barrier is **lack of customer interest in green initiatives**. Several studies confirmed that a lack of customer interest for green initiatives inhibits the adoption of such initiatives (see, e.g., Rossi et al., 2013; Evangelista, 2014; Tacke et al., 2014; Evangelista et al., 2017; El Baz & Laguir, 2017). While Rossi et al. (2013) stated that European customers lack true commitment in demanding green service provisions, the works of Evangelista (2014), Evangelista et al. (2017), and El Baz and Laguir (2017) acknowledged that it is in fact a lack of customer awareness of green service provisions that contributes to customers' lack of interest for such service provisions. These studies focused on the Italian, Italian/British, and Moroccan transport sectors, respectively. Furthermore, Tacke et al. (2014) highlighted that nine out of the ten German LSPs studied confirmed that customers are not willing to share the costs of ecological measures with their LSP, which significantly impedes the adoption of green initiatives by German LSPs.

Moreover, a **lack of infrastructure** supporting the adoption of green logistics measures was reported as a barrier by some studies (see, e.g., Beškovnik & Jakomin, 2010; Rossi et al., 2013; Tacke et al., 2014; Pålsson & Johansson, 2016). For instance, in their study of the Southeastern European transport market, Beškovnik and Jakomin (2010) highlighted that transport infrastructure in Southeast Europe is not conducive to green logistics development – particularly for the adoption of more advanced and collaborative logistics practices, such as intermodal transportation. Railways, ports, and hinterland terminals in Southeast Europe are underdeveloped and are still state-owned property. Thus, due to a lack of focus on transport infrastructure modernization, road transport is massively used to transport goods in the region. In fact, the share of road freight transport is significantly higher in Southeast European countries than in North European countries (i.e., 80% versus 57%). According to their study, railway infrastructure is very poor in the region and as a result, transport networks cannot be optimized as intermodal inland connections with hinterland terminals practically do not exist in Southeast Europe. Interestingly, in the studies of the German and Swedish logistics sectors, Tacke et al. (2014) and Pålsson and Johansson (2016) acknowledged that a lack of infrastructure was cited as a barrier by *some* of the studied LSPs; however, this was not found to be as a significant of a problem compared to the results uncovered by Beškovnik and

Jakomin (2010). Tackén et al. (2014), for instance, expressed that only *one* of the ten German LSPs studied cited a lack of infrastructure as a barrier. Furthermore, Pålsson and Johansson, (2016) found that a lack of infrastructure was only problematic for changing the mode of transport from road to rail, which they explained is due to the current *capacity* limitation of Swedish Rail.

Several studies highlighted other market-related *barriers*. For instance, Rossi et al. (2013) found that a **lack of supply chain collaboration** among different players in the same supply chain on green initiatives acts as a significant barrier. Furthermore, Oberhofer and Dieplinger (2014) cited that some Austrian LSPs mentioned that one of the main obstacles to realizing a holistic environmental system are **differences among the markets** in which an LSP operates in. These Austrian logistics companies stated that it becomes challenging to implement greener practices when they cooperate “with companies from countries where the development of environmental awareness is immature” (Oberhofer & Dieplinger, 2014, p. 245). Moreover, Tackén et al. (2014) uncovered that half of the German LSPs they studied cited competitors applying green washing as a strategy – and thus **competitive pressures** – as an inhibitor in adopting more sustainable practices. One of the LSPs emphasized that “green washing” increases marketing costs and prevents them from achieving ecological improvements (Tackén et al., 2014).

2.3.4 Government-Related Factors

Government-related factors mainly deal with actions undertaken by the government and/or regulatory bodies that either support or inhibit the adoption of green initiatives by LSPs. Such factors have extensively been studied in the literature. As was shown in Table 3, a total of twelve papers have confirmed the presence of certain government-related *drivers*. Two of the most common government-related *drivers* are **government support** and **regulatory pressure**. Government support is defined in two ways: (1) supporting LSPs by providing them with incentives and/or funding to adopt green initiatives, and (2) supporting LSPs by formulating proper environmental regulations. A vast majority of studies cited **government support** as a significant driver in promoting the adoption of green initiatives (see, e.g., Lin & Ho, 2008; Lin & Ho, 2011; Ho & Lin, 2012; Evangelista, 2014; El Baz & Laguir, 2017; Evangelista et al.,

2017). Additionally, other studies emphasized that **regulatory pressure**, which consequently forces LSPs to adhere to environmental regulations, motivates LSPs to implement more sustainable practices (see, e.g., Ho & Lin, 2012; Rossi et al., 2013; Tacke et al., 2014; Pålsson & Kovacs, 2014; Zhang et al., 2014). It is interesting to note that studies mentioning these two government-related drivers encompass all geographical regions in the world – that is, North America, Europe, Asia-Pacific, and Africa (refer to Table 3).

Furthermore, while the study of Lieb and Lieb (2010b) did not directly uncover government support and/or regulatory pressure to be a significant driver, it did highlight that many LSPs work with government agencies on sustainability issues. Perhaps LSPs work more closely with the government not only to comply with existing regulations but to influence subsequent regulations that might affect the logistics industry. In addition, Oberhofer and Dieplinger (2014) emphasized that “regulations are regarded as essential to improve the overall environmental situation of the whole sector” (p. 249).

Additionally, two studies highlighted an interesting perspective on regulatory pressure as a strong driver in motivating LSPs to adopt green initiatives. For instance, Pålsson and Kovacs (2014) stated that in their study of Swedish LSPs, government regulations set “minimum levels that elevate the performance of a group of companies in an industry or a country, which in turn can become more competitive – at least when compared to the same industry in other countries where requirements may differ” (p. 299). Similarly, Tacke et al. (2014) commented that rules demanded by German law, such as European emissions standards, act as a *minimum* requirement in terms of environmental performance of the logistics industry.

Government-related *barriers*, however, have less widely been confirmed in the literature. As was shown in Table 3, only six papers have confirmed certain government-related aspects that inhibit LSPs to adopt green initiatives. In the extant literature, a wide variety of perspectives on government-related *barriers* emerged. For instance, one study cited **unclear regulations** as a barrier in European LSPs (see, Rossi et al., 2013). Interestingly, the work of Pålsson and Johansson (2016) did not find this to be the case for Swedish LSPs, specifically. Furthermore, some studies highlighted a **lack of a well-defined regulatory framework** and **poor regulations** as barriers (see, e.g., Evangelista, 2014; Tacke et al., 2014; Evangelista

et al., 2017; El Baz & Laguir, 2017). Other studies emphasized that a **lack of incentives** offered by the government significantly inhibits LSPs to adopt green initiatives (see, e.g., Evangelista et al., 2017; Sureeyatanapas et al., 2018). Interestingly, in their cross-case study of Italian and British logistics firms, Evangelista et al. (2017) found a lack of incentives only to be the case for Italian firms. According to the authors, an overall lack of governmental support on green logistics initiatives as well as the existence of a regulatory framework not conducive to green logistics development is more evident in the Italian case than in the British.

2.3.5 Technology-Related Factors

Technology-related factors have least been studied in the literature. As was shown in Table 3, only three papers focused on technology-related *drivers*. Additionally, only three papers investigated technology-related *barriers*.

In the extant literature, technology-related factors are referred to as a green initiatives' technological, "complexity, compatibility, relative advantage, trialability, ease of use, perceived usefulness, information intensity, uncertainty, and so on" (Ho & Lin, 2012, p. 226). However, in studies of Chinese and Taiwanese contexts (see, e.g., Lin & Ho, 2008; Lin & Ho, 2011; Ho & Lin, 2012), scholars mainly considered technological, "...complexity, compatibility, and relative advantage because these three characteristics are important in influencing technical adoption behaviour" (Ho & Lin, 2012, p. 226).

In their study of technology-related *drivers*, Lin and Ho (2008) uncovered that the **explicitness and accumulation of technology** can influence the adoption of green initiatives in Taiwanese LSPs. In essence, they argued that an organization with more experience in the application and adoption of green technologies will have a higher ability to be more innovative in the technical sphere. Similarly, in studying the Taiwanese logistics context, Ho and Lin (2012) found that LSPs are more likely to adopt an environmental practice when they perceive that the practice is **less complicated** and **more compatible to their existing business operations**. Similar findings were uncovered for the Chinese context by Lin and Ho (2011).

In terms of technology-related *barriers*, Lin and Ho (2011) and Ho and Lin (2012) found that green initiatives' **technological complexity** acts as a significant barrier for LSPs in China and Taiwan, respectively. Interestingly, the more recent work of Pålsson and Johansson (2016) highlighted that a **lack of available green technology** specifically in terms of more *technical* initiatives such as cleaner vehicle technologies and non-fossil fuel-based vehicles impedes the adoption of green initiatives in Swedish LSPs. Apart from the work of Pålsson and Johansson (2016), technology-related factors have been studied in Asian countries only (refer to Table 3).

2.3.6 Framework of Drivers and Barriers

As shown in the preceding review of the literature on the topic of *drivers and barriers* affecting the adoption of green initiatives in LSPs, a wide variety of perspectives emerged, which I have summarized in Table 4. I will use these summarized influencing factors as the foundation – or starting point – in the analysis of drivers and barriers in the current study. Note that the *categories* in this framework were developed by Evangelista et al. (2018).

Given that the current study is of an *exploratory* nature, the analysis of drivers and barriers is *not* limited to those outlined in Table 4. Note that I assumed that if a factor's *opposite* emerges that is not outlined in Table 4, it is valid. For instance, “lack of management support” would be a valid *barrier*, or “available green technology” would be a valid *driver*.

Table 4

Framework of Drivers and Barriers

Category	Driver	Barrier
ORG	<ul style="list-style-type: none"> Management support Management knowledge Clear strategy Environmental culture Employee support Company size (if larger firm) Degree of internationalization 	<ul style="list-style-type: none"> Lack of employees Lack of management knowledge Company size (if smaller firm)
FIN	<ul style="list-style-type: none"> Cost savings ROI achievement 	<ul style="list-style-type: none"> High costs Uncertain ROI
MKT	<ul style="list-style-type: none"> Customer demands Competitive pressures Partner collaboration Environmental uncertainty 	<ul style="list-style-type: none"> Lack of customer interest in green initiatives Lack of infrastructure Lack of supply chain collaboration Differences in markets of operation Competitive pressures
GOV	<ul style="list-style-type: none"> Government support Regulatory pressure 	<ul style="list-style-type: none"> Unclear regulations Lack of a well-defined regulatory framework Poor regulations Lack of incentives
TEC	<ul style="list-style-type: none"> Explicitness and accumulation of technology Less technologically complex initiatives Initiatives compatible with organization 	<ul style="list-style-type: none"> Technologically complex initiatives Lack of available green technology

2.4 Summary Insights

This chapter set out to discover the current state of research in the academic literature on the topics of: (1) the types of green initiatives that have been adopted by LSPs, and (2) the associated drivers and barriers influencing the adoption of such initiatives.

Overall, less than 25 papers have been identified that investigated both topics (refer to Tables 1 and 3). Evidently, these topics are understudied in the extant literature. However, in Sections 2.1 and 2.3, I highlighted that an increasing number of studies have been published from 2013 onwards, emphasizing a need for new knowledge – particularly in new geographical regions – on these topics as a result of the start of the second Kyoto Protocol commitment period (i.e., active from 2013 to 2020). By comparing Tables 1

and 3, it is evident that Canada has not been the focus of any academic studies. As previously emphasized, most of the research in these areas come from European scholars. Furthermore, as shown in Tables 1 and 3, only two studies have examined the North American logistics industry – that is, the works of Lieb and Lieb (2010a) and Lieb and Lieb (2010b) – however, these studies have not specifically focused on the *Canadian* logistics market. Moreover, these studies are outdated (having been published in 2010). Given the recent technological advancements in green logistics, additional research is required. As such, I intend to fill this gap in the literature by investigating the Canadian logistics sector. This is the primary novelty and contribution of my work.

Additionally, I attempt to *extend* knowledge on the topic areas under investigation in two main ways. First, by comparing Tables 1 and 3, note that only a few studies investigated *both* topics simultaneously (i.e., the types of green initiatives and the factors influencing their adoption). For instance, a total of eight studies examined both topics (see, e.g., Lieb & Lieb, 2010b; Tacke et al., 2014; Zhang et al., 2014; Evangelista, 2014; Pålsson & Johansson, 2016; Evangelista et al., 2017; El Baz & Laguir, 2017; Sureeyatanapas et al., 2018). More significantly, some of these studies only discussed *one* influencing factor. For instance, Lieb and Lieb (2010b), Colicchia et al. (2013), and Zhang et al. (2014) only focused on *drivers* – an analysis of *barriers* was lacking, however (refer to Table 3). As such, a more comprehensive analysis – that is, one that encompasses *both* the types of green initiatives adopted by LSPs as well as the associated drivers *and* barriers – is limited in the reviewed literature. Thus, I attempt to *extend* knowledge in this area by providing a wider set of insights into both the types of green initiatives adopted by LSPs as well as the associated drivers *and* barriers. This is a significant contribution of my work.

Second, there has been no study that analyzed the drivers and barriers in depth from *all* the *five* previously mentioned categories, such as organization-related, finance-related, market-related, government-related, and technology-related factors (refer to Table 3). In particular, insights into the *technology-related* drivers and barriers are *very* limited in the literature (refer to Table 3). Hence, I also

attempt to *extend* knowledge in this area by studying drivers and barriers from *all five* categories. This is another significant contribution of my work.

3 Methodology

This chapter introduces the qualitative methodological approach (i.e., *multiple*-case study of eight small-to-medium sized trucking companies in Ontario) taken in the current study. All the intricacies involved with the research process are presented, such as the type of case study methodology chosen, assumptions, the research design process and data collection techniques employed, and an explanation of the type of analysis (i.e., thematic analysis) and software used to uncover important findings from data that are of qualitative nature. Additionally, strategies to ensure a reliable analytic procedure are presented. Moreover, the assurance of validity and reliability of the research findings is discussed. The purpose of this chapter is to illustrate the *lens* through which the current study has been conducted and analyzed. Lastly, the chapter concludes by highlighting yet another novelty of my work.

3.1 Research Methodology

3.1.1 Multiple-Case Study Approach

To answer the two main research questions of the current study outlined in Section 1.3, I chose to employ a *qualitative* research approach using *multiple*-case studies (i.e., a case study conducted on *multiple* trucking companies). The use of case study methodology in the current study was motivated by various factors. First, as summarized in Section 2.3.7, there is a lack of research on environmental sustainability conducted in the Canadian logistics context. Furthermore, as presented in Section 1.1, climate change is a current issue in Canada that necessitates investigation. When the two realities are combined, it becomes evident that this phenomenon requires *exploration*. Hence, in such situations, case studies are more appropriate, as they are argued to be used “to explore and better understand emerging, contemporary phenomena or issues in their real-world settings” (as cited in Barratt, Choi, & Li, 2011, p. 329).

Second, Voss, Tsikriktsis, and Frohlich (2002) argued that in the field of operations management, case study is an effective means of collecting *in-depth* information. The act of collecting in-depth information in the current study is motivated by the need to gain deeper insights into the “how” and “why” of environmental sustainability actions in Canadian trucking companies based in Ontario in terms of the green initiatives that have been adopted and the factors influencing their adoption. Though cost savings are claimed to be one of the primary motivations for implementing green initiatives (refer to Section 2.3.2), one aim of the current study is to investigate whether there are any *subtler* drivers and barriers that come into play in the process of adopting green initiatives. Thus, given the exploratory nature of the research questions (particularly the *second* research question), case study evidence is germane.

Third, a *multiple*-case study was chosen as it is conducive for explorative investigations and allows for the examination of a phenomenon from *several different* perspectives, thereby offering “stronger arguments for validity of study, as evidence is often considered more compelling” (Farquhar, 2012, p. 43).

3.1.2 Inductive Research

Case studies primarily employ an *inductive* approach to research (Merriam, 1998). This process involves uncovering concepts rather than testing existing theory in which the latter is typical in quantitative studies which use a *deductive* approach based on statistical procedures to test theories. In inductive research, as is the case in the current study, there are *no hypotheses* to be deduced from a theory to guide the investigation. As such, the purpose of inductive research is to build upon concepts by gaining an *intuitive* understanding of the natural setting under investigation. In such research, the researcher begins by collecting data that is relevant to answering the research question(s). Then, once a sufficient amount of data has been collected, the researcher steps back in order to get a “birds eye view” of his/her data in an effort to uncover any patterns/commonalities in hopes of offering deeper insights on a given topic. Such is the need in the current study, as the topic has not been previously investigated in Canada.

Additionally, the purpose of case studies is *not* to *generalize* the research findings but rather to provide an account of in-depth meaning. As argued by Merriam (1998), “in qualitative research, a single case of small non-random sample is selected precisely *because* the researcher wishes to understand the particular in depth, not to find out what is generally true of the many” (p. 208). However, given that the current study’s purpose, case selection, and data gathering require some rationale or *preconceived* ideas, adopting a purely inductive approach is not possible. Thus, it has been suggested by many scholars to use “*a priori* constructs to help shape the *initial* design” of the research study (as cited in Barratt, Choi, & Li, 2011, p. 330). These *a priori* constructs that guide the initial design of the study have previously been illustrated (refer to Tables 2 and 4). However, note that these constructs are considered as *tentative* as new ideas emerging from the multiple case study are welcome and are sought for in inductive research.

Moreover, *semi*-structured face-to-face interviews were used to collect data. Semi-structured interviews are employed when there is a need to explore a particular phenomenon from different perspectives (Cassell, 2015). In such interviews, the researcher is required to devise an *initial* set of questions around particular topics that enables the collection of *open-ended* insights from participants.

Open-ended questions allow participants to respond *freely* – that is, participants are not led in any way by the researcher in answering the questions.

3.1.3 Philosophical Assumptions and Chosen Paradigm

Creswell (2007) argued that all qualitative studies are based on an underlying philosophical foundation – or assumptions – that guide the entire research design process. Moreover, the author emphasized that each researcher brings his/her own paradigm, worldview, or set of beliefs into a qualitative research study. As argued by Creswell (2007), “good research requires making these assumptions, paradigms, and frameworks explicit in the writing of a study, and, at a minimum, to be aware that they influence the conduct of inquiry” (p. 15). Hence, my statement of assumptions and paradigms, discussed in the subsequent paragraphs.

Creswell (2007) outlines two philosophical assumptions: *ontological* and *epistemological*. While ontology is the study of the nature of *reality* and its characteristics, epistemology deals with the nature of *knowledge* and ways of knowing and learning about reality. In the current study, I have adopted a *constructivist* ontology. In this type of *ontological* assumption, Cassell (2015) argues, “We believe that the phenomena we investigate do not exist independently from ourselves as researchers. Rather, they are artificial creations that come into existence through our talk and discourse” (p. 10). Furthermore, I have adopted a *subjectivist* approach to *epistemology*. This type of *epistemological* assumption assumes “that the researcher does not have a privileged vantage point. Rather, we all interpret and make sense of the world in different ways and the interviewer can only report their own *interpretations* without any claim to privilege” (Cassell, 2015, p. 10).

Moreover, my stance with regards to the two assumptions is reflective of my *paradigm* – which is argued to be a second component of the qualitative research design process in Creswell (2007). I have chosen the *constructivist*-based paradigm. Hence, the “lens” through which my study is conducted is based on *interpretation* as it seeks to develop *subjective* meanings of the participants’ experiences – in which the

meanings are *varied* and *multiple*. This type of “lens” is conducive for inductive exploratory research which is based on semi-structured interviews (Creswell, 2007).

3.1.4 Merriam’s Case Study Approach

Three *foundational* methodologists in case study research are Robert Yin, Robert Stake, and Sharan Merriam (Yazan, 2015). I have chosen to employ Merriam’s case study methodology as it best fits with my philosophical assumptions and overall constructivist paradigm. Merriam’s case study approach is based on *constructivism* – that is, on understanding the meaning or knowledge constructed by people. As such, the prominent case study methodologist argues that “there are multiple interpretations of reality” (Yazan, 2015, p. 137), which I am consonant with. Yin’s approach, as argued by Yazan (2015) leans more towards *positivism* which assumes that research is more objective and generalizable, which is not the aim of the current study. Moreover, as argued by Yazan (2015), Stake’s approach is based on *non-determinism*, which argues that events occur randomly, by chance, which is also not the lens through which the current study is conducted.

Furthermore, in Merriam’s case study approach, *both* the researcher and the participants are *co-creators* of the reality and thus of the research findings. This is best highlighted in Merriam’s following remark:

The researcher brings a construction of reality to the research situation, which interacts with other people’s constructions or interpretations of the phenomenon being studied. The final product of this type of study is yet another interpretation by the researcher of others’ views filtered through his or her own (Yazan, 2015, p. 138).

Additionally, it is worth noting that most case study-based research in the literature employed Yin’s approach. For instance, the works of Perotti et al. (2012), Tacke et al. (2014), Evangelista (2014), El Baz and Laguir (2017), and Evangelista et al. (2017) all used Yin’s approach. However, in a recent systematic literature review of over 400 papers published on environmental sustainability in logistics, Centobelli et al.

(2017) emphasized that there is a lack of *interpretative* insights on the topic. As such, the authors called for more interpretative insights, which is what I aim to provide with the current study.

Lastly, it is important to emphasize that by using Merriam's case study approach, three dimensions of the research process are subsequently influenced: (1) the research design, (2) data analysis, and (3) validity and reliability strategies for ensuring credible research. Specific components of such areas used in the current study are outlined in Table 5 – which is adapted from Yazan (2015). Supporting discussions on such components are provided in the subsequent sections of this chapter.

Table 5

Components of Merriam's Case Study Approach

Dimension of Research Process	Explanation
Research Design	The literature review is an essential phase contributing to the research design. The theoretical framework emerging from literature review helps outline points of emphasis that guides the study. The research design involves: <ul style="list-style-type: none"> (1) Identifying a research problem (refer to Section 1.1) (2) Crafting research questions (refer to Section 1.3) (3) Conducting a literature review (refer to Chapter 2) (4) Using <i>purposeful</i> sampling to select cases
Data Analysis	Data analysis is the process of <i>interpreting</i> what people have said. The following analysis is used: <ul style="list-style-type: none"> ▪ Thematic analysis
Validity and Reliability Strategies	<p><i>Strategies to enhance internal validity:</i></p> <ul style="list-style-type: none"> (1) Member checks (2) Peer examination <p><i>Strategy to enhance external validity:</i></p> <ul style="list-style-type: none"> (1) Use of thick description <p><i>Strategies to ensure reliability:</i></p> <ul style="list-style-type: none"> (1) Explanation of researcher's position (2) The use of an audit trail

Adapted from: Yazan (2015)

3.2 Research Design

3.2.1 Units of Analysis

According to Farquahar (2012), specifying the units of analysis is an important component of the overall research design. Furthermore, as argued in the work of Barratt, Choi, and Li (2011), specifying the

units of analysis “helps to define the boundaries” (p. 330) of the case study and thus clearly outlines its focus. In the current study, the units of analysis include: (1) the *types of green initiatives* adopted by small-to-medium sized trucking companies based in Ontario, and (2) the *factors (in terms of both the drivers and barriers)* that affect the adoption of such initiatives in small-to-medium sized trucking companies based in Ontario.

3.2.2 Sampling Strategies, Selection of Cases, and Recruitment of Companies

After the units of analysis have been identified, Merriam’s case study approach calls for the use of *purposeful* sampling in choosing the cases for investigation (refer to Table 5). Purposeful sampling is a type of *non-probabilistic* sampling (note that I am *not* employing quantitative research in which there is a need to pursue probability-based sampling) that “is based on the assumption that the investigator wants to discover, understand, and gain insight and therefore must select a sample from which the *most* can be learned” (Merriam, 1998, p. 61). According to Merriam (1998), selection criteria is necessary for choosing cases and should reflect the purpose of the study. Thus, my selection criteria are as follows:

- (1) The *main* service(s) offered by the company should be *transportation*. As such, only *trucking* companies primarily offering transportation-based services should be chosen for the study.
- (2) The trucking companies have to be small-to-medium sized, given that almost all of the trucking companies in Canada are of this size and thus contribute greatly to the country’s pollution. Small-to-medium sized trucking companies are characterized as having a fleet size of less than 150 trucks (Kilcarr, 2017). Thus, trucking companies with less than 150 trucks should be chosen for the study.
- (3) The trucking companies chosen for the study should be based in Ontario. However, given that I am conducting *face-to-face* interviews, trucking companies with offices of approximately 100 kilometres north, south, east, and west of Ryerson University should be chosen in order to allow more convenient access in light of the time constraints for completing this thesis.
- (4) Trucking companies servicing a *wide range of industries* should be chosen, given the exploratory nature of the study. As cited by Perotti et al. (2012), companies operating in different industries

and thus transporting different products (i.e., temperature-sensitive or dry goods) can be a potentially relevant factor that influences the adoption of green initiatives. Additionally, Liimatainen et al. (2014) found that LSPs transporting liquid goods implement more energy efficient measures than those transporting general cargo or dry bulk products. Given such findings from other studies, it is expected that the industry in which a trucking company operates (and thus the types of products it transports) can play an influencing role in the adoption of green initiatives. Particularly, I expect trucking companies transporting temperature-sensitive goods (from the food and chemicals industry) to implement more initiatives, given previous research. Thus, to uncover whether industry type plays an influencing role, trucking companies servicing a variety of industries should be selected for the study.

- (5) High-level employees (e.g., President, Vice President, CEO, Owner, Director, Manager, Coach, etc.) who have been in such position at the trucking company for at least two years should be interviewed as these individuals have the *greatest knowledge* of the company culture, the overarching strategy, and have a significant amount of responsibility in the organization. As such, they are believed to be able to provide richer insights (Merriam, 1998).

As per Merriam's sampling strategies, *two* different *purposeful* sampling strategies were employed to select cases and recruit the participants: *maximum variation* and *snowball* sampling. A *combination* of these sampling approaches was employed since it was very difficult to recruit participants for the study.

Originally, I used OTA's database to recruit trucking companies from the province of Ontario that fit the selection criteria. Initially, I wanted to select cases based on *maximum variation* (as in having trucking companies servicing different industries selected, different geographical regions, or different types of high-level employees being interviewed, etc.) because I wanted to understand how *different* groups view the topic under investigation. Thus, for a two-month period (from August 2018 to September 2018) I either sent emails or directly called trucking companies that I found in the OTA's database. I initially contacted 87 companies that I believed fit my criteria; however, my efforts were largely unsuccessful, with the

companies either: (1) not replying, (2) stating that they were very busy, or (3) cancelling and/or not replying when an interview was scheduled. Nonetheless, the President of one of the 87 trucking companies I contacted replied and asked for a meeting. As per his request, I went directly to the company to meet with him. However, it turned out that this company did not fit my selection criteria; however, the President offered to help with the recruitment of trucking companies for the study. As such, I began to employ a *snowball* sampling approach thereafter, which involves asking a known individuals or previous participants of the study to refer me to other participants via their networks (Merriam, 1998). Meanwhile, my supervisor, who has connections in the CTA and OTA asked two representatives from these associations to help with the recruitment of trucking companies. Hence, from October 2018 onwards, a snowball sampling approach was employed.

