Corporate Greening of Canadian Manufacturers: A Partial Least Square Analysis

by

Faisal Faza

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Abstract

Many manufacturing companies are increasingly investing in green supply chain management. However, surprisingly little attention has been dedicated to the consideration of whether and how stakeholder pressure affects greening of the supply chain with consequent financial performance and competitive advantage outcomes. Thus, this study establishes a research model to investigate the interaction of these constructs and to reveal the role of green production and green supply chain management in the relationships. Data were collected through a cross-industry survey from 94 manufacturing companies in Canada. The data were analyzed using the Partial Least Square based Structural Equation Modeling (PLS-SEM) approach to test the hypothesized model. The findings provide managers with a new insight on the effects of stakeholder pressures on the adoption of green product design/processes, the greening of the supply chain, and the managerial commitment required for manufacturers to gain increased wealth and sustainable competitiveness.

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List of Acronyms

BRIICS	Brazil, Russia, India, Indonesia, China, and South Africa
CCPA	Canadian Centre for Policy Alternatives
CEPA	Canadian Environmental Protection Act
CFA	Confirmatory Factor Analysis
CMV	Common method variance
CSP	Corporate social performance
CSR	Corporate social responsibility
EC	Environment Canada
EFA	Exploratory Factor Analysis
EFD	Environmental friendly design
EMS	Environmental Management Systems
GHG	Greenhouse gas
GSCM	Green supply chain management
IEA	International energy agency
ISO	international standard organization
ISO	International standards organization
JIT	Just-in-time
OECD	Organization for Economic Cooperation and Development
PLS-SEM	Partial least square - structural equation modelling
SCM	Supply Chain Management
SME	Small and medium-sized enterprises
SPSS	Statistical Package for the Social Sciences (SPSS)
SSCM	Sustainable supply chain management (SSCM)
TBL	Triple bottom line (TBL)

1. INTRODUCTION

1.1 Background

The study and management of industrial pollution have been critical issues for society since the early days of the industrial revolution. Organizations have been paying increasing attention to environmental preservation since the negative impacts of industrialization were made public by reports and books such as "Silent Spring" by Rachel Carson in 1962, which was republished by Mark Lytle in 2007. Public and governmental reaction to this book included the launch of additional regulations and the formation of the U.S. Environmental Protection Agency.

The history of environmental management in Canada has largely mirrored that of the U.S. Similarly, the origin of the popular just-in-time (JIT) thinking in manufacturing and supply chain management (SCM) – developed and popularized by Japanese manufacturers in the 1980s – can be traced back to Henry Ford's efforts to vertically integrate the automotive supply chain practices, and the principles of JIT were first implemented for manufacturing efficiency and to reduce waste (Faurote, 1928). However, waste reduction in the early days of JIT was not for environmental protection but for resource saving and high productivity (Porter and Vanderlinde, 1995).

Stakeholder attention and the risk of negative media attention motivate companies to provide information about their practices (Nawrocka et al., 2009). Hence, sustainable supply chain management (SSCM), also known as green supply chain management (GSCM) practices have been increasingly adopted as organizations struggle to be green. Examining the operational processes and monitoring supplier activities have become important tasks for managers, and a number of companies is working with suppliers to reduce unnecessary packaging and potentially

hazardous materials as well as to improve their environmental profile, increase profit margins, and understand supplier's suppliers to assess and decrease environmental cost (Rao and Holt, 2005).

Walley and Whitehead (1994) stated that reacting to environmental problems has always been a no-win proposal for managers; thus, managers have interpreted environmental issues as an absurd philosophy and have underestimated their company's capabilities to become green. According to recent thinking, becoming green means that both the business and the environment can circumstantially win, and going green is no longer a cost threat to companies but it is a facilitator for innovation, new market opportunity, and wealth creation (Clarke et al., 1994). Nonetheless, many organizations still believe that going for green practices could end up in high costs which might prevent their products or services from getting competitive advantage over the competitors.

The implementation of GSCM practices incorporates a range of business processes and operations from green purchasing to manufacturing to customers and to green logistics (Zhu and Sarkis, 2006). According to Rao and Holt (2005), such green practices serve as a value driver for organizations who have good business sense, because adopting GSCM can result in higher profits. Along with the pressures from stakeholders and the market, many companies have developed and changed their sourcing strategies in order to stay competitive (Chiou et al., 2011). Since globally branded companies are facing the heaviest stakeholder pressures, various green standards have been established in recent years. These principles shaped the standard for Environmental Management Systems (EMS) like the British Standard for EMS BS7750 (1994) and the EU eco-management and audit scheme (1993), including international standard ISO 14000 series. Such standards are established to contribute to the implementation of EMS in organizations. However,

the most common internationally implemented standard is ISO 14001, which allows organizations to control and improve their environmental effect and performance. The EMS represents policies, procedures and audit protocols by regulating operations that create waste or emissions, and by enabling savings in energy and resource consumption for companies to improve their public image and environmental performance (Shrivastava, 1995).

1.2 Problem Statement

The world economy has changed significantly since the end of World War II. The rapid rise in international trade has become one of the major factors that have driven the growth in the world economy and globalization. The growth in trade is, in turn, the result of both technological improvements and reduction of trade barriers. Bulk carrier ocean transportation, advanced communication technologies (i.e. the internet), and satellite technologies have made international trade easier to drive transactions (Ghemawat et al., 2007). One of the harmful results of economic growth is the creation of pollution and the accumulation of waste. As an outcome of the environmental issues, both organizations and governments have gone under expanding pressures to lessen the environmental effects involved in production and consumption of goods and services.

Hansen et al. (2006) warns that the current climate warming is on the rise, and the average global temperatures could rise between 2 and 4.5 degrees Celsius by the year 2050 in contrast to the temperature increase of about 0.5 degree Celsius in the 20th century. In other words, this means that it will cause climate change, floods, droughts, and storms. The Organisation for Economic Co-operation and Development (OECD) reported that world transport carbon dioxide emissions are to increase by about fifty five percent by year 2030, and suggested to speed up for the

innovation of fully battery operated electric vehicles (i.e. Tesla Motors) and the management of the bulk carrier transportation system. In particular, manufacturing industries pose a threat on the environment and there will be increased energy consumption and carbon emissions due to the growth of population by 2050 (OECD, 2008). The quantity of CO_2 emission is almost uncontrollable and economies are facing recession globally while the need of industrialization is silently moving up. In this respect, GSCM is seen as one of the predominant factors in the management and preservation of the global environmental sustainability (IEA, 2009).

Many organizations still believe that the implementation of GSCM could end up in high costs which might prevent their products or services from being competitive against their competitors and hence result in financial loss. The problem is related to that surprisingly little attention has been paid to the consideration of whether and how stakeholder pressure affects greening of the supply chain with consequent financial performance and competitive advantage outcomes (e.g. Zhu et al., 2008; Chiou et al. 2011). In other words: can stakeholder pressure force the implementation of the GSCM practices that may lead to a win-win situation to managers in terms of competitive advantage and financial performance?

Thus, this study establishes a research model to investigate the interaction of these constructs and to reveal the role of green production and green supply chain management in the relationships. More specifically, this study draws on empirical research in the manufacturing business context to identify and test the relationships between stakeholder pressures towards green product design/processes and green supply chain management practices, with consequent financial performance and competitive advantage outcomes within the Canadian manufacturing industries.

1.3 Purpose of the Research

This study aims to fill the identified gap in literatures by constructing a model that identifies stakeholder pressures that have an impact on GSCM practices and greening of production, as well as the consequent financial performance and competitive advantage outcomes in the manufacturing industries. In addition, the model considers the role of management commitment. The model will be empirically tested using a partial least square approach on a survey data collected from Canadian manufacturers. In sum, the purpose of this research is answer the following research questions:

1. What is the relationship between stakeholder pressures towards greening of production and the implementation of GSCM practices?
2. What is the relationship between the implementation of GSCM practices and financial performance, and competitive advantage?
3. What is the role of management commitment in relationships between stakeholder pressures, green production and GSCM, financial performance and competitive advantage?

The study makes use of the stakeholder theory (Freeman, 1984) to fill the identified gap and refine the understanding of linkages between these relationships. Moreover, the study proposes a conceptual model and tests it empirically over survey data by using the Partial Least Squares based Structural Equation Modelling (PLS-SEM) approach, which is suitable for testing models where relationships are not strictly defined and identified by prior theory. The results of this study are considered to serve as an eye-opener for managers and researchers and to provide a basis for further research focused on corporate greening and green supply chain management.

1.4 Research Method

This study builds a conceptual model based on previous research in green production and supply chain management. The conceptual model, including fourteen hypotheses, is built on the basis of theory and will be investigated and tested over a quantitative survey data collected from Canadian manufacturers. The data will be analysed using basic exploratory analyses as well as the more advanced PLS-SEM approach. Hence, the study has two methods for statistical analyses : (1) Exploratory Factor Analysis (EFA) that validates the reliability of the survey items using Statistical Package for the Social Sciences (SPSS) version 22, and (2) PLS (partial least square) modelling to identify the relationship between the constructs. Table 1.1 shows the research method.

Table 1.1 Overview of the Research Method

Steps	**Activities**
Research Planning	• Define the research problem • Search for relevant literature • Collect key findings from literature • Initial theoretical constructs are defined • Measurement items (indicators) for the theoretical constructs are adapted from the literature • Conceptual model is constructed
Design/ Data Collection	• Supervisor reviews the survey questionnaire • Designed an online survey questionnaire using fluid survey tool • Provided a link for managers to access survey questionnaire • Primary (raw) data is gathered from the respondents
Data Analysis	• A two-step approach (measurement and structural model) is used • The measurement is assessing the constructs and their items through EFA for model building using SPSS (22) • PLS-SEM is used to evaluate the model using Smart-PLS (3)
Interpretation of results and contributions to theory and practice	• Discussion of the outcome of the research model • Theoretical managerial contributions, implications and limitations concludes the study

1.5 Relevant Literature

The first step is to review relevant literature to increase the understanding of the research field. The following keywords were used to search databases: “green supply chain”, “stakeholder theory”,” corporate social responsibility”, “green product”, ”green process”, “green supply chain performance”. Publishers chosen included EBSCO, Emerald, Elsevier, Science Direct and IEEE, and the search focused on the title and the abstract. Since GSCM is a new concept, the search was narrowed by selecting publications that meet two criteria: 1) Academic studies published after the year 1980, 2) which utilized a survey approach on GSCM practices. First, 74 articles were reviewed, including 11 world forum reports. Second, items (indicators) and constructs (latent variables) were chosen and defined based on the literature, and a research model was constructed.

1.6 Research deliverables

The study provides the following deliverables:

- A conceptual model showing the hypothesized relationships between stakeholder pressure towards greening of production and the implementation of GSCM practices, and their impact on financial performance and competitive advantage.
- Empirical evidence in partial support of the established research model using survey data from Canadian manufacturers.

1.7 Relevance

The current study builds on the stakeholder theory that assumes the understanding of the importance of acknowledging stakeholder pressures can assist companies to perform well in engaging in green environmental friendly products to achieve environmental performance and a

competitive advantage (Freeman, 1984). Prior empirical research has studied small-, medium- and large enterprises from different industries and locations around the world. The present study narrows down the scope of the empirical test by focusing on small and medium sized companies in Canada within multiple sectors of manufacturing industries. Thus, the results from this research can help especially managers of Canadian manufacturers that have recently started or a considering to start the implementation of GSCM, to enhance their production and operations, and to better connect their efforts for performance improvement and economic gain.

1.8 Thesis Contribution

This study makes important contributions to the green environmental management literature and practice. First, it offers theoretical arguments on the relationships between stakeholder pressure and corporate greening. The resulting model builds upon three academic literature streams (stakeholder theory, corporate sustainability, and corporate performance) and extends the current understanding of GSCM. Second, the study confirms empirically the relations between constructs in the model. Third, it provides support for the argument that greening of a company's supply chain can increase their competitiveness and lead to better economic performance. Fourth, the study offers the validated model as a basis for optimization research in the field of operations management by showing the relative impacts of green production and GSCM on performance.

1.9 Organization of the Thesis

This study is organized as follows. Chapter 1 outlines the background, the problem, the purpose of the study, methodology, research deliverables, relevance, contributions, and organization of the thesis. Chapter 2 presents a Literature Review focused on the relevant literature streams related to the stakeholder theory, corporate sustainability, and corporate performance. Chapter 3 explains the

research methods by outlining the EFA analysis and PLS-SEM modelling, describing how the data were collected, and presenting the characteristics of the sample. Chapter 4 tests hypotheses empirically as well as presents, interprets, and discusses the results. Chapter 5 concludes study with implications, limitations, and suggestions for future research.

2. LITERATURE REVIEW

This chapter presents a literature review of the major theories, concepts, and ideas relevant to the topic of the study. The thesis is situated within the context of three bodies of theoretical literature: 1) the stakeholder theory and its impact on environmental issues, 2) corporate sustainability in the implementation of GSCM, and a particular focus on 3) corporate performance in the pursuit of becoming green. A total of over 70 theoretical and empirical research articles within the three research streams (Figure 2.1) were investigated, and a basic conceptual model was established.

Figure 2.1: Literature review streams

2.1 Stream I: Stakeholder theory

A stakeholder is commonly defined as "any group or individual who can affect or is affected by the action of accomplishing of the organization's goals" (Freeman, 1984). The stakeholders' idea grasps the concept of redefining an organization to where it should be and how it should be developed. The basis of an organization is to manage the interests, needs and opinions of a group of people that share a common interest in a project or business (Freeman, 1984). Managers of a firm are responsible for satisfying the needs of those interested in the business management or

project (Freeman, 1984). They have to insure and secure the right decision making for their shareholders, while ensuring the success of the firm for the security of long term stakes for each group. The role of managers and the definition and purpose of a stakeholder is ever changing and has been disputed over time. Freeman (1999) – who is the originator of the stakeholder theory – extended the theory by adding "To maximize shareholder value, managers must pay attention to key stakeholders". This extension of the theory includes a basic rule, which examines the importance of incorporating the outlook of those interested in a business and their activities, in accordance with the management of the organization. Additionally, an extensive role of stakeholders is to hold managers socially responsible (Harrison and Freeman, 1999).

The stakeholder theory guideline of corporate legitimacy is characterized such that organizations ought to be working and managing to the advantage of its stakeholders. Essentially, legitimacy is a character of acknowledgement inside of society (Freeman, 1984). Subsequently, adoption of certain protection might increase a company's legitimacy to work by internal and external characters and/or stakeholders. All the rules and principles of the stakeholder theory are known as normative stakeholder theory in literary works. Normative stakeholder theory contains a theory of how directors or partners ought to act and ought to bring the formation of association, taking into account some moral standard commitment to advance stakeholder interests (Harrison and Freeman, 1999). This is in line with the institutional theory that the normative pressures are regularly applied by inside or outside partners who have a personal stake in the association (DiMaggio and Powell, 1983). The way organizations manage stakeholders (i.e. the shareholders, workers, customers, suppliers, governments, non-legislative associations, global associations, and the community) is normally a key highlight of the corporate social responsibility (CSR) idea

(Harrison and Freeman, 1999). However, the reaction to environmental concerns in socially responsible way still remains as a social and business problem (Kassinis and Vafeas, 2006).

2.2.1 Stakeholder Pressure

Pressure from different stakeholders has influenced the adoption and application of environmental management practices in corporate management strategies (Sarkis et al., 2010; Henriques and Sadorsky, 1999). Thus, a firm's decision to implement environmental practices may be influenced by supply chain stakeholders, especially customers and suppliers. Moreover, firms can decrease environmental effects in final product development by following environmental quality standards that their customers are concerned about (Sarkis et al., 2010).

Previous research has examined the link between stakeholder pressures and environmental management practices and found that a higher amount of pressures from stakeholders increases the probability of implementing environmental practices, but small firms are found very responsive to pressures (Darnell et al., 2010). Firms will engage in eco-design sustainability practices when economic, social and environmental stakeholders are managed with good strategies (Sharma and Henriques, 2005). Stakeholder theory principles and empirical studies suggest that increased environmental pressures from various stakeholder groups influence the implementation of different green practices such as green production in terms of product design/process, internal green management and greening the supplier or the selection of suppliers for green products. Stakeholder theory demands a company to assemble a monitoring system when building its relationship with an unknown stakeholder group as it creates corporate objectives feasible and improves its organizational methods (Roberts, 1992).

The greening of the supply chain is not merely about any individual companies, rather it concerns supply networks including various stakeholders (Vachon and Klassen, 2006
). However, as the supply chain becomes more global, it usually involves a variety of companies from different geographical locations, and environmental problems are never about a single company or country, rather it is an increasingly important global issue. Therefore, sustainability requires contributing to various kinds of green innovation practices, from green product design to processes to the management of the disposal of that product to satisfy various stakeholders' interests (Yu and Ramanathan, 2014). As shown in Table 2.1, Yu and Ramanathan (2014) have classified stakeholder pressures into one dimension, while Chien and Shih (2007) have classified stakeholder pressures into two dimensions; i.e. internal and external stakeholder pressures. Both classifications are equal in terms of magnitude, but the researchers used different methodological routes.

2.2 Stream II: Corporate Sustainability

Over the past decade, supply chain management (SCM) has played an important role for organizations' success. Simultaneously, the green supply chain (GSC) has emerged as an important element of the environmental and supply chain strategies of numerous organizations. SCM thinking underlies GSCM practices, and GSCM has been highlighted in academic literature by both SCM and environmental management theories. However, the author that has most contributed to the concept and interpretation of GSCM is Srivastava (2007), who classified the concept as a marriage between SCM and green thinking (Figure 2.2.) Srivastava's concept combines the green fundamental into inventing, designing, manufacturing, distributing and reusing the product, factoring all concepts that have been identified previously by other literary works.

Many studies, including this study, have derived their topics from Srivastava's classification.