Moreover, as cited in the work of Merriam (1998), snowball sampling “involves identifying participants from people who know people who know people who know what cases are *information-rich*, that is, good examples for study, good interview subjects” (p. 63). Employing snowball sampling was a largely successful for two main reasons: (1) I was able to recruit all the required participants that fit the selection criteria, and (2) I was able to achieve maximum variation, or access to information-rich cases, as per the recommendations of participants and/or my known network of individuals.

In total, I recruited and studied *eight* trucking companies. This was an appropriate sample size as most qualitative scholars suggest “using at least two to four, but no more than 10-15 cases” (as cited in El Baz & Laguir, p. 1458). Furthermore, in the field of *operations management*, four to ten cases are recommended, with case numbers on the higher end (i.e., 7-10) helping offer deeper insights and guard against researcher bias (Barratt, Choi, & Li, 2011). Moreover, Merriam’s approach calls for ending the sampling process when *saturation* is achieved – that is, when a point is reached in the analysis of data that sampling more data will not lead to more and/or new information related to the research questions (Merriam, 1998). This was the case in the current study after the eighth interview; thus, an adequate amount of data has been collected for the study.

Furthermore, a brief introduction to the characteristics of the eight small-to-medium sized trucking companies studied is provided in Table 6. Note that according to Ryerson University guidelines for conducting ethical research, participants of the study must remain confidential. In addition, confidentiality was also assured to participants in order to encourage openness of response during the data collection stage. Thus, the eight companies were given the following pseudonyms: Alpha, Beta, Gamma, Delta, Epsilon, Zeta, Eta, and Theta. Likewise, participants were given pseudonyms to ensure the strictest confidentiality. Furthermore, any information that could reveal the identity of the participants or the case study companies was removed (such as major clients of the companies, partners, etc.). Ethics approval for conducting the current study was granted on August 14, 2018 (see Appendix A).

Table 6

Summary of Eight Small-to-Medium Sized Trucking Companies Studied

Company	Date of Interview	Position of Participant(s)	Experience in Position	Year Company Founded	Fleet Size	Number of Employees	Industries Mainly Serviced	Reach
Alpha	January 21, 2019	Human Resources Coach	4 years	1991	45 power units 60 trailers	66	Electronics Industrial goods Food Hazardous goods	Canada and the U.S.
Beta	October 9, 2018	President & Director of Safety	21 and 11 years, respectively	1987	77 trucks	137	Furniture Electronics Pharmaceuticals Industrial goods Retail	Canada and the U.S.
Gamma	November 13, 2018	Vice President of Operations	4 years	2013	80 tractors	90	Food	Canada and the U.S.
Delta	October 22, 2018	Owner	3 years	2015	65 trucks	75	Food	Canada and the U.S.
Epsilon	October 9, 2018	Owner	12 years	1980	15	22	Chemicals Veterinary supply	Southern Ontario
Zeta	November 14, 2018	Vice President & Operations Manager	17 and 8 years, respectively	1997	25	9	Furniture	Ontario
Eta	January 24, 2019	General Manager	5 years	2012	6	17	Food	Canada and the U.S.
Theta	January 21, 2019	Owner	5 years	2014	7	6	Medical equipment	Canada and the U.S.

3.2.3 Interview Design and Protocol

The interview guide was designed on the basis of the literature review. The interview followed a *semi*-structured design to encourage participants to answer *freely* with no preconceived categories (apart from types of green initiatives). This was done in order to gather *explorative* insights. Thus, participants were invited to answer (mainly) *open-ended* questions on the following eight subjects: (1) about themselves, (2) about the company profile, (3) about the current environmental strategy of the company, (4) about the green initiatives that have been adopted to-date, (5) about their attitudes (positive and negative) with regards to the adoption of green initiatives, (6) about potential *stakeholders* that can act as drivers and/or barriers in the adoption process, (7) about their perspectives on the other drivers and barriers influencing the adoption of green initiatives, and (8) on green initiatives that might be adopted by the company in the future. See Appendix B for a copy of the complete interview guide.

Cassell (2015) recommends piloting the interview – that is, *pre-testing* the questions before conducting the actual interviews. Therefore, interview questions were pre-tested for clarity by five people with *different* backgrounds but with knowledge of the logistics and/or trucking sectors. Individuals with a *relevant* knowledge base were purposely chosen for the pre-test as they are most familiar with the terminology and material and thus were in the best position to comment on the design of the interview and the clarity of the questions. Thus, the interview was pre-tested in a pilot study including five individuals: (1) two high-level employees from the CTA and OTA, (2) two logistics professors at different universities, and (3) the President of one trucking business not involved in the sample of eight companies studied. Following the pilot test, the interview questions were revised as per the recommendations of the five individuals to ensure greater clarity.

3.2.4 Data Collection

Face-to-face interviews were conducted for the study whereby I physically went to the case companies under investigation to interview the participants. All participants were sent a copy of the

interview guide in advance of the scheduled interview to familiarize themselves with the questions. Moreover, all interviews were recorded using an audio-recorder (with the participants consent), and each interview lasted approximately one to two hours. In total, among the eight companies studied, 555 minutes of discussion were recorded. This roughly translates to a total of 9.25 hours of data collected. Following each interview, I listened to the audio-recording and then transcribed the discussion. In total, following the transcription of the interviews, 97 single-spaced pages of data emerged for analysis.

3.3 Data Analysis

3.3.1 Analysis and Software

As per Merriam's suggested data analysis strategies, in analyzing the transcribed interviews, I conducted a *thematic analysis* for each individual case (i.e., a within-case analysis). Thematic analysis is one of the most common types of qualitative data analysis whose purpose is to identify themes or patterns in the data that are *important* in answering the research questions (Maguire & Delahunt, 2017). Thematic analysis involves "much more than simply summarizing the data; a good thematic analysis interprets and makes sense of it" (Maguire & Delahunt, 2017, p. 3353).

Furthermore, in thematic analysis, there are two levels of themes: *semantic* and *latent*. Semantic themes are those that are *explicit* or surface meanings of the data whereas latent themes identify the *underlying* meaning(s) of the data (Maguire & Delahunt, 2017). Thus, in analyzing the interviews, the search for both semantic and latent themes in the data was employed given the nature of the two research questions. For instance, the first research question involves an *identification* of the types of green initiatives that have been mentioned by participants, whereas the second research question requires greater *interpretation* of the data in identifying the influencing factors (i.e., the drivers and barriers).

Additionally, as previously discussed, an *inductive* approach was employed in conducting the *research*. However, in Section 3.1.2, I highlighted that I had a set of preconceived ideas (or *a priori* constructs) that helped act as a guide and provide some structure to my research, given the inductive

approach. Thus, following the literature review, I already had an idea of some of the important themes that I would look for in the data (i.e., the types of green initiatives that were adopted as well as the drivers and barriers). I have outlined these “themes” in Tables 2 and 4, given their popularity in the extant literature. However, I have also emphasized that these ideas are *tentative* and that the search for new themes in the data is welcome. Thus, in conducting the analysis, my aim was two-fold: (1) explore which themes (i.e., the types of green initiatives, drivers, and barriers) commonly found in the literature are also found in Canada (i.e., if there is an overlap among the themes identified in the literature and in Canada), and (2) discover whether there are any new themes that have not previously been found in other studies (i.e., any new green initiatives, drivers, or barriers).

Moreover, conducting a thematic analysis involves a systematic and *ongoing* process of organizing and *categorizing* meaningful parts of the data as they relate to the research questions – a process called *coding*. Coding involves identifying segments of the data to help capture an interesting meaning as it relates to a particular theme (Maguire & Delahunt, 2017). My aim in the coding of interviews was to uncover the underlying meanings or examples that illustrated a particular theme (note that the themes used to start the analysis of transcripts were primarily developed from the literature review, though these were considered tentative given the exploratory nature of the current study).

Furthermore, note that coding is an *iterative* process (Maguire & Delahunt, 2017) as codes/categories can emerge and/or change as new interviews are analyzed – this is particularly the case with semi-structured interviews, where participants are encouraged to answer *freely*. Given such *iterative* process of coding and the *substantial* amount of data collected (i.e., 97 pages of interviews), QSR NVivo 12, a Computer-Assisted Qualitative Data Analysis Software (CAQDAS) package, was used to categorize the data. NVivo is an excellent tool to use with *larger* datasets (Galan-Diaz, Conniff, & Craig, 2014), and I was most familiar with this software given my experience with it during graduate-level research methods courses. For such reasons, NVivo was used for the categorization of data in the current study. The *final* coding scheme (or categorization of data) from NVivo (note that coding was an *iterative* process) in terms

of the types of green initiatives, organization-related factors, finance-related factors, market-related factors, government-related factors, and technology-related factors is shown in Appendices C, D, E, F, G, and H, respectively, in order to illustrate how the codes were developed. Additionally, to ensure reliable research by creating an audit trail, as suggested by Merriam (1998), NVivo was also employed. The use of an audit trail is discussed in greater detail in Section 3.4.

In order to illustrate the coding procedure, note the following example. After reviewing the literature, the government was found to be a key stakeholder inhibiting the adoption of green initiatives in LSPs. One overarching “theme” commonly raised in the literature that exemplifies how the government acts as a barrier is “poor/weak regulations”. Thus, in categorizing the transcript data, “Government-Related Barriers” was a first-level code – or highest-level category (refer to Appendix G). However, following the review of transcripts, a common *pattern* emerged in the data that provided *meaning* to “poor/weak regulations” – that is, several participants emphasized that it is in fact weak *enforcement* of environmental regulations that acts as a government-related barrier to adopting green initiatives. Thus, “weak enforcement of regulations” became as a second-level code (i.e., “theme”) in NVivo (refer to Appendix G). Following the review of transcripts, however, several participants provided unique examples of this theme. For instance, in terms of “weak enforcement of regulations”, participants exemplified this as: (1) not having enough inspections on-road to ensure that all carriers obeyed environmental regulations, (2) the government poorly regulating the establishment of new businesses (i.e., business start-up process is *very* lenient; thus, corrupt behaviour can arise), and (3) environmental regulations are not enforced evenly in the trucking industry (i.e., as a result of unstandardized regulations, there are “winners” and “losers” in the industry). These three examples are essentially patterns that emerged across the data as they were repeatedly cited by many of the participants; thus, they formed third-level codes in NVivo (refer to Appendix G). Any portion(s) of the transcripts that discussed one of these three themes/patterns were placed in the appropriate coding category.

The assurance of a *reliable* coding procedure is discussed in the next section.

3.3.2 Strategies to Ensure a Reliable Analytic Procedure

How can I ensure that I *correctly* interpret the data and follow the *same* coding scheme in analyzing *all* the interviews? This involves the issue of analytic reliability. Thus, in order to ensure that my coding of data is reliable, I have followed the strategies offered by Campbell et al. (2013), given that I collected semi-structured interview data. These authors argued that coding reliability is understudied (particularly for *semi*-structured interviews); thus, they proposed an approach to ensure greater reliability in a situation where: (1) a *single* coder (as is the case in this thesis) is required to code all the transcripts, and (2) *interpretation* is the main analytic goal (as is also the case in this thesis).

Campbell et al. (2013) recommended a two-step procedure to ensure reliable coding, which involves establishing: (1) intercoder *reliability*, and (2) intercoder *agreement*. According to the authors:

Intercoder reliability requires that two or more equally capable coders operating in isolation from each other select the same code for the same unit of text. Intercoder agreement requires that two or more coders are able to reconcile through discussion whatever coding discrepancies they may have for the same unit of text—discrepancies that may arise, for instance, if some coders are more knowledgeable than others about the interview subject matter (as cited in Campbell et al., 2013, p. 297).

These two steps were employed in the current study. I also used *two* other coders, as suggested by Campbell et al. (2013). These two coders were individuals that were *most familiar* with the study's topic and with my work (i.e., two university professors in the logistics domain). Given that coding in this study requires *interpretation*, Campbell et al. (2013) argued that it is vital to choose coders who are most knowledgeable with the study's topic; hence the reason for choosing such individuals.

Moreover, Campbell et al. (2013) claimed that because there are: (1) many units of analysis (i.e., in the current study, many different types of green initiatives, drivers, barriers, etc.) that can be identified, and (2) varying levels of knowledge among the coders, it is necessarily for the primary researcher most

familiar with the work to mark *segments* of the text for coding. This is done because in the presence of three individuals of varying knowledge levels, disagreements may arise on *which segments* of the text contain a particular meaning. For such reason, when I gave a transcript to the two coders, I marked certain *segments* (i.e., the start and end of the text) in which a particular code applied to for a total of 57 coding instances. The two coders were then required to insert a code that they believed best fit the marked segment. The codes and themes were *thoroughly* discussed with the coders in advance of their coding (i.e., I explained the definitions, provided examples, etc.). Note that I gave one complete interview transcript (approximately 15% of my entire dataset) to the two coders. As outlined in Campbell et al. (2013), 10% of the dataset is sufficient for conducting the intercoder reliability test.

Furthermore, I then compared the coding among the two coders and myself. For semi-structured interviews, Campbell et al. (2013) suggested to conduct the intercoder reliability test by calculating the percentage of agreement on coding instances. Thus, percentage agreement was calculated among all three coders (see Table 7). Additionally, Campbell et al. (2013) suggested that an 80% to 90% agreement among three coders constitutes as reliable. If a percentage agreement of less than 80% was achieved, the authors recommended to then conduct the second step – that is, intercoder *agreement*. As shown in Table 7, 78.947% was attained during the intercoder reliability test, so the second step had to be employed.

Table 7

Intercoder Reliability Test Results for Three Coders

Average pairwise percent agreement	Pairwise percentage agreement between coders 1 & 3	Pairwise percentage agreement between coders 1 & 2	Pairwise percentage agreement between coders 2 & 3
78.947%	75.439%	78.947%	82.456%

According to Campbell et al. (2013), intercoder *agreement* is a particularly helpful step in *exploratory* studies. Campbell et al. (2013) explained that this step involves a process where at least three coders “code a transcript, compare codings, and then *discuss* their disagreements in an effort to reconcile

them and arrive at a final version in which as many discrepancies as possible have been resolved” (p. 305). Out of 57 coding instances, 18 of them were in disagreement. Therefore, the two coders and I engaged in a two-hour discussion that involved reconciling different viewpoints on the 18 coding disagreement instances. Following the discussion, an important discovery was made – most of the disagreements occurred because coders either interpreted drivers or barriers either as causes or effects. To provide a simple illustration of what this means, see the following coding instance:

The newer trucks are designed to be more aerodynamic and with engines that burn less fuel – approximately 2 gallons less per 100 miles, which translates into significant fuel savings. Fuel used to be cheaper ten years ago, but because it’s more expensive now, the trucks are manufactured in such a way to burn less fuel.

Coders either coded this as “ability to save on fuel” or “cost savings” or “having green technology available in the marketplace”. Note that these are all *drivers* influencing the adopting green initiatives – in the preceding quote, this was specifically the case for adopting latest-model trucks. However, “the ability to save on fuel” and “cost savings” were interpretations of the *effect* or *result* of purchasing newer truck models. The *cause* in this case was the fact that green technology is readily available in the marketplace – which is what essentially acts as the *underlying* driving force. During the intercoder agreement discussion, all three coders agreed that it is better to code/interpret the data – particularly in analyzing the drivers and barriers – based on the *cause* rather than the *effect* interpretation, unless the interpretations of “cost savings” as a driving force was solely and explicitly raised by the participants. It was agreed upon that this would lead to richer insights, as cost savings are typically one of the main drivers for adopting green initiatives, as per the reviewed literature.

The interview was coded a second time by all three coders with the previously discussed approach in mind. As a result, the percentage agreement significantly improved – i.e., to 96% for 57 coding instances. As per the minimum 80% reliability threshold according to Campbell et al. (2013), the coding process is

now reliable, and the single knowledgeable coder can start coding other interviews based on the agreed upon approach. Thus, this approach was taken in coding the remainder of the interviews.

3.4 Validity and Reliability

Merriam's case study approach calls for "producing valid and reliable knowledge" (Merriam, 1998, p. 198), particularly if the aim is to provide practical implications – that is, useful results for professionals in a given field. Producing credible knowledge involves ensuring internally and externally valid as well as reliable research. Merriam (1998) outlined specific perspectives and strategies on ensuring valid and reliable research. Thus, in the current study, Merriam's strategies for ensuring *internal validity*, *reliability*, and *external validity* are employed. Supporting discussions are provided in turn.

According to Merriam (1998), "*Internal validity* deals with the question of how research findings match reality. Do the findings capture what is really out there?" (p. 201). Merriam (1998) recommends conducting: (1) *member checks*, and (2) peer examination. *Member checks* involve sending the *interpreted* data back to the original participants from whom they were derived in order to ask them to check if the interpretations are plausible. This is a very important component of Merriam's case study approach. Therefore, this strategy was employed and the interpreted findings (i.e., each within-case analysis) were sent back to the participants. Any changes, modifications, and additions as per the participants' requests and/or suggestions were made. Furthermore, *peer examination* involves asking knowledgeable individuals to comment on the findings. This strategy was also employed as two individuals most familiar with the topic and my work reviewed my *interpreted* findings and offered recommendations for improvement, which were also taken into consideration in an effort to enhance the interval validity of the study.

Furthermore, according to Merriam (1998), "Reliability refers to the extent to which research findings can be replicated. In other words, if the study is repeated, will it yield the same results?" (p. 205). However, according to Merriam (1998), this is *very* difficult – particularly for qualitative research that requires in-depth insights – as *interpretation* is challenging to replicate, and because human behaviour is

never static. Nonetheless, to ensure the greatest reliability possible given these realities, Merriam (1998) suggested two strategies to ensure that the results are dependable: (1) *clarifying the researcher's position*, and (2) *creating an audit trail*. According to Merriam (1998), in clarifying the researcher's position, the researcher should explain his/her assumptions, the basis of selecting the participants and a description of them, as well as should provide a background on the context of the study. All these aspects were previously discussed in the thesis. Moreover, Merriam (1998) also recommended creating an audit trail – that is, a detailed account of the research process that would allow other researchers to best replicate the current study. This involves describing in detail how the data were collected, analyzed, etc. Note that these steps were all previously explained in the detail in the thesis. Additionally, it is worth noting that the decision to use a software for analysis in the current study (i.e., NVivo) was also made in an attempt to save the data in order to provide an audit trail – that is, an account of the data analysis process (i.e., examples of themes and codes), should any researcher wish to replicate the current study.

Lastly, according to Merriam (1998), “*External Validity* is concerned with the extent to which the findings of one study can be applied to other situations. That is, how generalizable are the results of a research study?” (p. 207). Merriam (1998) recognized that though research findings must ensure external validity, this is much more difficult to do in qualitative research given that the purpose is *not* to produce generalizable results. However, the author suggested that in order to enhance the *possibility* of the results of a qualitative case study being generalizable to practitioners in the field, for instance, *thick description* should be used in writing the findings. Thick description involves writing the findings in such a way so as to provide enough details (e.g., the context surrounding a particular situation, who was involved, specific dates in which an action occurred, etc.) for the readers to be able to determine how closely their personal situations match the research situation and the findings. This suggested strategy was employed in writing the findings of the within-case analysis, which are presented in the next chapter.

3.5 Summary Insights

This chapter set out to illustrate the *lens* through which the current study was conducted and analyzed. Justification for using a qualitative approach – i.e., case study methodology – was provided, in addition to a detailed explanation of the research design and the rationale behind choosing Merriam’s case study approach. As previously emphasized, Centobelli et al. (2017) highlighted that there is a lack of *interpretative* insights on the topic and called for more interpretative research in the domain of green logistics. As such, in the current study, I examine the adoption of green initiatives in logistics from a new perspective – that is, by using a more *interpretative* approach offered by Merriam (1998). This is the second novelty and contribution of my work.

4 Analysis

This chapter presents the case reports on the within-case analysis of *each* of the eight small-to-medium sized trucking companies in Ontario that have been investigated as part of the *multiple*-case study. A discussion on each company's profile, its implemented green initiatives (in terms of alternative fuels, vehicle technologies, operational strategies, truck replacements, and other initiatives), and the associated drivers and barriers (in terms of organization, finance, market, government, and technology-related categories) affecting the adoption of such initiatives is provided. Relevant quotes from the coding of interview data are included in order to exhibit each participants' perceptions on the topics under investigation.

As highlighted in Section 3.2.2, to encourage openness of response during the data collection stage, all participants were assured that their company names would remain confidential. As such, the companies have been given the following pseudonyms: Alpha, Beta, Gamma, Delta, Epsilon, Zeta, Eta, and Theta. Additionally, in referring to the participants, only pseudonyms were used to ensure the strictest confidentiality.

4.1 Alpha

Alpha incorporated in 1991. Since then, the company has exponentially grown to become one of the leading trucking companies in the industry today. The company currently has a total of 66 employees. Furthermore, Alpha services four main industries: electronics, industrial goods, food products, and some hazardous materials. The company is entirely dry-van asset-based; however, it contracts carrier partners who have reefer fleets should their client(s) require the transport of temperature-controlled goods. Thus, Alpha takes a holistic approach to transportation – with a mix of own assets and strong partnerships, the company strives to offer the most effective and efficient transportation services throughout all of Canada and the U.S. With regards to the company’s fleet size, Alpha has 45 power units and 60 trailers which are all relatively modern. The average age of their tractors is under three years and their trailers are all under ten years, with the exception of the ones they send cross-border, which are typically under five years of age. In studying Alpha, I interviewed the company’s Human Resources Coach, whom I will refer to as “HA” henceforth.

4.1.2 Alpha’s Green Initiatives

Table 8 summarizes the main types of green initiatives that have been adopted by Alpha, as commented by HA.

Table 8

Green Initiatives Adopted by Alpha

Category	Types of Green Initiatives
Alternative Fuels	
Vehicle Technologies	<ul style="list-style-type: none">▪ Aerodynamics (i.e., trailer skirts)▪ Tires (i.e., low-rolling resistance)▪ Auxiliary power units for idle reduction
Operational Strategies	<ul style="list-style-type: none">▪ Speed limits▪ Driver training▪ Route optimization▪ Intermodal transportation▪ Supply chain collaboration
Truck Replacements	<ul style="list-style-type: none">▪ Fleet modernization
Other Initiatives	<ul style="list-style-type: none">▪ Collaboration on green innovation (i.e., academic institutions)▪ Artificial intelligence

4.1.2.1 Vehicle Technologies in Alpha

Within the last five years, Alpha has started **skirting its trailers** and has implemented **low-rolling resistance tires** and **auxiliary power units**. HA emphasized that, *“We have seen a significant amount of fuel savings as a result.”*

4.1.2.2 Operational Strategies in Alpha

Alpha takes **driver training** very seriously. The company believes that the truck driver plays a vital role in helping improve the fuel economy and thus invests a significant amount of resources to educate the drivers on how to optimally operate the equipment. Moreover, Alpha has recently sent two of its employees to obtain designations. As a result, the company now has a Certified Driver Trainer and a Certified Director of Safety whose roles are to train the truck drivers. Furthermore, Alpha holds a “Driver Meeting” once per year in the spring-time to review drivers’ performance and has an intense “on-boarding training week” which newly hired drivers are required to attend and are adequately paid for. Interestingly, to help reduce fuel consumption, Alpha purposely creates a competitive environment among the drivers. The company sets an optimal miles per gallon rate every quarter and the driver that hits and/or surpasses the metric – and thus drives most efficiently – receives a prize, such as a free vacation. HA expressed that, *“Gamification is one of the most effective tools for increasing productivity in an organization, which is why we make it a contest!”* Additionally, the company **limits its truck speeds** and HA remarked that this greatly helps with fuel savings.

Apart from implementing many intra-company initiatives, Alpha also leverages a variety of external stakeholders in order to promote more efficient operations. HA emphasized that they capitalize on **intermodal transportation** and have a rail program in place through which they work with rail companies to ship the goods that they bring from the U.S. to Western Canada. Similarly, the company has a strong network of **supply chain partners that it collaborates with** to deliver shipments in areas that it does not service and/or if the shipments require equipment (such as reefers) that the company does not own. Moreover, Alpha aims to further grow its network – primarily to expand its footprint in the U.S – by partnering with other carriers to achieve greater last-mile delivery efficiencies.

4.1.2.3 Truck Replacements in Alpha

Alpha's brand of choice for trucks has been Volvo for the past five years. HA explained that this is mainly due to *"Volvo vehicles already having all the green technology equipped in them."* As a result, the company capitalizes on **modernizing its fleet** often.

4.1.2.4 Other Initiatives in Alpha

Alpha is interested in implementing better *trailer* technology that will allow the company to extract valuable data and is **collaborating with local colleges to promote innovation** in this department. HA highlighted that,

We have recently funded a capstone project at a local college and engaged with students in developing a unit that can be placed inside a trailer to determine the optimal use of capacity; to measure on-road bumps; and, to provide notifications if the trailer tips outside of the threshold.

Additionally, the company has a robust **route optimization** system already in place; however, HA commented that the company aims to integrate all aspects with regards to the management of its fleet into one system that can provide optimal summary data. As a result, Alpha has partnered with a local software developer in the last year to create a platform based on **artificial intelligence** that will help the company plan its transportation operations more efficiently to ensure greater on-time performance. HA mentioned that this local software developer sees a great potential in the application of artificial intelligence in transportation and thus wishes to partner with a local transportation company, like Alpha, in order to research how to best implement such nascent technology in the transportation sector. According to HA,

The artificial intelligence program will be able to help us with route optimization and transport planning by considering current traffic flow, high traffic density, and traffic patterns. It will be able to forecast the effect of current weather and critical events, such as states of emergency, which we recently saw when the entirety of New York and the Pennsylvania border shut down for commercial traffic – we had nine drivers stuck on the Canadian side of the border at this time and they couldn't enter the U.S... so we could plan a little better in the future. I'm also hoping that through this

platform we'll have better communication – you know, we won't have to read Twitter or other news programs to see who's open and who's not...

Given that the company engages in a significant amount of cross-border transportation, HA expressed that implementing

Artificial intelligence will help us choose the most optimal mix of conveyance options that are available – whether that is the use of company fleet, partner carriers, the rail, or a combination of all three – to transport goods all across Canada and the U.S.

Though the implementation of the platform seems promising, HA commented that it has not been a quick process. Alpha has worked hard with the software developer in the last year to implement the platform; however, even after a year's worth of effort, the company has yet to have something concrete. HA predicted that it will not be until another eight months before Alpha has a pseudo platform to test out. Nonetheless, HA concluded that Alpha's *"tech push will be huge over the next few years."*

4.1.3 Alpha's Drivers and Barriers

Table 9 summarizes the main drivers and barriers identified in Alpha.

Table 9

Drivers and Barriers Influencing the Adoption of Green Initiatives by Alpha

Category	Type of Driver	Type of Barrier
ORG	<ul style="list-style-type: none"> ▪ Management support ▪ Environmental culture ▪ Clear strategy ▪ Employee support 	<ul style="list-style-type: none"> ▪ Lack of employees
FIN	<ul style="list-style-type: none"> ▪ ROI achievement 	<ul style="list-style-type: none"> ▪ High costs
MKT	<ul style="list-style-type: none"> ▪ Combatting driver shortage issue ▪ Combatting aging trucking industry ▪ Customer demands ▪ Partner collaboration on green initiatives (i.e., trucking associations) 	<ul style="list-style-type: none"> ▪ Anti-competitive practices
GOV		<ul style="list-style-type: none"> ▪ Weak enforcement of regulations
TEC		

4.1.3.1 Organization-Related Factors in Alpha

As shown in Table 9, organization-related *drivers* are common in Alpha. The company has a **clear strategy** that is strongly **supported by management** which has helped spearhead its adoption of green initiatives. In relation to Alpha's 2014 Annual General Meeting, HA commented that,

The President communicated to our whole team what it is that we wanted to do moving forward. We do not want to be a traditional trucking company – we want to be a transportation solutions provider. Though we are limited with our own fleet in terms of the services that we can provide, we aim to have a strong network of carrier partners that share the same values. Reducing negative environmental impact is eventually going to be everybody's lifestyle, so why don't we move in the right direction now?

As exemplified in the preceding quote, Alpha acknowledges the growing importance of environmental-consciousness in society and aims to achieve a first-mover advantage in the green trucking sphere by differentiating themselves through a more disruptive approach. As such, the company is willing to experiment with emergent technologies such as artificial intelligence in order to achieve its goals. Although Alpha has clearly set and communicated its strategy with its entire team, the company's values are diffused beyond the organization to partner carriers, as Alpha *purposely* seeks partners with likeminded values that are able to support its overarching strategy.

Moreover, though Alpha promotes an **environmental culture** within its organization, HA stressed the importance of communicating it regularly to employees in the following remark:

You have to explain why it matters to them. If you can't do a good job communicating why adopting something new is important, you are never going to get the buy-in from your team that you need to be successful. Even if you invest the money – if your employees aren't actually committed to the process of implementing it – then you're just flushing money down the toilet...so you really have to put that bug into people's minds...if they can understand and appreciate how they can positively impact – well that just inspires them even more.

As exemplified in the preceding quote, Alpha recognizes that the diffusion of an environmental culture throughout the organization and **employee support** are intrinsically linked and act as vital drivers for the adoption of new initiatives. As such, the company encourages a bottom-up approach in strategy development as employees from all levels of the organization have a say on company direction. Therefore, Alpha attempts to *inspire* input from its employees – in fact, the company’s core values were developed as a team during the 2014 Annual General Meeting. To further highlight Alpha’s emphasis on employee involvement, the company allows its truck drivers to choose the trucks that they want to drive – regardless of the cost – at the time when the company purchases new equipment.

In relation to organization-related *barriers*, Alpha believes that it is difficult to implement green initiatives **without having employees** devoted to managing them. Interestingly, HA expressed interest in tackling this barrier by leaving the role of a Human Resources Coach. According to HA,

People in this business don’t necessarily have the time to focus their energy into looking at greener practices because we are all so involved in the day-to-day operations. So, this is part of the motivation of me moving into a new role this year – it’s to look at special projects like these [the adoption of green initiatives] to see how we can further improve on our environmental goals.

4.1.3.2 Finance-Related Factors in Alpha

High costs have been identified as a *barrier* that inhibit Alpha’s adoption of some green initiatives. However, HA expressed that *“this is only the case for adopting a drastic measure, such as converting our fleet to run on an alternative fuel.”* Less drastic measures are financially feasible for the company. Interestingly, Alpha has **achieved an ROI** on its previously implemented green initiatives as a result of better planning and data collection, which has *driven* the company to further adopt green initiatives.

4.1.3.3 Market-Related Factors in Alpha

Several market-related *drivers* were identified in Alpha.

In 2017, Alpha developed a fuel incentive program and had set clear metrics for the company’s optimal miles per gallon rate that encouraged drivers to operate the trucks more efficiently. Though fuel savings were part of the company’s goals, they were not the main reason for implementing a fuel incentive

program. Rather, Alpha's underlying motivation was to implement a company-wide profit-sharing program. According to HA, *"any costs that were saved from promoting fuel efficiency were redistributed among employees in the form of quarterly profits, with truck drivers being the key recipients."* Evidently, Alpha is well aware of the current **driver shortage issue** that plagues the Canadian trucking industry and in an effort to combat some of the uncertainties associated with this market trend, has adopted certain measures that make the company a more attractive workplace for drivers – such as increased pay and the ability to choose the trucks they drive. Similarly, the company recognizes that **trucking is an aging industry** and thus plans to partner with universities to attract younger workers – primarily in order to *"collaborate on topics such as environmental initiatives and innovation."* Interestingly, the company's in-house IT is always a co-op student from a local college. HA strongly believes that the adoption of artificial intelligence will attract younger workers.

Furthermore, **customer demands** act as a driver in Alpha. HA confirmed that certain customers previously inquired about the company's green initiatives – primarily clients transporting organic fruits and juices. However, HA concluded that customers are generally not interested in green service provisions, specifically. Rather, *"clients demand more efficient and effective service levels, with less damages and delays, which can be fulfilled through the adoption of green initiatives."* Essentially, Alpha views the provision of exceptional levels of service as a *by-product* of the adoption of green initiatives. Moreover, HA expressed that the company *"will never be a discount carrier and our customers are willing to pay more for higher-quality service,"* which HA believes can inevitably be fulfilled through the implementation of certain green initiatives, such as the use of artificial intelligence.

Additionally, HA acknowledged that Alpha's partnership **with a local trucking association** acts as a driver in promoting the adopting green initiatives. As HA remarked that, *"We want to be able to to participate in initiatives being put out by the Ontario Trucking Association. We really want to be a part of that and are doing everything we can to help them out."* HA further emphasized that Alpha is currently working closely with the OTA to help eliminate delete kits in the industry. According to HA, delete kits are

a form of engine tampering and are essentially *“by-passes to a tractor’s emissions system which delete emissions information allowing the truck to look like it is performing great.”*

In relation to market-related *barriers*, however, HA remarked that although delete kits are illegal, the use of them is widespread in the Canadian trucking industry. HA believes that such **anti-competitive practices** are a strong barrier and claims that they significantly impede Alpha’s ability to further engage in adopting green initiatives. According to HA,

There are so many what I call “cowboy carriers” out there who are not compliant with environmental regulations, tax legislation, and employment legislation. What that does to our industry is it lowers our rates. So, why would a customer pay a company like us jacked up rates when they can go next door to some “cowboy carrier” who’s half the price? What’s most unfortunate is that there are a lot of really good transportation companies – especially in Southern Ontario – that are committed to environmental initiatives, but it gets ruined by those who don’t have the same values.

4.1.3.4 Government-Related Factors in Alpha

One main government-related *barrier* was identified in Alpha. HA believes that it is the government’s responsibility to level the playing field among trucking companies by eliminating the illegal use of delete kits in the industry. However, HA expressed that the government *“has weak enforcement of regulations and not enough inspections on the road.”* As such, the presence of anti-competitive practices in the industry coupled with a **weak enforcement of regulations** are the most significant barriers inhibiting the adoption of green initiatives in Alpha, according to HA.

4.2 Beta

Beta incorporated in 1987. The company operates all across Canada and the U.S. and has two facilities – one in Ontario and the other in California. Beta’s facility in California serves as its subsidiary and operates by the same guiding principles as its Canadian parent. Between the two facilities, Beta has a total of 137 employees (84 in Ontario and 53 in California) and a total of 77 trucks (44 in Ontario and 33 in California). The company’s equipment is relatively modern with the average age of its trucks under three and four years in its Canadian and American fleets, respectively. Beta strictly operates dry-van assets and serves five main industries: high-end electronics, furniture, pharmaceuticals, industrial goods, and retail. Furthermore, the company has achieved steady growth in the last 30+ years and prides itself on its ability to maintain successful relationships with clients as it has a very loyal customer base. In studying Beta, I interviewed the company’s President and the Director of Safety. Henceforth, I will refer to them as “PB” and “DSB”, respectively.

4.2.1 Beta’s Green Initiatives

Table 10 summarizes the main types of green initiatives that have been adopted by Beta, as commented by PB and DSB.

Table 10

Green Initiatives Adopted by Beta

Category	Types of Green Initiatives
Alternative Fuels	<ul style="list-style-type: none">▪ Biodiesel▪ Hydrogen▪ Compressed Natural Gas (CNG)
Vehicle Technologies	<ul style="list-style-type: none">▪ Aerodynamics (i.e., trailer skirts, fairings)▪ Tires (i.e., low-rolling resistance)▪ Auxiliary power units for idle reduction▪ Light materials (i.e., aluminum trailers)
Operational Strategies	<ul style="list-style-type: none">▪ Driver training▪ Route optimization▪ Intermodal transportation▪ Supply chain collaboration
Truck Replacements	<ul style="list-style-type: none">▪ Fleet modernization
Other Initiatives	<ul style="list-style-type: none">▪ Collaboration on green innovation (i.e., academic institutions)▪ Recycling materials (i.e., anti-freeze)

4.2.1.1 Alternative Fuels in Beta

Beta has implemented a wide variety of green initiatives (refer to Table 10). The company has not officially adopted alternative fuels but has heavily been engaged in testing them throughout the years. For instance, the company started experimenting with **hydrogen fuel injections** about ten years ago. PB commented that the company has tried three units from different manufacturers in the past; however, it was not satisfied as the use of hydrogen injections caused many issues in the trucks such as engine damage. Interestingly, PB believes that there have not been any *“significant advancements in the field of hydrogen injections in the last decade.”*

Furthermore, Beta previously experimented with **biodiesel** but had experienced several problems. Both PB and DSB acknowledged that biodiesel clogs fuel filters, negatively affects the engine performance and after-exhaust treatment and is not effective in colder temperatures, such as in the harsher winter climates of Canada. Interestingly, PB claimed that the only reason that biodiesel is used in Canada is because *“the Minister of Agriculture strongly advocates it as it has pushed the price of corn up 40%.”*

Additionally, Beta has recently tested a **CNG** truck for a short period of time. The company, however, is currently looking at another supplier to lease a new CNG truck to conduct further testing as it had experienced issues with the previous CNG truck. Moreover, PB highlighted that, *“Within the last year in Ontario, we’ve started to see a lot of players enter the CNG field and try to do different things.”* As a result, Beta is keenly interested in capitalizing on this trend and converting its fleet to CNG.

Furthermore, PB believes that a CNG fleet conversion will help eliminate all the problems associated with the after-exhaust treatment in trucks. According to PB, *“90% of the issues we have with trucks today are related to the after-exhaust treatment.”* Thus, in order to operate a more efficient fleet, Beta strives to achieve a first-mover advantage in the CNG field. As such, for the last two years, Beta has studied CNG adoption in great depth; the company has examined the availability of CNG infrastructure, re-evaluated its own operations to determine the feasibility of adopting CNG, talked to several CNG engine manufacturers, and has tested CNG trucks.

It is interesting to note that PB does not believe in electric trucks, claiming that “*the battery technology simply isn’t there yet for long-haul trucking.*” Nonetheless, PB sees light-duty vehicles with return-to-base operations as feasible avenues for electric truck applications.

4.2.1.2 Vehicle Technologies in Beta

Beta has adopted several aerodynamic enhancements over time and has witnessed fuel savings as a result. The company has **skirted its trailers** and has implemented **fairings**. Additionally, Beta purchased **auxiliary power units** to reduce idle times. Additionally, the company purchased **low-rolling resistance tires**. Interestingly, Beta always considers the **weight of truck materials** to ensure greater freight capacity. This is best exemplified in PB’s following remark:

When buying new equipment, we’re always trying to be weight-conscious. For example, it costs a lot of money to buy a trailer with aluminum cross members because they are more expensive than steel cross members, but it takes 300 pounds out of the trailer. I would guess that there are a lot of guys in the trucking industry who don’t know that.

4.2.1.3 Operational Strategies in Beta

Beta recognizes that truck drivers play an important role in managing fuel efficiency and thus heavily invests in **driver training**. The company makes use of educational videos from truck and engine manufacturers on drivability in order to teach the drivers how to efficiently operate the vehicles. Moreover, Beta has a rewards system in place to motivate the drivers to take the education seriously. The company strongly advocates efficient driving and thus has purposely created a competitive environment for drivers to compete on attaining the lowest idle times and best fuel economy. Furthermore, in order to make it evident for the drivers and thus to further increase their competitiveness, Beta regularly and openly posts the drivers’ results so that every employee in the company can see how each driver is performing. Additionally, according to DSB, “*We sometimes divides the drivers into teams by placing two drivers in a truck to compete against each other on fuel economy and idle time.*”

Similarly, PB believes that not only does engaging with employees help to maximize the efficiency of operations, but it also aids in ensuring a smoother adoption of new technologies. For instance, when Beta

purchased trucks with automatic transmissions, some of the company's drivers resisted to try this new technology as they were used to manual transmissions. As a result, PB stresses the importance of openly communicating with the truck drivers, as highlighted in the following quote:

I think a lot of the trucking companies introduce new technology, but I don't think a lot of them do a good job of actually talking to the drivers, dealing with them, and telling them why they changed the technology in the vehicle, what exactly that does, and how to maximize the benefits. I'm not sure how many of them actually do a good job of relating to the drivers and making them part of the solution.

Furthermore, Beta makes use of **route optimization** to achieve greater efficiencies by planning routes more effectively. The company has previously done some **intermodal** work with rail companies. This was mainly to help customers with the capacity issue, as according to PB, *"Several years back, there were not enough trucks on the road to move freight."* As a result, Beta made use of rail during peak seasons to move more freight. However, given that Beta transports some specialized and high-value products, sometimes it is not possible for the company to capitalize on intermodal transportation. Nonetheless, Beta will strive to make greater use of intermodal transportation in the future, according to PB. Furthermore, Beta has **collaborated with other supply chain partners** (such as local carriers in various regions in Canada and the U.S.) to consolidate deliveries in order to minimize the amount of trucks the company has in operation for long-hauls. According to PB, *"We try to consolidate shipments whenever we can in order to ensure that our trucks are always running at maximum capacity."*

4.2.1.4 Truck Replacements in Beta

Previously, Beta has implemented aerodynamic improvements by purchasing add-ons for its trucks. However, in recent years, the company started to purchase latest-model trucks with all these features already equipped in them. According to PB, *"The biggest advancement nowadays in terms of fuel savings is through the purchase of new equipment."* As such, Beta strives to **maintain a modern fleet**.

4.2.1.5 Other Initiatives in Beta

At Beta, there is a belief that sustainability can be achieved beyond the transportation function. As such, the company places great importance on promoting environmentally-friendly behaviour in-house – primarily through **recycling materials**. According to PB, “*We have recycled anti-freeze for years.*” Furthermore, Beta is interested in **collaborating on green innovation**. For instance, the company is currently working with a local college to develop an electrical generation unit that can replace a physical generator.

4.2.2 Beta’s Drivers and Barriers

Table 11 summarizes the main drivers and barriers identified in Beta.

Table 11

Drivers and Barriers Influencing the Adoption of Green Initiatives by Beta

Category	Type of Driver	Type of Barrier
ORG	<ul style="list-style-type: none">Management supportManagement knowledgeEnvironmental cultureClear strategyEmployee support	<ul style="list-style-type: none">Small company size
FIN	<ul style="list-style-type: none">ROI achievement	<ul style="list-style-type: none">High costs
MKT	<ul style="list-style-type: none">Combatting driver shortage issueCustomer demandsPartner collaboration on green initiatives (i.e., trucking associations)	
GOV		<ul style="list-style-type: none">Poor involvement in green initiativesLack of incentives
TEC		<ul style="list-style-type: none">Lack of green technologyRisks with new technology

4.2.2.1 Organization-Related Factors in Beta

Several organization-related *drivers* are particularly influencing in Beta in terms of motivating the adoption of green initiatives (refer to Table 11). Most importantly, the company has a **clear strategy** that is based on continuous improvement with regards to the efficiency of operations. Additionally, a strong **environmental culture** was detected in Beta, as exemplified by PB’s following remark:

For us, it's about efficiencies and the environment. It's not the only decision we make, but it's definitely a big part of that decision-making process when we're buying our equipment. At the end of the day, it's not only about the costs. As long as it's not going to cost us a lot more money to run the new product – and if the only benefit is a cleaner environment – I'd be happy to try it.

In terms of its continuous improvement strategy, Beta uses SmartWay as both a resource and a guide for constantly refining the efficiency of its operations and measures its improvement against SmartWay benchmarks. The company invests a significant amount of effort in monitoring and interpreting data, as it believes that collecting data is useless without proper interpretation. As highlighted by DSB,

We have a series of “improvement teams” established within the organization where each manager is given one or two teams to monitor. One of the ones I look at is our fuel efficiency. Every month, we're tracking our fuel usage versus distance travelled, our overall carbon footprint, and our idle times against a range where we expect our drivers to be. In order to evaluate our footprint, twice a year we take an in-depth look at our fleet – we try to break it down based on the year of the truck, the transmissions, and the engines to see which ones will be of more benefit to keep in the fleet.

Beta also views **employee support** as an important driver in the adoption of green initiatives. The company has established a “Miles Per Gallon club” where employees are rotated throughout different roles as part of varying departments in the organization. This is done to ensure that *each* employee understands *why* the company is implementing new initiatives. Beta's management team believes that this is highly necessary in order to promote a smoother implementation of such initiatives. Involvement of employees from all levels in the company's decision-making process is of utmost importance as Beta believes that this garners the necessary employee support for the adoption of future initiatives. Evidently, the diffusion of an environmental culture throughout the organization that is *strongly supported by management* and employee support are intrinsically linked in Beta. PB provided an interesting remark to highlight the important role of management in promoting the adoption of green initiatives, as exemplified in the following quote:

Back in the day, a lot of the trucking companies used to be run by guys like me that drove a truck or were mechanics, so they had some mechanical aptitude. The problem today is that they're run by the Chief Financial Officer – who's got an accounting background – and is less mechanically-inclined. So, what's going to happen if the new technology is not supported from the top and then the guy in the shop starts to try something and it doesn't work?

Interestingly, PB not only believes that the adoption of new technologies needs to be supported from management in order to be effectively implemented, but also that management must have the knowledge base necessary to recognize what is best for the company. As such, PB stressed that a **knowledgeable management team** is a subtle yet crucial underpinning for ensuring the successful adoption of green initiatives – in fact, the adoption of such initiatives is most effective when the managers have a good mechanical understanding. DSB, however, further hinted that a knowledgeable management team is essentially the underlying reason for the company having such a risk-taking mindset, as is evident from its willingness to convert its fleet to CNG. According to DSB,

We've always tried to be innovative in the company. We've tested all kinds of things over the years because we want to be on the leading edge of technology. We always want to be adaptive – and, we like to be challenged!

4.2.2.2 Finance-Related Factors in Beta

PB acknowledged that the **achievement of an ROI** has *motivated* the company to adopt further green initiatives. Furthermore, Both PB and DSB confirmed that they have seen an ROI on the company's previously adopted initiatives, typically between two to four-years time. However, according to PB,

It really takes a little bit of legwork on your part to really project forward what the savings and ROI are to you and likely if you can save enough money. Then, maybe you don't need to charge your customers extra.

As such, PB stressed that an ROI can only be realized if companies invest effort in projecting the savings themselves. Nevertheless, **high costs** act as a *barrier* for Beta; however, only due to the disadvantage that the company faces in comparison to large trucking companies. For instance, PB emphasized, “When

*automotive manufacturers want to sell new products, they approach the largest carriers first and reduce their upfront costs by 40%” in order to encourage larger carriers’ adoption as manufacturers believe that this will initiate the sale of a greater quantity of their products. As such, **small company size** acts as a barrier in Beta, given that the company is at a disadvantage from the outset compared to larger carriers in the industry.*

4.2.2.3 Market-Related Factors in Beta

Market-related *drivers* also play a significant role in influencing the company to adopt green initiatives (refer to Table 11). Beta is keenly aware of the **driver shortage issue** in Canada and has acknowledged that purchasing new trucks greatly helps with attracting truck drivers to their business. Thus, the company strives to maintain a modern fleet with reliable equipment in order to combat some of the uncertainties associated with this market trend.

Furthermore, both PB and DSB commented that **customer demands** influence the company’s decisions to implement certain green initiatives. This is best exemplified through PB’s following remark:

I think more and more customers in this industry are looking at sustainability, but I haven’t seen them driving down and saying that they’ll pay more for it, specifically. There are a growing number of customers that are only hiring carriers with a certain amount of sustainability. I think that there’s a sale back to it – I mean at the end of the day; customers want to work with a company that’s doing the right thing.

Evidently, Beta has not necessarily seen its customers demands greener service provisions; however, the company has previously adopted certain green initiatives (e.g., intermodal transportation) to ensure more timely service for its loyal customer base in times of greater need for capacity. Thus, it is not customer pressure for greener service provisions that drives the company to adopt more environmentally-friendly practices; rather, it is customers’ demand for more *timely* services. Hence, in providing more timely and reliable services, Beta is driven to implement more collaborative initiatives like intermodal transportation and supply chain collaboration. Hence, it can be said that customer pressures *indirectly* motivate Beta to adopt green initiatives.

Moreover, Beta has a **close relationship with a local trucking association** which motivates the company to be at the forefront of adopting green initiatives. Beta is actively involved with helping the OTA achieve its environmental objectives for the industry. According to PB,

The government always cries that they don't have enough manpower, so we do all the background work. We go and talk to manufacturers about equipment, road guys about infrastructure, tire guys...like we'll go through every variable scenario and just lay it out for them so that they have enough information to make a good decision. Unfortunately, some of these environmental initiatives don't gather a lot of traction because most people in the government worry about being re-elected so they always try to pick the low-laying fruit that will show some sort of quick benefit to the general public.

4.2.2.4 Government-Related Factors in Beta

As highlighted in the preceding quote (refer to the last quote of Section 4.2.2.3) **poor government involvement in green initiatives** acts as a *barrier* that impedes Beta's adoption of green initiatives.

Additionally, a **lack of incentives** provided by the government was also cited as a barrier. DSB commented that a helpful program was previously in place – known as the Green Commercial Vehicle Program (GCVP) of Ontario – which had offered substantial rebates for carbon-reducing technologies (such as alternative fuel vehicles) and various fuel-saving devices (such as aerodynamic or tire improvements). However, with the recent change of government, and as of July 3rd, 2018, the GCVP was cancelled (Ontario Ministry of Transportation, 2018). In 2018, Premier Doug Ford of the Progressive Conservative Party of Ontario won the general election and cancelled most of the environmental programs in the province. As a result, Beta, who had applied for the GCVP to fund their purchase of CNG trucks, was not able to receive the sought incentives. DSB heavily criticized the Ontario government, as evidenced in the following remark:

In Ontario we have a very budget-oriented administration when compared to California. There, they have a robust grant program in place for alternative fuel vehicles. They are currently offering

\$100,000 for CNG-powered trucks, \$150,000 for hybrids, and \$200,000 for the adoption of fully electric trucks.

Furthermore, PB believes that with the abundance of natural gas in Canada, incentivizing the adoption of CNG-powered trucks is the *fastest* way to green the trucking industry; for such reason PB has expressed concerns over the lack of incentives. According to PB,

We've [trucking companies] constantly pushed the government. Somebody's got to push CNG thing to have the government offset some of the costs. There has to be enough of CNG manufactured to bring the costs down and the only way to reach that is to actually incentivize it to a certain degree to get some kind of results – or to get more people interested – because that will help bring economies of scale in manufacturing and then CNG just may become commonplace.

4.2.2.5 Technology-Related Factors in Beta

Given that Beta has extensively experimented with various technologies in the past (such as testing different alternative fuels), the company has experienced two main technology-related *barriers*. First, according to PB, there are a **lack of green aftermarket products** which makes it difficult to adopt practices that lead to better environmental performance. PB claimed the following:

Most vendors just aren't there. They're tackling issues that they think they can make money off of but they're selling it as if they're trying to help the world. I'm not sure if we even have somebody out there specifically designing products that are going to be greener in certain applications. I'm pretty sure that we could be more innovative in the trucking industry.

Second, DSB expressed concerns over some **risks associated with the adoption of new technologies**. For instance, DSB remarked that, “*You can engineer a solution for a problem...but what other problems are you creating?*” as the company had experienced several issues of technical nature with the adoption and testing of various alternative fuels (e.g., engine damage). Additionally, the company had problems with electronic controls and sensors in newer trucks that have necessitated almost weekly repairs. Interestingly, Beta also sees risks with new technologies from a financial perspective. According to DSB,

If I go to a supplier to purchase say a new electric truck at \$275,000, I won't be able to finance that with a 10% down payment. They won't take the rest because they don't know what the resale is on it. Because it's a completely new technology, there's no bottom number or blue book value on it.

To further highlight the risks associated with the re-sale value of new technologies, PB emphasized,

There is a used truck market, but the used truck market has always been seven to nine years behind the new market. When we switched to electronic controlled engines back in 1988, nobody wanted them. However, after about eight years they all wanted them because they were very robust and way better than the mechanical engines. Unfortunately, the used truck market takes a really long time...

4.3 Gamma

Gamma is a family-owned trucking business that incorporated in 2013. The company has a total of 90 employees. Additionally, Gamma has 80 tractors with the average age of its fleet varying from one to six years; however, most of the tractors are latest-models and are thus relatively modern. Moreover, Gamma has achieved exponential growth since its inception and aims to continue expanding its business. The company serves both Canadian and U.S. markets; however, most of its operations are in Eastern Canada and Midwest U.S. Furthermore, Gamma services the food industry and strives to be the best asset-based carrier specializing in the transport of perishable commodities. As such, the company owns a fleet of both reefers and dry-vans. In studying Gamma, I interviewed the company's Vice President of Operations, whom I will refer to as "VPOG" henceforth.

4.3.1 Gamma's Green Initiatives

Table 12 summarizes the main types of green initiatives that have been adopted by Gamma, as commented by VPOG.

Table 12

Green Initiatives Adopted by Gamma

Category	Types of Green Initiatives
Alternative Fuels	▪ Hydrogen
Vehicle Technologies	▪ Aerodynamics (i.e., trailer skirts) ▪ Tires (i.e., low-rolling resistance, auto-tire inflation systems)
Operational Strategies	▪ Driver training ▪ Route optimization
Truck Replacements	▪ Fleet modernization
Other Initiatives	

4.3.1.1 Alternative Fuels in Gamma

Gamma has adopted limited green initiatives (refer to Table 12). The company has briefly investigated the adoption of natural gas in the past; however, VPOG does not believe that natural gas is feasible in colder Canadian temperatures as fuel lines, filters, and the CNG pressure regulator can freeze in the winter-time. Gamma, however, has recently experimented with **hydrogen injections** in attempt to

reduce DEF consumption; however, the company ran into major issues and *“had to replace the tested truck as the engine had been permanently damaged.”* According to VPOG, *“I think that in the next seven to eight years, electric trucks will be more common, so we might buy a couple just to try them out.”* As such, Gamma is keenly interested electric-powered trucks.

4.3.1.2 Vehicle Technologies in Gamma

Interestingly, according to VPOG, *“We have many partner carriers who we switch trailers with.”* As a result, Gamma takes advantage of different kinds of fuel-saving technologies from its partner carriers’ equipment such as **trailer skirts** and **auto-tire inflation systems**. Furthermore, the company has recently implemented **low-rolling resistance tires** on two of its trucks.