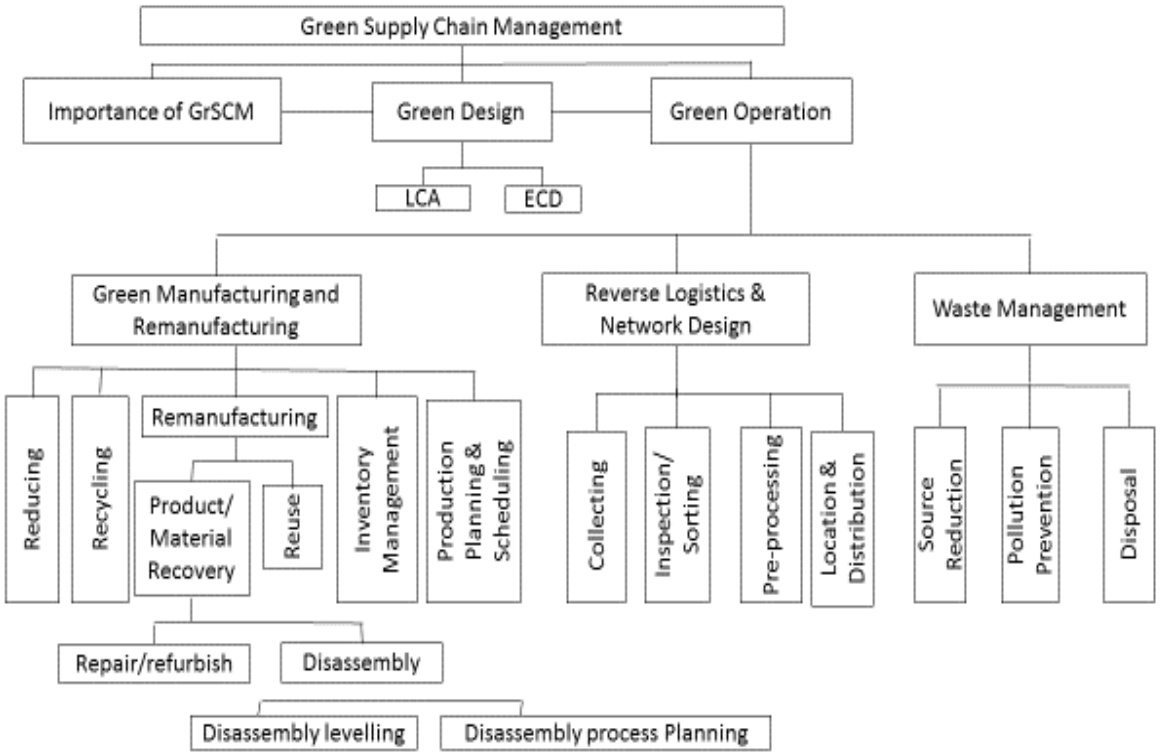


Figure 2.2: Classification based on problem context in supply chain design (Srivastava, 2007)

Although "greening" has a vague meaning in different fields, the term demonstrates not simply mixing environmental performance with financial desire but also developing a critical new source of competitive advantage in terms of environmental management (Porter and van der Linde, 1995). In the past couple of decades, several studies have attempted to explore and define GSCM in the context of the environment. GSCM is well-defined as the functionalities of purchasing activities that includes disassembling, reduction, recycling, reuse, and substitution of materials (Narasimhan and Carter, 1998). Traditionally, it starts at the acquisition of raw materials and ends with distributing products and services to the consumer. However, business organizations are now

interested in other factors that have been highlighted by academics like: compliance with green regulations, the initial stages of product development; green purchasing; development of green practices; packaging; and supply chain partnerships (Zsidisin and Siferd, 2001). Furthermore, Zhu and Sakris (2004) identify GSCM as a contributing factor in closer working relationships between companies and their operations for a more efficient supply chain processes. Surprisingly, the advancement of GSCM has played a positive role in the environment, and it has allowed organizations to use these environmental concerns as an advantage in the market. The implementation of efficient processes, the use of environmentally friendly products and the preservation of resources have given organizations an edge in the market. The implementation of GSCM not only has a positive effect on the environment, but also assist in a company's long and short term strategy, brand value and reputation on the market (Zhu et al., 2005).

Growing environmental concerns, however, have caused customers to pressure companies into incorporating environmental management in their supply chains. An implementation of environmental management brings organizations an advantage over competitors, if they are successful in discussing solutions for environmental issues that could be implemented with an appropriate environmental management system (Yu and Ramanthan, 2014). Furthermore, Yu and Ramanathan (2014) and Chiou et al. (2011) classify GSCM into a number of categories. As shown in Table 2.1, Yu and Ramanathan (2014) have focused on GSCM practices and shrunken them into two dimensions. However, Chiou et al. (2011) classified GSCM into five dimensions. Most studies apply different dimensions for the same component of GSCM practices in various literatures. For this reason, a high complexity is involved in GSCM practices in contrast to the rest

of the constructs in this study. GSCM is mainly composed of five parts in literary works: eco-design, process, environmental management system, greening the suppliers, and supplier selection.

Table 2.1 Dimensions of GSCM practices

	Yu and Ramanathan (2014)	Chiou et al. (2011)
GSCM practices	Green product/process design Internal green management	Green product innovation Green process innovation Green managerial innovation Greening the supplier Supplier selection

According to Chiou et al. (2011), environmental management solves environmental disasters and improves environmental performance by associating various green practices into product and process development including the development of new technologies. In addition, Rao and Holt (2005) pointed out that organizations implementing GSCM practices have improved competitiveness, and suggested that competiveness consists of improved efficiency, quality, productivity and cost savings. Zhu et al. (2008) also pointed out that alternative research has examined how GCSM initiatives and greening of suppliers impact environmental performance, but has not acknowledged the correlation between GSCM practices and competitive advantage. Chiou et al. (2011) argue that greening the supplier through "green innovation" contributes significant benefits to the environmental performance and competitive advantage. Following Yu

and Ramanathan (2014) and Chiou et al. (2011), this study incorporates three main components that influence on the overall corporate performance in GSCM practices:

1. Green product design/process innovation
2. Management commitment towards greening
3. Greening of the supply chain

These three identified components will be discussed in detail in the following.

2.3.1 Green Product Design/Process innovation

Production is a compound of different concepts. A concept that has gained recognition as a critical characteristic to the encouragement of green production is product design. Product design has been also acknowledged in operations and supply chain management literature in the context of environmental research (Zhu et al., 2008). Any product design that contains environmentally friendly materials, will lower the dangers on the environment (Zsidisin and Siferd, 2001). Preventing water contamination, air pollution, and waste management contributes to the environmental performance at all stages of the product life cycle. Encouraging green waste product design provides efficiency in supply chains, and materials used for the product will advocate a better occupational health and product lifecycle (Zhu et al., 2008). It is therefore essential to understand the effects and relationship of incorporating GSCM procedures and, more specifically, sustainable product design and process innovations.

Environmentally friendly design (EFD) focuses on creating products that are designed with product reusability to reduce waste disposal. EFD targets the production of products and minimizes

the products environmental impact throughout its whole life cycle from creation to disposal, without compromising the product standards on performance and cost (Zsidisin and Siferd, 2001). Examining a product at the design stage is a challenging process in determining what environmental impacts the product will have during the creation, consumption and disposal stages of the life cycle of that product, and therefore green innovation in product design contains the process to alter a products design to eliminate negative effects on the environment during any stage of a product's life cycle (Zhu et al., 2008).

Along with the increasing awareness of GSCM practices in the manufacturing context, it makes sense to investigate if any producers are willing to modify their raw materials, production and processes to meet with the international new standards. At the design stage, materials, supplies and ingredients are chosen appropriately to determine what is needed to both create and dispose of the product. The foundation of EFD is based on product and process development that are environmentally conscious design and that should incorporate the following features to prevent the impact on natural resources and the environment. As illustrated by Zsidisin and Siferd (2001), the product design and processes should be:

- Designed with commitment to reduce/eliminate all hazardous materials
- Design to eliminate unsafe processes in manufacturing
- Design for ease of disassembly, collecting, processing, and remanufacturing
- Design for resource reduction, reuse, recycle, substitution of materials
- Design for ease of disposability that will not have a negative impact on the environment
- Design for green purchasing

- Design for energy efficiency and renewable energy

Examining different green waste management processes separately contributes to the implementation and advancement of green practices and the improvement of environmental performance of organizations. When an organization can plan its processes with ease and determine the most efficient and environmentally friendly processes, it can then replace any processes that are inefficient or counterproductive, with those that are supplied by developed partnerships within the supply chain (Zsidisin and Siferd, 2001). However, the development of supply partnership improves the creation of new and innovative practices in the development of products and processes. Porter and Vanderlinde (1995) point out that knowledge of environmental impacts is very crucial and, hence, elevates (un)certainty about future benefits.

2.3.1.1 Green manufacturing and remanufacturing

An imperative but incomplete component of GSCM is "product characteristics". Operations within a firm can be improved by concentrating on managing and exploiting their resources in an efficient and effective manner. Employing lean manufacturing is a challenge to GSCM, because it decreases efficiency by eliminating errors and product defects but improving product and process quality. Another critical concept of green manufacturing that has also been identified by Srivastava (2007), includes the product's formation, inventory control, and whether the product is recycled or disposed. If companies focused primarily at the root of the issue, which states 'green manufacturing', then it would assist to maintain good environmental performance by allowing products to be recycled or reused for minimal waste. Montabon et al. (2007) suggest that a company must administer its resources efficiently and minimize energy consumption to endorse a

‘green’ operational approach by implementing an appropriate recycling system. Subsequently, 'remanufacturing’ refers to product restoration through reuse and recycling in a supply chain of a business. Although remanufacturing in a supply chain plays a positive role in conserving the environment, it can be a complicated and slow process that should only be integrated if this would be commercially feasible; hence, this process should be economically efficient and viable, and thus not hinder the production of goods or profitability of the business (Johnson and Wang, 1995).

When product disassembly is complete, manufacturers can either melt down the elements or recycle the whole product, and/or reuse it to create a whole new product in the value chain. Nonetheless, product quality management is the delivery of improved products, prevention of pollution from the end product to the original product, as recycled materials do not conform to the quality of the original ones, therefore hurting durability and appearance (Klassen and Whybark, 1999). Although operational cost are reduced through recycling and reuse of items, there are times that products cannot be reused or repaired and requires to be disposed (Krikke et al., 2003). Accordingly, companies have to be very cautious when reusing parts as it could develop defective products and customer dissatisfaction, even though customers demand environmentally sustainable products (Klassen and Whybark, 1999).

Krikke et al. (2003) pointed out that if a product is returned by a customer, it is recommended that an analysis of the product takes place to determine whether parts are to be recycled, reused, and/or repaired, and whether the utilization of this process would incur additional labor cost. Although recycling materials has many advantages, the disadvantages of recycling materials are added processes such as collection, logistics, storage, inspection, re-processing and allocation (Krikke et

al., 2003). Consequently, the remanufacturing process influences inventory maintenance and control, and therefore increases cost and expenses on resources.

The management of recycled materials and products require design for green engineering, environmentally conscious manufacturing, for removal of specific parts or material to minimize cost (Johnson ad Wang, 1995). Remanufacturing is an integrated manufacturing process for recycling, and it is extensively applied in the automobile and electronics industry. It consists of two process concepts: (1) product recovery and (2) reusability. Product recovery varies in different industries and contexts; the most commonly understood explanation is that product recovery related to value reclaim from the products at the end of its valuable life (salvage value), and reuse of materials and products consists of four types: direct reuse, repair, recycling and remanufacturing (Srivastava, 2007). Product recovery can be categorized as five procedures: repairing, refurbishing, remanufacturing, cannibalizing and recycling (Thierry et al., 1995).

Product lifecycle management is another important portion of GSCM, and it allows organizations to retrieve and remanufacture products at the end of their lifecycle. It is crucial to a company's efficiency and speed to use products that are recyclable, and that disassemble and ensemble with ease. Although product lifecycle management is very complex, it is used by different types of companies just to add to product responsibility and accountability (Zhu et al., 2008).

2.3.1.2 GSCM and the Global Environment

The challenge to be green remains a significant concern for stakeholders. However, it is important to note that business organisations should not perceive GSCM as only beneficial to the global environment but also as a source of competitiveness. By adopting green operations, companies can

attract more customers by differentiating themselves from competitors (Rao and Holt, 2005). Moreover, companies can engage their customers in a community and gain greater brand name or reputation. Thus, it is feasible to study and report the environmental performances in the context of manufacturing industries in Canada. In particular, it makes sense to focus on the impact of stakeholder pressures on the implementation of GSCM practices for corporate sustainability and on performances within organizational competitiveness.

Many literatures refer to GSCM as a green purchasing (Srivastava, 2007). When purchasing a product, customers typically only consider the product benefits, the attached offers and services, not the environmental influence they may have after the product is disposed. Supply chains are increasingly focusing on green operations and logistics, so their products are disposed with minimal environmental effects. Greening the supply chains not only lowers costs, but also builds trusted supplier relationships with manufacturers and society to gain legitimacy and improve the environmental, economic, and social performances to their innovative products. However, the purpose of GSCM is to decrease the environmental effects and misuse of important resources, from the removal of raw materials to the disposal of products (Hervani et al., 2005).

The objective of green purchasing is to insure that purchased items are required to have environmental features like recyclability, reusability, and absence of harmful materials (Carter and Carter, 1998; Hervani et al., 2005). Purchased products must reach environmental characteristics determined by the buyer such as eliminating waste, encouraging recycling, reuse, resource reduction and substitution of materials. Green purchasing targets the purchase of sustainable materials and cost efficiency, without jeopardizing quality of the items bought and delivered

(Narasimhan and Carter, 1998). The lack of communication and knowledge sharing among suppliers makes the original equipment manufacturer (OEM) standards and regulations difficult to comply with.

In order to understand the fundamentals behind the rapid growth of GSCM in recent years, it is crucial to comprehend the term supply chain and its relationship with the natural environment. The major principle of GSCM is to stay away from suppliers who are not environmentally conscious to improve their environmental reputation with the civil society, regulators and other stakeholders. Conversely, a number of companies are now working with their suppliers to reduce unnecessary packaging and hazardous materials, and to improve their environmental profile as well as understand the challenges and demands of suppliers' suppliers in order to assess and decrease environmental cost. Environmental issues are difficult matter for business organizations because operations like sourcing, manufacturing and logistics are being blamed for a majority of environmental issues. Growing concerns add immense pressure on business operations from inside and outside organizations such as workers, government agencies and not for profit organizations (Sarkis, 2006). This does not include the rising demand of environmentally friendly products requested by customers and environmental associations. The massive pressure has forced organizations to adopt environmentally friendly image of products, processes, system of technologies, and business strategy (Vachon and Klassen, 2006).

A sustainable sourcing and procurement fundamentals of green purchasing functionalities on sustainable product development and process in literary works is factored as follows:

- Buyers must demand materials that have green design specification for reusability and

remanufacturing (Handfield et al., 2002)

- Buyers specify that purchased products must not contain environmentally unpleasant hazardous materials (Handfield et al., 2002)
- Buyers require public disclosure of environmental record (Handfield et al., 2002)
- Buyers demand their suppliers to adopt and maintain an environmental management system (Hervani et al., 2005)
- Supplier supporting program and activity (e.g. assessment, training and monitoring) (Handfield et al., 2005)
- Information sharing and Collaboration on material sourcing (Handfield et al., 2005)

Green purchasing manages the whole GSCM primarily with environmentally friendly products, as it is the introduction of greening of the products and its processes. The mess of environmental factors in purchasing activity may add to the complexity of the process as it requires the consideration of the supplier's environmental view, costing, lead-time, quality and flexibility (Handfield et al., 2002).

2.3.2 Management commitment towards greening

This section discusses the implementation of GSCM procedures and the companies' compliance with regulations and standards from the perspective of the environmental management system, as well as the environmental regulations in the manufacturing context.

2.3.2.1 Environmental Management Systems (EMS)

Green management innovation cannot be ignored/disregarded in the implementation of GSCM procedures. This is especially relevant, because senior management support is one of the most important factors in a successful application of innovation (Hervani et al., 2005). Zhu and Sarkis (2004) studied Chinese manufacturing industry and concluded that getting support from top or middle level managers has a convincing impact on exercising a successful internal environmental management. However, greening the supplier and supplier selection have of a high importance when included in the GSCM practices in general. Nevertheless, there are also other systems of standards or measure of performance that global buying firms often recommend their suppliers to implement (Hervani et al., 2005). The most internationally recognized standard is the international standard organization (ISO) that has established the 14000 series with a guidelines to help organizations reduce environmental impact by adopting environmental management systems (Hervani et al., 2005). The ISO framework is not conclusive, but instead it sets an arrangement of techniques that decrease environmental damages. The 14001's rules incorporate a policy to help organizations' goals to prevent pollution and enhance the support of EMS over time. ISO 14000 series standards are the most broadly implemented by organizations world-wide for the prevention of the environment and is classified as follows:

- Environmental Management Systems: 14001, 14002, 14004
- Environmental Labeling: 14020, 14021, 14022, 14023, 14024, 14025
- Environmental Auditing: ISO 19011 (Ex ISO 14010, 10411, 14012)
- Evaluation of Environmental Performance: 14031
- Life Cycle Assessment: 14040, 14041,14042, 14043

The Canadian government has also established laws on corporate social responsibility (CSR) regulations related to manufacturing industries. However, it is still in the development stage and some bills are in force in activities such as cleaner production, clean water, and clean air pollution control regulations. Moreover, some other specific regulations, such as reduction of hazardous material are deployed by environment Canada together with Health Canada. Thus, it is necessary to check if manufacturers comply with the domestic laws and international regulations when producing products. It is evident that many Canadian manufacturers have already built up EMS in environmental issues such as the ISO 14000 series. The organizational EMS system measured by the adoption of ISO 14001 requires the following:

- Collaborations with consumers for sustainable product development (e.g. eco-design and Packaging) (Zhu and Sarkis, 2004)
- Assessment and documentation delivery (Hervani et al., 2005)
- Organizational learning by acquirement of ISO 9000 and ISO 14001 certificates (Zhu et al., 2008)
- Commitment of GSCM practices from senior management (Zsidisin and Siferd, 2001)
- Compliance with governmental environmental regulations with local, regional, national and international laws (Hervani et al., 2005)

2.3.2.2 Environmental Regulations in the Manufacturing Industry

The original Canadian Environmental Protection Act (CEPA) was developed in the mid-1980s in response to growing public concern about the presence of toxic substances in the environment and as a result, the federal government developed the Canadian Environmental Protection Act (CEPA,

1999). Many broad environmental laws are passed at the federal level with Provincial agencies creating plans and programs to implement and enforce the laws. The Canadian government uses environmental policy to help protect the environment for future generations while interfering with manufacturers as little as possible. Canada, U.S., and the European Union are somewhat similar in terms of their industrial coordination, infrastructures, and business cultures, but they differ in terms of green activism and awareness.

Murphy and Poist (2000) – in their surveys to U.S., Canadian, and European Union Members of the Council of Logistics Management – found that Canada and Western Europe frequently are represented as having more advanced programs for managing and responding to environmental issues. Murphy and Poist (2000) further noted that western nations are more efficient in recycling and reusing materials. For the sake of improvements, Canada has put together a set of laws with regulations on climate change, CO_2 emissions, classification, labeling, and packaging of substances, and the preservation of the natural environment.

2.3.3 Greening of the supply chain

This section introduces and discusses trust and the danger involved in a global buyer-seller relationships in the supply chain or supply network connections, including environmental management systems. Moreover, it provides some examples of the topic.