4.3.1.3 Operational Strategies in Gamma

Gamma has started to realize that truck drivers play a significant role in the quest to save fuel. As a result, the company has recently designated its safety department to train the drivers. Currently, the safety department is responsible for showing videos to drivers that explain how to operate equipment safely and efficiently. As the company grows, however, Gamma plans to formalize the **driver training** process. As highlighted by VPOG in the following quote:

Before we could train one driver and he could tell five or six of his buddies, but we can’t due this anymore as we’ve been increasing our fleet size. Now, we have about 80 drivers and we need to have formal sit-down lectures. We have recently outsourced this to a consulting company because they are experts at it.

Moreover, Gamma also makes use of **route optimization**. The company currently uses software for optimizing routes using real-time data and has noticed a significant amount of fuel savings on a yearly basis. Furthermore, the company plans to focus more on optimizing its routes in the future. VPOG explained that route optimization is particularly important in the winter-time in Canada as more fuel is burned during colder temperatures and when travelling on snowy and/or hilly roads. As a result, the company refrains from servicing certain regions in the winter due to the increased cost of fuel and thus finds route optimization useful in such situation.

4.3.1.4 Truck Replacements in Gamma

Gamma's overall philosophy is that the greatest efficiencies are attained through the purchase of new trucks. As such, Gamma strives to **maintain a modern fleet**. According to VPOG, "*We have recently purchased two 2017 model trucks with aerodynamic features already included.*" As such, rather than purchasing aerodynamic improvements in the form of add-ons, the company capitalizes on purchasing new trucks with aerodynamic features already equipped in them. Gamma, however, plans to bring in an expert soon and/or sit down and discuss as a team what the company can do to further reduce its carbon footprint in the near future.

4.3.2 Gamma's Drivers and Barriers

Table 13 summarizes the main drivers and barriers identified in Gamma.

Table 13

Drivers and Barriers Influencing the Adoption of Green Initiatives by Gamma

Category	Type of Driver	Type of Barrier
ORG		<ul style="list-style-type: none">▪ Lack of management support▪ Lack of employees
FIN	<ul style="list-style-type: none">▪ Cost savings	<ul style="list-style-type: none">▪ High costs
MKT	<ul style="list-style-type: none">▪ Combatting carbon tax uncertainties	<ul style="list-style-type: none">▪ Lack of customer interest in green service▪ Lack of infrastructure
GOV		<ul style="list-style-type: none">▪ Lack of incentives▪ Absence of a clear source of information▪ Poor involvement in green initiatives▪ Weak enforcement of regulations
TECH	<ul style="list-style-type: none">▪ Availability of green technology	<ul style="list-style-type: none">▪ Risks with new technology

4.3.2.1 Organization-Related Factors in Gamma

Two main organization-related *barriers* have been identified in Gamma (refer to Table 13). First, there is a **lack of management support** for green initiatives, as exemplified by VPOG's following remark:

We don't talk enough about green initiatives here. I think that we need to talk about it more in meetings – we need to have some sort of quarterly goals. Right now, I'm the only one in the

company that thinks about it and I don't even have anyone on the team that can help me find cleaner practices.

Second, as highlighted in the preceding quote, VPOG illustrated some of the challenges associated with a **lack of employees** devoted to managing green initiatives, stressing that the adoption of more environmentally-friendly practices requires a team effort.

4.3.2.2 Finance-Related Factors in Gamma

Cost savings act as a *driver* in motivating Gamma to adopt green initiatives. For instance, VPOG commented that *“implementing sustainable trucking practices helps lower the overall costs of doing business for us.”* VPOG particularly emphasized that certain initiatives (i.e., modernizing the fleet, driver training, and route optimization) have resulted in significant fuel savings for the company. Gamma plans to reinvest these savings in order to grow the business in the near future. As such, it can be said that green initiatives *indirectly* help with Gamma's growth.

Additionally, VPOG acknowledged that **high costs** of latest-model trucks act as a *barrier* which hinder the company's purchase of new equipment.

4.3.2.3 Market-Related Factors in Gamma

At the time of the interview with VPOG (i.e., November 13, 2018), VPOG expressed that, *“We do not want to be too carbon-intensive because the current situation with carbon taxes is unclear.”* Note that federal carbon taxes came into effect on April 1, 2019. VPOG was unsure of how the enactment of carbon taxes will play out at the time of the interview. Evidently, **combatting uncertainties associated with carbon taxes** acts as a *driver* in motivating Gamma to adopt green initiatives.

Moreover, a **lack of customer interest in green services** acts as a *barrier*. According to VPOG, *Honestly, I don't think that customers are really interested in sustainability. At the end of the day, they only care about the service. From their standpoint, they'd rather have a fleet that's performing on-time deliveries than one that's green washing.*

Gamma essentially believes that capitalizing on the adoption of green initiatives would shift the company's focus away from customer service. However, Gamma would gladly implement more environmentally-friendly practices if its customers demanded them – and were willing to pay more for such services.

Furthermore, a **lack of infrastructure** was acknowledged as a barrier by VPOG, as exemplified in the following quote:

Before we can start implementing things like alternatives fuels – for instance, like electric trucks and charging stations – we need to have the infrastructure for current diesel trucks to park and fuel up. As of now, we don't even have enough of this infrastructure in place.

4.3.2.4 Government-Related Factors in Gamma

In relation to government-related factors, only *barriers* have been identified in Gamma.

First, VPOG highlighted that a **lack of incentives** significantly hinders the company's adoption of green initiatives. VPOG particularly emphasized that Ford's new government had eliminated many of the incentives previously offered for trying out fuel-saving devices, such as auxiliary power units.

Second, VPOG believes that the government **has not provided a clear source of information on incentives for green initiatives**, as exemplified by VPOG's following remark:

I tried looking into how you can have the government pay for auxiliary power trial units. I didn't look too much into the details because it didn't make much sense to me. I really don't want to put in hours of research into something that I can't get any answer from.

Moreover, VPOG highlighted that the government has **poor involvement in green initiatives** in terms of adopting impractical mandates as well as **weak enforcement of regulations** overall. This is best exemplified by VPOG's comments regarding the recent ELD mandate. According to VPOG,

ELD's are going to cause a storm in Canada next year. There are a couple of ways you can work around regulations in Canada – legally too. You can drive longer than in the U.S, we don't have the infrastructure to have thousands of trucks parked outside on the road, neither does the colder weather permit strict hours. Right now, the driver can move around for 20-30 minutes on paper logs even though we don't condone it, but if there's a storm, he'll push it for 20 minutes rather than

stopping on the road and he'll justify in his logs what had happened. Even though we have ELDs coming to Canada, in the long-term, they're going to result in unnecessary increased cost of business. To be honest, it's really just government involvement in an area where it doesn't need it.

Interestingly, VPOG suggested that the government should pursue a more effective approach when regulating the trucking industry, as exemplified in the following quote:

We need a less restricted environment in Canada. We need more pro-business initiatives rather than trying to tamper climate down and increasing the costs for trucking companies. Rather than discouraging fuel usage, the government should encourage more efficient practices. Basically, the current structure right now is you're going to be punished – but that has to change because it doesn't make too much sense to be restricting economic output.

4.3.2.5 Technology-Related Factors in Gamma

The **availability of green technology** in trucking has been identified as a *driver* in Gamma. According to VPOG,

Every piece of equipment that's hitting the road nowadays is more environmentally-friendly. There are so many options that are built into the specifications of trucks that are environmentally-friendly (e.g., aerodynamics, DEF, etc.), so you don't even have a choice not to be sustainable when you buy a new piece of equipment.

Interestingly, VPOG noted that there have been significant advancements in reefer technologies such as the “*use of telematics, simpler configurations that allow easy repairs, and more efficient energy usage*” that greatly reduce the amount of fuel consumption. In fact, VPOG believes that reefers are already fully-loaded in terms of being maximally equipped with green technologies.

Furthermore, Gamma experienced several issues with the DEF system (i.e., filter clogs, engine damage, inability to repair the trucks, etc.). As such, VPOG has become skeptical when it comes to adopting **new technologies as a result of some of the risks associated** with their performance. This is the primary technology-related *barrier* identified in Gamma.

4.4 Delta

Delta incorporated in 2015 as a partnership. The company currently has 75 employees and 65 trucks in its fleet that are around five years old. Since its inception, and thus in less than five-years time, the company has exponentially grown its fleet size. Delta, however, plans to further expand its business and has set aggressive growth targets. Moreover, the company operates in both Canada and the U.S. and services the food industry (i.e., both fresh and frozen produce). As such, Delta has both reefers and dry-vans in its asset base. Interestingly, Delta serves two large and well-known Canadian grocery retailers. In studying Delta, I interviewed the company's Owner, whom I will refer to as "OD" henceforth.

4.4.1 Delta's Green Initiatives

Table 14 summarizes the main types of green initiatives that have been adopted by Delta, as commented by OD.

Table 14

Green Initiatives Adopted by Delta

Category	Types of Green Initiatives
Alternative Fuels	
Vehicle Technologies	▪ Tires (auto-tire inflation systems)
Operational Strategies	▪ Speed limits ▪ Driver training
Truck Replacements	▪ Fleet modernization
Other Initiatives	▪ Maintenance

4.4.1.1 Vehicle Technologies in Delta

Delta has implemented a limited amount of green initiatives (refer to Table 14). In terms of vehicle technologies, the company has recently purchased ten new trailers with **auto-tire inflation systems**. According to OD, *"Under-inflated tires burn a lot more fuel. By purchasing trailers that inflate themselves, we have witnessed a large percentage of fuel saved. We are planning to purchase more of these trailers in the next five years."*

4.4.1.2 Operational Strategies in Delta

Delta **limits its truck speeds**. According to OD,

In Ontario, you can't have a truck that goes over 105 kilometres per hour, so all our trucks are equipped with speed limiters. This is a must in Ontario versus the U.S., which doesn't require it. If you drive 120 kilometres per hour, for instance, not only will you endanger people, but you will also burn more fuel.

As exemplified by OD's preceding quote, in Delta, speed limiters are not only implemented because of provincial regulations; rather, the company was able to witness a significant amount of fuel savings by limiting the speeds at which it operated its trucks. Furthermore, Delta invests a significant amount of resources in **training its drivers**. In order to do so, Delta collaborates with its insurance company, as highlighted by OD's following remark:

I'm not sure if this is common in the industry, but our insurance company gave us a helpful tool to improve the driver's performance. As a result, we have a built-in system that consists of tutorials, tests, quizzes, and puzzles that allow us to educate the drivers on operating equipment safely and efficiently.

Additionally, representatives from Delta's insurance company visit Delta every three months to examine Delta's progress and provide suggestions for improvement. Delta's insurance company is keenly interested in improving the drivers' performance because it wants to minimize the occurrence of on-road accidents caused by Delta's drivers. Thus, the insurance company takes a very active role in the training of Delta's drivers by creating and re-creating lecture materials for Delta's managers to use to train and re-train drivers, respectively. For instance, Delta's insurance company *requests* that newly hired drivers in Delta drive three to six months alongside a more experienced driver. OD emphasized that this has resulted in increased costs for the business; however, it has also led to safer and more efficient driving.

4.4.1.3 Truck Replacements in Delta

In relation to the Volvo brand, according to OD, *"We've witnessed that that newer trucks are about 20% more fuel-efficient than older models as a result of better aerodynamics."* For such reason, Delta is

currently capitalizing on **fleet modernization** as it believes that most of the efficiencies with regards to fuel savings are gained through new equipment purchases. In the future, as the company wishes to significantly increase its fleet size, it plans to purchase newer models of Volvo trucks with all the aerodynamics features already equipped in them (e.g., trailer skirts, fairings, etc.).

4.4.1.4 Other Initiatives in Delta

Delta takes **maintenance** very seriously. According to OD, “*One of the best practices we have here is in-house maintenance.*” The company conducts stringent pre-trip and post-trip inspections at their facility and never sends out a truck until it is *fully* fixed. Additionally, OD stressed that the company never goes cheap on maintenance. For repairs, Delta always purchases new parts. For instance, given that the company services hotter destinations, recap tires are never used (i.e., old tires that are refurbished) as they can come off in hotter temperatures and result in “*unnecessarily expensive service calls of over \$1,000 USD per tire.*” As such, OD believes that having all maintenance conducted in-house results in savings for the business. As such, Delta capitalizes on preventative maintenance to ensure greater reliability of equipment, particularly given that the company works with some of the largest grocery retailers in the country who contribute a significant amount of profit to Delta’s business. OD commented that at Delta “*we reinvest all savings into the business for future growth.*”

4.4.2 Delta’s Drivers and Barriers

Table 15 summarizes the main drivers and barriers identified in Delta.

Table 15

Drivers and Barriers Influencing the Adoption of Green Initiatives by Delta

Category	Type of Driver	Type of Barrier
ORG		<ul style="list-style-type: none"> Small company size
FIN	<ul style="list-style-type: none"> Cost savings 	<ul style="list-style-type: none"> High costs
MKT	<ul style="list-style-type: none"> Combatting driver shortage issue Customer demands Partner collaboration on green initiatives (i.e., insurance company) 	<ul style="list-style-type: none"> Competitive pressures Anti-competitive practices in the industry Lack of infrastructure
GOV		<ul style="list-style-type: none"> Lack of incentives
TEC	<ul style="list-style-type: none"> Availability of green technology 	<ul style="list-style-type: none"> Risks with new technology

4.4.2.1 Finance-Related Factors in Delta

As discussed throughout Section 4.4.1, Delta is currently focusing on reducing its costs of doing business in order to be able to reinvest the savings to achieve its aggressive growth targets. For such reason, Delta has implemented certain green initiatives – even though they are more expensive – because the company believes that these initiatives will result in significant **cost savings** in the *long-term*. Examples of this are investing more money into in-house maintenance and purchasing high-quality parts for repairs to reduce the occurrence of future breakdowns; or, purchasing latest model trucks that are more fuel-efficient. Thus, the ability to achieve cost savings *drives* Delta to adopt green initiatives – even though the primary focus is not necessarily on environmental sustainability.

Additionally, OD has acknowledged that **high costs** of newer equipment act as a *barrier* in adopting green initiatives – primarily in terms of high truck prices. Interestingly, however, OD also commented on insurance costs as a barrier. According to OD,

When I started this business, trucks were \$100,000 CAD. Right now, they're very expensive – a new truck costs anywhere between \$175,000 to \$200,000. Do you know why? These trucks are built in Mexico, sold to the U.S, and then we buy them from the U.S. Because you have to factor in the current exchange rate of 30%, truck prices start around \$175,000 CAD today. Insurance costs are also between 20% to 30% - it costs me more than \$800,000 a year to insure my fleet...so it's very difficult to sustain in this business.

4.4.2.2 Market-Related Factors in Delta

In the previous section (refer to Section 4.4.2.1), Delta acknowledged that high costs act as a barrier in adopting green initiatives. Interestingly, however, OD expressed that some of these high costs can be offset by pursuing relationships with certain stakeholders. For instance, according to OD,

Everybody complains about the prices in this industry, but at the end of the day, you have to know who you're dealing with. Let's say that I have a dealer that I buy trucks from. If he sells me something bad, then he knows that he might not get the next order. That's why we try to build relationships with dealers, financing companies, insurers, customers – even the Ministry of

Transportation – because when you know these people on a base where it’s almost like a friendship, they won’t look to overcharge you. If you’re truly open to people in this industry, they will share their wisdom – you just need to learn how to listen and take the good and put it into motion.

For such reason, Delta has **partnered with its insurance company** on training its drivers. As a result, the insurance company *motivates* Delta to capitalize on and refine its driver training process.

Furthermore, Delta’s **customers demand** latest-model equipment, as exemplified by OD’s following remark:

The customers we have right now, they are not small customers – they are big customers – and they speak very highly of us. So, we invest a lot of time into pleasing them because that’s when you can get better loads. My customers demand that our trucks are reliable. They demand new equipment and they want to see us grow.

Given that Delta transports food-grade products for two large and well-known grocery retailers, the company is motivated to maintain a more modern fleet to ensure the fulfillment of its customers’ demands and subsequently profitable future business.

Moreover, the **driver shortage trend** in the market encourages Delta to purchase newer Volvo trucks. According to OD,

Everyone’s talking about the driver shortage but let me tell you something. In reality, there are actually a lot of drivers out there, but there are not a lot of good drivers and that’s what the problem is. So simply put, if you have a newer truck, you are able to attract these better drivers and stay in business.

In terms of market-related *barriers*, **competitive pressures** hinder Delta’s ability to invest in a wider variety of green initiatives. For Delta, sustainability is not a present concern; rather, the company has an overarching goal to purchase another carrier in the future and thus expand its fleet size in order to remain competitive in the industry. According to OD, competitive pressures are very strong in the trucking sector, as exemplified by the following quote: *“There are so many companies out there that are buying out other companies to make themselves bigger. When you are bigger, you are more powerful, and you can start*

dictating when everything happens.” Thus, as a result of rampant mergers and acquisitions in the industry (as seen from OD’s perspective), Delta is forced to sacrifice sustainability for company growth by investing more into fleet expansion as opposed to green practices.

Additionally, OD acknowledged that the presence of **anti-competitive practices** has a negative effect on the pursuance of green initiatives. According to OD, *“There are many carriers in this industry that will cut corners and that lowers the rates on our loads so we’re not able to earn the money to implement sustainable trucking practices.”* OD remarked that these carriers “cut corners” by not complying with environmental and tax legislation. However, OD also commented that this is a modest barrier because the company is able to receive higher rates from its current loyal base of large clients by focusing on providing reliable customer service.

Furthermore, OD has driven hybrid cars for a long time and has a good understanding of electric vehicles. As such, OD is keenly interested in trying out electric trucks in the future. However, according to OD, *“In all these years, I’ve never seen a charging station for electric trucks.”* Thus, a **lack of charging infrastructure** forces OD to take a reluctant stance when it comes to adopting an electric fleet.

4.4.2.3 Government-Related Factors in Delta

OD strongly believes that the government can do more to help *smaller* carriers green their operations. A **lack of incentives** – specifically for small trucking companies - acts as a *barrier* in adopting green initiatives in Delta. Interestingly, however, OD believes that the government favours large carriers when providing incentives. For instance, as remarked by OD,

There are these government grants for aerodynamics – but you have to be of a certain size. This is why the small companies will struggle. For a company like Bison [one of the largest transport companies in Canada] – the government paid for almost all their aerodynamics because they’re big and that’s what they wanted to try out.

OD expressed that a lack of incentives offered to smaller carriers places them in a *continuously* disadvantageous position in comparison to larger trucking companies. Evidently, **small company size** also acts as a barrier, as was subtly implied by OD’s preceding quote.

4.4.2.4 Technology-Related Factors in Delta

OD acknowledged that the technologies that latest-model trucks are built with are inherently greener. According to OD, *“The newer trucks are designed to be more aerodynamic and with engines that burn less fuel – approximately 2 gallons less per 100 miles, which translates into significant fuel savings.”* As such, from OD’s perspective, **readily available green technology** acts as a *driver* in the adoption of green initiatives by Delta. At the same time, however, OD expressed that newer equipment is more difficult to repair in the event of a breakdown because it contains too many computers and sensors. Thus, **risks with technology** were also identified in Delta as a *barrier*.

4.5 Epsilon

Epsilon incorporated in 1980. The company operates exclusively in Southern Ontario. Moreover, Epsilon services two main industries – chemicals and veterinary supply. The company has 22 employees – most of which are long-standing and have been at Epsilon for about 25 years. Additionally, the company has leased 15 *straight* trucks. Interestingly, Epsilon’s equipment is very modern; the average age of its fleet is under three years, with most of its trucks being 2016 and 2017 models. At the end of 2018, the company leased two new 2018 model trucks. Epsilon’s trucks are all on full maintenance leases. In studying Epsilon, I interviewed the company’s Owner, whom I will refer to as “OE” henceforth.

4.5.1 Epsilon’s Green Initiatives

Table 16 summarizes the main types of green initiatives that have been adopted by Epsilon, as commented by OE.

Table 16

Green Initiatives Adopted by Epsilon

Category	Types of Green Initiatives
Alternative Fuels	
Vehicle Technologies	▪ Aerodynamics (i.e., trailer skirts)
Operational Strategies	▪ Speed limits ▪ Driver training ▪ Route optimization
Truck Replacements	▪ Fleet modernization
Other Initiatives	

4.5.1.1 Vehicle Technologies in Epsilon

Epsilon has adopted a limited amount of green initiatives (refer to Table 16). OE believes that aerodynamic features are important for fuel savings, so Epsilon has implemented **trailer skirts**. Interestingly, OE commented that “*the newer models of straight trucks are not equipped with aerodynamic features (e.g., nose cones) anymore. I don’t know why they [manufacturers] did it but nowadays you have to buy nose cones as add-ons.*” According to OE, this is very unfortunate as nose cones help with managing air flow in straight truck applications and lead to greater fuel savings. Moreover, OE highlighted an

interesting paradox, as exemplified in the following quote: *“We try to purchase latest-model equipment that’s better for the environment but mind you we always found that the newer technology on the trucks actually burns more fuel.”*

4.5.1.2 Operational Strategies in Epsilon

Epsilon makes use of **speed limits**. Moreover, according to OE, *“We do some **driver training**, but a lot more could be done. As of now, our drivers are in charge of most of their routing.”* In the future, OE plans to focus more on driver training – particularly in terms of educating the drivers on how to operate equipment more efficiently. Additionally, OE believes more resources should be invested into **route optimization**. Currently, Epsilon has geo-trackers that are hooked onto the Electronic Control Module (ECM) of the trucks that allow the company to gather a plethora of data on the performance of drivers, the state of the vehicles, as well as their real-time location. However, OE believes that the company should monitor and interpret this data in order to extract valuable information. This is something that Epsilon has not been doing thus far.

4.5.1.3 Truck Replacements in Epsilon

Epsilon has implemented a limited variety of green initiatives mainly because the company has leased its trucks and thus has limited options through its leasing agreement. According to OE,

We used to have really good used equipment that we tweaked and altered for our own purposes, but this became very expensive over time because it resulted in a lot of downtime with the repairs, so we went along with full maintenance leases. I had anticipated that as we grew, we would own all brand-new trucks, but leasing new equipment is the same thing, really – just someone else bears the brunt if anything goes wrong.

As such, to mitigate some of the risks associated with equipment breakdown, Epsilon has chosen to lease its trucks. However, in **modernizing its leased trucks**, the company does strive to be green. As a result, Epsilon specifically prioritizes the leasing of trucks that are latest-models and are more environmentally-friendly. For instance, in 2007 and 2008, the company received a commemorative plaque for leasing all

equipment that had the latest engine upgrades and proper emissions which were deemed environmentally-friendly at the time.

4.5.2 Epsilon's Drivers and Barriers

Table 17 summarizes the main drivers and barriers identified in Epsilon.

Table 17

Drivers and Barriers Influencing the Adoption of Green Initiatives by Epsilon

Category	Type of Driver	Type of Barrier
ORG	<ul style="list-style-type: none"> Environmental culture 	<ul style="list-style-type: none"> Lack of management knowledge Lack of employees
FIN		<ul style="list-style-type: none"> High costs
MKT		<ul style="list-style-type: none"> Anti-competitive practices Lack of customer interest in green service
GOV		<ul style="list-style-type: none"> Lack of incentives Absence of a clear and central source of information Lack of uniformity among government bodies Weak enforcement of regulations
TEC		<ul style="list-style-type: none"> Lack of green technology

4.5.2.1 Organization-Related Factors in Epsilon

Though Epsilon has not implemented a wide variety of green initiatives (refer to Table 17), interestingly, it has an enduring **environmental culture** which *drives* the company to exclusively lease environmentally-friendly trucks. As remarked by OE, *“We could still be running old equipment but our whole premise is to be good to the environment – that’s what my father stood for and that’s why I try to lease new trucks.”*

However, Epsilon’s management team poorly diffuses its environmental culture throughout the organization, as exemplified by OE’s following remark:

I think employees would care more about green initiatives if that was the thing – if they were enthused about being a part of making things better, like if we set up some sort of rewards system for them – I think they’d be all for it.

As a result of poorly diffusing its environmental culture throughout the organization, Epsilon's management is unable to garner the necessary employee support to successfully implement green initiatives. Thus, the company has a **lack of employees** dedicated to managing green initiatives, which evidently acts as a *barrier*. For instance, according to OE,

We're big on technology – we have those trackers that are hooked onto the ECM of the truck. We can grab all kinds of wonderful data on it like see who's harsh-breaking or the wear-and-tear on the tires, but we don't have enough people to look at that – we just get the highlights. We're capturing all this useful data to improve our operations but big freakin' deal if we're not able to do anything with it, so there's no point. We need people to sift through all this data and interpret it in a meaningful way.

Nonetheless, OE alluded that because of a **lack of management's knowledge** on extant green initiatives, it becomes difficult for Epsilon's management to properly direct its employees in managing such initiatives. The difficulty associated with gaining knowledge is best exemplified by OE's following comment:

You really have to look for all the information yourself – you really have to take a genuine personal interest in educating yourself about everything that's going on in the industry. You have to read all the material; you constantly have to check Today's Trucking and Truck News in order to really keep up with everything as best as you can because there's no course for it.

Evidently, it can be said that a lack of a knowledgeable management team in relation to green initiatives greatly contributes to an ineffective allocation of employees to tasks that are dedicated to managing green initiatives – yet another barrier.

4.5.2.2 Finance-Related Factors in Epsilon

OE acknowledged that **high costs** act as a *barrier*, primarily in terms of the expensive nature of aerodynamic truck features. According to OE, “Nose cones and fairings used to be on every straight truck before. Now they don't put them on – it's an add-on, which costs you an extra couple grand, so overall, it has become more costly.”

4.5.2.3 Market-Related Factors in Epsilon

In relation to market-related factors, only *barriers* have been identified in Epsilon.

First, OE acknowledged that **anti-competitive practices** are widespread in the Canadian trucking industry, primarily in terms of the use of delete kits by carriers. As highlighted by OE, *“There are all these secret investigations that are now taking place in the industry. They [detectives from the Ministry of Environment] are going after the ministry-approved shops and the smaller guys that are using engine by-passes.”* OE emphasized that the illegal practice of engine tampering creates a problematic situation for the trucking industry because it lowers the rates that trucking companies who are compliant with regulations can charge their customers. As a result, these companies are unable to attain the necessary profits to be able to invest in pursuing green initiatives.

Second, OE confirmed that the company’s **customers do not inquire about green initiatives** which discourages Epsilon in adopting more sustainable practices. In fact, OE claimed that *“customers displaying environmentally-friendly behaviour on their websites only do so as a marketing ploy and are not really concerned about the environment.”*

4.5.2.4 Government-Related Factors in Epsilon

In relation to government-related factors, only *barriers* have been identified in Epsilon.

First, OE commented that there is a **lack of incentives** offered by the government in terms of rebates, tax breaks, etc. for aerodynamics. OE expressed that incentives *“would greatly help with the adoption because they would alleviate some of the hardships associated with the costs of equipment.”*

Second, OE believes that the government **has not provided a clear and central source of information** that could help with the adoption of green initiatives. For instance, OE called for the provision of a what-if analysis and/or study on the ROI of green initiatives that could help the company with deciding on which initiatives to implement. However, OE also expressed that there is no clear and central source of such information provided by the government because there is a **lack of uniformity among government bodies**. These two barriers are best exemplified in the following quote:

In the grand scheme of things, the Ministry of Environment doesn't know what the Ministry of Transportation is doing. They don't work together, which is crazy. Actually, a lot of these government bodies don't work well together...I think that that government could certainly work more closely with the ministries – the Ministry of Environment, the Ministry of Transportation, and Transport Canada. If they could suggest some programs like what you could do if you spend X amount of dollars, what the ROI would be, I would do my best to ensure that my team follows.

Third, OE remarked that the government does a **poor job in enforcing environmental regulations** across the board, which is counter-productive in motivating trucking companies to pursue more environmentally-friendly operations. According to OE,

Certain segments of the trucking industry are running the same old crap that they ran 25 years ago. There is simply not the enforcement for it. Why don't they [the government] make it like the ISO [the International Organization for Standardization]? That used to be a big thing, but you don't hear about it so much anymore. Standards need to be more stream-lined and uniform, like it shouldn't be just me trying to be a good guy with 15 trucks, it's also got to be the guy that's got 150, 400 trucks, so these things really work against the success of the carrier.

4.5.2.5 Technology-Related Factors in Epsilon

A **lack of green technology available in the marketplace** is the primary technology-related barrier identified in Epsilon. The company mainly experiences this barrier through its leases as it does not have the opportunity to lease straight trucks with aerodynamic features already equipped in them, given that they are not manufactured with these features anymore. Nowadays, aerodynamic features are in the form of add-ons. According to OE,

I think that we could implement a lot more [green initiatives] at our size, but this is part of having the full maintenance leases. Even if there were certain initiatives, once you lease a truck, you're married to that truck – you don't just buy a brand-new truck and dump it after two years. So, I'm not in control of that [green initiatives] because when we spec the truck that's what we run with for a couple of years unless there's a problem.

As such, it can be said that it is in fact the maintenance leases themselves that limit Epsilon in terms of not having enough options to implement a wider variety of green initiatives.

4.6 Zeta

Zeta started business in 1997 with four employees and two trucks. In 22 years, the company has grown to 25 employees and almost five times the number of trucks. Zeta has a wide range of assets; apart from having nine straight trucks, the company also has panel and parcel vans as well as crew vehicles. The company's equipment is very old – the average age of its truck fleet is twelve years. Moreover, Zeta only operates in Ontario and transports to many rural communities in the northern-most parts of the province. Furthermore, Zeta specializes in full-service office installations and is a well-known commercial moving company. Additionally, Zeta has been awarded a federal government contract for the province of Ontario and only services the furniture industry, specializing in the relocation and installation of government offices. As such, the government is its main customer. The company also deals with the disposal of furniture, which it environmentally decommissions in its warehousing facility. In studying Zeta, I have interviewed the company's Vice President and the Operations Manager. Henceforth, I will refer to them as "VPZ" and "OMZ", respectively.

4.6.1 Zeta's Green Initiatives

Table 18 summarizes the main types of green initiatives that have been adopted by Zeta, as commented by VPZ and OMZ.

Table 18

Green Initiatives Adopted by Zeta

Category	Types of Green Initiatives
Alternative Fuels	
Vehicle Technologies	
Operational Strategies	<ul style="list-style-type: none">▪ Speed limits▪ Driver training▪ Route optimization
Truck Replacements	
Other Initiatives	<ul style="list-style-type: none">▪ Recycling materials▪ Maintenance

4.6.1.1 Operational Strategies in Zeta

Zeta believes that truck drivers play an important role in ensuring safe and efficient operations. As such, the company has formal **driver training** in place. For instance, Zeta has created a booklet that drivers are required to read in order to learn how to operate equipment safely and efficiently. OMZ also regularly talks to the drivers about their performance in an attempt to reduce overall idle times. As such, OMZ strives to engage in an on-going discussion with the drivers. Interestingly, Zeta has a unique way of training its drivers. According to OMZ, *“Usually around December – when we get a bad storm – we bring in the drivers on a Saturday to have them practice driving in the snow.”* This is done to ensure that drivers receive the necessary experience when it comes to operating equipment in harsher climates. Zeta finds this necessary as it does business in very remote communities where the roads are not properly maintained in colder temperatures.

Moreover, Zeta makes use of **speed limits** and believes that they greatly help with fuel savings. The company also uses **route optimization**. However, this is done on a very basic level without the use of software. Typically, the company’s managers plan the routes every day for the drivers based on Google Maps.

4.6.1.2 Other Initiatives in Zeta

Overall, Zeta has implemented a limited amount of green initiatives (refer to Table 18). This is primarily because the company focuses most of its environmentally-friendly efforts on its non-transportation side of business – that is, on the installation and disposal of furniture. In fact, the company is very pro-environmental on its furniture disposal side and has obtained green certification to properly **recycle materials**. Likewise, Zeta owns a 25,000 square foot warehousing facility in which it *“follows strict environmental guidelines in tearing down furniture and in recycling wood, plastic, gas cylinders, fabric, insulation, and metal materials separately and properly.”* Green disposal practices are at the forefront of Zeta’s business operations.

On its transportation side, however, Zeta capitalizes on in-house preventative **maintenance**. Zeta believes that focusing on preventative maintenance can help ensure higher reliability of equipment. Aside

from the regular maintenance of vehicles scheduled every X number of kilometres, Zeta takes in the trucks sooner for maintenance than necessary. For instance, though regular maintenance is religiously scheduled every three months in the company, Zeta will arrange the full check in of trucks after two months – particularly if a truck had not been used in a while. VPZ and OMZ both claimed that *“this gives us piece of mind knowing that the fleet is in good condition and is safe to send all across the province”* – especially in colder temperatures in northern Ontario. Additionally, the company has a mobile mechanic that meets the truck driver anywhere in the province in the event of a breakdown. Hence, Zeta prioritizes reliability over sustainability in terms of its trucking operations.

4.6.2 Zeta’s Drivers and Barriers

Table 19 summarizes the main drivers and barriers identified in Zeta.

Table 19

Drivers and Barriers Influencing the Adoption of Green Initiatives by Zeta

Category	Type of Driver	Type of Barrier
ORG	▪ Environmental culture	▪ Lack of management knowledge
FIN		▪ High costs
MKT	▪ Customer demands	▪ Lack of infrastructure
GOV		▪ Lack of incentives
TEC		▪ Lack of green technology

4.6.2.1 Organization-Related Factors in Zeta

In terms of organization-related *drivers*, a strong **environmental culture** has been identified in Zeta. Interestingly, though the company has not adopted a wide variety of green initiatives on its transportation side, its strong environmental culture has been transferred onto its furniture disposal side. According to VPZ,

There was a time where our President was going to the gym at GoodLife fitness and they didn’t recycle there which drove him nuts. So, he started paying our drivers – and fuel – to have them go around and pick up the garbage from different gyms and take it to the waste. Ever since then, I’ve

started paying more attention to bettering things – like it’s really carried onto the way we dispose of things here.

Additionally, OMZ emphasized,

I don’t think that there’s a lot we can do with the trucks – they’re all diesel. That’s why our President has always pushed us to recycle so much more with our furniture because he’s aware of the footprint that he leaves with our trucks.

Evidently, in order to offset some of the negative side effects of trucking, Zeta’s management capitalizes on strictly ensuring environmentally-friendly disposal practices. Thus, a strong environmental culture greatly motivated Zeta to adopt green practices in terms of recycling materials.

In terms of organization-related *barriers*, a **lack of management knowledge** has been identified in Zeta. For instance, according to VPZ, *“I don’t know what options we have other than what we’ve done so far [maintenance].”* OMZ, however, emphasized that they do make an effort to educate themselves on green technology in trucking, but cited some barriers in doing so, as exemplified in the following remark:

I get those trucking magazines and go through them but it’s 99% towards the trailer aspect and it’s not for our type of trucks. I’ll skim through the magazine from time to time but it’s more for cross-country transport and it’s not involved with what we do. Unfortunately, I never even thought to look further than what we already do.

4.6.2.2 Finance-Related Factors in Zeta

VPZ and OMZ both emphasized that **high costs** of equipment act as a strong *barrier*. For such reason, the company runs an outdated fleet as constantly *“updating the fleet with newer truck models is too expensive.”* Zeta already invests a significant amount of resources in the maintenance of vehicles and in the training of drivers and thus sees investments in latest-model equipment as too costly.

4.6.2.3 Market-Related Factors in Zeta

In terms of market-related *drivers*, **customer demands** acted as a significant driving force in motivating the company to pursue green certification related to properly disposing furniture and associated

materials. According to VPZ, *“Having green certification was mandatory in order to be able to win over the government contract.”*

Furthermore, a **lack of infrastructure** has been identified as *barrier* in Zeta. Given that 50% of the company’s business is in Toronto, the company mainly conducts short-haul trips. As such, the company is interested in adopting electric-powered trucks in the future. However, as a result of inexistent electric-charging stations for trucks in the province, the company finds it challenging to do so. Additionally, OMZ subtly implied that *current* infrastructure for trucks has not been well-developed. According to OMZ, *“When we go to rural areas up north, there are no gas stations, no truck stops, no stores – no nothing. So, it’s not like someone can bring you 300 extensions cords to charge your truck up there.”*

4.6.2.4 Government-Related Factors in Zeta

OMZ believes that the government could do a lot more to encourage the adoption of green initiatives. According to OMZ, the government **does not offer incentives** that would help Zeta finance the adoption of green initiatives, which acts as a key *barrier*. Even though the company exclusively works with/for the government, Zeta complains that the government does not effectively motivate the company to pursue more environmentally-friendly transportation, primarily because it does not care about protecting the environment. This viewpoint is best exemplified by OMZ’s following remark:

We work with the Ministry of Environment almost every day, but they have never really paid attention to our trucks. I know that there are trucking companies out there that have millions and could buy a better fleet, but subsidies would really help us out – in fact, it would encourage us to implement green initiatives sooner.

4.6.2.5 Technology-Related Factors in Zeta

According to Zeta’s management team, there is a **lack of green technology** for *straight* trucks. This is the primary technology-related *barrier* identified in Zeta. According to VPZ: *I’ve seen the bigger trucks with those things on the sides, on the back doors, and the wings and all those aerodynamics, but I’ve never seen them on straight trucks. If they were offered for our applications, our President would 100% be willing to purchase them.*

4.7 Eta

Eta is a recently established subsidiary of a large and well-respected Canadian meat company. Eta's parent company had been paying transportation brokers and carriers significant amounts of money for many years to haul its freight between Canada and the U.S. Given that the company believed it could conduct its transportation function in-house, in an effort to save on costs and obtain more control over its freight, it had established Eta in 2012. Eta currently has 17 employees. Furthermore, the company has six reefer trucks in fleet; however, Eta has set aggressive growth targets to increase its fleet size to 20 reefers by the end of 2020. The average age of Eta's fleet is six years. Lastly, though the company services the food industry across Canada and the U.S, most of its operations are in the U.S Midwest. In studying Eta, I interviewed the company's General Manager, whom I will refer to as "GME" henceforth.

4.7.1 Eta's Green Initiatives

Table 20 summarizes the main types of green initiatives that have been adopted by Eta, as commented by GME.

Table 20

Green Initiatives Adopted by Eta

Category	Types of Green Initiatives
Alternative Fuels	
Vehicle Technologies	<ul style="list-style-type: none">▪ Aerodynamics (i.e., trailer skirts)▪ Tires (i.e., low-rolling resistance)
Operational Strategies	<ul style="list-style-type: none">▪ Speed limits
Truck Replacements	
Other Initiatives	

4.7.1.1 Vehicle Technologies in Eta

Eta has adopted a limited amount of green initiatives since its inception in 2012 (refer to Table 20). However, the company has started to capitalize on implementing more carbon-reducing technologies in the last two years and has plans to purchase more environmentally-friendly vehicle technologies in 2019 and 2020. In 2017, the company implemented **low-rolling resistance tires** on one of its trucks. Then, in 2018, Eta **skirted one of its trailers**. GME highlighted that the company has experienced a significant amount of

fuel savings as a result. Thus, according to GME, “*We plan to purchase more trailer skirts, low-rolling resistance tires, and auto-tire inflation systems in the next five years.*”

4.7.1.2 Operational Strategies in Eta

Eta makes use of **speed limits**. According to GME, “*they do help with fuel savings, but this is more of us following the law than anything else.*”

Furthermore, GME emphasized that they talk to drivers about idle times, but they do not have formal driver training in place. This is primarily because the company currently does not have a safety department. However, Eta plans to implement formal driver training as its fleet size expands as it recognizes the importance of having drivers efficiently operating the vehicles. Driver training will be handled by the company’s safety department, once it has been established.

4.7.2 Eta’s Drivers and Barriers

Table 21 summarizes the main drivers and barriers identified in Eta.

Table 21

Drivers and Barriers Influencing the Adoption of Green Initiatives by Eta

Category	Type of Driver	Type of Barrier
ORG		<ul style="list-style-type: none"> ▪ Lack of employees
FIN	<ul style="list-style-type: none"> ▪ Cost savings 	<ul style="list-style-type: none"> ▪ High costs ▪ Uncertain ROI
MKT	<ul style="list-style-type: none"> ▪ Combatting driver shortage issue 	
GOV		<ul style="list-style-type: none"> ▪ Absence of a central source of information
TEC	<ul style="list-style-type: none"> ▪ Availability of green technology 	<ul style="list-style-type: none"> ▪ Risks with new technology

4.7.2.1 Organization-Related Factors in Eta

The main organization-related *barrier* identified in Eta is **lack of employees** devoted to managing green initiatives. According to GME,

The amount of time needed to figure out and select which sustainability areas are suitable for our company is a big disadvantage. We have a lack of personnel to implement the necessary changes and to monitor them to see if they are good for our company. I would imagine that as we grow, we

will add a Safety and Compliance Department – which we currently don't have – and designate one person to look after the training of drivers. In my mind, a Safety/Compliance Manager is a non-revenue generating position, so implementing sustainable trucking practices – like formal driver training – can basically bring some revenue back in or savings. So, there would be a lot of things that this person would be asked to do – one of which would be to monitor the training of drivers – in order to offset their salary.

In order to implement green initiatives, GME expressed that showing an ROI to the ownership team is the most important factor in gaining approval from management to adopt such initiatives. However, currently Eta does not have qualified and sufficient human resources to: (1) research extant initiatives, (2) discover if there are any rebates and/or incentives, (3) figure out which initiatives are most suitable for the company, (4) ensure a smooth implementation process, and (5) properly monitor the changes. As a result, Eta is unable to pursue the adoption of green initiatives in great depth. The company's current focus is on growth; once Eta reaches its growth target, however, GME will look to establish more departments within the organization that would help with the adoption of green initiatives.

4.7.2.2 Finance-Related Factors in Eta

GME expressed that the strongest *driver* that motivated the company to implement initiatives such as trailer skirts and super-single tires was the ability to achieve **cost savings**. Implementing such initiatives had resulted in a significant reduction of fuel consumption, according to GME.

The need to achieve cost savings is, however, at the request of the parent company's management who is only concerned about ROI. Initiatives for which an **ROI is uncertain** – or unknown – is the strongest *barrier* in Eta that significantly hinders the company's adoption of green initiatives. According to GME,

Our owners would disapprove [of green initiatives] if we couldn't build a case on ROI or something that our parent company could benefit from. We have deeper pockets than other small carriers because we have their [the parent company's] financial backing, but if I can't show them an ROI on something, they won't proceed with it.

Evidently, the parent company had successfully transferred its cost savings mentality onto its subsidiary.

High costs involved with new equipment purchases are another cited barrier in Eta. GME acknowledged that they do not have enough revenue on their trucking side to be able to finance the purchase of more modern equipment. Additionally, due to the company's small fleet size, they are unable to achieve economies of scale. As a result, the company does not even have money to pay for a test study to try out some new initiative, such as the adoption of a particular type of alternative fuel. Nonetheless, Eta's representative expressed that they have financial support from their parent company; however, only if they are able to build a case around ROI, as mentioned previously.

4.7.2.3 Market-Related Factors in Eta

Combatting the driver shortage issue is an important *driver* in Eta in terms of motivating the company to purchase latest-model trucks in the near future, according to GME. As exemplified in the following quote:

In the next few years, we will definitely purchase upgraded trucks with better fuel economy. Yes, it has to do with lowering our overall fuel costs, but it's about driver comfort as well. I know it's not part of sustainable trucking practices, but driver satisfaction is a big thing these days – you want to try and limit their turnover.

Interestingly, GME commented that Eta allows its drivers to choose the type of trucks that they want to drive. According to GME, *"We have Freightliner and Kenworth trucks in our fleet. The reason we went with those is because that's what our drivers wanted."* Evidently, Eta prioritizes driver satisfaction.

4.7.2.4 Government-Related Factors in Eta

GME believes that there is a lack of governmental involvement in the trucking sector on the topic of green initiatives. According to GME, this is primarily through a **lack of provision of environmental information** that would help trucking companies gain a deeper understanding of the benefits of adopting green initiatives. This lack of information acts as a *barrier* in the adoption of green initiatives by Eta, as exemplified by GME in the following quote:

If the government was able to come in and lay it all out for a smaller company like ours – and if they could show us case studies of what other companies have done, the benefits, and the ROI – I

think more of us would look into adopting green initiatives. If the government were able to come up with a one-package deal, like a consultant-type thing, showing what they can do for us, how they can help us with the monitoring and implementation – and they don't really disappear after. If we had a program like that, I'm pretty sure that smaller trucking companies would look at green initiatives more closely.

4.7.2.5 Technology-Related Factors in Eta

GME acknowledged that the **existence of a wide variety of green technology for reefers** acts as a key *driver* in helping Eta adopt more environmentally-friendly practices. According GME, *“Nowadays, reefers are manufactured to be maximally fuel-efficient as they are more aerodynamic and equipped with telematics that provide real-time data and alerts on temperature variations along a GPS-tracked route.”* As such, GME believes that reefers are already manufactured to be fully-loaded in terms of green technologies because of the inherent high energy needs associated with temperature-controlled units in the first place. However, GME also expressed concerns over some **risks associated with implementing new technologies**, a *barrier* that is best exemplified in the following quote:

One of the things that scares me the most about some of the things that are out there is the reliability of the equipment. If we do upgrade our truck to some type of alternative fuel, for instance, then what would the reliability of the equipment be in our winter climate, the daily use of trucks, etc. Potential downfalls are always on the back of my mind...

GME is skeptical about trucks running on alternative fuels, specifically. Eta's management team has attended several conferences in the last couple of years where portions of the conference were on alternative fuels. According to GME, larger companies such as UPS are currently testing all sorts of alternative fuels in order to determine which ones offer the best payback; however, GME is doubtful about the reliability of alternative fuels in harsh Canadian climates. As such, according to GME, *“alternative fuels are not in the cards for us”* and that Eta will mainly focus on initiatives related to vehicle technologies (i.e., aerodynamic and tire improvements) in the near future.

4.8 Theta

Theta is a family-run trucking company founded in 2014. The company has six employees along with seven trucks who are, on average, two to three years old. Theta has both reefers and dry-vans in its asset base; however, the company conducts a significant amount of business transporting time-sensitive and temperature-controlled shipments and thus makes greater use of reefers. Moreover, Theta services both the Canadian and U.S. markets but mainly conducts transportation services from Wisconsin and Texas into Canada. Interestingly, Theta is the only company in Canada that transports high-value healthcare equipment from various U.S. states into Canada for a well-known American multinational conglomerate who manufactures and distributes diagnostic imaging agents and radiopharmaceuticals for imaging modalities used in medical imaging procedures. As such, Theta specializes in transporting million-dollar medical diagnostic equipment (e.g., CT image machines) for one primary client. In studying Theta, I interviewed the company's Owner, whom I will refer to as "OT" henceforth.

4.8.1 Theta's Green Initiatives

Table 22 summarizes the main types of green initiatives that have been adopted by Theta, as commented by OT.

Table 22

Green Initiatives Adopted by Theta

Category	Types of Green Initiatives
Alternative Fuels	
Vehicle Technologies	▪ Auxiliary power units for idle reduction
Operational Strategies	▪ Speed limits ▪ Driver training
Truck Replacements	▪ Fleet modernization
Other Initiatives	

4.8.1.1 Vehicle Technologies in Theta

Some of Theta's trucks are equipped with **auxiliary power units** in an effort to promote idle time reduction. Interestingly, for trucks that are not equipped with auxiliary power units, Theta employs a different strategy to reduce idle times. According to OT,

If it's the summer or winter time, we make use of these reserve areas across North America. Right now, our drivers go to the truck stop to a special area that you can rent in advance. When the truck is parked, there is a pipe that goes inside and blows cold air if it's summertime and hot air during the winter. We are paying only \$10 for 24 hours and our trucks are not burning any fuel when parked.

4.8.1.2 Operational Strategies in Eta

OT believes that **driver training** is very important – particularly in terms of ensuring greater fuel savings. Currently, OT holds regular meetings to talk to the drivers about their driving performance, primarily about idle times as Theta's focus is to reduce overall idling and thus save on fuel. Nonetheless, OT also noted that most of the truck drivers have been at the company since its inception and are already experienced with operating equipment efficiently. Thus, given the small number of drivers that the company has, OT tries to maintain a good relationship with each driver. As such, the drivers return the favour as exemplified in OT's following remark:

I have a very experienced driver and you know what he is doing? He is following up on fuel prices for me. He is a company driver, but he is acting like he's the owner of the company and he's trying to help me save on fuel. Believe it or not, this is very important. For example, a gallon of fuel in Missouri is around \$3.40 – in California it's around \$4.25. You see the difference? Almost a dollar difference from state to state! So, if I send a driver to California and his fuel tank is empty, he doesn't have to fill up the whole tank in California – he can fill it up elsewhere where fuel is cheaper. This is why talking to the drivers is important.

Furthermore, Theta makes use of **speed limits**; however, OT is not fond of limiting truck speeds. Before founding Theta, OT was a truck driver. As such, from personal experience, OT believes that limiting truck speeds puts Canadian truck drivers in great danger, as exemplified by the following anecdote:

In the Titanic movie, they were trying to slow down and reverse the ship to avoid hitting the iceberg. Instead, however, if they had sped up, they might have had the chance to save the ship and all those passengers. Similarly, if someone is beside your tailgates and you're both driving 105 kilometres

per hour and something comes up in front of you in your lane, you either have the option to speed up or apply the brakes. If you apply the brakes, it will be hard to stop an 80,000-pound vehicle quickly, but if you speed up, you might just get the chance to change your lane. Unfortunately, Canadian truck drivers aren't allowed to do this and that's why many get into accidents.

4.8.1.3 Truck Replacements in Theta

Overall, Theta has implemented a limited amount of green initiatives (refer to Table 22). The company's principal aim is to ensure that its trucks are safe and reliable given that it transports million-dollar medical equipment. Hence, Theta strives to maintain a modern fleet. As such, when purchasing new equipment, Theta typically buys truck models that are relatively new – usually, two to three years old. Given that the truck body is still sturdy after two to three years of use, Theta invests in the replacement and/or upgrade of engines, should they lower their performance over time. In the near future, the company plans to **modernize its fleet**. Theta's strategy in replacing its trucks is best exemplified by OT's following remark:

I like to get trucks that are around three years old. I never buy the newest trucks which are around \$200,000 – not because of the money – but because I'm always thinking business mentality. For example, if I buy a 2016 model truck right now, it's about \$65,000 with mileage of about 90,000 kilometres. Let's say that the engine is gone. If I have to rebuild the engine, it will cost me about \$35,000. So, in total, a relatively new truck with a completely new engine will cost me \$100,000 (i.e., \$65,000 + \$35,000), and I will save \$100,000 – which I can use to buy another truck.

4.8.2 Theta's Drivers and Barriers

Table 23 summarizes the main drivers and barriers identified in Theta.

Table 23

Drivers and Barriers Influencing the Adoption of Green Initiatives by Theta

Category	Type of Driver	Type of Barrier
ORG		
FIN		<ul style="list-style-type: none"> ▪ High costs ▪ Uncertain ROI
MKT	<ul style="list-style-type: none"> ▪ Combatting driver shortage issue 	<ul style="list-style-type: none"> ▪ Anti-competitive practices ▪ Push-back from oil industry ▪ Competitive pressures
GOV		<ul style="list-style-type: none"> ▪ Weak enforcement of regulations ▪ Poor involvement in green initiatives
TEC		<ul style="list-style-type: none"> ▪ Risks with new technology ▪ Lack of green technology

4.8.2.1 Finance-Related Factors in Theta

OT repeatedly cited that **high costs** act as a significant *barrier* in purchasing new trucks. As highlighted in the preceding section (refer to Section 4.8.1.3), latest-model trucks that are equipped with green technology are around \$200,000, which according to OT, is very expensive for Theta. As a result, OT purchases trucks that are two to three years old and invests in engine replacements if need be.

In addition to high costs, OT also acknowledged that an **uncertain ROI** also acts as a barrier. According to OT,

Not all the trucks come with auxiliary power units, so people don't want to spend an additional \$15,000 to \$16,000 CAD to purchase one as an add-on. I'm not even sure when you could cover this money – maybe in the long-term – but realistically in one to five years you're not even going to have this truck because by then it's going to be too old. So, this is a garbage investment, really.

Given that Theta strives to have updated truck models, investing in certain green initiatives as add-ons is unfeasible because the company's trucks will be replaced before an ROI can be achieved on the add-ons. Therefore, it does not make to much economical sense to invest in various add-ons in the domain of vehicle technologies, according to OT.

4.8.2.2 Market-Related Factors in Theta

OT acknowledged that the **driver shortage trend** in the market *motivates* Theta to have a more modern fleet, even at the expense of the high cost of equipment. According OT,

I usually go for Volvo's because Volvo is the 'Mercedes' in the trucking industry. So, I purchase Volvo's because hiring a driver is a problem these days and the drivers demand luxury vehicles. Before, hiring a driver was much easier. Now, I have drivers calling me asking how old my trucks are, what brand they are, if they are automatic or manual, etc. The industry is changing...

Moreover, OT expressed that three market-related *barriers* hinder the adoption of green initiatives.

The first market-related barrier that OT highlighted is the presence of **anti-competitive practices** in the industry which creates an environment in which it is difficult to invest in green initiatives. OT views this as a barrier from several perspectives and has cited three different kinds of anti-competitive practices that are currently plaguing the Canadian trucking industry.

First, as commented by OT in the following quote: *"There are so many trucking companies that are buying fuel under religious objects (temples) to avoid paying taxes. Of course, this affects me, because I can't race with these guys."*

Second, OT emphasized,

There are so many load brokers that are taking loads and giving them to transportation carriers – but they are just balloon companies. They open up a business for three months, they take their money but don't give you yours and then they close the business and open up a new one under a new name. Believe me, we have 100,000 brokers in Ontario today and 80% of these brokers are fake in this industry. I recently lost \$3000 because a cheque got bounced because it was a fake company. When this kind of money loss happens, I'm unable to save money to invest in green initiatives.