2.3.3.1 Global Supply Chain Risks in the Buyer-Seller Relationship

Many companies have moved their production facilities offshore to benefit from lower production costs and services (Gupta, 2009). China's role in the global recession economy is very important

for many countries, and many companies worldwide have selected manufacturers in China because of lower production cost and services. Many firms in the U.S. and Canada depend on Chinese suppliers. In the world's largest toy companies, 80 percent of the imported products were manufactured and supplied by Chinese suppliers. In 2007, Mattel Inc. recalled over ten million Chinese manufactured toys because of excessive levels of lead in the product (Casey and Zamiska, 2007). Lead is a poisonous substance that can cause health problems in children, including brain damage and other mental and physical development related issues, such as learning shortages.

Environmental issues are increasingly adding to strategic preparation in organizations due to a demanding environmental regulations and increasing concern from governments and the general public (Zhu and Geng, 2005). Working closely with suppliers in the primary stages of product development process reduces the negative impact on the environment, and the advancement of strategic supply-chain partnerships is fundamental to a company's implementation of GSCM. Working partnerships and assessment systems are fundamental to establish a suitable level of product and service quality. Companies that want to build closer supplier relationships may require to work closely with suppliers to provide acceptable counsel, assistance, advice, and to contribute their knowledge and skills to assist their suppliers in the development of more green practices, but this consumes time and resources for both parties. However, many large companies establish their own environmental specifications for their suppliers to save time and resources (Rao, 2002).

Even though short and long term collaborative relationships are commonly discussed in buyer-supplier literature, there is a considerable amount of issues that exist in implementing sustainable supply chains (Seuring and Muller, 2008). Establishing and sustaining short and long-term

partnerships are costly and risky because of insufficient communication; the costs of these relationships are commonly higher than the benefits that are associated with attaining them. In addition, Seuring and Muller (2008) have projected what communication and coordination efforts to be maintained in developing relationships to make supply chains operational. Interactions between organizations are uncertain and difficult to manage due to the social and cultural differences and sometimes becomes challenging for companies to communicate (Seuring et al., 2010). Yet, green supply management efficiency can be beneficial by implementing strategic purchasing with business partnerships.

For decades trust has been known as a constituent of an important regulatory mechanism tool for SCM actors in the formation of supplier collaboration (Gold and Seuring, 2010). But origin of trust may vary among associations when it comes to an environmental issues to comply with environmental standards and assessment on the basis of continuous monitoring (Hervani et al., 2005). There is a critical issue concerning the part of composing formalized contracts as a defensive tool to encourage trust-building efforts among organizations in the negotiation of future contracts (Hervani et al., 2005). Consequently, some suppliers anticipate that an agreement is a legal document that can be enforced by the law. But others may, in any case, see an agreement as an announcement of desires, similar to a marriage certificate and see it as a starting point for beginning negotiations and transactions.

Another important crucial aspect in product life cycle stages is information access. A company's supply chain management abilities are developed by information-sharing with suppliers to achieve

green supply (Gold and Seuring, 2010). Inventory network directors need to have information on products specification to assess for potential threat of an approaching material to workers, potential customers and the surrounding habitat, including consequences of its disposal after utilization need to be considered before purchase of that inventory. Access by inventory network managers to such sort of data would clearly benefit the information streams along the supply chain networks. Data sharing acknowledged through organization centered methodology with suppliers adds to improvement of organization's SCM network capacities (Gold and Seuring, 2010).

Trust is the belief that one relationship partner will act to the greatest benefit of the other partner. Trust adds the responsibility and commitment between SC actors that facilitates the interaction among organizations, and additionally encourages data sharing between SC business partners (Gold and Seuring, 2010). The partnering of parties may differ, but the mutual use and exploration of resources such as shared warehouses, shared transportation networks, raw materials, facilities and equipment, will advance business efficiency. Accordingly, businesses will be able to scale and scope in terms of economy and profitability by sharing facilities in order to produce larger quantities of product and increase efficiency. The positive impacts of consolidation are viewed as beneficial to a business environmental sustainability and society. The benefits of collaborative supply-chain management are likely to obtain better exploitation of resources to increase improvement in environmental and social performance.

2.3 Stream III: Corporate Performances

This section introduces the importance of environmental and financial performances as well as the non-financial competitive advantage. Therefore, what constitutes GSCM practices is broad and

blurry and hard to measure. Focusing on the magnitude of some of the elements of a green supply chain practices, and financial performances from literature are put together to reveal the relationships among them and their influence on competitive advantage.

2.4.1 Challenges for achieving sustainability

The challenges for achieving sustainability based on the OECD (2008) reports include:

Population Growth: This is the main challenge to sustainability. There were 1.75 billion people on the planet in 1910; today there are about 7 billion and the population would be reaching to 9 billion by 2050.

Depletion of resources: Economics of scale production has created a depletion and a scarcity of the natural resources. Resources are vanishing at an alarming rate (e.g. trees).

Unaccountable growth and consumption: Economics of scale production may cause climate change resulting in environmental disaster and economic loss

Collaboration: Collaboration is one of the main hindrances for business growth and sustainability. Companies must collaborate with a range of stakeholders to increase innovative ideas, information sharing, increase capabilities, and increase bulk transportation

One important component is resource efficiency that has become an important factor in various policies and business regulations. The Canadian 2050 for an innovative sustainable and resource efficiency strategy is the key for achieving both economic and environmental goals. Environmental

assessments are made by different environmental appraisals, such as the IEA (2012) who warned that the global consumption of natural resources at the current level may result in an extreme threat of overexploitation of resources that may cause a severe breakdown potentially. The effective utilization of raw materials and a sustainable resource management has picked up importance with respect to environmental, social and financial measurements. In recent years the environmental and financial performance have become business problems that are affecting business decisions.

Manufacturing industries represent a huge piece of the world's consumption and waste generating. In any case they have the capability to possibly become the driving force for the establishment of sustainable society (OECD, 2009). Worldwide pressure on efficient resource consumption and the improvement of sustainability is an important source of innovation and a significant resource for manufacturing competitiveness. These perspectives have arrived at the consideration of the organizations, to improve cleaner production practices towards improving environmental performance, and accepting social environmental responsibilities (OECD, 2009).

2.4.2 Performance in supply chain management

The idea of triple-bottom-line (TBL) is emerging in the manufacturing industries. This approach focuses on the economic value of an organization as well as the environment and social impacts. More precisely, sustainability reporting creates linkages across the entire value chain. Externally, it can be used to enhance their environmental image, both for the public/consumers and for the competitors. In other words it covers economic, social, and environmental issues of an organisation, in such a way to achieve unmatched advantage in the industry. These are known as

the 3Ps (people, planet and profit) or the "three pillars of sustainability". The categorization into three parts – social, environmental, and economic – was originally formulated by John Elkington in 1994, and has since been adopted by many organizations to expansively evaluate performance.

Contradicting definitions of sustainability in various literature of SCM caused to build an appropriate concept of sustainability that factored environmental and social issues in combination with economic goals and a company's long term predictions. This definition of sustainability supports the TBL approach (Elkington, 1994). Seuring and Muller (2008) have also observed varying understanding of the definition of sustainability in SCM that indicates "the triple bottom line approach, where a minimum performance is to be gained in the social, environmental, and economic property". Differently, Gold and Seuring (2010) support the idea that a source of inter-organizational competitive advantage is a result of sustainability in supply chains.

2.4.3 Environmental performance

Companies can increase their environmental achievements by adopting environmental management in GSCM. Furthermore, organizations can increase value to core business programs by adopting environmental sustainability development platforms. GSCM advocates efficiency and collaboration that consists of improving environmental performance, developing competitiveness and cost saving (Rao and Holt, 2005). Thus, companies can gain new business opportunities and improve competitive advantage by improving their green corporate image through improved environmental performance. Vachon and Klassen (2008) demonstrate a link between environmental performance and competitive advantage in their survey of North American firms, although research by Rao (2002) focused on firms in South East Asia (i.e. Malaysia, Philippines,

Indonesia, Thailand, and Singapore) could not link environmental, economic performance and competitive advantage. Other research has examined how green initiatives impact environmental performance (Porter and Van Der Linde 1995; Zhu et al., 2008), but has not acknowledged the correlation between green innovation and environmental performance. Accordingly, we must examine whether the three categories of green innovation play a role in environmental performance. Therefore, this study presents a research into the Canadian manufacturing context to collect evidence to examine a possible link between financial and competitive advantage.

2.4.4 Financial performance

The idea of a sustainable supply chain is to reduce cost while helping the environment. Sustainability is a key for companies to reduce cost. It is all about environment but also equates financial, long term leadership with long term vision, highly sighted from investors and public image, while GSCM practices are about environment friendly innovation, new ways of smart packaging, reducing waste by applying less material on containers. This can be defined as the process of using environment friendly inputs and transforming these inputs through environmental friendly outputs that can improve or be recycled within the existing process to generate profit (Rao and Holt, 2005). Other important cost reduction indicators that increasingly have impact on the financial performance are reduction of cost for materials purchased, cost for energy consumption, fee for waste treatment and discharge, operational cost and employee training cost.

2.4.5 Corporate Social Performance

The concept of corporate social performance (CSP) in the environmental perspective is similar with corporate social responsibility (CSR) and socially responsible behavior. These terms are used

interchangeably in empirical research as the concept of CSP is at times listed under the CSR umbrella and vice versa (Carroll, 1999). Thus, in this research CSP and CSR are used for the same meaning. CSR is the concept of sustainable supply chain in regards of building corporate image while helping the environment. The fundamental characteristics of corporate social obligation concepts is the involvement of shareholders, employees, customers, suppliers, governments, non-profit organizations, international organizations, and other stakeholders.

An issue that surfaces oftentimes in considerations of corporate social obligation is whether there is an evidence on the relationship between a firm's social responsibility performance and financial performance. Shockingly, quantifying this relationship has been commonly disadvantaged by measurement problems. The criteria for measuring financial performance and social responsibility are debatable, and especially, the estimation of social responsibility is difficult. However, over the years, studies on the social responsibility and financial performance relationship have produced varying results. Orlitzky et al. (2003), in a thirty years exhaustive investigation, have supported their conclusion that social performance and financial performance are positively related. The researchers have also noted that the trade-off between social responsibility and financial performance from the mangers perspective is not well justified after thirty years of research.

Setting corporate responsibility principles into practice can be difficult and challenging. However, many companies fight to validate the management of social and environmental concerns in terms of business profits. Most recently, the discussion of responsibility of companies are all branched from an article of Bowen et al. (2001), which stated that companies should reconsider strategies and solve various pressures of society by incorporating social and environmental elements. Many

companies understand that the responsibility for their products starts as soon as that product is produced and how it is perceived, designed, and purchased. From an environmental perspective, the responsibility includes resource extraction, transportation, production, packaging, distribution, and disposal. In the business and society literature, it has been argued that particular part of CSR includes the environmental issues, but between business and society there is an ethical principle that takes into account that they are jointly shaped with continuous exchanges and this theory confirms the competitive position of a company, gained by the integrity between the firm and its stakeholders (Carroll, 1999).

The Social Issues should focus on improving performance of a company by taking into account, the views of various actors in society and applying them to strategic methods. Carroll (1999) introduced the idea "what is good for a company is mutually good for society". The argument presented was that the expectations from corporate stakeholders and society, were the responsibilities of the corporates. In the business and environment literature, environmental management refers to the green management of corporate interaction with the environment. In particular, corporate environmental objectives include environmental supply chain management (Handfield et al., 2005) and environmental green purchasing (Narasimhan and Carter 1998). These concepts emphasize on moral responsibility of companies and social responsibility by using moral management that can distinguish between good and bad regarding the society and future generations (Carroll, 1999).

As stated by the international institute of sustainable development (IISD, 2013), the idea of CSR includes companies integrating social and environmental problems with business operations and interactions with stakeholders. Stakeholder pressures can seek to improve a company's ethical, social and environmental behaviour as a support for management commitment. Indeed, the overall performance of a company should be measured based on its combined contribution to social, environmental, and financial performances. However, a crucial element of CSR examines how organizations work with their internal and external stakeholders to ease social and environmental concerns into business strategy and operations.

2.4.6 Green supply chain and Competitiveness

Initiating a green manufacturing strategy is a very complicated issue because it introduces different impacts on performance and requires considerable change in management procedures. Even the simplest changes require managers to examine a multitude of stages and aspects that often lead to reorganization. Hence, it is extremely crucial to examine beneficial patterns of strategic environmental sustainability development and what effects they will have on competitiveness. Dangelico and Pujari (2010) argue that environmental managerial innovation adoption is to match an environmental strategy with other key issues such as corporate objectives and the whole product life cycle. Managerial commitment must be considered as a component that can influence a company's competitive advantage. However, green production that deals with environmental concerns infers extra production costs, which have a negative impact on competitiveness. Green innovation addressing sustainability challenges across product design, and product process in the material selection to reduce toxic substances adding pollution prevention programs in the production, can bring substantial product differentiation and competitiveness for these products in

the market place (Porter and van der Linde, 1995). Product design and manufacturing processes, in broad indicates an innovative strategic treatment to pollution prevention. Pollution prevention programs could be cost savings in product development and improvements in product quality and brand reputation of the organization. This will in turn make the company more competitive in the market (Dangelico and Pujari, 2010; Porter and van der Linde, 1995).

Many practitioners argue that the control of pollution in the manufacturing sector is an absurd philosophy and an "end of pipe approach". In this appreciation, Sarkis et al. (2011) point out that the product life cycle management combined with an organization's EMS is of significance to monitor the manufacturing production line for environmental performance. In addition, Chien and Shih (2007) emphasize that companies chasing the so-called "green manufacturing" need to implement product life cycle management to help firms reduce toxic materials in product design and process, and argues that green manufacturing is an economically viable alternative to traditional manufacturing systems and this is because green manufacturing helps improve financial and environmental performance. Thus, introducing aspects of a company's strategic outlook towards the environment allows us to focus on a sustainable green manufacturing strategy, and to recognize essential factors in organizational competitiveness towards sustainability.

A key solution to conquering pressures from customers, competitors and regulators is constant innovation (Porter and Van der Linde, 1995). Therefore, the adoption of environmentally critical materials and the implementation of GSCM practices within a firm's value chain with the objective to reduce waste and maximize resource efficiency is very important (Handfield et al., 2005).

A research by Rao and Holt (2005) shows an increase in a company's competitive advantage resulted in the reductions of production costs and increase economic efficiency when environmental initiatives were incorporated. A company's competitiveness can also be enhanced by reconstructing corporate performance and compliance with the environmental regulations (Handfield et al., 2005). Finally, corporate competitiveness and improved environmental performance are heightened by the adoption of GSCM through internal and external environmental management (Shrivastava, 1995; Porter and van der Linde, 1995). Chen et al. (2006) suggest that green product and process innovations are positively associated with competitive advantage. Some studies consider the impact of GSCM practices on environmental and financial performance, and other few studies focus on the influence of GSCM practices on competitive advantage.

In conclusion, the studies reviewed in this research demonstrate that greening the supply chain has positive effects on green innovation (Rao, 2002; Porter and Van Der Linde, 1995; Shrivastava, 1995). Furthermore, green innovation has a positive impression on competitive advantage (Porter and Van Der Linde, 1995; Klassen and Whybark, 1999; Rao, 2002; Rao and Holt, 2005). Additionally, greening of the supply chain has a positive influence on environmental performance and competitive advantage (Rao, 2002; Rao and Holt, 2005). As considered previously, green innovation is composed of green product design, green process and internal management. Although Chen et al. (2006) studied the influence of green product and process innovation on competitive advantage and the green image of an organization, they did not analyze the influences of greening of the supply chain on an organization's economic performance. Holt and Ghobadian (2009) in their study of green supply chain management practices amongst UK manufacturers found that the least influential pressures are related to corporate social responsibility.

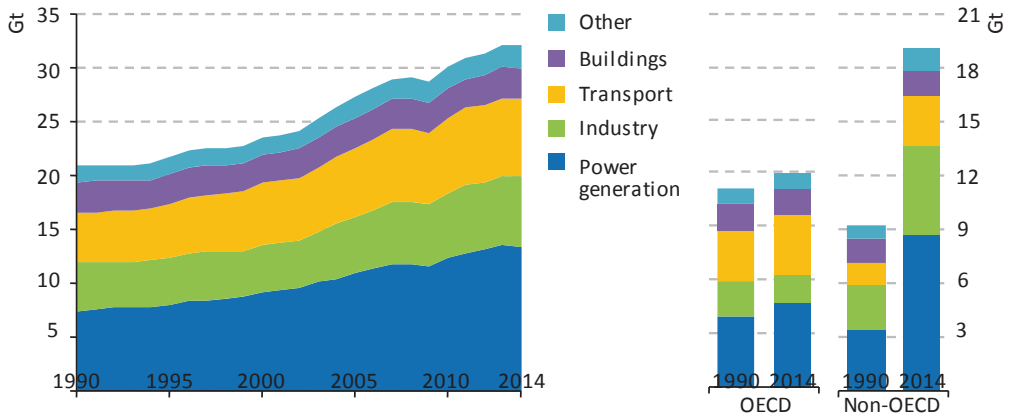
2.4.7 Waste Management

An issue that calls for special consideration is waste management. Waste management, also referred to as lean production, is defined as the process of reducing waste, which can lead to an increased wealth and improved financial performance (Rao and Holt, 2005). Achieving green design into GSCM practices makes waste management a more successful process and contributes to fully recyclable and environmentally friendly products. However, the failure to create recyclable products increases waste production and deems the product not 'green', no matter how efficient their logistics processes are (Srivastava, 2007). Despite the development of many environmental regulations and the pressures from the stakeholders, waste management has increased severely, and how to make the most out of disposed goods becomes a global problem for many companies.

2.4.8 Emissions and Futuristic Overview

The overall global greenhouse gas (GHG) emissions have doubled in emerging and developing countries since the early 1970s and approximately two-thirds of this increase come from China. Some of the countries which will need to play key role in the adoption of GSCM practices can be identified to be a non-OECD members considered to be emerging economies such as Brazil, Russia, India, Indonesia, China, and South Africa (also known as BRIICS economies).