Third, OT stressed,

In this industry, there are so many bad people...like there are some drivers that are using their fuel cards and selling their fuel to other trucking companies at gas stations...and this is happening too

many times. If you don't constantly follow up on your fuel expenses, you won't be able to catch this.

In general, OT claimed that because of the presence of anti-competitive practices, the rates on loads are lowered in the industry and the company is not able to earn the necessary profit to be able to invest some of the money into green initiatives.

Moreover, the second market-related barrier that OT highlighted is strong **push-back from the oil industry**, primarily in developing alternative fuel technologies. According to OT,

In 2011, in Turkey they successfully patented a boron fuel-cell vehicle which has a 20 horsepower electric engine; is able to travel at a maximum speed of 80 kilometres per hour and 100 kilometres in distance; consumes 1 kilogram of boronhydride per 35 kilometres; and, the only thing coming out of the exhaust pipe is water. But the oil companies don't want this kind of research because they want to keep their industry active...

Furthermore, the third market-related barrier that OT highlighted is the rise of **competitive pressures** in the industry. OT was originally interviewed on January 21, 2019 for this study. However, following the member-checking phase (as suggested in Merriam's case study methodology to ensure reliable research), OT wished to contribute new insights to illustrate how Canada's trucking industry had changed from January 2019 to April 2019. Thus, a second discussion took place on May 14, 2019 in which OT emphasized that many trucking companies had to close their business within the four-month period as a result of rising competition in the market. According to OT's new insights,

I would like to emphasize a couple of things now since April transportation business in Canada is not good. There are so many reasons for this...For example, car companies are closing, China has started to buy pork meat from Canada, so no more shipments are going to Mexico. Right now, there are too many trucking companies competing in the industry, but there is not enough freight to keep the wheels turning. So many trucking companies are looking for outbound to U.S. and Canada and load brokers are now taking advantage of this. For example, before they were paying around \$3,600 from Toronto to California. Now, they are offering between \$2,400 and \$3,000 for 2,500

miles. Just driver and fuel cost per mile is \$1.30 per mile (i.e., \$0.60 per driver + \$0.70 for fuel x 2,500 miles = \$3,250)! Trucking companies cannot pay \$0.60 or over per mile anymore, so truck drivers are leaving to search for better companies. I am now hiring owner-operators. Even the larger companies are having a difficult time at the moment and small companies are closing their businesses...

4.8.2.3 Government-Related Factors in Theta

In relation to anti-competitive practices, OT cited the government as a *barrier* – primarily because it makes no effort to regulate the industry to ensure a properly competitive environment for trucking companies. Such **weak enforcement of regulations** is best exemplified in OT’s following remark:

What is the government doing with all the fake load brokers in the industry? Nothing. The government should regulate everything under the same parameter...like requiring companies to put a \$100,000 deposit into a bank account when opening up a new business.

Additionally, OT cited that there is **poor government involvement** on the topic of green initiatives in three main ways. First, according to OT,

I don’t trust the government because I’ve never seen the government do something good for trucking industries or for climate change. They are just talking, but they’re doing nothing really. I don’t see proof that the government is dealing even with the larger trucking companies because if they were, they would have alternative fuel demo trucks on the road that say ‘working with the Ministry of Transportation’ or something like that. In Europe, they’re very strict...they’re helping trucks run on biofuels. Even with public busses, in Monaco I’ve seen public busses that say, ‘working with hydrogen companies’, but I’ve never seen this in Canada.

Second, OT claimed that the Ministry of Transportation never offers support for trucking companies in terms of educational material. For instance, when the manufacturers brought in the new DEF system, the Ministry of Transportation did not offer free educational courses for mechanics on how to handle any necessary DEF repairs. Thus, issues with the DEF system were rampant in the industry as no one knew how to deal with them. OT highlighted that “it costs \$600 per hour to have the Ministry of

Transportation come in an discuss the newest environmental regulations.” As such, rather than helping small trucking companies understand new regulations, the government is causing a burden by increasing the costs of doing business.

Third, OT remarked,

A couple of years back, they started using boat tails in the U.S as this was supposedly good for the environment and helped save fuel. In Canada, we have rules that tractor-trailer combinations cannot be longer than 75 feet, so when we started implementing boat tails, our trailers were longer than the regulated size and you know what happened? The Ministry of Transportation gave \$490 tickets to the drivers.

Overall, OT believes that the government – particularly the Ministry of Transportation – is useless when it comes to helping with climate change. In fact, OT criticized the government for placing the blame on trucking companies with regards to pollution, as exemplified in the following quote:

The government is not looking for any alternative options to handle climate change, they’re just attacking trucking businesses! Is there no other way to save the world? I’ll tell you this. Why don’t you change the asphalt? Because asphalt is black in colour, if I’m not mistaken, we have a 10-degree higher temperature in the world today just because of black-coloured asphalt. Why don’t they use cement to build the roads? Yes, it might be more costly, but its more solid because it doesn’t result in sink holes that you have to keep on fixing. So, why isn’t the government building cement roads to save the environment? They’re just attacking the trucking industry!

4.8.2.4 Technology-Related Factors in Theta

OT highlighted two main technology-related *barriers* when it comes to adopting green initiatives.

First, OT commented that there are always **risks associated with new technologies**, such as the breakdown of equipment. OT remarked that Theta had many issues with the DEF system, which necessitated many repairs. According to OT,

In 2008, they came up with the DEF system, which is 0 emissions, but it has never been tested before. Suddenly, all the trucking companies started having problems with the filters which they

couldn't fix. Manufacturers have to do something about this because they can't keep bringing new products to market without testing them. So, who's really testing all these products? Sadly, trucking companies.

Second, OT stressed that there is a **lack of green technology** available in the marketplace. OT claimed that truck manufacturers are not capitalizing on manufacturing equipment that is made to run on alternative fuels. Additionally, OT believes that there have not been any significant advancements in green trucking technology, as exemplified in the following remark: *"In 20 years, Volvo improved just 0.4 litres per 100 kilometres. This is ridiculous! They couldn't find another alternative in 20 years?"*

5 Discussion

This chapter *synthesizes* the findings from *each* within-case analysis from Chapter 4 to provide a summary of the current state of adoption of green initiatives in the eight small-to-medium sized trucking companies studied in Ontario. Additionally, an overview of the *main* drivers and barriers that have arisen in the multiple-case study is presented. Supporting discussions for both topics are also included as per the categories of: (1) the types of green initiatives adopted by the trucking companies (in terms of alternative fuels, vehicle technologies, operational strategies, truck replacements, and other initiatives), and (2) the factors influencing the trucking companies' adoption of such initiatives (in terms of organization-related, finance-related, market-related, government-related, and technology-related drivers and barriers). Lastly, the findings are compared against the results from other studies in the literature and potential explanations are offered for *new* findings uncovered in the current study.

5.1 An Overview of Green Initiatives Adopted by the Studied Companies

The main types of green initiatives adopted across the eight small-to-medium sized trucking companies in Ontario are summarized in Table 24. It is worth noting that initiatives part of the “Operational Strategies” category are most commonly adopted (refer to the shaded portion of Table 24), with **driver training** and **speed limits** being the first and second-most implemented practices, respectively. Additionally, **fleet modernization** has been found to be widespread, while the adoption of **alternative fuels** is not. Moreover, note that two companies (Alpha and Beta) have implemented the widest variety of initiatives.

Table 24

A Summary of the Green Initiatives Adopted by the Studied Companies

Category	Initiative	Alpha	Beta	Gamma	Delta	Epsilon	Zeta	Eta	Theta	Total
Alternative Fuels	Biodiesel		●							1
	Hydrogen		●	●						2
	Natural Gas (CNG)		●							1
Vehicle Technologies	Aerodynamics (skirts, fairings)	●	●	●		●		●		5
	Tires (low-rolling resistance, auto-tire inflation systems)	●	●	●	●			●		5
	Auxiliary power units for idle reduction	●	●						●	3
	Lighter materials		●							1
Operational Strategies	Speed limits	●			●	●	●	●	●	6
	Driver training	●	●	●	●	●	●		●	7
	Route optimization	●	●	●		●	●			5
	Intermodal transportation	●	●							2
	Supply chain collaboration	●	●							2
Truck Replacements	Fleet modernization	●	●	●	●	●			●	6
Other Initiatives	Collaboration on green innovation	●	●							2
	Artificial intelligence for transport planning	●								1
	Maintenance and repairs				●		●			2
	Recycling materials		●				●			2

5.1.1 Alternative Fuels Adopted by the Studied Companies

The adoption of alternative fuels is not widespread among the studied companies (refer to Table 24). In fact, none of the companies studied have actually implemented alternative fuel-based fleets; only two companies (i.e., Beta and Gamma) have been engaged in *testing* them.

For instance, while Beta started experimenting with **hydrogen injections** a decade ago, Gamma had only recently started to do so. Nonetheless, both companies reported that they have experienced many

issues with the hydrogen injection units – most notably permanent engine damage – which necessitated costly repairs. Furthermore, Beta had tried hydrogen injection units from three different manufacturers in the past and was not satisfied each time. Additionally, Beta’s President emphasized that there have not been any significant advancements in hydrogen injection units in the last decade and thus is unwilling to further focus on this type of alternative fuel.

Similar viewpoints regarding alternative fuels have also been expressed in recent studies in other developed countries such as Germany and Sweden. For instance, almost all the German LSPs investigated by Tacke et al. (2014) have tried alternative fuels; however, many were unconvinced because the use of alternative fuels had caused much damage to their engines. Generally, alternative fuels have had little success in the operations of German LSPs. More recently, Pålsson and Johansson (2016) found that Swedish LSPs perceived significant effects on reducing transportation emissions by 2020 by implementing alternative fuels; however, most of them do not believe in having available commercial solutions by 2020 and for such reason, are very skeptical about the implementation. This is surprising given that Sweden is home to two of the largest heavy-duty truck manufacturers in the world – Volvo and Scania – and is thus at the forefront of designing and manufacturing new vehicle technologies (Liimatainen et al., 2014). Hence, if Swedish LSPs – who mainly operate in and purchase trucks from a country with a leading automotive industry – believe that there is a lack of available technology for alternative fuel trucks, it can be assumed that Canadian trucking companies take an even more dubious stance, given that Canada’s automotive industry is not particularly strong. For instance, in 2017, Canada did not manufacture any heavy-duty trucks, and its Freightliner and Daimler facilities closed in 2002 and 2009 (Smith, 2018), respectively, which had ended much of the *research and development* in Canada with regards to new trucking technologies, particularly for alternative fuels.

Furthermore, only Beta has experimented with **biodiesel**. However, the company encountered several problems, such as the clogging of fuel filters and issues with the after-exhaust treatment in trucks. Additionally, not only does Beta’s President believe that the production of biofuels is unsustainable and unethical (i.e., causes damage to crops in the natural environment), but biofuels are also ineffective for

harsher Canadian climates as they freeze temperatures 10 degrees below zero. Beta's President acknowledged that biofuels are not conducive for Canadian climates and cited that they are unfairly pushed onto the trucking industry by the Minister of Agriculture, given that the production of biodiesel has increased the price of corn by 40% in Canada. Interestingly, such ethical issues regarding biodiesel have also been highlighted in the work of Tacke et al. (2014).

Moreover, Beta is also the only company to recently test a **CNG** truck. Beta's President pointed out that an increasing number of CNG fuelling stations are being built across Canada. Additionally, several trucking companies in Canada have started converting their fleets to CNG in the last year. Beta's President has witnessed this to be the case through attendance at various industry conventions and events. As such, Beta is keen on entering the CNG field in order to keep up with the market trends. Furthermore, Beta's President believes that natural gas is a viable alternative fuel because it eliminates all the problems associated with the after-exhaust treatment in trucks and thus offers many benefits in the long-term. It is also important to note that Beta's General Manager also acknowledged that there has been an increasing focus on natural gas-powered trucks at various industry conferences in Canada in the last year.

Some companies expressed interest in adopting **electric** trucks (i.e., Gamma, Delta, and Zeta). This may be resulting from being under the influence of increased media attention on electric trucks since 2017, given that this year marked the unveiling of the Tesla Semi in the U.S. – Elon Musk's all-electric heavy-duty truck that is capable of travelling approximately 480 kilometres on a single charge (Lambert, 2017). In 2017, Tesla announced that by 2019 and 2020, it planned to introduce its all-electric heavy-duty trucks to market and thus garnered much attention in the media. Following Tesla's announcement in 2017, many other well-known automotive manufacturers such as Volvo, Hyundai, Volkswagen, Daimler, Toyota, and the Nikola Motor Company announced similar plans (Carey, 2018), thereby collectively gaining greater media attention on electric-powered trucks and consequently influencing many trucking companies.

While Gamma does not believe that it will be until the next seven to eight years before electric trucks become commonplace, Delta and Zeta both expressed concerns with a lack of charging station infrastructure. Zeta particularly emphasized that there is a lack of infrastructure in the northern-most regions

of Ontario, given that it conducts much of its transportation in remote communities. Nonetheless, Zeta is interested in adopting electric trucks given that 50% of its operations are local and thus require short-haul trips that could potentially be run on a single charge. Furthermore, Beta's President – though unwilling to adopt electric trucks due to the company's focus on long-distance and cross-country transport (i.e., greater than 500 kilometres) – emphasized that electric trucks could be a feasible alternative for companies like Zeta, who conduct local trips (i.e., within 250 kilometres in distance). Additionally, it is worth noting that there are roughly 5,000 charging stations for electric *cars* across Canada, with the highest concentration of stations in Ontario, Québec, and British Columbia; however, charging stations for electric trucks have yet to be developed (Chhabra, 2017). Moreover, 55% of the charging stations in Canada for electric cars are concentrated in major cities and are not built on provincial highways *between* cities to support long-distance travel (Yuen, 2018). This may be problematic in adapting such charging stations for trucks in the future, as trucks primarily conduct long-distance transportation which would require a network of charging stations in more remote regions.

Overall, most of the studied companies have not experimented with alternative fuels nor displayed interest in this area. For the companies that had tested such fuels (i.e., Beta and Gamma), they have had little to no success, which is in line with the findings of other studies (see, e.g., Tacke et al., 2014). However, two companies (i.e., Beta and Eta) highlighted that there has been an increasing focus on natural gas in the Canadian trucking sector in recent years, and one company (i.e., Beta) is strongly interested in adopting a CNG fleet in the near future.

This recent and growing focus on natural gas-powered fleets in Canada may not necessarily be driven by environmental reasons, however. Rather, industry economics may be at play, which justify the trending shift towards natural gas in the Canadian trucking industry. For instance, Canada is the world's fifth largest producer of natural gas and is currently plagued with the issue of having natural gas supply exceed domestic consumption (National Energy Board, 2017). This issue has further been intensified by the exponential increase in the United States' – traditionally Canada's primary natural gas export market – shale gas production in recent years. As such, Canadian natural gas manufacturers – who have drilling

equipment already in place but no profitable market to sell their gas to – may be starting to push their natural gas onto the trucking industry, which is already highly energy-intensive and focused on reducing fuel costs. Given that CNG is almost half the price per litre than diesel in Ontario – compare 65.9 cents versus 120.6 cents as of June 10, 2019 (Ontario Ministry of Energy, 2019) – and emits 25% less emissions (Clean Energy Fuels, 2016), it can be an attractive alternative fuel for the trucking industry.

5.1.2 Vehicle Technologies Adopted by the Studied Companies

More than half of the studied companies have implemented some sort of initiative related to vehicle technologies (refer to Table 24). As shown in Table 24, **aerodynamic** and **tire improvements** are the most popular vehicle technologies. In terms of aerodynamics, the implementation of **trailer skirts** (most common) and **fairings** (cited only by Beta) is widespread. **Low-rolling resistance tires** and **auto-tire inflation systems** are examples of frequently adopted tire improvements. All the companies that have implemented aerodynamic improvements (i.e., Alpha, Beta, Gamma, Epsilon and Eta) and tire improvements (i.e., Alpha, Beta, Gamma, Delta, and Eta) have noted that they have achieved a significant amount of fuel savings as a result. Furthermore, the adoption of such initiatives is also common in Swedish and German LSPs (see, e.g., Liimatainen et al., 2014; Tacke et al., 2014; Pålsson & Johansson, 2016).

The implementation of technical actions (i.e., aerodynamic and tire improvements) in Canadian trucking companies, as illustrated in Table 24, can potentially be explained by three main reasons.

First, these initiatives may commonly be implemented because they are directly related to the transportation function – which is a core competence of trucking companies. Given that the primary assets of trucking companies are vehicles – and the primary purpose of such companies is the transportation of goods – any initiatives that relate directly to the trucks themselves can offer significant opportunities for greening and are thus implemented.

Second, these two initiatives might widely be adopted because many of the trucking companies studied took advantage of the incentives offered under the GCVP of Ontario – that is, prior to its cancellation in 2018. For instance, from 2008 to 2018, the GCVP offered a 30% rebate for trailer skirts (Truck News, 2017) – which is the most common aerodynamic improvement adopted by the studied

companies. Given that most of the trucking companies studied were founded prior to the 2018 cancellation of the GCVP, they may have had the chance to take advantage of these incentives in earlier years, hence the wider adoption of such initiatives.

Moreover, one company (i.e., Eta) implemented trailer skirts in 2018 and expressed interest in purchasing more in the next five years. This is rather interesting given that incentives for such technologies have been cancelled in 2018, hence Eta must have other reasons for implementing trailer skirts apart from taking advantage of incentives. One potential explanation is that Eta is able to perceive the potential benefits of trailer skirts. This is evidenced by Eta's General Manager's comment which highlighted that the company was able to immediately experience a significant amount of fuel savings as a result of skirting one of its trailers. Hence, given that Eta sees more potential in trailer skirts in terms of reducing emissions and lowering its fuel expenses, it may be more likely to implement such technologies in the future. It is worth noting that though there might not necessarily be a causative relationship present – and examining this was not the focus of the study – previous studies (see, Rao & Holt, 2005) have illustrated that when firms witness a potential to reduce emissions, they may also see opportunities for economic gains and are thus willing to implement such initiatives.

Lastly, the adoption of **auxiliary power units** and **lighter materials** has also been reported by some of the companies studied (refer to Table 24). However, these initiatives were not as popular – note that auxiliary power units were adopted by three companies (i.e., Alpha, Beta, and Theta), while the use of lighter materials was only mentioned by one company (i.e., Beta).

The use of auxiliary power units might be less common because companies are able to find more economical measures to implement elsewhere in order to obtain the same benefits (i.e., idle reduction). Auxiliary power units are used primarily for idle reduction – that is, to power trucks when they are not in use (i.e., when they are parked, with the engine turned off) to provide heat and/or cold air for the truck drivers while resting. However, according to Theta's Owner, they now cost between \$15,000 to \$16,000 CAD. Perhaps companies are able to reduce idling by other less costly measures like taking advantage of reserve areas for resting that can be rented in advance for as low as \$10 – as raised by Theta's Owner – or

perhaps by training their drivers to reduce idle times (note that driver training is the most widely implemented initiative found in the study). Therefore, adopting auxiliary power units might not make economical sense for the companies in the presence of other less costly measures offering the same and/or similar benefits.

Moreover, the use of lighter materials is not common in the studied companies. One potential explanation for this is that Canadian trucking companies may have less motivation to implement lighter weight trucks than trucking companies in the U.S. or Europe, for instance. This is because Canada has a maximum gross vehicle weight allowance of 46,500 kilograms, which is greater than that allowed in the U.S. and in most European countries (i.e., roughly 36,000 kilograms) (Jakubicek, 2016). Hence, there is less of a need for extra payload rate that can be achieved through the adoption of lighter trucks than in other regions where the maximum vehicle weight limit is lower.

5.1.3 Operational Strategies Adopted by the Studied Companies

As illustrated in Table 24, the highest concentration of initiatives adopted by the studied companies is in the area of *operational strategies*. This is a very common finding in the extant literature (see, e.g., Perotti et al., 2012; Colicchia et al., 2013; Liimatainen et al., 2012; Liimatainen et al., 2014; Zhang et al., 2014; Tacken et al., 2014; Pålsson & Johansson, 2016; El Baz & Laguir, 2017; Sureeyatanapas et al., 2018). It is worth noting that these studies examined different geographical regions (i.e., countries in Europe, Asia, Africa), yet uncovered the same results. Therefore, it can be said that the focus on green initiatives related to operational strategies is common in the logistics and transportation industries, regardless of the geographical location. This may be because these initiatives (such as training drivers, limiting truck speeds, optimizing distances travelled) are directly related to the *transportation function*, which is a core competence of any logistics firm. Note that the transportation function specifically deals with the *movement* of goods “from where they are sourced to locations where they are demanded” (Goldsby, Iyengar, & Rao, 2014, para. 1) and is an essential activity in any logistics firm. However, when compared to the category of vehicle technologies (refer to Section 5.1.2), in which initiatives are also directly related to the transportation function, changes to operations (such as capitalizing on driver training efforts) might be less

costly than monetary investments in vehicle technologies (such as the purchase of auxiliary power units) and, as a result, may be more commonly implemented.

Furthermore, as highlighted in Table 24, **driver training** is the most widely adopted initiative by the studied companies. This is in line with the findings of Liimatainen et al. (2012), Tacke et al. (2014), and Sureeyatanapas et al. (2018). Almost all of the studied companies – with the exception of Eta – currently have driver training in place. However, Eta’s General Manager emphasized that formal driver training would be implemented by the end of 2020 as the company expands its fleet size from six to 20 trucks.

Moreover, it is important to note that different approaches to driver training were uncovered in the study. For instance, Alpha and Beta use gamification – that is, they purposely create a competitive environment in which drivers are required to compete on attaining the lowest idle times and most efficient overall performance. Additionally, these two companies use incentive schemes (i.e., a rewards system) to motivate their drivers. The use of incentive schemes in driver training is not commonly found in the literature. For instance, out of the ten German LSPs interviewed, only three had implemented driver incentive schemes (see, e.g., Tacke et al., 2014). Similarly, most Finnish LSPs have not adopted driver incentive schemes – though they have considered doing so (see, e.g., Liimatainen et al., 2012). Alpha and Beta may be more motivated to implement incentive schemes in light of the projected shortage of 48,000 drivers by 2024 in Canada (Canadian Trucking Alliance, 2016). Furthermore, other companies studied made use of partners in training their drivers. For instance, while Gamma outsources its driver training to a consulting company, Delta collaborates with its insurance company in training its drivers. Epsilon, Zeta, and Theta have less formal in-house driver training in place. Generally, however, there is a clear agreement among the representatives from the eight trucking companies studied about the importance of driver training in managing fuel economy.

Furthermore, the widespread adoption of driver training can potentially be explained by two main reasons. First, driver training is directly related to the *transportation function* – which is a core competence of trucking companies. However, driver training may be a less costly investment than the purchase of vehicle technologies (e.g., aerodynamics, auxiliary power units, etc.), for instance, and thus a more

attractive alternative for trucking companies to implement in order to better manage their fuel economy. Second, companies may be willing to capitalize on driver training because in addition to having it help ensure more efficient driving and thus better fuel economy, the presence of well-educated drivers is also directly related to increased safety of trucking operations. Currently, safety is a trending topic in Ontario trucking. A total of 7,674 accidents involving heavy-duty trucks occurred in 2018 in Ontario, which is the highest the province has seen in the last four years (Somani, 2019). According to the Ontario Provincial Police, the main reason for these accidents is uneducated drivers (Somani, 2019). Thus, the studied companies may implement driver training with the *main* aim of ensuring safe operations, but also experience more efficient driver performance as a *by-product*. Delta's Owner particularly emphasized that Delta's insurance company takes driver training very seriously and thus collaborates with Delta in training drivers as it wishes to ensure safer driving. Additionally, increased reliability and safety is also very important in Zeta.

Moreover, most of the studied companies stated that they **limit the speeds at which their trucks travel** – this was cited by representatives from Alpha, Delta, Epsilon, Zeta, Eta, and Theta. However, as evidenced in the current study, this may be because speed limits are required by Ontario law (i.e., a maximum speed of 105 kilometres per hour), as was highlighted by Delta and Theta. Additionally, most of the companies – with the exception of Theta – agree that limiting truck speeds helps with fuel savings. Furthermore, **route optimization** is also a widely adopted initiative (i.e., cited by Alpha, Beta, Gamma, Epsilon, and Zeta). Vehicle routing using real-time data to minimize distances travelled and circumvent congestion is also a widespread initiative found in other studies (see, e.g., Perotti et al., 2012; Liimatainen et al., 2012; Colicchia et al., 2013; Zhang et al., 2014; Tacke et al., 2014; Liimatainen et al., 2014; Pålsson & Johansson, 2016; El Baz & Laguir, 2017; Sureeyatanapas et al., 2018).

Additionally, it is interesting to note that more *collaborative* initiatives – such as **intermodal transportation** and **supply chain collaboration** – are not commonly implemented (i.e., only Alpha and Beta cited the adoption of such initiatives). This is also a reoccurring finding in the literature, with many studies emphasizing that initiatives requiring collaboration with external partners are not widespread (see,

e.g., Perotti et al., 2012; Pieters et al., 2012; Pålsson & Johansson, 2016). However, the work of Tacke et al. (2014) found contrasting findings in that intermodal transportation is common among logistics companies in Germany – particularly shifting goods from road to rail transport.

The lack of use of intermodal transportation by the studied companies may be a result of poorly developed railway infrastructure in Canada. For instance, though Canada is 28 times the size of Germany (Country Size Comparison, n.d.), it has only 7,000 kilometres more railway lines – compare approximately 48,000 kilometres in Canada versus 41,000 kilometres in Germany (Railway Technology, 2014). Additionally, the existing rail infrastructure is less developed as Canada has one major *freight* rail operators (i.e., Canadian National Railway) versus 150 private freight rail operators in Germany (Railway Technology, 2014). As such, it can be said that the market structure of freight rail transportation in Canada is *monopolistic*, which may promote inefficiencies and stunt development in this sector. This is evident by a lack of high-speed railway lines in the country, compared to more than 1,300 kilometres of high-speed railway networks present in Germany and more than 400 kilometres of new high-speed railways lines under construction from 2013 onwards (Railway Technology, 2014). Moreover, according to a recent Forbes study, when certain sectors are monopolistic, they inevitably give rise to corruption – most common in the transportation sector – in which there is a privileged relationship between the industry and government (Machado, 2015). This may be the case in Canada as in 2017, several members of the Canadian International Freight Forwarders Association wrote a letter to the Minister of Transport and Minister of International Trade expressing their concerns related to Canadian National Railway's freight operations since 2017 (Canadian International Freight Forwarders Association, 2018).

5.1.4 Truck Replacements Adopted by the Studied Companies

Fleet modernization is commonly pursued in the studied companies (refer to Table 24). Almost all the companies studied – with the exception of Zeta and Eta – aim to have an updated fleet. Similar findings were uncovered in the works of Perotti et al. (2012) and Tacke et al. (2014). However, decisions to modernize fleets may not necessarily be for complying with new emissions standards. For instance, many of the companies believe that the greatest efficiencies are gained by purchasing latest-model equipment (as

cited by Alpha, Beta, Gamma, and Delta). In fact, some of these companies refuse to purchase certain vehicle technologies (such as aerodynamics) as add-ons; rather, they invest in updating their fleets as the latest-model trucks come with these features already equipped in them. Theta's Owner specifically emphasized that purchasing such add-ons does not make much economical sense as an ROI cannot be achieved on them before the truck must be replaced. Likewise, some companies (i.e., Alpha, Delta, Eta, and Theta) believe that having more updated fleets helps attract truck drivers in light of the driver shortage and reported that drivers are increasingly interested in the brands and models of trucks that the companies have.

5.1.5 Other Initiatives Adopted by the Studied Companies

Only two companies (i.e., Alpha and Beta) **collaborate with academic institutions to promote innovation** in the green trucking sphere (refer to Table 24). While Alpha collaborated with college students to design more environmentally-friendly trailer technology, Beta is currently working with a local college in developing an electrical generation unit that can replace a physical generator. Interestingly, Alpha's IT is always a co-op student from a local college. Such use of partners in achieving sustainability efforts has also been found in the literature (see, e.g., Lieb & Lieb, 2010b; Sureeyatanapas et al., 2018). However, Alpha and Beta *specifically* partner with *academic institutions* in order to attract younger workers in light of the aging trucking industry in Canada. Perhaps Alpha and Beta believe that younger employees can provide them with access to data, experience, and most importantly, a different perspective (primarily technology-minded), which can help them stay on top of technology trends in order to be more competitive in the industry in the future.

Furthermore, **maintenance for additional safety and/or reliability** and **recycling materials** were only cited by a few companies in the study – i.e., Delta and Zeta, and Beta and Zeta, respectively. The use of recycling materials – particularly in relation to packaging – has also been found to be quite neglected in the literature (see, Colicchia et al., 2013). Perhaps this is because such initiatives are not directly related to the transportation function – i.e., the *core competence* of logistics firms. Furthermore, in the study of Liimatainen et al. (2012), some companies stated that proper maintenance and safety improvements are

implemented by some LSPs. Representatives from Delta and Zeta believe that properly maintained vehicles result in more efficient trucking operations.

Lastly, the use of **artificial intelligence** has been cited by Alpha. To the best of my knowledge, this is a *new* finding. To-date, no academic studies cited the adoption of artificial intelligence by *LSPs*.

However, predictive analytics (a function of artificial intelligence) are starting to be applied in trucking to identify patterns and reach solutions that humans do not have the capacity to process (Pyzyk, 2019). For instance, predictive analytics can help ensure safer trucking operations by aggregating *different* data on each truck driver (e.g., hours of service, violations, etc.) in order to determine which drivers are most likely to get into an accident. According to Pyzyk (2019),

That information not only allows a manager to identify drivers who could use additional training but also which loads best suit higher-risk drivers. For example, machine learning can identify a high-risk driver and recommend against matching that person with a high-priority load that needs to travel through challenging winter weather (para. 35).

Additionally, one artificial intelligence model increasing gaining popularity in the trucking sector involves analyzing drivers' satisfaction and their likelihood to quit. As highlighted by Pyzyk (2019),

This driver-retention software compiles data that detect driver performance — HR reports, prior accidents or citations, hard braking incidents, on-time deliveries, in-cab video and in some cases, driver route preferences. The software sends managers a notification that a certain driver is at risk of terminating their employment and recommends outreach (para. 41).

This is a particularly useful application of artificial intelligence in trucking given the current driver shortage (Pyzyk, 2019).

In Alpha, however, the application of artificial intelligence is for transport planning purposes. One potential explanation for the reported use of artificial intelligence by Alpha in the current study is the prominent and growing use of artificial intelligence in the North American *transportation* market that is not found elsewhere. For instance, artificial intelligence in the *transportation* sector, specifically, is expected to exceed \$3.5 billion by 2023, with the fastest growing category being the application of software-

enabled artificial intelligence features (P&S Market Research, 2018) – similar to what Alpha is working on with the local software developer. North America, however, accounted for 44% – i.e., the largest share – of the global artificial intelligence *transportation* market in 2017 (P&S Market Research, 2018). This may be due to government support and the *long-haul* nature of transportation in Canada and the U.S. For instance, as of March 22, 2017, the Government of Canada started funding the Pan-Canadian Artificial Intelligence Strategy program to promote the application of artificial intelligence in the transportation sector, among many others (Canadian Institute for Advanced Research, 2017). Additionally, there are more than 750,000 heavy-duty trucks in Canada in which most conduct long-haul transportation (Government of Canada, 2017). As such, the application of artificial intelligence is both a profitable long-term opportunity in Canada as well as is best suited for *long-haul* trucking, which is characterized by erratic schedules (Canadian Institute for Advanced Research, 2017) and large distances common in Canada. Thus, given an environment conducive for the development of artificial intelligence, its adoption by logistics firms in Canada can potentially be expected.

5.2 An Overview of Drivers and Barriers in the Studied Companies

A wide variety of drivers and barriers were uncovered in the study (refer to Table 25). It is worth mentioning that *most* of the drivers and barriers identified in the studied companies are part of the “Market-Related” category. Additionally, note that only *barriers* emerged as part of the “Government-Related” category and that no company cited the government as a driving force.

In general, there is a strong overlap between the drivers and barriers found in the literature and in this study (compare Table 4 to Table 25). However, three market-related *drivers* and two market-related *barriers* (refer to the shaded portions of Table 25) emerged that are not found in the extant literature – to the best of my knowledge – and thus are *novel* findings. While the three market-related *drivers* (i.e., combatting the aging trucking industry, driver shortage, and carbon taxes) are expected as they reflect the current market situation in Canada; the two-market related *barriers* (i.e., the presence of anti-competitive practices and a male-dominated industry) are surprising findings. Supporting discussions are provided in

turn. Additionally, this section concludes with a discussion on the special case of Alpha and Beta – the two companies that have implemented the widest variety of green initiatives.

Table 25

A Summary of the Drivers and Barriers Identified in the Studied Companies

Category	Factor	Factor Type	Alpha	Beta	Gamma	Delta	Epsilon	Zeta	Eta	Theta	Total
ORG	Driver	Management support	●	●							2
		Management knowledge		●							1
		Clear strategy	●	●							2
		Environmental culture	●	●			●	●			4
		Employee support	●	●							2
	Barrier	Lack of employees	●		●		●		●		4
		Lack of management support			●						1
		Lack of management knowledge					●	●			2
		Small company size		●		●					2
FIN	Driver	Cost savings			●	●			●		3
		ROI achievement	●	●							2
	Barrier	High costs	●	●	●	●	●	●	●	●	8
		Uncertain ROI							●	●	2
MKT	Driver	Customer demands	●	●		●		●			4
		Combating aging trucking industry	●								1
		Combating driver shortage issue	●	●		●			●	●	5
		Combating carbon tax uncertainties			●						1
		Partner collaboration on green initiatives	●	●		●					3
	Barrier	Lack of customer interest in green services			●		●				2
		Lack of infrastructure			●	●		●			3
		Anti-competitive practices	●			●	●			●	4
		Competitive pressures				●				●	2
		Push-back from oil industry								●	1
GOV	Barrier	Lack of incentives		●	●	●	●	●			5
		Absence of a clear and central source of information			●		●		●		3
		Poor involvement in green initiatives		●	●					●	3
		Weak enforcement of regulations	●		●		●			●	4
		Lack of uniformity across government bodies					●				1
TEC	Driver	Availability of green technology			●	●			●		3
	Barrier	Lack of green technology		●			●	●		●	4
		Risks with new technology		●		●			●	●	4

5.2.1 Organization-Related Factors in the Studied Companies

All the *organization-related* factors that arose in the studied companies are in line with the findings in the extant literature. The same is true for *finance-related* factors (to be discussed in Section 5.2.2). Note that both organization-related and finance-related factors are both *internal* factors in that they deal with aspects that are present *within* a company. Perhaps this is why there is a high degree of overlap among the

identified organization-related and finance-related factors in this study and those found in the reviewed literature. Logistics companies – regardless of their location of operation(s) – all face the same set of constraints that collectively influence their competitive position in the industry, which may be why the same results in relation to organization-related and finance-related factors are repeatedly found in the literature. For instance, all organizations consist of the following four aspects: (1) a culture, (2) financial assets, (3) employees, and (4) knowledge (Spacey, 2016). Thus, most of the drivers and barriers that are commonly found in the literature deal with factors that are part of one or more of these aspects. A supporting discussion on the *most common* organization-related *driver* and *barrier* identified in the study (i.e., **environmental culture** as a *driver* and a **lack of employees** as *barrier*) is provided in the subsequent paragraphs.

The most common organization-related *driver* that arose in this study is **environmental culture** – this was found to be a driving force in *half* of the studied companies (i.e., Alpha, Beta, Epsilon, and Zeta). However, the presence of an environmental culture greatly differed among the companies and its effect on organizational practices also varied. For instance, in Alpha and Beta, environmental culture was strongly diffused throughout the organization by management – so much so that it garnered employee support for adopting green initiatives. As a result, employees were strongly *engaged* in the process of adopting green initiatives as Alpha and Beta encouraged a *bottom-up* approach to management. It is also worth noting that these two companies implemented the most initiatives (refer to Table 24). Evidently, a strong environmental culture that is **supported by management** and diffused throughout the organization (thus leading to **employee support**) are intrinsically linked in Alpha and Beta.

In Epsilon, however, the situation is different. The presence of an environmental culture was transferred onto the current Owner from their father. However, Epsilon's Owner did not transfer the environmental culture onto its employees; thus, the company's employees are not motivated to work towards helping the Epsilon promote more environmentally-friendly operations. Nonetheless – though the company is constrained by its leasing agreement – Epsilon's Owner always strives to lease the latest-model

trucks as a result of the enduring environmental culture (i.e., Epsilon's Owner tries to be as much environmentally-friendly as possible within the constraints of its leasing agreement). Furthermore, Zeta also has an environmental culture. However, in Zeta, the environmental culture was only diffused onto its furniture disposal side by management and not its transportation side of business. Both Epsilon and Zeta have implemented a limited amount of green initiatives (refer to Table 24).

Given that the two companies that have implemented the widest variety of initiatives – i.e., Alpha and Beta – differ in that they both *diffuse* their environmental culture, it can be said that the diffusion of an environmental culture throughout the organization is an important factor in motivating Canadian trucking companies to adopt green initiatives, as it garners the employee support necessary to implement such initiatives successfully. The importance of imbuing an *entire* organization with an environmental culture in creating a strong motivation to green transportation has also been found in the study of Pålsson and Kovacs (2014). However, it is also worth noting that both Alpha and Beta were the only two companies that had established **specific strategies** in attaining environmental goals. For instance, while Alpha's management sets specific metrics every quarter in terms of lowering fuel consumption and promoting more efficient operations, Beta's management closely follows the metrics established under the SmartWay program and strives to continuously improve on them. Both companies, however, wish to differentiate themselves and establish a first-mover advantage in the industry – though in differing ways: Alpha through the implementation of artificial intelligence for transport planning and Beta in terms of adopting a CNG fleet. Thus, the type of strategy that a company has set to attain better environmental performance is irrelevant; rather, it is the act of having *a strategy* in the first place that is important. Evidently, both Alpha and Beta's management have a clear structure that allows them to *track* the company's progress *over time* and thus guide the constant improvement of the efficiency of operations. Banerjee et al. (2003) also emphasized that a clear company strategy is a crucial underpinning as it “determines the direction for greening transportation because the approach taken by top management in environmental issues is essential for this matter (as cited in Pålsson & Johansson, 2016, p. 675).

Moreover, it is interesting to note that the four companies that had an environmental culture – that one way or another influenced the company’s adoption of some type of green initiative – are all *older* companies. For instance, Alpha was founded in 1991, Beta in 1987, Epsilon in 1980, and Zeta in 1997. The companies that did not have an environmental culture were *recently* founded – Gamma in 2013, Delta in 2015, Eta in 2012, and Theta in 2014. Perhaps this can best be explained by the following remark by Delta’s Owner, who increased the company’s fleet size to 65 trucks within three years (i.e., from 2015 to 2018):

In this industry, you need to learn how to listen. You have to learn what’s good, try it out – and if it fails – well then you know it doesn’t work so you having to keep on trying again and again until you figure out how to cut out bad habits. Trucking has been a learning experience for me since I started this business with my partner in 2015. The reason it has grown so much in the last three years is because we focus on re-investing everything we get back into the business – so for us, it was go all in or go home from the start.

Delta’s Owner illustrated that newly founded companies are focused on establishing themselves in the marketplace and their attention is *not* on improving environmental performance. As hinted in the preceding quote, in the quest to establish themselves, newly founded companies are stuck in a vicious cycle of trial and error until they figure out what works best. Older companies, on the other hand, who have had more time to *accumulate* both knowledge and experience with regards to trucking operations and best practices, are now able to shift their focus onto environmental performance.

Furthermore, in terms of organization-related *barriers*, the most common barrier that emerged in the study is **lack of employees**. This has been cited by *half* of the studied companies (i.e., Alpha, Gamma, Epsilon, and Eta). According to these companies, they do not have enough *knowledgeable* employees to help manage the adoption of green initiatives. Representatives from some companies (i.e., Alpha) are even switching to new roles to focus more on green initiatives in light of this problem. Though a lack of employees has been identified as a barrier by some LSPs in other studies (see, e.g., Evangelista, 2014; Evangelista et al., 2017), it seems more pronounced in the Canadian logistics sector as it was mentioned by

representatives from *half* of the companies studied. One potential explanation for this is that the shortage of qualified logistics and supply chain industry professionals is more marked in Canada than elsewhere. DHL recently surveyed more than 350 supply chain professionals across all continents and uncovered that the current demand for supply chain professionals exceeds supply by a ratio of 9:1 and that the shortage of supply chain workers will reach crisis mode by 2020 (Canadian Shipper, 2017). This situation is more pronounced in Canada so much so that the country had increased its immigration targets by 15% from 2016 to 2017 to attract foreign knowledge workers to fill the looming Canadian supply chain talent deficit (Argentus, 2016). Additionally, this situation is further intensified by the aging Canadian trucking industry in which the presence of older workers impedes technological progression.

5.2.2 Finance-Related Factors in the Studied Companies

As mentioned in Section 5.2.1, there is a high degree of overlap among the finance-related drivers and barriers identified in this study and in the extant literature. In relation to finance-related *drivers*, it is interesting to note that **cost savings** were only mentioned by three of the studied companies (i.e., Gamma, Delta, and Eta). This is surprising given that many other studies in the literature evidenced greater support for cost savings as a key driver for the adoption of green initiatives by LSPs (see, e.g., Rossi et al., 2013; Pålsson & Kovacs, 2014; Oberhofer & Dieplinger, 2014; Evangelista et al., 2017). Evidently, there is a lack of evidence to argue that *mere* cost reduction is a constant and critical driver for motivating Canadian trucking companies to implement green initiatives. Perhaps this is because plenty of evidence emerged in the study to support that the economics associated with the adoption of green initiatives have to be married up with an environmental culture and supporting strategy that is driven by management. For instance, note that the primary motivation for companies that had adopted the widest variety of green initiatives (i.e., Alpha and Beta) was not to save costs; rather, the intrinsic link between environmental culture, management support, and a clear strategy played out as stronger drivers.

It is also interesting to note that the **ability to achieve an ROI** was cited as the main finance-related *driver* by Alpha and Beta. Tacken et al. (2014) argued that economically doubtful investments in green

initiatives are likely to be rejected. This is seen in the case of Eta and Theta (refer to Table 25). However, what distinguished Alpha and Beta from the other six companies studied is that they were the only two companies that were able to *witness* an ROI on previously implemented green initiatives, which had motivated them to further adopt other initiatives. In fact, Beta's President specifically acknowledged that the company was able to see an ROI within two to four years-time on previously implemented green initiatives. This is in line with the findings of a 2009 study conducted by the Danish Transport and Logistics Association (DTL). In their comprehensive analysis of fuel-saving measures, DTL found that most measures have an expected payback period of less than two years (Liimatainen et al., 2012). However, according to the current study, it seems as though these short payback periods are not enough to motivate Canadian trucking companies to implement green initiatives. A potential explanation for this is offered by Ogburn and Ramroth (2007) who argued that energy-saving initiatives have been pushed onto the trucking industry for more than a decade but most of the trucking companies were unwilling to implement such initiatives because they required *proof* of the savings in their *own* operations and lacked the resources to carry out the necessary tests. This is further evidenced in the following remark by Beta's President: "*It really takes a little bit of legwork on your part to really project forward what the savings and ROI are to you and likely if you can save enough money.*" Given that a **lack of employees** also emerged as a strong *barrier* in this study, it can be assumed that Canadian trucking companies lack the qualified human resources to help with ROI projections.

Lastly, in relation to finance-related *barriers*, **high costs** emerged as the most common barrier. *All eight* companies complained about the high prices for trucks and/or related green vehicle technologies in Canada, while Delta also highlighted the high costs of insurance. High costs as a main finance-related barrier is argued to be the most significant hurdle to greening transportation (see, e.g., Rossi et al., 2013; Tacke et al., 2014; Evangelista, 2014; El Baz & Laguir, 2017; Evangelista et al., 2017).

5.2.3 Market-Related Factors in the Studied Companies

Collectively, most of the drivers and barriers that arose in this study are concentrated in the “Market-Related” category (refer to Table 25). As such, it can be said that *external* factors are, overall, more significant than internal factors in the studied companies.

Firstly, in discussing *new* findings, it is evident that most of the studied companies view the adoption of green initiatives as a strategy to mitigate some of the risks associated with current industry trends in Canada. As such, most of the companies (with the exception of Epsilon and Zeta) were *driven* to implement certain green initiatives in order to **combat some of the market uncertainties** associated with either: (1) the **aging trucking industry**, (2) the **enactment of carbon taxes**, and/or (3) the **driver shortage issue** in Canada (refer to Table 25). One study reported that market uncertainties drive LSPs to implement more sustainable practices (see, Lin & Ho, 2008). However, given that these authors used *quantitative* research methodology, they were unable to provide deeper insights into which *specific* types of market uncertainties played as important *drivers*. In the current study, however, the types of market uncertainties uncovered as driving forces are directly in line with the three main industry trends in *Canada*, specifically, and for such reason, are not found in other studies.

In terms of market-related *drivers* that are unique to the Canadian logistics case, Alpha exemplified how the aging trucking industry motivated the company to partner with a local college to advance knowledge in green innovation in trucking technologies. On the other hand, Gamma highlighted a desire to combat the risks associated with the enactment of carbon taxes in Canada. At the time of the interview (i.e., November 13, 2018), Gamma planned to bring in an expert to help figure out ways in which the company can reduce its environmental impact given that Gamma was not sure of how the enactment of carbon taxes in 2019 would affect its business. The most interesting finding, however, is the sheer amount of support among the studied companies for purchasing latest-model trucks as a strategy to attract truck drivers to their businesses. *More than half* of the studied companies (i.e., Alpha, Beta, Delta, Eta, and Theta) are currently capitalizing on fleet modernization to fulfill truck drivers’ demands, which mainly revolve around having

newer and more luxurious trucks to operate. Evidently, this study attested to the *severity* of the current driver shortage issue in Canada as even in the presence of *high costs* of trucks (which was cited as the *main barrier* by *all eight* companies studied), five of them are willing to spend more money on purchasing latest-model trucks in order to please drivers. Interestingly, some even go as far as purchasing the brands of trucks (i.e., high-end Volvo or Freightliner) that their drivers *specifically* demand – which was the case in Alpha, Eta, and Theta. Theta’s Owner particularly noted that truck drivers looking for business call the company to inquire about the state of its fleet – i.e., the brand(s) and model(s) of trucks, as well as their transmission types (i.e., automatic or manual).

Furthermore, in terms of market-related *barriers*, a **lack of infrastructure** was pointed out by three companies (i.e., Gamma, Delta, and Zeta). While Delta only reported a lack of infrastructure in terms of charging stations for electric trucks, Gamma and Zeta emphasized that in addition to a lack of infrastructure for electric trucks, there is also a lack of infrastructure in Canada for *current* trucks – most notably the issue of insufficient truck stops. Many studies in the literature cited a lack of infrastructure as a barrier for adopting green initiatives (see, e.g., Beškovnik & Jakomin, 2010; Rossi et al., 2013; Tacke et al., 2014; Pålsson & Johansson, 2016).

Moreover, it is worth noting that a wide variety of perspectives emerged about the role of **customers** – that is, whether they act as a *driver* or a *barrier* (refer to Table 25). For instance, Alpha, Beta, Delta, and Zeta acknowledged that their customers *drive* them to implement green initiatives (refer to Table 25). Alpha and Beta, however, differed from Delta and Zeta in that they cited that their customers did not demand greener service provisions, specifically; rather, Alpha and Beta believe that the adoption of certain initiatives (such as artificial intelligence for transport planning and intermodal transportation, respectively) will lead to better service levels overall and greater customer satisfaction and thus are motivated to implement such initiatives. Evidently, Alpha and Beta do not see a trade-off between (1) the adoption of green initiatives, and (2) the provision of timelier service; rather, they believe that one leads to the other. Moreover, Delta’s customers (i.e., large and well-known grocery retailers) demand that the company has

newer equipment, which is why Delta's Owner capitalizes on modernizing the company's fleet. Furthermore, Zeta's strict adherence to environmental guidelines in recycling furniture was demanded by its primary client (i.e., the government) through the federal contract that Zeta won for the province of Ontario. On the other hand, Gamma and Epsilon emphasized that their **customers are not interested in green initiatives**. Additionally, representatives from Eta and Theta did not even comment on the role of customers.

Evidently, in the current study, customers emerged as both a *driver* and a *barrier*. Perhaps this is because trucking companies servicing a wide range of industries (e.g., electronics, industrial goods, dry and temperature-sensitive food, retail, veterinary supply, pharmaceuticals, chemicals, furniture, hazardous goods, healthcare, etc.) were studied. Liimatainen et al. (2014) also found that customer interest in the environmental performance of the LSP greatly differed based on the industry sector, with customers from the *chemical industry* demanding energy efficient initiatives the most. This was not the case, however, in the current study as the only company servicing the chemical industry (i.e., Epsilon) had expressed that its customers are *not* interested in green initiatives. The only two companies that confirmed customer interest for greener service provisions were Delta and Zeta. A potential explanation for this is that the *size* of the customer might play an important role in the strength of customers' demands. Note that Delta and Zeta are the only two companies studied (apart from Theta) who have one or two *major* customers they do business with. For instance, Delta has two major customers (i.e., two large and well-known grocery retailers) while Zeta only has one (i.e., the federal government). Thus, one or two *major* customers account for 100% of the companies' earnings and thus may exert a *significant* influence when compared to companies who have *many* customers in which each accounts for a *small percentage* of the companies' turnover.

Additionally, other stakeholders, such as **partners**, were also cited as a type of market-related *driver* by some companies (i.e., Alpha, Beta, and Delta). This finding was also attested by Lieb and Lieb (2010b). Alpha and Beta, however, differed from Delta in that they have a close and *long-term* relationship with the OTA, while Delta only partnered with its insurance company. A close relationship with the OTA

may offer the companies some benefits, as Alpha and Beta had implemented the most initiatives. As the OTA represents all trucking companies from Ontario (and in other Canadian provinces and the U.S.), it serves as a key industry network for establishing partnerships between trucking companies, customers, suppliers, owner-operators, etc., as well as for informing the trucking industry of current trends. As such, given Alpha's and Beta's close connection with the association, it can be said that these two companies are the first to hear about new trends and for such reason, have adopted the most initiatives thus far. The *breadth* of implemented green initiatives in Alpha and Beta may be explained by two main reasons, as follows.

First, it can be due to their *learning curves* (Kagan, 2019). As these companies are the first to hear about industry trends through their relationship with the OTA, they can become better informed and prepared than their competitors once certain green initiatives become more important in the industry. This is most evident in Alpha's current implementation of artificial intelligence for transport planning and Beta's shift towards a CNG fleet conversion – initiatives that are risky in nature, yet trendy. As such, Alpha's and Beta's learning curves for developing and adopting more innovative measures would be steeper than those of less-informed competitors, and thus offer a first-mover advantage.

Second, it can be due to the presence of *economies of scope*. Economies of scope form efficiencies based on *variety* – that is, when “the production of one good reduces the cost of producing another related good” (Chappelow, 2019, para. 1). Through their close and *long-term* relationship with the OTA, Alpha and Beta might have grown their networks – particularly with suppliers and customers. Note that out of the eight companies studied, Alpha and Beta service the most industries while the other six companies service a maximum of two. For instance, Alpha services the electronics, industrial goods, hazardous goods, and dry-food industries; Beta the furniture, pharmaceuticals, industrial goods, electronics, and retail industries; Gamma, Delta, and Eta only the temperature-sensitive food industry; Epsilon the chemicals and veterinary supply industries; Zeta only the furniture industry; and Theta only the medical equipment industry. As a result of having customers from multiple industry sectors, Alpha and Beta may be forced to offer a wider range of services to satisfy different demands from customers that are part of different industries. For

instance, through their strong network of carrier partners throughout Canada and the U.S., Alpha and Beta may be able to offer services for clients apart from general transportation, such as emergency shipments, warehousing, etc. Thus, through their range of services offered, they may find the benefits of introducing new initiatives to be higher than the marginal costs because these new initiatives are mainly “built on already existing services, knowledge, and internal structures” (Isaksson & Huge-Brodin, 2013, p. 231).

Furthermore, it is interesting to note that in the presence of a hypercompetitive trucking market in Canada, only two companies (Delta and Theta) cited **increased competition** as a *barrier*. This may be due to the strong presence of **anti-competitive practices** in the Canadian trucking industry – most notably, illegal activity – which was cited by *half* of the studied companies (refer to Table 25). Given that this barrier has not been cited in the literature, it is a *new* finding and is the hallmark of this study as it was acknowledged by 50% of the studied companies and explained in great depth (and with great concern) by the participants. While the four companies all confirmed the presence of anti-competitive practices in the industry, many different types of fraudulent actions were highlighted. For instance, Alpha and Delta acknowledged that certain trucking companies in the industry do not comply with environmental and tax legislation. Theta specifically highlighted that such companies purchase fuel under religious objects to avoid paying taxes. Furthermore, Alpha and Epsilon explicitly cited the widespread use of delete kits (i.e., engine tampering). Additionally, Theta emphasized that the presence of fake load brokers in the industry along with the selling of fuel cards at gas stations creates a serious anti-competitive situation in the market. All four companies, however, expressed that the presence of anti-competitive practices lowers the industry’s rates on loads causing the companies to attain less profits overall, thereby not offering them the opportunity to invest a portion of their earnings in measures like green initiatives.

5.2.4 Government-Related Factors in the Studied Companies

The presence of anti-competitive practices, as illustrated in the preceding section, can be a result of the government’s **weak enforcement of regulations** in the trucking industry, which was a common barrier (refer to Table 25) as it was cited by *half* of the companies (Alpha, Gamma, Epsilon, and Theta).