Figure 2.1 Global energy-related CO_2 emissions by sector and region



Source: OECD/IEA, 2015 (Note: Gt = Giga tonnes)

CO_2 emissions from the industry sector in these countries doubled from 1990 to 2014, but decreased by quarter from the industrial sector in OECD countries (see Figure 2.1). However, CO_2 emissions from transport doubled in non-OECD countries. Non-OECD countries, collectively, represented fifty five percent of global CO_2 emissions in 2012. The emission growth in China was around three percent, emissions grew about five percent in Africa, the Middle East and Latin America grew roughly at four percent. However, emissions decreased in North America by four percent and also decreased in Europe by around one percent. Unsurprisingly, the international energy agency (IEA, 2014) report indicates that the OECD member countries were emitting the bulk of GHG emissions globally prior to 2010. The top ten world largest CO_2 emitters are accounted for around two-thirds of the world emissions (IEA, 2014a). The largest supply chain emitters today is China followed by United States of America, India, Russia, Japan, Germany, Korea, Canada, Iran, and Saudi Arabia. In addition, the BRIICS countries GHG emissions has also increased by forty five percent approximately in 2010. The scenario suggests that GHG emissions will continue to grow by 2050. Energy and industry related emissions are projected to more than

double to 2050 compared to 1990 levels (IEA, 2014). Any prediction of future emissions is subjective because of higher industrial productivity as population growth is on the rise.

The world demand for energy is estimated to increase by eighty percent between 2010 and 2050 (OECD, 2008). Transport emissions are predicted to double between 2010 and 2050, due to a high demand for cars in developing countries. The overall CO_2 emitted from manufacturing and electricity usage by industries worldwide is approximately forty percent. The electric system of Canada is one of the cleanest electricity systems in the world, with almost eighty percent of electricity supply emitting no GHGs (EC, 2015). (Table 2.1) depicts the expected CO_2 emission in Canada between the periods of 2006 to 2020.

Table 2.1 *Greenhouse Gas Emissions in Canada, 2006 to 2020*

	2006	*2010*	*2015*	*2020*
	Mt CO2	*Mt CO2*	*Mt CO2*	*Mt CO2*
Residential	**39.8**	**43.9**	**48.3**	**51.9**
Commercial	**37.7**	**43.1**	**51.1**	**58.4**
Transportation	**162.4**	**170.8**	**197.7**	**217.3**
Industrial: non-regulated	**41.6**	**42.8**	**47.9**	**52.4**
Industrial: regulated	**343.6**	**370.7**	**389**	**396.9**
Agriculture, wastes and others	**96.0**	**100.9**	**112.1**	**123.1**
Total	**721.1**	**772.3**	**846.1**	**900.0**

Source: Environment Canada.

The EC predicts that Canada's emissions will rise by 2020 and beyond, and thus this will deviate Canada's position farther more from the Copenhagen Kyoto protocol commitments. OECD

members of the developed countries were expected to reduce emissions by about five percent relative to 1990 within the time frame of 2020-2030 (IEA, 2012). It is important to note that transportation and agriculture sectors are contributing the highest levels of greenhouse emissions but are also decreasing.

3. METHODS

The conceptual model of this research was developed based on the review of literature. The model was constructed to examine the relationship amongst stakeholder pressures towards greening of production and the supply chain (in terms of GSCM), as well as the role of managerial commitment, and the consequences in terms of financial performance and competitive advantage. This chapter explain methods of this research: (1) survey, (2) data collection, (3) questionnaire development, (4) pre-test analysis, (5) research model, (6) hypotheses development, and (7) data analysis and procedures and statistical methods.

3.1 Survey

A survey was used to collect data across multiple manufacturing industries (Appendix A). The population for the research includes small to medium sized enterprises (SMEs) in the Canadian manufacturing context. The selection of these Canadian firms was appropriate because these firms are expected to fit into the proposed GSCM practices framework. As well, it may be assumed that all these firms develop and practice some sort of GSCM practices. Furthermore, the survey includes industries that have a similar industry structure, and that maybe subject to similar environmental uncertainty.

3.2 Data Collection

The sampling frame for this study includes CEOs, senior managers, managers, operations managers, production managers, procurement managers, and team leaders. The respondents were given the opportunity to select “other” from the checkbox to input their position if their title was not listed in the questionnaire. The population of interest has three distinct characteristics that

impact the generalizability of this study and as a result will be addressed in the remainder of this section: (1) small-medium sized firms; (2) only those considered polluters in the manufacturing industry; and (3) only Canadian firms.

The underlying reason that the present study included small and medium sized firms is to investigate whether smaller companies are ISO certified and to find their lack of environmental management capabilities. Other than the oil and mining industries, the reasons for selecting the most polluters from these industries is because (1) these industries are changing rapidly due to globalization and technological advancements, environmental issues are growing fast, and a significant regulatory acts are always introduced globally for these industries, (2) Canada is one of the advanced nations that contribute to pollution regardless of the government's strong environmental enforcement, (3) Canadian products are also popular in the European markets where strict environmental regulations exist.

In this study, an online questionnaire survey is the research instrument and an invitation totaled 1135 possible respondents to complete the questionnaire: (1) 1000 by email through Scott's directories subscribers, and (2) a list of 135 Canadian manufacturers e-mail addresses collected from industry Canada were sent directly by the author to the respondents to complete the survey questionnaire. The design of the questionnaire for the survey was prepared in a logical manner, as shown in table 3.2 and items were coded accordingly. Before deployment, the questionnaire were verified by the thesis supervisor for a review and approval. Subsequently, the survey were deployed to the intended respondents. The e-mail method was used for efficiency rather than using a time consuming postal mailing method. Data were collected from survey respondents between

February and November 2015 through Fluid surveys services in an excel format and imported to an SPSS file to verify for missing values and to build a model using exploratory factor analysis (EFA). Section 4.2 shows the rate of respondents including their discussions.

3.3 Questionnaire development of the variables/constructs

This section describes the items used in measuring the constructs in the proposed model. The questionnaire was divided into eleven main sections: company profile as a basic data, stakeholder pressures towards greening, green product design/process, and greening of the supply chain, with consequent performances (environmental, social and financial performance) and competitive advantage. Table 3.1 shows the items used in measuring the constructs for this study.

Table 3.1 Measurement Items

Constructs (Latent variables)	**Measurement Items**	**Item #**
Stakeholder pressures (adapted from Yu and Ramanathan, 2014)	Customers	STP1
	Supply chain partners (e.g. supplier)	STP2
	Actions by competitors	STP3
	Marketing department	STP4
	Shareholders	STP5
	Regulators and legislators	STP6
	Environmental activists or organizations	STP7
Product Design Innovation (adapted from (Chiou,2011; Chen et al., 2006; Yu and Ramanathan, 2014)	Using less or non-polluting/toxic materials	PDI1
	Designing and improving environmentally friendly packaging	PDI2
	Endorsing recycling	PDI3
	Using eco-labeling	PDI4
	Practices that minimise waste when designing a product	PDI5
	Considering opportunities for reuse/recycling/recovery of material	PDI6

	Substituting for more environmentally friendly alternatives	PDI7
Product process Innovation (adapted from (Chiou, 2011; Chen et al., 2006; Yu and Ramanathan, 2014)	Lower consumption of water, electricity, gas and petrol during production, use or disposal	PPI1
	Recycling, reuse and remanufacturing of materials and parts	PPI2
	Using cleaner or renewable technologies to reach savings (such as energy, water, waste)	PPI3
	Redesign of production and operation processes to improve environmental efficiency	PPI4
	Redesign and improvement of products or services to meet new environmental criteria or directives (e.g. environmental directive)	PPI5
Management Commitment towards greening (adapted from Chiou et al., 2011)	Clear annual targets for energy conservation, recycling or waste reductions	MGC1
	Clear environmental mission statement to guide environmental decision-making	MGC2
	Well-defined responsibilities for an environmental manager and/or an environmental team	MGC3
	Regular training programmes to our employees to improve their awareness in protecting the environment	MGC4
	Continuously monitoring the quality of our environmental practices	MGC5
Greening the Supplier (adapted from (Chiou, 2011; Chen et al., 2006; Yu and Ramanathan, 2014)	Certification such as ISO14000	GTS1
	Their participation in our environmental awareness seminars and training sessions	GTS2
	Their compliance to our environmental technical advice	GTS3
	Their involvement in the early product design and development.	GTS4
	Our auditors report to assess the environmental performance of suppliers	GTS5
Green Supplier Selection (adapted from (Chiou, 2011; Chen et al., 2006; Yu and Ramanathan, 2014)	Their capacity to meet the needs of the enterprise	GSS1
	Cost components	GSS2
	Environmental compliance and acceptance of auditing programs	GSS3
	ISO 14010 certification	GSS4

	Environmental management systems	GSS5
	Informal assessment criteria	GSS6
	Consistently monitoring a set of environmental criteria that suppliers must meet	GSS7
Environmental Performance (adapted from Chiou, 2011; Yu and Ramanathan, 2014; Chien and Shih, 2007)	Important environment related certifications	ENP1
	Targets imposed on energy conservation, recycling or waste reductions	ENP2
	Decrease of consumption for hazardous/harmful/toxic materials	ENP3
	Reduction of air emission	ENP4
Financial Performance (adapted from Chiou, 2011; Yu and Ramanathan, 2014; Chien and Shih, 2007)	Decreased of cost for materials purchasing	FNP1
	Decrease of cost for energy consumption	FNP2
	Decrease of fee for waste treatment	FNP3
	Decrease of fine for environmental accidents	FNP4
	Decrease of operational cost	FNP5
	Decrease of training cost	FNP6
	Decrease of fee for waste discharge	FNP7
Social performance (adapted from Ghobadian, 2009)	An environmentally or socially responsible image	SOP1
	Public opinion/societal expectation	SOP2
	Good ethical practice or information	SOP3
Competitive advantage (adapted from Chiou, 2011; Chen et al., 2006)	Reduction of hazardous waste and emissions	CMP1
	Consumption of less resources, such as energy, water, electricity, gas and petrol	CMP2
	Compliance to environmental regulations	CMP3
	Customer satisfaction in relation to product design and development	CMP4
	Product design and innovation skills	CMP5
	Quality of products and services	CMP6
	Production cost	CMP7

Company profile: This section collects information on the profiles of the firms, such as respondents position within the company, type of manufacturing industry, number of employees in the organization, approximate turnover, the age of the firm, and if the firm is ISO 14001certified. A five-point scale used for all of these items is (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree).

Stakeholder pressures towards greening: The questionnaire items regarding the construct ‘‘Stakeholder pressures” includes items 1–7 and are adopted from the research conducted by Yu and Ramanathan (2014). The respondents were asked whether they experience a lot of pressure to adopt environmentally friendly practices from internal and external stakeholder pressures.

Product design/process innovation: Items 1–7 for design and items 1-5 for process are adapted from the research conducted by Chiou (2011); Chen et al. (2006); and Yu and Ramanathan, (2014). The respondents were asked if the environmental actions had been taken into consideration by management, during product design and process.

Greening of the supply chain: Items 1-5 are based on how to green the suppliers, and 1-7 addresses the selection of suppliers; they are adapted from Chiou (2011); Chen et al. (2006); and Yu and Ramanathan (2014). GSCM practices asks subjective evaluations pertaining to the relative emphasis on various action practices. In order to verify this, respondents were asked to indicate the importance and how suppliers or subcontractors are selected in terms of greenness within the manufacturing context, and the compliance to meet environmental criteria and certifications.

Management commitment towards greening: Items 1-5 are based on the literature of managerial innovation with a specific focus on management commitment to environmental issues and a clear environmental mission statement to guide environmental decision-making, training and monitoring on the quality of environmental practices. The questions were adapted from Chiou et al. (2011).

Environmental performance: Items 1-4 were adapted from Chiou et al. (2011); Wu and Ramanathan, (2014); and Chien and Shih (2007). The respondents were asked if the environmental actions had been taken into consideration by management, during environment related certifications, targets imposed on energy conservation, recycling or waste reductions, and whether the company has performed significantly better.

Financial Performance: Items 1-7 were adapted from Chiou (2011); Yu and Ramanathan (2014); Chien and Shih (2007). The questions were based on consumption of less resources (on energy conservation, recycling or waste reductions) and whether the company has performed significantly better in terms of environmental actions that led to a cost saving and has performed better in that year.

Social Performance: Items 1-3 are based on ethical practices, environmental and social responsibilities, and were adapted from Ghobadian (2009).

Competitive advantage: Items 1-7 were used in this section that represents competitive advantage variable and is adapted from Chiou et al. (2011) and Chen et al. (2006). The respondents were asked if performed better than their competitors regarding environmental actions on improvements in the design and innovation skills, while providing quality of products and services.

3.4 Pre-test analysis

The use of the pre-test analysis was to validate the sampling size and identify whether there was any indication of missing values amongst the respondents. To avoid biasness for missing values, the series mean will not be used and hence, the imputation model is used (Appendix C). The imputation model creates patterns from the responses and then predicts the probability if one was to answer for that missing value and replaces it with a rounded number that is closer to the predicted value rather than just the mean value. The pre-test analysis makes use of the SPSS (22) multiple imputation formula.

3.5 Research model

The constructs "social performance" and "environmental performance" were excluded from this study and the proposed research model because those areas of study are exhausted. The present research model suggests that all GSCM practices are useful in the sustainability of greening of the supply chain environment. In addition, it proposes that the pressures from an organization's stakeholders toward implementing GSCM practices may improve the overall greening of the supply chain through green production that may contribute to their competitiveness in the market

and enhance their financial performance. Figure 3.1 shows the proposed research model with hypothesized relationships. Hypotheses shown in the model will be discussed in chapter 3.2.

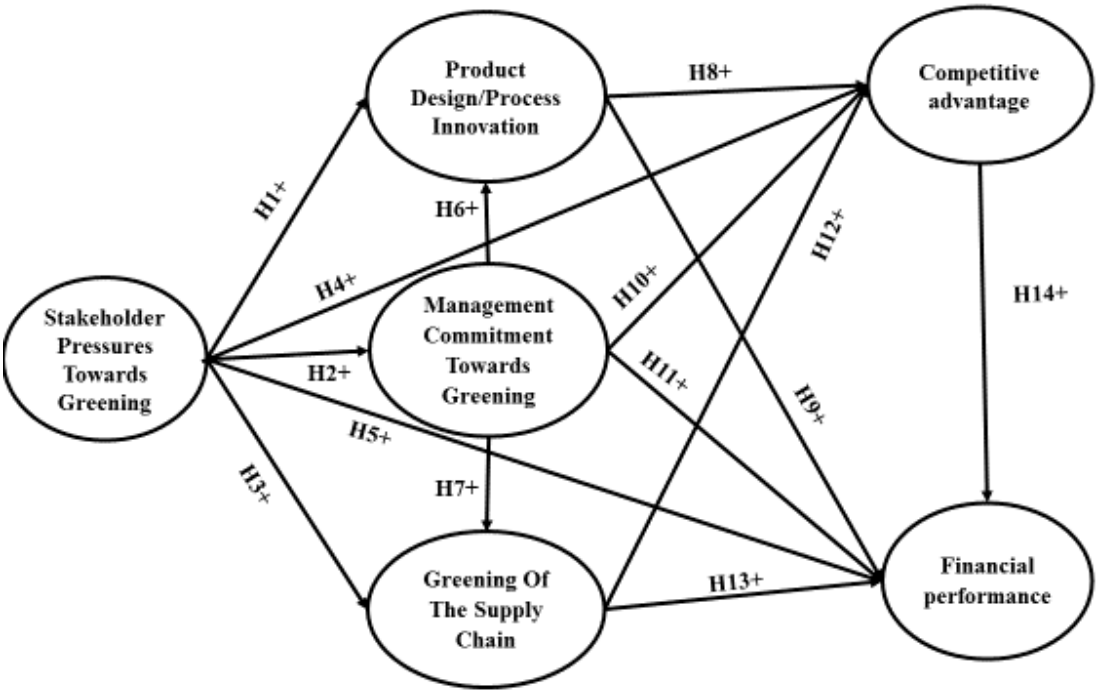


Figure 3.1: The research model and involved hypotheses of this study

First, the research model examines the STP on product design/process for corporate sustainability towards GSCM practices. As there is little work done in this area, the proposed model uses three main components of GSCM practices (green product design/ process, management commitment towards greening, and greening of the supply chain). Even though there are growing concerns about the climate change, few studies have attempted to address a measurement of stakeholder pressures on greening of the supply chain.

Second, the research model examines the STP on corporate performances (financial performance and competitive advantage). There has also been little work done in this area; few previous studies have attempted to find the relationship between GSCM practices and financial performance but not STP on financial performance.

Third, the research model will examine for the Stakeholder pressures on competitive advantage which has not been covered in previous research on greening of the supply chain. Competitive advantage is frequently used in the supply chain literature but not measured relatively with STP. Stakeholder theories have described that competitive advantage add value in customer's eyes from the perspective of customer's perception only. Again, this study focuses specifically on stakeholder pressures towards greening, which has received little attention in previous studies.

Fourth, the research model will examine GSCM practices on both organizational performance and competitiveness. Organizational performances frequently addressed in the supply chain literature but the greening effects are tested on environmental performance rather than business performance. Alternatively, the effects are tested on competitive advantage (long-term business performance) or financial performance (short-term business performance) separately rather than addressing both types simultaneously which would be a relevant approach when trying to understand the effects of greening on corporate performance.

Finally, the research model will examine organization's environmental performance on competitiveness. This is frequently address in the supply chain literature, but studies generally fail

to address the consecutive effect of organization's competitive advantage on its financial performance. All the above proposed research model dimensions are adapted from the literature (e.g. Yu and Ramanathan, 2014; Ghobadian, 2009, Chien and Shih, 2007; Chiou et al., 2011).

3.6 Hypotheses explained

Based on the EFA analysis, this research model has proposed fourteen hypotheses testing. From reviewing the relevant literature, many studies found that environmental management is generally beneficial for environmental performance and some aspects of financial performance of the organization. Numerous studies have proved that stakeholder pressures may contribute to various kinds of corporate sustainability towards GSCM innovation practices such as green product design and process that lead to enhanced environmental production (Sharma and Henriques, 2005). Based on the principles of STP theory and the results of empirical studies, it can be argued that firms make changes on product design and processes in response to the growing environmental pressures from different stakeholder groups. Yu and Ramanathan (2014) have proved the relationship between stakeholder pressure and internal management but failed to prove between stakeholder pressure and green product design/process. There is no indication of other study on the relationship between stakeholder pressure and management commitment, competitive advantage and greening of the supply chain. Therefore, hypotheses H1 – H5 are proposed for this research model.

H1: Stakeholder pressures towards greening have a significant positive impact on product design/process innovation

H2: Stakeholder pressures towards greening have a significant positive impact on management commitment towards greening

H3: Stakeholder pressures towards greening have a significant positive impact on greening of the supply chain

H4: Stakeholder pressures towards greening have a significant positive impact on competitive advantage

H5: Stakeholder pressures towards greening have a significant positive impact on financial performance

Chiou et al. (2011) have shown the relationship between internal management and greening of the supply chain, the relationship between product design and management. Therefore, hypotheses H6 and H7 are proposed for this research model.

H6: Management commitment towards greening has a significant positive impact on product design/process innovation

H7: Management commitment towards greening has a significant positive impact on greening of the supply chain

Chiou et al. (2011) pointed out that there is a relationship between product design/process innovation and competitive advantage, but there were no studies that have attempted the findings

of the influence of product design/process, on financial performance. Therefore, hypotheses H8 and H9 are suggested:

H8: Product design/process innovation has a positive relationship with competitive advantage

H9: Product design/process innovation has a positive relationship with financial performance

Although Chiou et al. (2011) showed that there is relationship between management and competitive advantage and financial performance, the literature review did not include any studies that indicate of relationship between management commitment and financial performance in the GSCM. Therefore, hypotheses H10 and H11 are suggested:

H10: Management commitment towards greening has a significant positive relationship with competitive advantage

H11: Management commitment towards greening has a significant positive relationship with financial performance

Chiou et al., (2011) pointed out that organizations implementing the greening of the suppliers has improved competitive advantage, and also suggested that competiveness consists of improved efficiency, quality improvement, productivity improvement, and cost savings, but haven't proved

the impact of competitive advantage on financial performance. Chen et al. (2006), Yu and Ramanathan, (2014); and Chiou et al., (2011) pointed out that there are numerous studies that have considered in finding the impact of GSCM practices on environmental and financial performance but there were very few studies that have attempted the findings of the influence of greening of the supply chain on competitive advantage and financial performance. Therefore, hypotheses H12 and H13 are suggested:

H12: Greening of the supply chain has a significant positive relationship with competitive advantage

H13: Greening of the supply chain has a significant positive relationship with financial performance

Although Chien and Shih (2007) studied the influence of GSCM practices on financial performance, they did not analyze the influences of competitive advantage on financial performance. Thus, hypothesis H14 is suggested:

H14: Competitive advantage has a significant positive relationship with financial performance

Table 3.2 summarizes the 14 hypotheses and shows the key GSCM literature that influenced building the proposed research model of the present study. The listed previous studies provide full or partial support to the establishment of the research hypotheses in the model. It should be noted

that the listed studies are empirical research papers on their respective topics, as Zsidisin and Siferd (2001) argue that green supply chain research should adopt theoretically supported empirical research.

Table 3.2 Supporting empirical research for hypothesized relationships in the research model

Hypothesis	**Supporting literature**
H1: Stakeholder pressures towards greening have a significant positive impact on product design/process innovation	Darnall et al. (2010); Yu and Ramanathan (2014); Ghobadian (2009); Chien and Shih (2007); Sarkis et al. (2010)
H2: Stakeholder pressures towards greening have a significant positive impact on management commitment towards greening	Yu and Ramanathan (2014); Freeman (1984); Henriques and Sadorsky (1999); Sarkis et al. (2010)
H3: Stakeholder pressures towards greening have a significant positive impact on greening of the supply chain	Chiou et al. (2011); Sarkis et al. (2010); Sharma and Henriques (2005); Chien and Shih (2007); Zhu et al. (2005); Zhu and Sarkis (2007); Ghobadian (2009); Vachon and Klassen (2006)
H4: Stakeholder pressures towards greening have a significant positive impact on competitive advantage	Ghobadian (2009); Zhu et al. (2005); Sharma and Henriques (2005)
H5: Stakeholder pressures towards greening have a significant positive impact on financial performance	Chien and Shih (2007)
H6: Management commitment towards greening has a significant positive impact on product design/process innovation	Chiou et al. (2011); Zhu and Sarkis (2006); Yu and Ramanathan (2014)
H7: Management commitment towards greening has a significant positive impact on greening of the supply chain	Montabon et al. (2007); Carter et al. (1998); Zhu and Sarkis (2004); Bowen et al. (2001b)
H8: Product design/process innovation has a significant positive relationship with competitive advantage	Theyel (2000); Rao and Holt (2005); Chiou et al. (2011); Shrivastava (1995); Chen et al. (2006)
H9: Product design/process innovation has a significant positive relationship with financial performance	Zhu et al. (2008); Chien and Shih (2007); Klassen and Whybark (1999)

H10: Management commitment towards greening has a significant positive relationship with competitive advantage	Klassen and Whybark (1999); Chiou et al. (2011)
H11: Management commitment towards greening has a significant positive relationship with financial performance	Zhu et al. (2008)
H12: Greening of the supply chain has a significant positive relationship with competitive advantage	Chiou et al. (2011); Zhu et al. (2005)
H13: Greening of the supply chain has a significant positive relationship with financial performance	Chien and Shih (2007); Rao and Holt (2005); Zhu et al. (2008); Zhu et al. (2010)
H14: Competitive advantage has a significant positive relationship with financial performance	Rao and Holt (2005); Porter and Van der Linde (1995); Zhu et al. (2008); Sarkis et al. (2010); Theyel (2000)

3.7 Data Analysis Procedures and Statistical Methods

Data analysis for this study includes various statistical methods. First, the Statistical Package for the Social Science (SPSS) version 22.0 is used in assessing the factors for this research model. Second, a partial least square variance based approach is used. This approach is implemented using SmartPLS (3) software to evaluate Cronbach's alpha, composite reliability, average variance extracted, R-squared, item loadings, ß-values, t-statistics, standardized root mean square residual (SRMR), and heterotrait-monotrait ratio of correlations (HTMT), and correlations of the constructs. As this part requires the acceptability of a sample size greater than 100, most software are not stable with small sample size. However, SmartPLS is a popular software that solves sample size issues based on variability of the variables, which also provides a goodness of fit for the overall model with a small sample frame. In general, even if sample size is lower than 100, SmartPLS and its PLS-SEM approach are appropriate and stable (Lowry and Gaskin, 2014).

4. RESULTS

This chapter examines in detail the statistical results of the study. Results are presented in four sections. Section 4.1 starts with the analyses of the questionnaire, characteristics of the respondents, and the response rates based on the data collected from the survey using descriptive statistics. It identifies the job titles of respondents, the size of respondent organizations, industry type, the age of firm, and the annual turnover of the firm. In section 4.2, EFA analysis is applied to the proposed model using SPSS (22), describing the use of Eigenvalue criterion to select the factors. Section 4.3 describes why PLS approach is used, and 4.4 tests the hypothesized model and examines the validity and reliability of the constructs. Section 4.5 shows the results of the t-statistics for the proposed model and the adjusted model. Section 4.6 shows the correlations of the constructs, and 4.7 details the goodness of fit for the proposed model. Section 4.8 discusses the effect of the control (dummy) variables. Section 4.9 discusses the output of the research model.

4.1 Questionnaire Response Rate

The manufacturing firms targeted in the survey were all located in Canada. For the four rounds of questionnaires deployed to potential respondents and the campaign report (Appendix B) shows that 103 out of the 1135 companies have responded promptly. The questionnaires with missing values of more than fourteen percent were excluded by the SPSS imputation model, therefore after data is filtered, 94 data (8.3%) were considered usable for this study. Tables 4.1(a) – 4.1 (e) show the characteristics of the responding companies.

Table 4.1a shows the job titles of the respondents and those were ranged from the employee in charge of production to top executives. Top managers and senior managers (52%) were the most

frequently reported job titles in charge of management. Middle managers were about (31%), and approximately (17%) did not reveal their job titles. This result can be seen that the greening of the supply chain often require the top managers responses.

Table 4.1(a) Respondents managerial position (N=94)

Title	**Frequency**	**Percentage (%)**
CEO	7	7.4
Controller	2	2.1
COO	1	1.1
Environmental Management Representative	1	1.1
Manager	17	18.1
Operations manager	14	14.9
Procurement Manager	4	4.3
Production Manager	5	5.3
Senior manager	25	26.6
Team Leader	2	2.1
V.P. of Operations	1	1.1
Unknown	16	17.0
Total	*94*	*100.0*

Table 4.1(b) shows the statistics of the respondents with respect to their industry type and ISO certification. Most of the respondents (49 %) come from 5 industries: Automotive, Car and transport Equipment, Chemical Rubber and Plastic Products, computer and electronic products, Electrical equipment appliances and components, and Food and Food Processing Equipment industries. 34 % come from agriculture, construction tools, foundry, metal and plastic, packaging, paper, Pharmaceutical, satellite and telecommunications, steel, and cloths industries. In addition, around 16% of the companies are ISO 14000 certified and approximately 42 % with no

certifications, and a 41% with no indication of ISO 14000 certification. The car and transport equipment sector companies in this sample all have ISO14000 certification. All of the companies are classified as small- and medium-sized companies. Table 4.1b also shows the proportional number of targeted respondents of all manufacturing firms in Canada is 1135/1460=78 percent. The data were collected from Scott's directories (National business prospector unlimited) and Industry Canada (IC).

Table 4.1(b) Respondents' Industry type (N=94); IC= Industry Canada

Industry	**Number in the sample**	**Number in Canada**	**Percentage (%)**	**ISO 14000**	
				Yes	**No**
Agriculture machinery Equipment (IC)	2	37	2.1	1	1
Aluminum Coil Coating (Aluminium rolling)	1	20	1.1		1
Automotive vehicles manufacturing	10	45	10.6	1	4
Chemical Rubber and Plastic Products	7	37	7.4		3
Computer and peripheral equipment	9	144	9.6	1	6
Construction and building material	3	56	3.2		1
Electrical equipment , appliances and components	14	480	14.9	4	7
Food and Food Processing Equipment (Frozen food manufacturers)	6	75	6.4	1	4
Foundry, Iron foundry	2	53	2.1		
Hand tools (IC)	1	51	1.1	1	
Hospitality products	1	5	1.1	1	
Laboratory Products (medical equipment and supplies)	1	23	1.1		1
Mechanical connection systems of metal or plastic (Rubber, plastic hose and belting)	1	14	1.1		
Medical Disposable Products(medical equipment and supplies)	1	23	1.1		1
Metal and plastic fabricated construction products (IC)	1	56	1.1		1
Metal Castings and Metal Refining	2	6	2.1		2
Mouldings/wood products (industrial mould)	1	68	1.1		
Packaging and packaging bottles and jars(Plastic bottles)	2	37	2.1		2
Pulp and Paper manufacturing	3	26	3.2	3	
Pharmaceutical manufacturing	3	27	3.2		1
Satellite, telecommunications	1	122	1.1		1
Specialized equipment manufacturer for several industries(commercial &service equipment)	1	23	1.1		1

Steel, Steel LAB Products, and Sheet metal Manufacturing (Prefabricated metal)	3	17	3.2	2	1
Telecom and military (weapons- IC)	1	10	1.1		1
Wiping cloths/tack rags (textiles)	1	5	1.1		1
Total Yes/No			2.1	16.0%	42.6%
Unknown	16		17.0	41.5%	
Total	*94*	*1460*	*100.0*	*94*	*100%*

Table 4.1(c) shows the number of employees in the industry of respondents. There are 41 companies out of 94 (43.6%) with less than 100 employees, 22 of these (23.4%) have employees between 100 and 300, and only 4 companies (4.3%) have over 1000 employees.

Table 4.1(c) Respondents' firm size in terms of employees (N= 94)

Number of employees	**Frequency**	**Percentage (%)**
Under 10	6	6.4
10-50	15	16.0
51-100	20	21.3
101-300	22	23.0
301-500	10	10.6
501-1000	0	0.0
Over 1000	4	4.3
Unknown	17	18.1
Total	94	100.0

Table 4.1(d) shows the financial turnover of the industry in Canadian dollars (CAD). There are 32 companies out of 94 respondents (34.0%) make under 5 million dollars per year, 14 (14.9%) make under 10 million, 10 (10.6%) make under 15 million, 2 (2.1%) make under 20 million, 4 (4.3%) makes under 25 million, 1 (1.1%) make under 30 million, 15 (16.0%) make over 30 million a year and 16 companies (17.0%) did not reveal their capital. The data shows that most of the respondents are small to medium size enterprises. The main purpose of using descriptive analysis is to describe the basic features and characteristics of the data in this study.

Table 4.1(d) Respondents turnover in million CAD ($) dollars (N= 94)

Capital	**Frequency**	**Percentage (%)**
Under 5	32	34.0
5-10	14	14.9
11-15	10	10.6
16-20	2	2.1
21-25	4	4.3
26-30	1	1.1
Over 30	15	16.0
Unknown	16	17.0
Total	94	100.0

Table 4.1(e) shows the age of the industry in years. There are 7 companies out of 94 respondents (7.5%) under 5 years old, 13 (13.8%) under 10 years, 10 (10.6%) under 15 years, 6 (6.4%) under 20 years, 9 (9.6%) under 25 years, 7 (7.5%) under 30 years, 27 (28.7%) over 30 years old and 15 companies (16.0%) did not reveal about their industry age.

Table 4.1(e) Respondents' Age (N=94)

Capital	**Frequency**	**Percentage (%)**
Under 5	7	7.4
5-10	13	13.8
11-15	10	10.6
16-20	6	6.4
21-25	9	9.6
26-30	7	7.4
Over 30	27	28.7
Unknown	15	16.0
Total	94	100.0

4.2 Exploratory Factor Analysis

Before developing the hypothesis, the data from the survey were examined in SPSS for exploratory factor analysis (EFA) to find the number of factors to use in this research model, and to build the hypothesized model based on the EFA output. The extraction method on SPSS (22) was used to reveal the number of the significant factors for this model.

The SPSS Output shown in Table 4.2 lists the eigenvalues associated with each factor after extraction and rotation. The eigenvalues associated with each factor represent the variance explained by that particular linear component and the SPSS also displays the eigenvalues in terms of the cumulative percentage of variance explained (Table 4.2). If measures are affected by Common Method Variance (CMV), i.e. common method bias, the correlations among them can be inflated or deflated depending upon several factors. This is because exploratory factor analyses in SPSS rely on orthogonal rotations and items are equally weighted even though their factor loadings vary. In this case it is assumed that the CMV affects all variables, resulting that the first few factors explain relatively large amounts of variance (especially factor 1) because it has a large common shared variance on all constructs suggesting the absence of common method bias, whereas subsequent factors explain only small amounts of variance (Visinescu et al., 2015; Lindell and Whitney, 2001).

SPSS then extracts all factors with eigenvalues greater than 1, which leaves us with 8 factors at the beginning. Not all factors are retained in an analysis, meaning, the eigenvalues associated with a construct indicate the meaningful importance of that factor. However, some items are not related to the constructs and after dropping all items that their loadings is less than 0.50, it is logical to

retain only six factors that have an Eigenvalue greater than one (>1) for the proposed model are feasible. Together these six factors explain a total of 70.7 percent of the variance (see Table 4.2).

Table 4.2 Common method variance

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.162	39.234	39.234	12.162	39.234	39.234	6.156	19.857	19.857
2	3.610	11.645	50.878	3.610	11.645	50.878	4.782	15.426	35.283
3	2.085	6.727	57.605	2.085	6.727	57.605	3.949	12.740	48.023
4	1.604	5.173	62.778	1.604	5.173	62.778	2.561	8.261	56.284
5	1.371	4.421	67.200	1.371	4.421	67.200	2.291	7.389	63.673
6	1.083	3.493	70.693	1.083	3.493	70.693	2.176	7.020	70.693
7	.971	3.131	73.824						
8	.817	2.636	76.459						
9	.787	2.539	78.998						
10	.717	2.312	81.310						
11	.629	2.029	83.340						
12	.586	1.891	85.231						
13	.506	1.634	86.865						
14	.460	1.484	88.349						
15	.424	1.368	89.717						
16	.410	1.324	91.041						
17	.341	1.100	92.141						
18	.326	1.052	93.193						
19	.293	.946	94.139						
20	.266	.859	94.997						
21	.227	.733	95.730						
22	.218	.703	96.433						
23	.210	.676	97.110						
24	.164	.528	97.638						
25	.151	.487	98.124						
26	.138	.447	98.571						
27	.123	.397	98.968						
28	.101	.327	99.294						
29	.096	.309	99.603						
30	.071	.230	99.833						

31	.052	.167	100.000						

Extraction Method: Principal Component Analysis.

Another technique for a quick glimpse of all the eigenvalues that are greater than one (> 1) is by using the scree plot. The graph of the scree plot (Figure 4.1) shows the eigenvalues on the vertical axis (Y) and the variables associated with on the horizontal axis (X), and the coordinates of (X,Y) represents the value of the eigenvalue to represent a significant variable. Therefore, the cut-off point for selecting factors should be at the point of inflection of the curve. The scree plot represents the research sample used for this research and it appears that the point of inflection is at the factor 6. Even though scree plots are very valuable, factor range should not be based on this criterion alone. Kaiser (1960) recommended the retention of all eigenvalues that are greater than 1.