Alpha believes that there are not enough inspections, particularly in light of the widespread use of delete kits in the industry. Similar viewpoints are present in Gamma. Epsilon, however, expressed that regulations are not evenly enforced among carriers of different sizes in the industry and calls for the creation of more uniform standards like the ISO. Theta believes that the government poorly regulates the establishment of load broker businesses, which is why there are so many “fake” load brokers in the province.

Moreover, as is commonly found in other studies (see, Evangelista et al., 2017; Sureeyatanapas et al., 2018), a **lack of incentives** offered by the government also emerged as a prominent government-related *barrier* in the current study (i.e., it was cited by Beta, Gamma, Delta, Epsilon, and Zeta). This confirms the current situation under the new government, which had cancelled much of the previously offered incentives for carbon-reducing technologies.

Additionally, some companies expressed other government-related *barriers* like (1) an **absence of a clear and central source of information** (cited by Gamma, Epsilon, and Eta), (2) **poor government involvement in green initiatives** (cited by Beta, Gamma, and Theta), and (3) **lack of uniformity across government bodies** (cited by Epsilon). In relation to the first point, while Epsilon and Eta emphasized that there is no study conducted by the government to outline the potential ROI on certain initiatives, Gamma expressed that the information provided on government websites for carbon-reducing technologies is unclear. In relation to the second point, Beta believes that the government is not interested in green initiatives as politicians only look to implement the low-laying fruit in order to get re-elected; Gamma views the adoption of the ELD mandate as unnecessary as it will increase the costs of doing business; and, Theta believes that the government only “talks” about initiatives but does not do anything concrete to help trucking companies green their operations. Theta also cited that the government never offers free educational courses for trucking companies to help them get up to speed once a new mandates has been established (such as with DEF).

Lastly, it is worth noting that only government-related *barriers* emerged in the current study (refer to Table 25). Evidently, there is a strong consensus among the studied companies in that the government does not in any way *support* the adoption of green initiatives by Canadian trucking companies.

5.2.5 Technology-Related Factors in the Studied Companies

As shown in Table 25, more evidence of technology-related *barriers* than *drivers* emerged in the current study. Generally, there is strong overlap between the technology-related drivers and barriers that emerged in the current study and those found in the literature; however, the **risks associated with newer technologies** *barrier* is more pronounced in the current study.

First, it is interesting to note that seven of the eight studied companies commented on the state of the availability of green technology in trucking (refer to Table 25). While Gamma, Delta, and Eta agreed that **green technology in trucking is readily available** and acts as a key *enabler* in the adoption of green initiatives, Beta, Epsilon, Zeta, and Theta believe that there is a **lack of green technology in trucking** and emphasized that this acts as a *barrier*.

Gamma and Eta – who both transport food-grade products and have reefers in their fleet – both believe that there have been significant advancements in reefer technologies (such as the use of telematics, simpler configurations for easier repairs, and more efficient energy usage). In essence, they both believe that refrigerated trailers are already fully-loaded in terms of green technologies. Furthermore, Gamma and Delta emphasized that the latest trucks are manufactured to be more environmentally-friendly in the first place.

Beta, Epsilon, and Zeta, on the other hand, believe that there is a lack of green technology in trucking, which is in line with the findings of Pålsson and Johansson (2016). Beta claimed that there are not enough vendors offering green technologies and believes that there could be more innovation in the trucking industry. Epsilon and Zeta, however, complained that certain features, such as aerodynamics, do not come with *straight* trucks anymore and have to be purchased as add-ons.

Moreover, in further relation to technology-related *barriers*, several different perspectives on the risks associated with the adoption of new technologies were illustrated in the current study. *Half* of the studied companies believe that risks associated with adopting new technologies acts as a strong barrier (i.e., Beta, Delta, Eta, and Theta). For instance, Eta's General Manager believes that alternative fuels are not practical in Canada due to colder temperatures. Beta – who has heavily been engaged in testing different kinds of alternative fuels for many years – confirmed the multitude of problems that the company had in doing so, primarily in terms of permanent engine damage and the clogging of fuel filters in colder temperatures. Beta and Delta agreed that the new trucks are built with too many electronic controls and sensors and easily break down. Beta's Director of Safety particularly emphasized that these electronic controls and sensors necessitated almost weekly repairs in the company. Furthermore, Theta confirmed that new technologies have not been tested by manufacturers prior to market release, which is why many trucking companies have technical issues, as was the case with the DEF system. Similarly, while some studies in the literature highlighted that new technologies are more complex and thus cause technical hardships for LSPs (see, e.g., Lin & Ho, 2011; Ho & Lin, 2012), Beta further emphasized that it is also difficult to obtain credit because financing companies do not know the resale value on an entirely new technology. Evidently, risks associated with new technologies are not taken lightly by the studied companies.

5.3 Summary Insights

Overall, there is a high degree of overlap in the findings uncovered in the current study and those found in other academic studies. Nonetheless, the current study evidenced *three new* findings: (1) the application of **artificial intelligence for transport planning**, (2) several market-related *drivers* unique to Canada, such as combatting various market uncertainties (i.e., the **aging trucking industry**, the **driver shortage issue**, and **carbon tax uncertainties**), and (3) one main market-related *barrier* (i.e., the prevalence of **anti-competitive practices** in the industry).

Additionally, two companies (i.e., Alpha and Beta) evidenced greater support for adopting green initiatives as they have implemented the *widest variety* of initiatives (refer to Table 24). As such, these two trucking companies show a more environmentally *progressive* attitude towards adopting green initiatives when compared to Gamma, Delta, Epsilon, Zeta, Eta, and Theta. Given the findings in the current study, I was able to notice certain features in Alpha and Beta that might explain why these two companies are more environmentally *progressive* than others.

First, only in Alpha and Beta is there an intrinsic link between **management support** and **employee support** as both work together to drive the adoption of green initiatives. The presence of an enthusiastic management board has a positive and “spearheading” influence on employees in gaining their support to implement new actions; however, at the same time, the board welcomes and *encourages* employee involvement in the formulation of company strategy. Thus, in the quest to adopt new initiatives, there is both a *top-down* (i.e., management to employee) and *bottom-up* (i.e., employee to management) exchange of ideas. For instance, employees have a say on the establishment of core values in the company and the types of trucks and/or new technologies to be implemented and are rotated throughout different roles in the company to gain broader insights on the adoption of *any* new initiative. The establishment of core values as a team in Alpha and a series of “improvement teams” in Beta serve as tactics to achieve an overarching strategy. Alpha and Beta are the only two companies that have set strategies to achieve a first-mover advantage in the trucking sphere by pursuing more innovative measures and have established clear quarterly goals and metrics in doing so. Through the formation of a **clear and specific strategy**, these companies can *track* their progress over time; thus, the existence of a clear guidance structure allows Alpha and Beta to continuously ensure environmental improvement of their operations. This is also evident through their ability to achieve an ROI on previously implemented initiatives. A clear environmental strategy, however, is not present in Gamma, Delta, Epsilon, Eta, and Theta, and these companies have also implemented a *limited* amount of green initiatives.

Second, Alpha and Beta are the only two companies that are *currently* closely connected to the OTA. As such, they are at a significant advantage when compared to other trucking companies. Not only are they the first to hear about trends, but through their relationship with the OTA, they are also in a better position to network in the industry and establish new partners because of OTA's reigning presence in the trucking industry. According to the findings in this study, the adoption of more *advanced* initiatives – such as intermodal transportation and supply chain collaboration – require a *collaborative* approach and thus many partners. By seeking partnerships, trucking companies are able to share knowledge and resources with other parties and thus can *broaden* their scope of initiatives. Though some companies made efforts to establish partnerships (such as Gamma with other carriers, and Delta with its insurance company), without a close connection to the OTA, they are not exposed to a *wider* variety of potential partners to choose from which would help them implement more collaborative initiatives.

Lastly, it is worth highlighting that Alpha and Beta – who are most environmentally progressive – are the only two companies that have *dry-van* trucks *exclusively* in their asset base and do not transport temperature-sensitive goods. Though some studies evidenced that the type of industry serviced can play an influencing role in the adoption of green initiatives by LSPs (see, e.g., Perotti et al., 2012; Liimatainen et al., 2014), this was not found to be the case in the sample of eight companies interviewed for the study. Other research reported that LSPs transporting liquid goods, products requiring temperature-control using reefer fleets, and those servicing the food and chemicals supply chains adopted more energy-efficient measures than LSPs transporting general cargo and dry bulk goods, which sharply contrasts the findings from the current study. Given the exploratory nature of the current study, future research is required to explore in greater depth the influence of industry type on the adoption of green initiatives by Canadian trucking companies.

6 Conclusion

This chapter presents the final remarks for the study. The main findings from the multiple-case study are summarized and the contributions of the work are emphasized. Additionally, the implications of the work – both theoretical and practical – are discussed. Lastly, two main limitations of the work are highlighted, and five topic areas for future research are suggested.

6.1 Final Remarks

This study presents *exploratory* insights from a multiple-case study of eight small-to-medium sized Canadian trucking companies based in Ontario. The work captures a *broad* picture of the current state of green initiatives adopted by the studied companies and identifies a dynamic set of influencing factors that affect their adoption. In general, the implementation of green initiatives in trucking is at an early stage, with most of the trucking companies in Ontario pursuing a modest amount of green initiatives. However, the study also revealed that trucking companies have started to perceive environmental sustainability as a critical issue and are increasingly feeling a need to somehow “green”.

All eight companies studied implemented green initiatives but in different ways, which confirmed the suitability of the initial selection of cases. Overall, however, a high degree of variation among the cases has been identified and thus no unanimous picture could be discerned from the eight companies. Nonetheless, I was able to distinguish between two sets of companies: (1) those that are more environmentally *progressive* (i.e., Alpha and Beta) and have adopted a wide variety of green initiatives, versus (2) those that are environmentally *stagnating* (i.e., Gamma, Delta, Epsilon, Eta, and Theta) and have only implemented a limited amount of green initiatives.

This study set out to answer the following research questions:

1. What are the green initiatives that have been adopted by small-to-medium sized trucking companies in Ontario?
2. What are the drivers and barriers that can affect the adoption of green initiatives by small-to-medium sized trucking companies in Ontario?

The following provides a summarized answer to those questions.

In relation to the first research question, the findings indicate that most of the trucking companies studied focus on *internal* initiatives as opposed to external ones. As such, initiatives that require *collaborative* efforts – such as intermodal transportation and supply chain collaboration – are limited in the

Canadian case, which confirms previous studies (see, e.g., Pieters et al., 2012; El Baz & Laguir, 2017). Alpha and Beta are the only two companies that have pursued collaborative actions which was a result of having strong networks of partner carriers throughout Canada and the U.S. In general, however, initiatives related to *operational strategies* – particularly training drivers, limiting truck speeds, and optimizing routes, which are of simple and inexpensive nature – are widely implemented among the studied companies. Additionally, maintaining a modern and fuel-efficient fleet has also been found to be important and many of the companies have capitalized on aerodynamic and tire improvements.

Furthermore, though there is evidence across the studied cases of *most* of the initiative types identified in the literature review being implemented, it is worth noting that no individual company has adopted *all* the outlined measures, for instance. This suggests that there is still plenty of room for further development. Nonetheless, some companies – such as Alpha and Beta – displayed greater interest in adopting more *innovative* measures that involve nascent technologies. For instance, while Alpha is currently working towards establishing an artificial-intelligence-based platform to optimize transport planning and routing, Beta is in the process of testing CNG-powered trucks in hopes of a CNG fleet conversion in the near-term. Both companies have adopted a more *proactive* approach to environmental sustainability in terms of having the initiative to start trying out more innovative measures, and Alpha's entrance into the artificial intelligence-based transport domain is a *new* finding.

In relation to the second research question, the findings indicate the presence of many drivers and barriers; however, those related to *organizational* and *market* aspects are most prevalent. In general, however, there is a high degree of overlap among the drivers and barriers identified in the current study and those in the literature. In terms of *organization-related* factors, an **environmental culture** was found to be a widely cited *driver* in motivating trucking companies to adopt certain green initiatives, while a **lack of employees** was cited as a common *barrier*. Additionally, two *new* findings have been uncovered in the current study in relation to *market* aspects. First, *more than half* of the studied companies were *driven* to modernize their fleets in an effort to attract truck drivers to their businesses, which exemplified the *severity*

of the **driver shortage issue** in Canada. Second, examples of **anti-competitive practices** in the industry were also revealed with *half* of the companies citing this as a major *barrier* to the adoption of green initiatives. Both *novel* findings mirror current market trends in Canada and thus are unique to the Canadian case and not found elsewhere. Furthermore, it is also worth noting that the government was not found to be a *driver* in any way, and *all eight* companies cited an example of *at least one* government-related *barrier*. Most, however, agreed that the government **poorly enforces regulations** in the trucking sector and thus creates an environment that is not conducive to the development of green logistics. Lastly, technology-related *barriers* such as a **lack of green technology** and **inherent risks with new technologies** were also marked.

6.2 Implications

This study offers several *theoretical* and *practical* implications.

Theoretically, this study *builds* on previous research in the domains of: (1) the types of green initiatives adopted by LSPs, and (2) the drivers and barriers that can affect LSPs' adoption of such initiatives. However, the study's novelty is that it offers more *interpretative* insights, which, according to Centobelli et al. (2017), are lacking in the literature. By examining the topic from a *new* perspective – that is, Merriam's case study approach – the current work revealed *deeper* insights into some of the *subtler* drivers and barriers influencing the adoption of green initiatives.

For instance, five works using case study methodology – i.e., Perotti et al. (2012), Tackén et al. (2014), Evangelista (2014), Evangelista et al. (2017), and El Baz and Laguir (2017) – all used Yin's approach. As such, these authors were only able to confirm the *presence* of certain green initiatives, drivers, and barriers, without offering richer interpretation. As an example to highlight the novelty of my work – in reference to the most recent study of the five, i.e., El Baz and Laguir (2017) – these authors highlighted that driver training is a particularly widespread initiative adopted by Moroccan LSPs; however, they did not explain how exactly driver training was employed by the studied companies. In the current study, I was

able to provide richer insights. I illustrated that driver training is employed in different ways, such as by using gamification, collaborating with insurance companies, or outsourcing the training to a consulting company. Additionally, El Baz and Laguir (2017) confirmed that management support and employee support act as key drivers. However, they did not offer insights into how exactly management support and employee support drive the adoption of green initiatives. In the current study, I offered such insights. I highlighted that an intrinsic link between management support and employee support exists and emphasized that these two drivers are most effective in motivating the adoption of green initiatives when they operate in mutual *inclusivity* (as was the case in Alpha and Beta).

Moreover, an important contribution of my work is its comprehensiveness – that is, I studied both: (1) the types of green initiatives adopted by LSPs, and (2) the drivers and barriers affecting LSPs' adoption of such initiatives, by considering such factors from five different perspectives (organization-related, finance-related, market-related, government-related, and technology-related). As emphasized in Section 2.4, no other studies in the literature have done so to-date.

Additionally, another novelty of the study is its focus on the Canadian context, which has not been previously examined on the topics of green initiatives and influencing factors in logistics. As such, my work fills an important gap in the literature. The findings from this study can serve as a *foundation* for future research in the country on the topic – particularly in other provinces. Moreover, through the current study, I was able to bring some aspects to light that are unique to the Canadian case – primarily in terms of *market*-related aspects – such as the severity of the driver shortage issue, the intriguing widespread presence of anti-competitive practices in the Canadian trucking industry, etc. I was also able to show that colder weather can play a role in affecting the adoption of green initiatives. This can be of use to the *global* academic community. For instance, while Lin and Ho (2008) and Lin and Ho (2011) reported that market uncertainty exhibits significant influence on Taiwanese and Chinese LSPs' willingness to adopt green practices, the authors did not provide insights into which *specific* types of market uncertainties act as strong driving

forces. The current study, however, offers such insights, by illustrating how current trends in the Canadian trucking industry affect trucking companies' adoption of green initiatives.

Practically, this study offers two main implications. First, given that I have identified two different groups of companies in terms of their commitments to environmental sustainability (i.e., environmentally *progressive* and environmentally *stagnating*), and the fact that *none* of the eight studied companies cited the government as a *driver*, an important role *should be* fulfilled by the government. This is further emphasized by the fact that not only was the government not found to be a driver in any way in terms of promoting the adoption of green initiatives in the studied small-to-medium sized trucking companies in Ontario, but almost all of the studied companies also highlighted that the *current* governmental policies in place are ineffective. For instance, the government: (1) has adopted unnecessary regulatory mandates (e.g., ELDs) that increase the costs of doing business in small-to-medium sized trucking companies; (2) it charges such companies large sums of money for educational courses on new trucking regulations; (3) it favours large-sized carriers in terms of supporting their adoption of new initiatives; and (4) it has removed much of the incentives for green vehicle technologies in trucking. Given such reality, the government of Ontario should involve themselves more in helping support the greening of operations of small-to-medium sized trucking companies in the province. For instance, as a starting step, the government can distinguish between high performers (such as Alpha and Beta) and those that are stagnating in the industry. This can be done in order to provide stagnating companies with ideas of how they can further green their operations (i.e., high performers can act as role models) as many of them lack the knowledge to do so. Additionally, the government can implement a system based on a common set of standards that necessitates the reporting of environmental performance by all trucking companies. Not only would this force trucking companies to undertake strategies to ensure greater environmental performance of their operations, but it would also act as a tool for *differentiation* in the industry. This would be very useful for the high-performers, who aim to differentiate themselves in the market by achieving first-mover advantages in various domains.

Second, given that the type of industry serviced was not found to be an influence in the study, managers from trucking companies could benchmark their initiatives to companies in both their own and other industries. This is one of the hallmarks of the current study, as it can offer managers of trucking companies enhanced awareness of the types of green initiatives that are implemented in the trucking industry – regardless of the industry sector that each company services. As such, managers from trucking companies can better understand their company’s *potential* for implementing other initiatives, as this study offers several examples by illuminating different sets of practices adopted across eight small-to-medium sized trucking companies. Thus, with such provision of specific examples of initiatives, more companies in the industry may be motivated to examine the adoption of *further* green initiatives.

6.3 Limitations

There are two main limitations of the current study. First, because the study is of *qualitative* nature, statistical support is necessary to be able to *generalize* the findings to wider contexts – that is, to other countries, Canadian provinces, or trucking companies in Ontario. However, this was not the motivation of the work, as the primary aim was to uncover *exploratory* insights that can serve as an impetus for follow-up studies. Second, the current study does not capture *evolutionary* aspects of drivers and barriers nor the adoption of green initiatives *over time* – rather, it provides a *current* snapshot. As such, longitudinal studies would be needed in order to examine how drivers and barriers influencing the adoption of green initiatives can change over time.

6.4 Future Research Avenues

Given the results uncovered in this study, the following five research ideas are worth investigating.

First, as the current study offers a snapshot of an emerging area that is still in its infancy phase, it would be valuable to examine how certain initiatives, once implemented, actually pay-off. This pay-off could be assessed in a variety of ways: (1) in terms of *environmental* aspects, such as the reduction of the

carbon footprint; (2) in terms of *competitive* aspects, such as gained or lost market shares; and (3) in terms of *financial* aspects, such as increased revenues, etc.

Second, given that a wide range of influencing factors were concentrated in the *market-related* category in this study, it would be interesting to examine the *evolutionary* process of the adoption of green initiatives so that *leading trends* can be identified over time.

Third, in the quest to reduce emissions in the transportation sector in Canada, it would be worthwhile to conduct a similar study in other provinces to gather more comprehensive insights for the country. A larger sample also assists in providing a better ability to generalize.

Fourth, though no unanimous approach to implementing green initiatives has been identified in the current study, the mere presence of a strategy has distinguished high-performing companies from stagnating ones. Thus, it may be useful to explore the role that strategy plays in the adoption of green initiatives. For instance, Alpha employed a strategy in which it attempted to create common environmental awareness in the company (i.e., *broad penetration*) by having *all* employees in the organization take part in the formulation of the company's core values from 2014 onwards. Beta, on the other hand, pursued a more *specialized* approach. It had established a series of "improvement teams" within each function of the organization in which each team was dedicated to managing and/or spearheading environmental improvements within a *particular* domain. Thus, Beta's strategy involved more *functional specialization*. Therefore, it may be interesting to investigate different strategy *types* and their respective effects on the adoption process of green initiatives.

Lastly, this study uncovered a *new* finding which marked the application of artificial intelligence in trucking which had not been found in previous studies. Given this reality, it would be interesting to examine the effects of adopting artificial intelligence for transport planning. Future research studies could examine the following: How would *substantial* amounts of data obtained from an artificial-intelligence-based platform affect corporate decision-making in LSPs? Perhaps, would the adoption of artificial

intelligence for transport planning *impede* the implementation of *other* types of green initiatives in LSPs?

Such interplay of dynamics would be worthwhile to investigate as we progress into the future.

Appendix A

Ethics Approval of Current Study

To: Nina Jovanovic
Global Management Studies
Re: REB 2018-262: The Adoption of Sustainable Initiatives: A Case of Small Trucking Firms in Ontario
Date: August 14, 2018

Dear Nina Jovanovic,

The review of your protocol REB File REB 2018-262 is now complete. The project has been approved for a one year period. Please note that before proceeding with your project, compliance with other required University approvals/certifications, institutional requirements, or governmental authorizations may be required.

This approval may be extended after one year upon request. Please be advised that if the project is not renewed, approval will expire and no more research involving humans may take place. If this is a funded project, access to research funds may also be affected.

Please note that REB approval policies require that you adhere strictly to the protocol as last reviewed by the REB and that any modifications must be approved by the Board before they can be implemented. Adverse or unexpected events must be reported to the REB as soon as possible with an indication from the Principal Investigator as to how, in the view of the Principal Investigator, these events affect the continuation of the protocol.

Finally, if research subjects are in the care of a health facility, at a school, or other institution or community organization, it is the responsibility of the Principal Investigator to ensure that the ethical guidelines and approvals of those facilities or institutions are obtained and filed with the REB prior to the initiation of any research.

Please quote your REB file number (REB 2018-262) on future correspondence.

Congratulations and best of luck in conducting your research.

A handwritten signature in black ink, appearing to read "Patrizia Albanese".

Dr. Patrizia Albanese, PhD
Chair, Ryerson University Research Ethics Board

Appendix B

Interview Guide

SECTION #1: ABOUT THE PARTICIPANT

1. What is your position at the company?
2. How long have you been in this position at the company?

SECTION #2: COMPANY PROFILE

3. How old is your company?
4. How many employees does your company have?
5. What is your company's fleet size?
6. What is the average age of your fleet?
7. What is the geographical scale of your company's operations?
8. Which industry does your company mainly service?

SECTION #3: CURRENT ENVIRONMENTAL STRATEGY

9. Have you set any goals in relation to the environmental sustainability of your operations?

SECTION #4: CURRENT SUSTAINABLE TRUCKING PRACTICES

10. Have you previously implemented any practices from the following categories?
 - Alternative fuels (some examples: biodiesel, natural gas, hydrogen, etc.)
 - Vehicle technologies (some examples: aerodynamic improvements, tire improvements, etc.)
 - Operational strategies (some examples: limiting truck speeds, optimizing routes, etc.)
 - Truck replacements (some examples: modernizing the fleet, etc.)
 - None
 - Other

SECTION #5: ATTITUDES

11. What do you think are the advantages of adopting sustainable trucking practices?
12. What do you think are the disadvantages of adopting sustainable trucking practices?

SECTION #6: STAKEHOLDERS

13. Which stakeholders do you think would approve or support your company if you adopt sustainable trucking practices?
14. Which stakeholders do you think would disapprove or discourage your company if you adopt sustainable trucking practices?

SECTION #7: FACTORS

15. What are the factors or motivators that make it easy for your company to adopt sustainable trucking practices?
16. What are factors or barriers that make it difficult for your company to adopt sustainable trucking practices?

SECTION #8: FUTURE SUSTAINABLE TRUCKING PRACTICES

17. Do you plan to implement any practices from the following categories in the next 1-5 years?
 - Alternative fuels (some examples: biodiesel, natural gas, hydrogen, etc.)
 - Vehicle technologies (some examples: aerodynamic improvements, tire improvements, etc.)
 - Operational strategies (some examples: limiting truck speeds, optimizing routes, etc.)
 - Truck replacements (some examples: modernizing the fleet, etc.)
 - None
 - Other

Appendix C

Coding of Types of Green Initiatives in NVivo

Appendix D

Coding of Organization-Related Drivers and Barriers in NVivo

Appendix E

Coding of Finance-Related Drivers and Barriers in NVivo

Appendix F

Coding of Market-Related Drivers and Barriers in NVivo

Appendix G

Coding of Government-Related Barriers in NVivo

Appendix H

Coding of Technology-Related Drivers and Barriers in NVivo

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Glossary

- 1) **Logistics service provider (LSP):** a business that provides services “*consisting of at least transportation*” (as cited in Evangelista, 2014, p. 66). Note that LSPs can offer other services in addition to transportation like: “*warehousing and inventory management, information-related activities, such as tracking and tracing, and value-added supply chain activities, such as secondary assembly and installation of products*” (as cited in Evangelista, 2014, p. 66). In this thesis, the types of LSPs studied are trucking companies.
- 2) **Green initiative:** an activity that “*minimizes the environmental impact*” (Campbell, 2011, para. 5). The definition of a “green initiatives” is very broad in the thesis and can include many different aspects involved with minimizing the environmental impact of transportation operations, such as new technologies, behavioural aspects, choice of business partners, etc.
- 3) **Driver:** “*something that provides impulse or motivation*” (as cited in Isaksson, 2012, p. 9). In this thesis, a “driver” is interpreted either as: (1) an *enabler* (e.g., the presence of a company strategy, environmental culture, etc.); an *argument* (e.g., ability to attain cost savings, etc.); or *stakeholder influence* (e.g., pressure/demands from customers, partners, etc.) that stimulate or motivate the adoption of green initiatives in LSPs.
- 4) **Barrier:** “*something that impedes progress or achievement*” (as cited in Isaksson, 2012, p. 9). In the context of this thesis, a “barrier” is interpreted as a *reality* or *argument* such as lack of infrastructure or high costs, respectively, which hinder the adoption of green initiatives in LSPs.
- 5) **Canadian Trucking Alliance (CTA):** “*a national association representing the trucking industry's viewpoint on national and international policy, regulatory and legislative issues*” (Officer of the Commissioner of Lobbying of Canada, 2019, para. 1).
- 6) **Ontario Trucking Association (OTA):** A *provincial* trucking industry association in Canada and a member of the CTA. The OTA is one of the largest trucking associations in North America; is

known as the voice of responsible trucking in Ontario; and, whose overall aim is to support on-going development in the trucking sector (Ontario Trucking Association, n.d.).

- 7) **Diesel Exhaust Fluid (DEF):** According to H2Blu (n.d.), DEF *“is a solution of 32.5% automotive grade urea and 67.5% de-ionized water. When it is injected into diesel exhaust, it helps convert polluting NOx into hydrogen and water vapor. DEF is a key component of Selective Catalytic Reduction technology, developed to meet the strict EPA and CEPA diesel emissions standards in place since January 2010”* (para. 1).