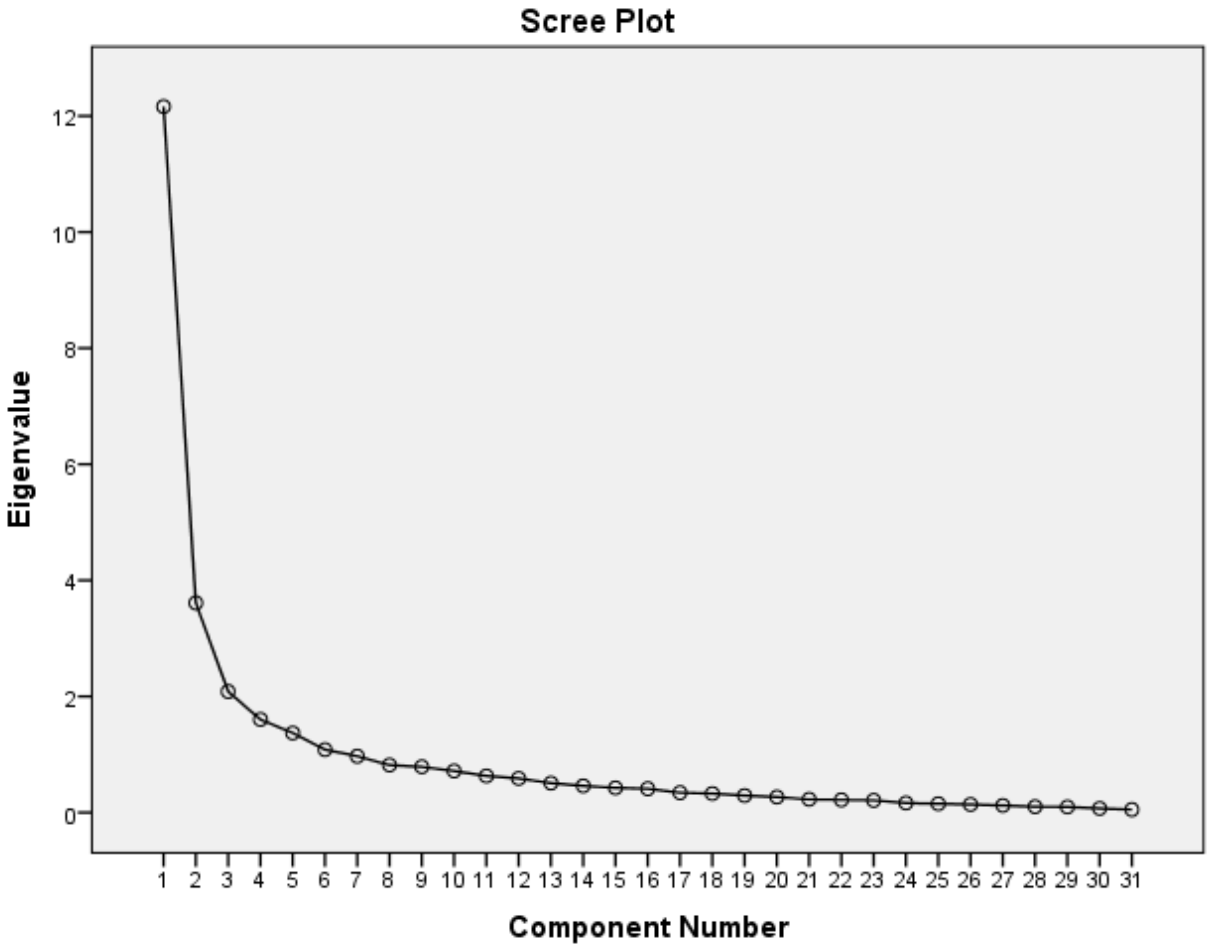


Figure 4.1 Eigenvalue scree plots

The study tested the measurement properties of the constructs using exploratory factor analysis (EFA) in SPSS, rather than confirmatory factor analysis (CFA), because CFA is a tool used to confirm or reject the measurement theory for an existing theory and EFA is used for new model building. Lowry and Gaskin (2014) suggested that EFA provides a more powerful tool when a model has not been established. In addition, they suggested that EFA is appropriate when sample size is smaller than 100, and CFA is appropriate when sample size is greater than 100. The item loadings after filtering are all above 0.50 (Table 4.3), which indicates interactions among the items.

Table 4.3 Significant EFA factors output

Rotated Component Matrix						
	Component					
	1	2	3	4	5	6
GTS3	.828					
GSS7	.814					
GSS5	.812					
GSS3	.786					
GTS1	.780					
GTS4	.751					
GTS2	.747					
GTS5	.732					
GSS4	.650					
STP3		.826				
STP1		.799				
STP4		.781				
STP5		.776				
STP2		.738				
PDI7			.824			
PDI2			.783			
PDI1			.771			
PDI3			.697			
PDI6			.627			
PPI1			.571			
MGC2				.702		
MGC5				.623		
MGC3				.618		
MGC1				.581		
CMP4					.807	
CMP6					.717	
CMP5					.684	
FNP4						.740
FNP6						.734
FNP5						.552
FNP1						.523
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.						
a. Rotation converged in 7 iterations.						

The Kaiser-Meyer-Olkin (KMO) and the related Bartlett's test provide a measure of appropriateness of factor analysis; 0.90 is very good, 0.80 is good, and less than 0.50 is

unacceptable. The value of the KMO Measure of Sampling Adequacy for this set of variables shows 83.2% which is labelled as good and consistent (Table 4.4). The Bartlett's test of sphericity tests the significance level of all the variables; and the test indicates that there are correlations in the data set that are appropriate for factor analysis.

Table 4.4 KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.832
Bartlett's Test of Sphericity	Approx. Chi-Square	2205.371
	df	465
	Sig.	.000

4.3 CB-SEM vs PLS-SEM

The reason for choosing the partial least based PLS-SEM over the co-variance based CB-SEM is straightforward. If the purpose of the research is strict theory testing, then the appropriate method is CB-SEM. In contrast, if the research goals is prediction and theory development, then the appropriate method is PLS-SEM. Conceptually and practically, PLS-SEM is similar to using multiple regression analysis (Hair et al., 2014). The use of PLS-SEM in SmartPLS delivers a more stable results and reliable than other software when data is less than 100.

4.4 Validity and reliability

Nunnally (1967) suggested that values as low as 0.50 are acceptable for initial construct development. Although a value of 0.70 was subsequently recommended by Nunnally (1978), and

items with their loading less than 0.70 are considered not reliable. Therefore, all items with a loading of less than 0.70 were deleted to increase the overall validity of the model. However, some variables such as the STP6 (pressures from regulations) on the EFA was not significant but it had 0.652 in the hypothesis testing, and when removed it has lowered the t-value of stakeholder pressure construct to product design/process innovation and therefore is decided to be included in the process because it was related to many items that have a significant effect on some of the variables. Item MGC1 is also affecting the overall t-values and was discarded from the process. Moreover, the estimates of all of the average variance extracted (AVE) of the latent variables were greater than the cut-off point (0.50) suggested by Fornell and Larcker (1981). Therefore, the tests exhibit convergent validity. The Cronbach's Alpha for these six latent constructs were calculated to test the reliability of the questionnaire. The reliability measures are listed in Table 4.5.The Cronbach's Alpha of each item is more than 0.75 and less than 1.0 (0.75 < Cronbach Alpha < 1.0), which means that the questionnaire has high reliability. In terms of composite reliability (CR), the values for all constructs were between 0.84 and 0.96 and are greater than the recommended value of 0.70. That means the measures of the constructs are highly reliable in terms of their internal consistency. Appendix D shows the bar graphs of AVE, CR, and Cronbach Alpha.

Table 4.5 Validity and reliability measures

Factors	**Average Variance Extracted (AVE))**	**Composite Reliability (CR)**	**Cronbach's Alpha (α)**	**Item code**	**Item Loadings**
Competitive advantage	.676	.862	.758	CMP4 CMP5 CMP6	.894 .760 .808

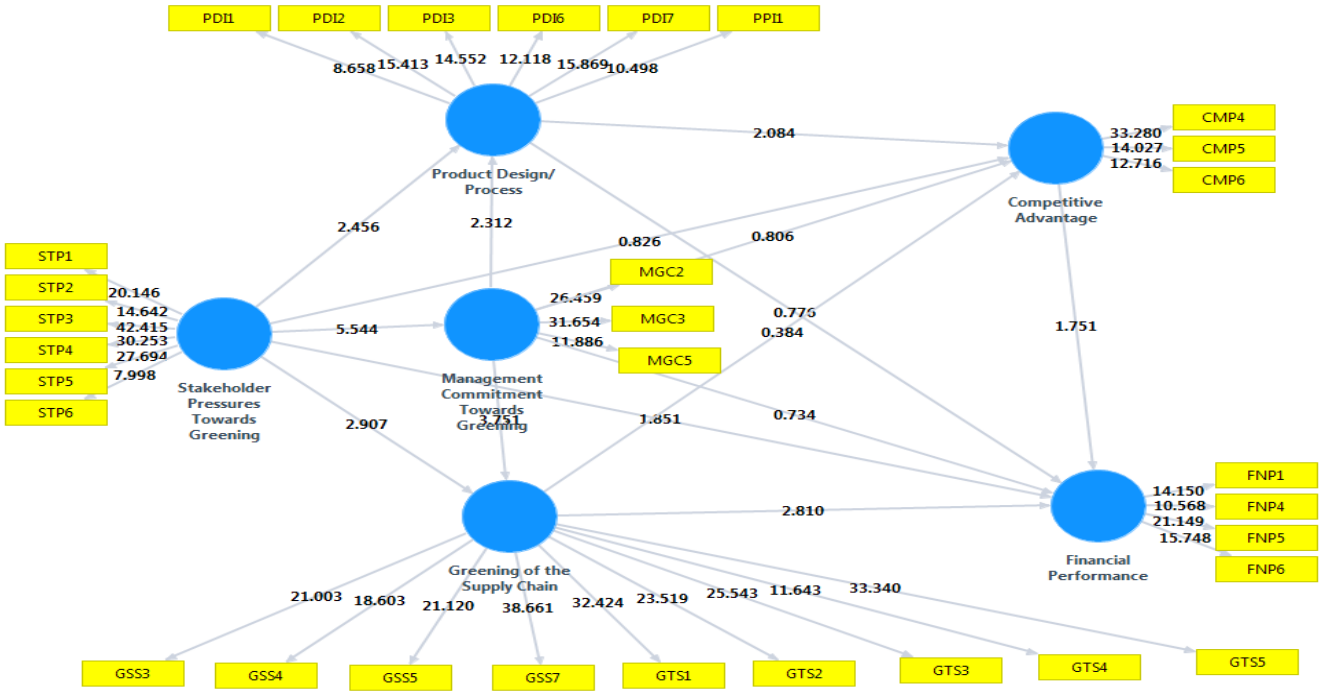
Financial performance	.585	.849	.766	FNP1 FNP4 FNP5 FNP6	.767 .703 .807 .779
Greening of the supply chain	.722	.954	.945	GSS3 GSS5 GSS7 GTS1 GTS2 GTS3 GTS4 GTS5	.830 .838 .892 .864 .868 .878 .742 .873
Management commitment towards greening	.697	.873	.783	MGC2 MGC3 MGC5	.879 .865 .755
Product design/process	.609	.903	.872	PDP1 PDP2 PDP3 PDP6 PDP7 PPI1	.761 .802 .812 .744 .806 .755
Stakeholder pressures towards greening	.676	.925	.902	STP1 STP2 STP3 STP4 STP5 STP6	.847 .816 .885 .866 .845 .652

4.5 Results of the structural model: t-statistical significance

The structural model with path coefficients are to test 14 hypotheses, as shown in Table 4.6. The threshold point for the t-values must be greater than or equal to 1.96 to be significant. All values less than 1.96 are considered insignificant. The first structural model test with path coefficients is illustrated in Figure 4.4. The path coefficients are measured to test these hypotheses between six latent constructs: ‘‘Stakeholder pressures towards greening represents an independent variable; whereas all the others are dependent variables, which are ‘‘product design /process innovation’’, ‘‘management commitment towards greening’’, ‘‘greening of the supply chain’, financial

performance and ‘‘competitive advantage’’. The causal effects between these latent variables in Figure 4.4 shows that out of the 14 proposed hypothesis, only 7 constructs were significant.

Figure 4.4 Hypothesized Structural Model Results



However, after some adjustments and deletion of the paths that were not significant, 9 out of 14 of the proposed hypothesis were found significant. The final survey data support nine of the fourteen hypotheses, as shown in Table 4.6 and Figure 4.5.The results were based on direct effect rather than the mediation effect. Therefore, nine hypothesis were found perfectly significant for the proposed model.

Figure 4.5 Adjusted model

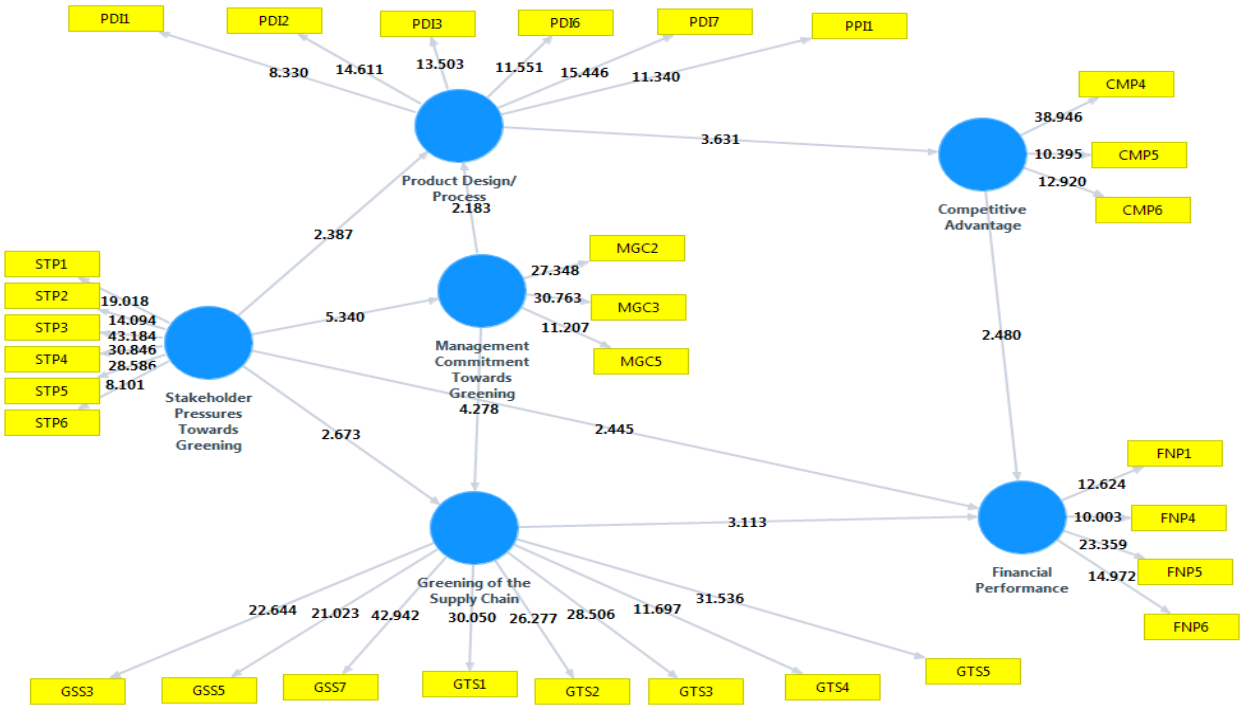


Table 4.6 Results of the structural model: t-statistical significance

Hypotheses	**Support (Yes/No)**	**Path coefficient**
H1: Stakeholder pressures have a significant positive relationship to product design/process innovation	Yes	2.387*
H2: Stakeholder pressures have a significant positive relationship to management commitment towards greening	Yes	5.340*
H3: Stakeholder pressures have a significant positive relationship to greening of the supply chain	Yes	2.673*
H4: Stakeholder pressures have a positive relationship to competitive advantage	No	.826
H5: Stakeholder pressures have a positive relationship to financial performance	Yes	2.445*
H6: Management commitment towards greening have a positive relationship Product design/process innovation	Yes	2.183*
H7:Management commitment towards greening have a positive relationship to greening of the supply chain	Yes	4.278*
H8:Product design/process have a positive significant relationship to competitive advantage	Yes	3.631*
H9:Product design/process have a positive significant relationship to financial performance	No	.775

H10:Management commitment towards greening have a positive relationship competitive advantage	No	.806
H11:Management commitment towards greening have a positive relationship financial performance	No	.734
H12:Greening of the supply chain have a significant positive relationship to competitive advantage	No	.384
H13:Greening of the supply chain have a significant positive relationship to financial performance	Yes	3.113*
H14: Competitive advantage have a positive relationship to financial performance	Yes	2.480*

(*, represent p level of significance at 0.05)

4.6 Discriminant Validity

The discriminant validity assessment ensures that a construct has the strongest relationships with its own indicators in comparison to any other construct in PLS path modelling (Hair et al., 2014). The discriminant validity has 3 criteria: the Fornell-Larcker Criterion, Heterotrait-Monotrait ratio of correlations (HTMT), and SRMR. The Fornell-Larcker criterion entails that the squared correlation between each pair of constructs should be less than the AVE estimates for each individual construct. Comparing the correlation coefficients given in Table 4.7, we can conclude that all of the squared correlations are smaller than the AVE for each individual construct. Therefore, these results together provide evidence of discriminant validity among the theoretical constructs. In the case where there is no constructs validity, reliability approximation may not be relevant (Fornell and Larcker, 1981).

Table 4.7 Fornell-Larcker criterion

Correlations of the Constructs	Competitive Advantage	Financial Performance	Greening of the Supply Chain	Management Commitment	Product Design/Process Innovation	Stakeholder Pressures towards greening
Competitive Advantage	.822					
Financial Performance	.462	.765				
Greening of the Supply Chain	.296	. 584	.850			
Management Commitment Towards greening	.396	.518	.643	.835		
Product Design/Process Innovation	.473	.416	.288	.472	.781	
Stakeholder Pressures towards greening	..386	.568	.563	.521	.479	.822

Heterotrait-Monotrait ratio of correlations (HTMT) method shows the direct and indirect effects of the constructs. If the HTMT value is below 0.90, discriminant validity has been established between two constructs (Henseler et al., 2015). Table 4.8 shows the correlations of the constructs.

Table 4.8 Heterotrait-Monotrait ratio of correlations (HTMT)

Correlations of the Constructs	Competitive Advantage	Financial Performance	Greening of the Supply Chain	Management Commitment	Product Design/Process Innovation	Stakeholder Pressures towards greening
Competitive Advantage	.1					
Financial Performance	.608	1				
Greening of the Supply Chain	.305	.661	1			
Management Commitment Towards greening	.511	.654	.737	1		
Product Design/Process Innovation	.582	.511	.302	.558	1	
Stakeholder Pressures towards greening	.463	.664	.601	.613	.530	1

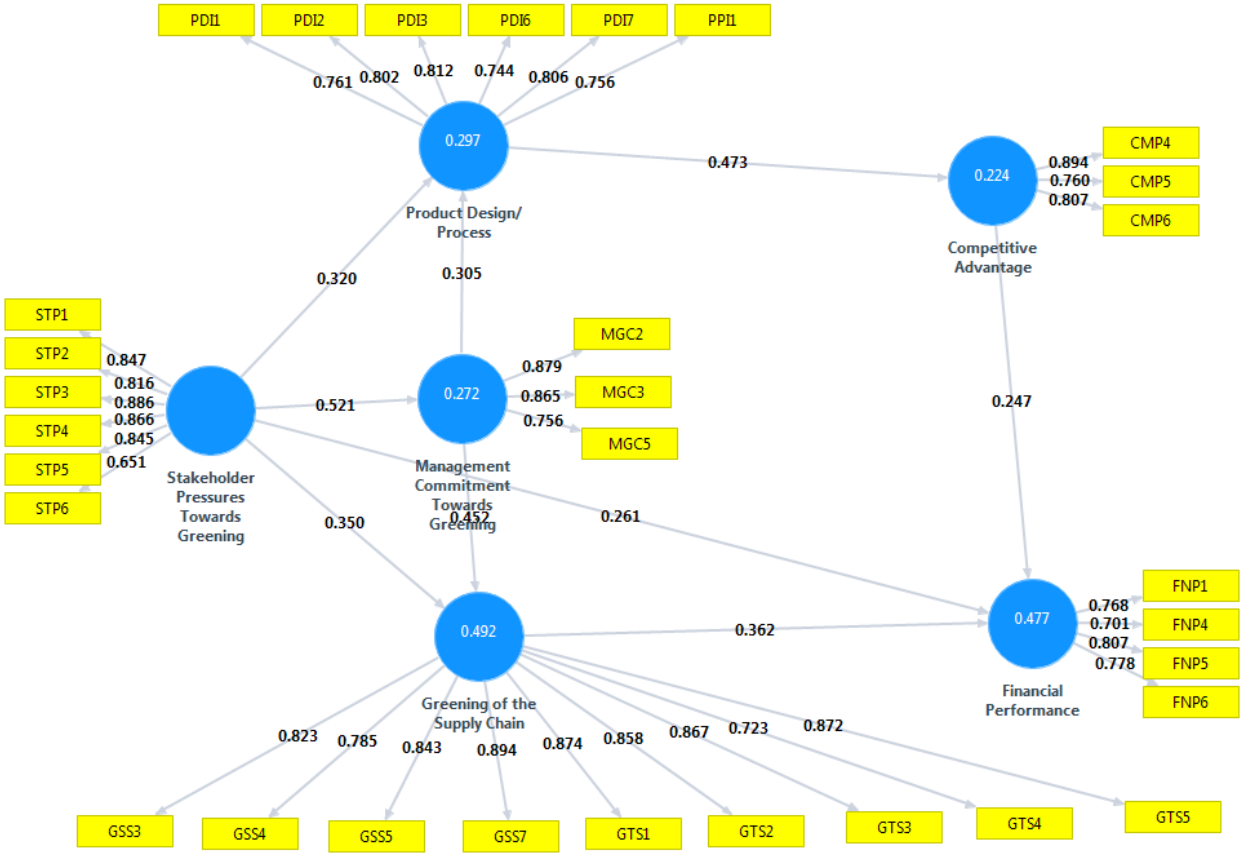
4.7 Goodness of fit of the model

The SRMR is the overall goodness of fit (GOF) measure for PLS-SEM modelling. Therefore, the SRMR is defined as the difference between the observed correlation and the predicted correlation. As Hair et al. (2014) suggested that a value less than 0.10 is considered a good fit. The SRMR for this model is approximately 0.09 (9.0%) which is interpreted as a good overall model fit. The R^2 beta values indicate how much of the dependent variable, can be explained by the other variables. The R^2 value ranges between 0.224 and 0.492 which represents the good correlations among variables. It indicates a high degree of correlation among all variables.

Figure 4.4 shows the results of the R-squared and the beta values of the constructs. Another method of finding the goodness of fit of the model is by using the relative chi-square ($\chi 2$).The relative $\chi 2$ statistics (GOF= $\chi 2$/d.f.) ratios equals the chi-square divided by the degrees of freedom. The

criterion for suggested by different researchers varies, ranging from less than 2 (Ullman, 2001) to less than 5 (Schumacker & Lomax, 2004).The relative χ2 statistics of this data is 2245.944 at 465 degrees of freedom implies that χ2/d.f. = 4.74 which is less than 5 and therefore the criterion for the model fit is accepted.

Figure 4.4 R-squared and Beta (β) values

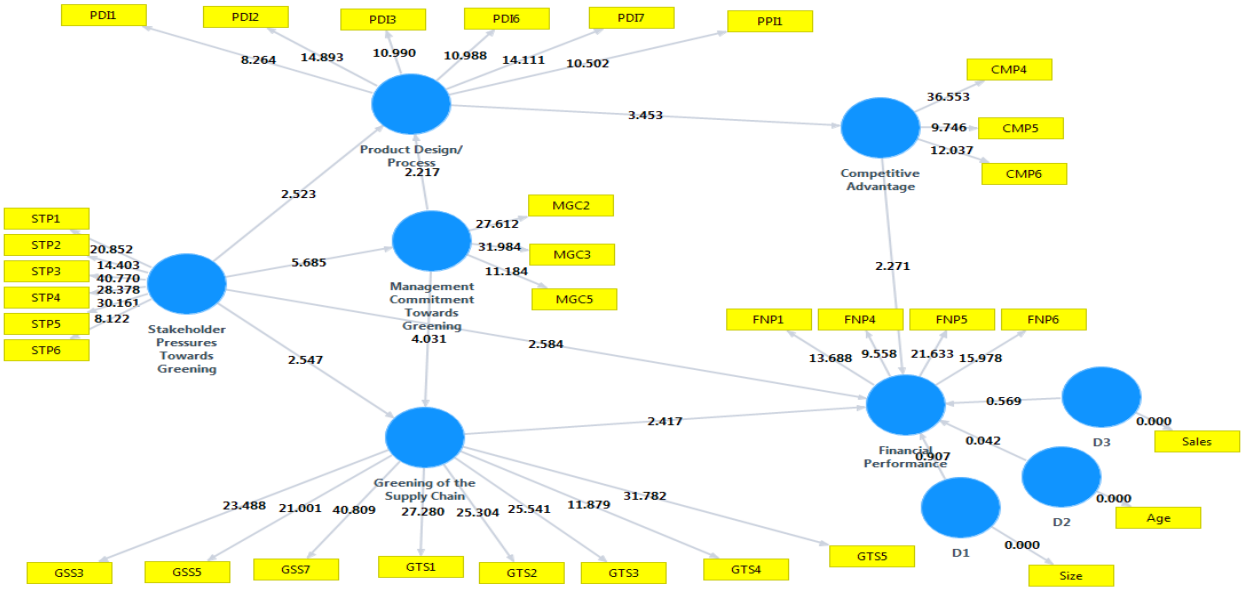


4.8 Control variables

This study has made an initial effort to find the effects of control (dummy) variables on financial performance by adding three control variables (age, size, sales) from the data to examine their roles on SME manufacturers' financial performance. Figure 4.5 shows the results of the control

variables. The control variables shows no indication of direct effect on the financial performance of the companies. The t-values of age, size, and sales are all not significant, and these control variables did not alter the significance of the constructs.

Figure 4.5 T-Statistics with control variables



5. CONCLUSION

5.1 Summary

Based on this study, Canadian companies have made improvements in GSCM practices, encouraged by stakeholders and consumer demands. The findings suggest that stakeholder pressures towards greening are the basis of sustainability; they drive the greening of production and the greening of supply chains and use the most perceived pressure on manufacturing firms, which mirrors the findings of previous studies (e.g. Darnall et al. 2010; Yu and Ramanathan,2014; Ghobadian, 2009; Chien and Shih, 2007; Sarkis et al., 2010; Chiou et al., 2011; Zhu et al., 2010; Sharma and Henriques, 2005; Zhu et al., 2005; Zhu and Sarkis, 2007).

In summary, business organizations are facing environmental challenges in the fulfilment of the daily needs of the global stakeholders. The stakeholder theory is broad and subjective that may or may not support the results of this study based on managers' perception on pressures coming from various stakeholders. However, according to the Stakeholder theory, managers' perception of stakeholder pressures will drive companies to the compliance of regulations and managerial commitment practices, which most of the results in this study were consistent with previous studies (e.g. Sarkis et al., 2010; Sharma and Henriques, 2005; Yu and Ramanathan, 2014; Chien and Shih, 2007) that highlight the important role of stakeholder pressures in improving green supply chain practices.

5.2 Discussion

The most unexpected finding in this study is a statistically significant direct link between stakeholder pressures towards greening and financial performance that have not been materialized

previously. The direct effect is verified by the hypothesis testing and appears to have a statistical support. The study supports the argument implied in other studies on the relationship between stakeholder pressures towards greening and GSCM practices (product design/process, management commitment towards greening, and greening of the supply chain) (Hypotheses 1, 2, 3). Changes or innovation created from stakeholder pressures is perceived to bring quality management commitment programs or product design/process reengineering that may have played a role to gain competitive advantage through product design/process innovation.

The respondents were arguably environmentally conscious based on their perception on product design/processes due to the reduction of hazardous substances from their products, but the output of this result shows no support that management commitment towards greening would have a direct impact on competitive advantage (Hypothesis 10). It can be assumed that management has impact on product design/processes innovation and that these skillful innovative progresses deliver value to their stakeholders and the organization. This, in turn, brings about organizational competitiveness and generates wealth to the organization's stakeholders. That way, managerial commitment has an effect on performance through indirect relationships.

The findings in support of Hypothesis 5 suggest that stakeholder pressures towards greening (i.e. the marketing department, customer needs) helps improve financial position of the firm by investing in green supply chain. Firms' perception on implementing greening of the supply chain may use EMS within cross-functional collaboration with other suppliers on how to design environmentally friendly products with the compliance of the EMS. The perceived pressures from stakeholders on management commitment (H3) on the greening of the supply chain suggests that

management requires to build close relationships with customers, suppliers for green purchasing, design specifications on environmental requirements, environmentally friendly design of material and energy that lowers the accumulation of waste and toxic materials. A significant improvement in the greening of the supply chain requires internal environmental audit programs. However, the study shows that few companies were ISO 14000 series certified; yet this cannot be definitive because approximately 42% of the participants did not respond to this question. ISO certified suppliers are required to follow the regulatory guidelines and environmental requirements, which may lead to a good reputation in the eye of customers. Supported hypotheses 6 and 7 suggest that managerial commitment has a statistically significant positive relationship with product design/process innovation and the greening of the supply chain. This is logical because, if companies attain excellence in their customer satisfaction in relation to their product design and development, product design and innovation skills, and quality of products will give competitive advantage to the firm and hence, promote new business opportunities and create wealth (H14).

Figure 5.1 Final validated model (with positive relationships)

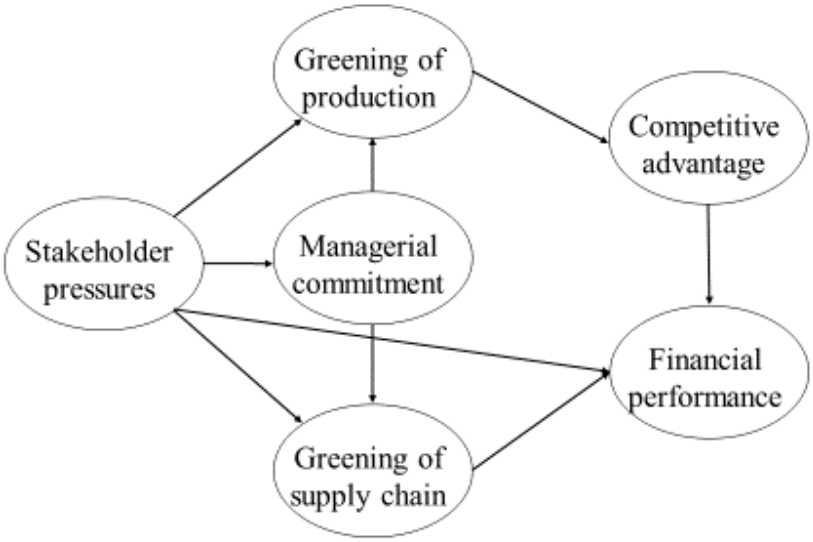


Figure 5.1 illustrates the final validated model and the relationships are interpreted as follows:

1) Stakeholder pressures towards greening are the basis of sustainability; they drive the greening of production and the greening of supply chains.

2) The stakeholder pressures in most literatures do not recognize an impact on financial performance; the results of this study show they advance financial performance.

3) Innovative green production (products/processes) leads to competitive advantage, while green supply chain management contributes to financial performance.

4) Commitment of senior management is imperative for the greening of production and the greening of supply chains.

5) Implementation of a closed loop production system (green production and green supply chain) creates wealth in terms of competitive advantage and financial performance.

5.3 Implications of the Study

An eye opener results of this study provide a number of managerial implications that may help a new insights concerning green supply chain management practices for manufacturers. The study may help researchers to extend their literature on the implementation of GSCM practices. The following points provide a summary of the key implications:

1) The study offers theoretical arguments on the relationships between stakeholder pressure and corporate greening and confirms empirically the relations between constructs in the model.
2) The resulting model builds upon three academic literature streams (stakeholder theory, corporate sustainability, and corporate performance) and extends the current understanding of GSCM.
3) The study provides support for the argument that greening of a company's supply chain can increase their competitiveness and lead to better economic performance rather than create merely costs.
4) The study offers the validated model as a basis for optimization research in the field of operations management by showing the relative impacts of green production and GSCM on performance.
5) The study suggests that managers in manufacturing companies should commit themselves to greening of production and supply chains, and implement GSCM practices in order to achieve long-term and short-term gains.

5.4 Limitations of the Study

This study has some limitations that would open doors for opportunities to further research studies. First, the study focused on a variety of Canadian manufacturing companies that differ in regards to the production line of their products rather than on a specific chosen industry within Canada. To increase generalizability of the research, specific industries in different locations of the globe should be investigated. The second limitation of this study is its exploratory rather than affirmative nature and the generalizability because of the small sample size; i.e. the low number of respondents (94) in the data. The third limitation of this research is that the study was not based on highly polluting industrial sectors (e.g. fossil and fuels, logistics) with their magnitude in emissions. Fourth, although the study addressed control factors when testing corporate performance effects, the analysis did not establish and test rival models, nor considered whether some of the control factors, such as size, sales, and age, would in fact be a driver of greening. For instance, one could argue that large companies have more resources to initiate greening of production and the supply chain.

5.5 Future Research Opportunities

Environmental sustainability in business is becoming a global challenge, and for this reason the study should be expanded by developing other, rival measurement models to develop good assessment on greening of the supply chains. Apparently, environmental management is somewhat subjective, i.e. managers of a firm claim their operations are environmentally friendly, even though it is nothing but big words or environmentally friendly operations have a very minor role in their business. Considering these aspects is a challenge due to the lack of objective data. Thus, academics should provide a diagnostic tools to help companies evaluate and measure their

capabilities on environmental issues. Extensive research is needed in this area to save future generations by bringing new innovations into the market (e.g. Tesla electric vehicles).

The increasing political, economic and social pressures unrest, regarding environmental pollution over the last few decades in the Canadian manufacturing industry have motivated firms to consider greening by enhancing their product design/process innovation. Investigating this study for comparative analysis in different countries will be another relevant research direction. Such international comparisons might help to find out whether the identified constructs of green operations are stable globally or reflective of different locations and cultures around the globe. Another important factor to consider is that studies have to investigate industry specific practices to be more objective than subjective. In the future research, more specific measurement items and rival models should be involved to evaluate the outcomes of greening by including financial indices, innovativeness of the firm, and a detailed environmental performance measures, as well as the awareness of ISO 14001. Other objective measures to examine green practices need to be developed, and performance data should be objective data to provide more accurate results.

5.6 Lessons from tools used

This study used the Partial Least Squares based Structural Equation Modeling (PLS-SEM) approach. The analyses were performed using SmartPLS, an easy-to-learn PLS-SEM software with a graphical user interface that can deliver a great value for variance-based causal modeling of individual and grouped variables. Despite the widespread availability of technical information on PLS, many GSCM researchers do not use PLS; rather, they use co-variance based modeling software such as Lisrel and Amos. These software are expensive and unstable when data is small

or hard to understand when theoretical base for hypotheses is weak. Thus, the key lessons regarding the tools include: For exploratory work, PLS-SEM should be selected. For confirmatory work, either covariance-based SEM or PLS-SEM may be used. Either way PLS works. In other words, PLS is an interactive software similar to a manual coding based multiple regression method. PLS gave this study a strength in building and testing the proposed model. Particularly, it allowed the model to extract the causal relationship between the latent (unobserved) variables and the manifest (observed) variables.

In this study, the preliminary EFA testing was conducted using SPSS, which was also knit and easy. However, the new version 3.0 of the SmartPLS has EFA built-in for model building. SmartPLS 3.0 is efficient in testing hypotheses using the variance-based path modeling analysis that provide results of the validity and reliability of the items including their constructs; e.g. Cronbach's alpha, composite reliability, average variance extracted, R-squared, item loadings, ß-values, t-statistics, standardized root mean square residual (SRMR) that provide the goodness of fit of the overall model, and the heterotrait-monotrait ratio of correlations (HTMT) that gives the direct and indirect causal relationship of the variables (correlations of the constructs). As a final word, statistical research on complex business phenomena such as stakeholder pressures and their consequences on organizational practices and corporate performance benefits significantly from the PLS-SEM method and subsequent tools.

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Appendices

Appendix A Survey Questionnaires

Green Supply Chain Management Practices

This questionnaire intends to collect information on green supply chain management practices amongst Canadian manufacturers. Some Questions can have multiple answers. Please feel free to ask surveyor if you need more information about the questions. The Likert scale is between 1-5: 1=Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.

Question 1: Stakeholder pressures

We are increasingly experiencing a lot of pressure to adopt environmentally friendly practices from

		1	2	3	4	5
STP1	Customers	○	○	○	○	○
STP2	Supply chain partners (e.g. supplier)	○	○	○	○	○
STP3	Actions by competitors	○	○	○	○	○
STP4	Marketing department	○	○	○	○	○
STP5	Shareholders	○	○	○	○	○
STP6	Regulators and legislators	○	○	○	○	○
STP7	Environmental activists or organizations	○	○	○	○	○

Question 2: Product design Innovation

In our product development, we prefer

	1	2	3	4	5
PDI1 using less or non-polluting/toxic materials	○	○	○	○	○
PDI2 designing and improving environmentally friendly packaging	○	○	○	○	○
PDI3 endorsing recycling	○	○	○	○	○
PDI4 using eco-labeling	○	○	○	○	○
PDI5 practices that minimize waste when designing a product	○	○	○	○	○
PDI6 considering opportunities for reuse/recycling/recovery of material	○	○	○	○	○
PDI7 substituting for more environmentally friendly alternatives	○	○	○	○	○

Question 3: Product process innovation

In the production process, we consistently endorse to

	1	2	3	4	5
PPI1 lower consumption of water, electricity, gas and petrol during production/use/disposal	○	○	○	○	○
PPI2 recycling, reuse and remanufacturing of materials and parts	○	○	○	○	○
PPI3 use of cleaner or renewable technologies to reach savings (such as energy, water, waste)	○	○	○	○	○
PPI4 redesign of production and operation processes to improve environmental efficiency	○	○	○	○	○
PPI5 redesign and improvement of products or services to meet new environmental criteria or directives (e.g. environmental directive)	○	○	○	○	○

Question 4: Managerial innovation

Our company's management is committed to

	1	2	3	4	5
MGI1 clear annual targets for energy conservation, recycling or waste reductions	○	○	○	○	○
MGI2 a clear environmental mission statement to guide environmental decision-making	○	○	○	○	○
MGI3 well-defined responsibilities for an environmental manager and/or an environmental team	○	○	○	○	○
MGI4 regular training programs to our employees to improve their awareness in protecting the environment	○	○	○	○	○
MGI5 continuously monitoring the quality of our environmental practices	○	○	○	○	○

Question 5: Greening the supplier

We consider green suppliers or subcontractors to meet environmental criteria primarily based on

	1	2	3	4	5
GTS1 certification such as ISO14000	○	○	○	○	○
GTS2 their participation in our environmental awareness seminars and training sessions	○	○	○	○	○
GTS3 their compliance to our environmental technical advice	○	○	○	○	○

GTS4 their involvement in the early product design and development.	○	○	○	○	○
GTS5 our auditors report to assess the environmental performance of suppliers	○	○	○	○	○

Question 6: Green Supplier selection

We select suppliers or sub-contractors primarily based on

	1	2	3	4	5
GSS1 their capacity to meet the needs of the enterprise	○	○	○	○	○
GSS2 cost components	○	○	○	○	○
GSS3 environmental compliance and acceptance of auditing programs	○	○	○	○	○
GSS4 ISO 14001 certification	○	○	○	○	○
GSS5 environmental management systems	○	○	○	○	○
GSS6 informal assessment criteria	○	○	○	○	○
GSS7 consistently monitoring a set of environmental criteria that suppliers must meet	○	○	○	○	○

Question 7: Environmental performance

Our company has performed significantly better in the following areas

	1	2	3	4	5
ENP1 important environnement relate certifications	○	○	○	○	○
ENP2 targets imposed on energy conservation, recycling or waste reductions	○	○	○	○	○
ENP3 decrease of consumption for hazardous/harmful/toxic materials	○	○	○	○	○
ENP4 Reduction of air emission	○	○	○	○	○

Question 8: Competitive advantage

Our company has performed significantly better in the following areas …

	1	2	3	4	5
CMP1 reduction of hazardous waste and emissions	○	○	○	○	○
CMP2 consumption of less resources, such as energy, water, electricity, gas and petrol	○	○	○	○	○
CMP3 compliance to environmental regulations	○	○	○	○	○
CMP4 customer satisfaction in relation to product design and development	○	○	○	○	○

CMP5 product design and innovation skills	○	○	○	○	○
CMP6 quality of products and services	○	○	○	○	○
CMP 7production cost	○	○	○	○	○

Question 9: Financial performance

Our company has performed significantly better in the following areas …

	1	2	3	4	5
FNP1 decrease of cost for materials purchasing	○	○	○	○	○
FNP2 decrease of cost for energy consumption	○	○	○	○	○
FNP3 decrease of fee for waste treatment	○	○	○	○	○
FNP4 decrease of fine for environmental accidents	○	○	○	○	○
FNP5 decrease of operational cost	○	○	○	○	○
FNP6 decrease of training cost	○	○	○	○	○
FNP7 decrease of fee for waste discharge	○	○	○	○	○

Question 10: Societal performance

We always maintain/present …

	1	2	3	4	5
SOP1 an environmentally or socially responsible image	○	○	○	○	○
SOP2 public opinion/societal expectation	○	○	○	○	○
SOP3 good ethical practice or information	○	○	○	○	○

Questions 11 - 17: Company's profile 11. What is the main sector of your manufacturing activity?

- ☐ Computer and electronic product
- ☐ Electrical equipment , appliance and components
- ☐ Chemical, rubber and plastic products
- ☐ Car and transport equipment
- ☐ Pharmaceutical
- ☐ Paper
- ☐ Food
- ☐ Other, please specify... _____

12. Is your company ISO14000 certified?

- ○ Yes
- ○ No

13. Please indicate your managerial position in the company?

- ☐ CEO
- ☐ Senior manager
- ☐ Manager
- ☐ Operations manager
- ☐ Production Manager
- ☐ Procurement Manager
- ☐ Team Leader
- ☐ Other, please specify... _____

14. How many people does your company employ? (Size)

- ○ (1) Under 10
- ○ (2) Between 10 and 50
- ○ (3) Between 51 and 100
- ○ (4) Between 101 and 300
- ○ (5) Between 301 and 500
- ○ (6) Between 501 and 1000
- ○ (7) Over 1000

15. When was the business established? (Age)

- ○ (1) Less than 5 years
- ○ (2) 5 - 10 years
- ○ (3) 11 -15 years
- ○ (4) 16 - 20 years
- ○ (5) 21 - 25 years
- ○ (6) 26 - 30 years
- ○ (7) Over 30 years

16. What was the turnover of your business unit in 2013? (In million (M) dollars $) (Sales)

- ○ (1) Less than 5 M
- ○ (2) 5 - 10 M
- ○ (3) 11-15 M
- ○ (4) 16 - 20 M
- ○ (5) 21 - 25 M
- ○ (6) 26 - 30 M
- ○ (7) Over 30 M

17. Do you like to have a copy of this research paper?

- ☐ No
- ☐ Yes, Please provide your e-mail address _____

Appendix B Campaign Report

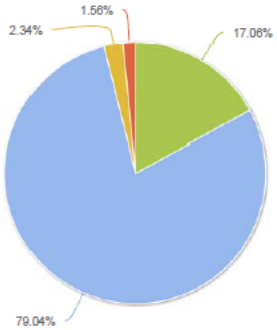
Campaign Report

BIG_3RDP_020215-carleton

Overview

Delivery	
Total Emails Sent	1,025
Delivered	985
Permanent Bounces	16
Temporary Bounces	24
Bounce %	3.90%
Spam Reports	0 out of 71 possible
Spam %	0.00%
Opens (HTML Only)	
Total Opens	307
People Who Opened	168
Opened %	17.06%
Click-Thrus (HTML & Text)	
Total Click-Thrus	58
People Who Clicked-Thru	45
Click-Thru %	4.57%
Click To Open Ratio %	26.79%
Replies	
Total Replies	0
People Who Replied	0
Reply %	0.00%
Unsubscribed	
Unsubscribed	0
Unsubscribed %	0.00%
Forward To A Friend	
Total # Forwards	0
Subscribed	
Total # Subscribed	0

Open Ratios



Click Ratios

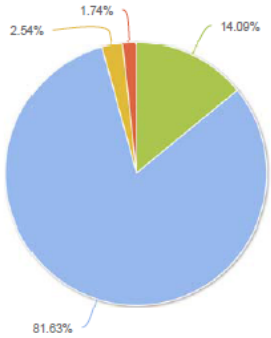
Click-Thrus

URL	Desktop Clicks	HTML Clicks	Mobile Clicks	TEXT Clicks	Other Clicks	Total Clicks
http://fluidsurveys.com/surveys/faisal-faza-Q9F/green-supply-chain-management-practices/	49	52	1	0	1	52
http://fluidsurveys.com/surveys/faisal-faza-Q9F/green-supply-cha	5	0	0	5	0	5
http://www.businessinformationgroup.ca/common_scripts/EmailV4/CustomSubscription.aspx?RID={email_address}&PC={Unsub_Code}	1	1	0	0	0	1

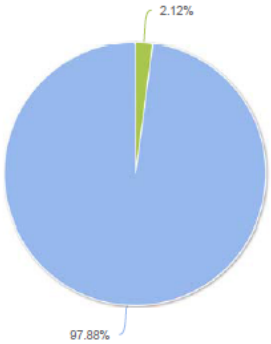
Overview

Delivery	
Total Emails Sent	1,379
Delivered	1,320
Permanent Bounces	24
Temporary Bounces	35
Bounce %	4.28%
Spam Reports	0 out of 97 possible
Spam %	0.00%
Opens (HTML Only)	
Total Opens	307
People Who Opened	186
Opened %	14.09%
Click-Thrus (HTML & Text)	
Total Click-Thrus	47
People Who Clicked-Thru	28
Click-Thru %	2.12%
Click To Open Ratio %	15.05%
Replies	
Total Replies	0
People Who Replied	0
Reply %	0.00%
Unsubscribed	
Unsubscribed	0
Unsubscribed %	0.00%
Forward To A Friend	
Total # Forwards	0
Subscribed	
Total # Subscribed	0

Open Ratios



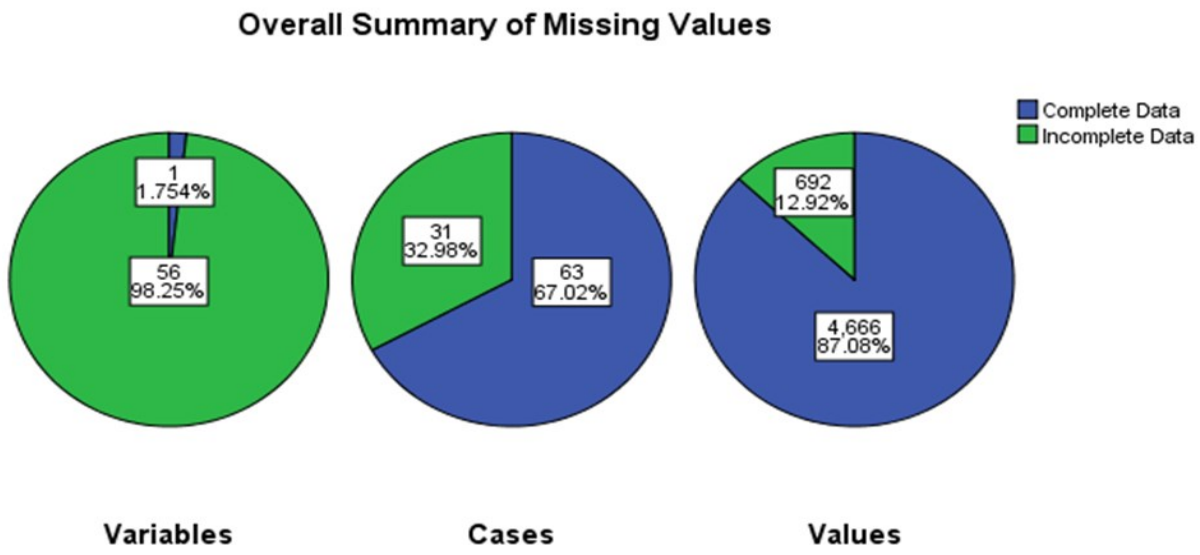
Click Ratios

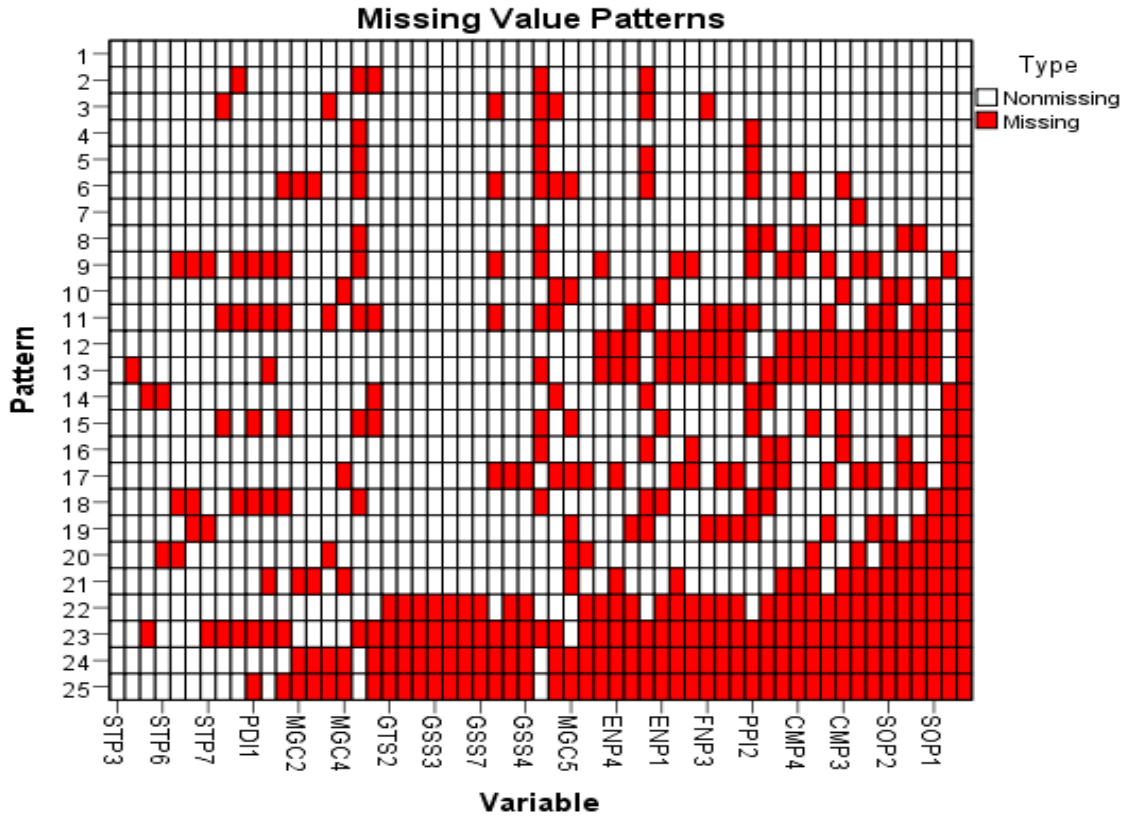


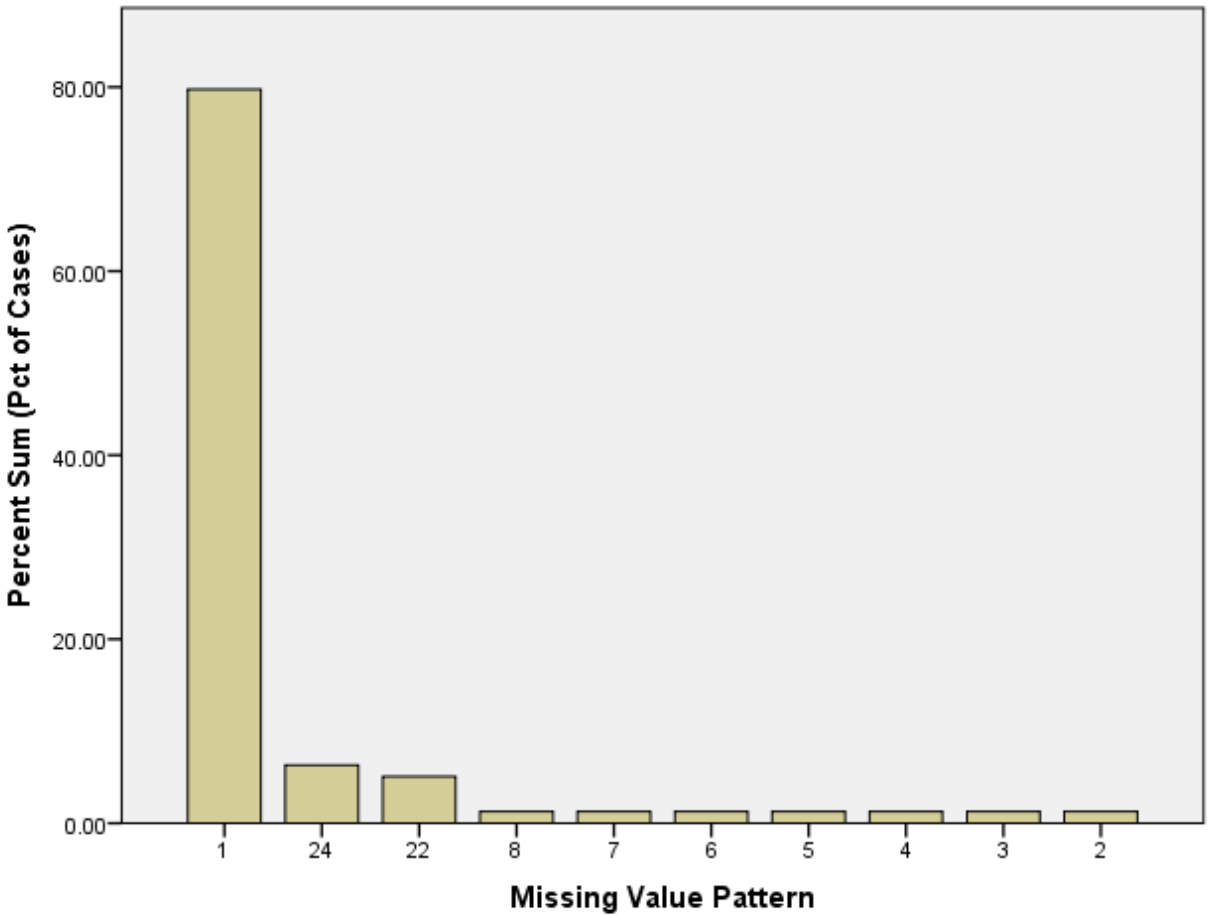
Click-Thrus

URL	Desktop Clicks	HTML Clicks	Mobile Clicks	TEXT Clicks	Other Clicks	Total Clicks
http://fluidsurveys.com/surveys/faisal-faza-Q9F/green-supply-chain-management-practices/	32	33	1	0	0	33
http://fluidsurveys.com/surveys/faisal-faza-Q9F/green-supply-cha	4	0	0	4	0	4
http://www.businessinformationgroup.ca/privacy	3	3	0	0	0	3
http://www.businessinformationgroup.ca	3	0	0	3	0	3
http://accountservices.ca/Customer_Care/faces/jspx/casl-main-url.jspx?	3	0	0	3	0	3
http://accountservices.ca/Customer_Care/faces/jspx/casl-main-url.jspx?pubprodcode={Unsub_Code}&useremail={email_address}&webuseroid={webuseroid}	1	1	0	0	0	1

Appendix C Imputation Model

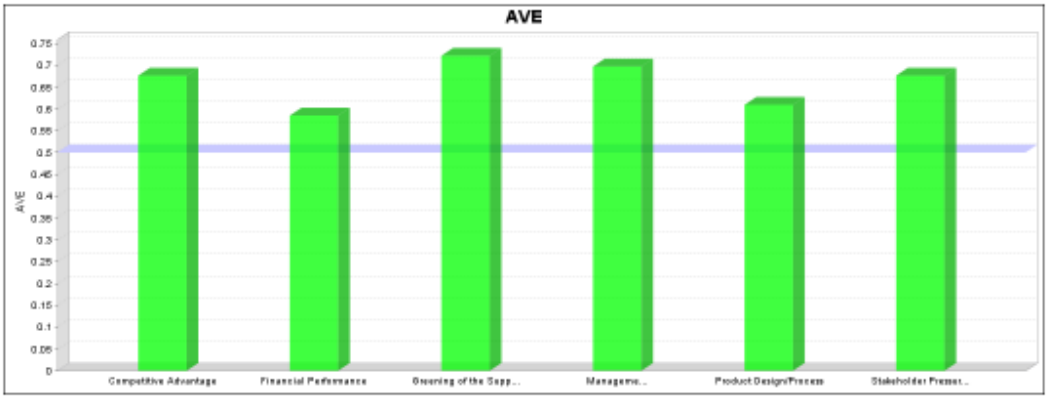


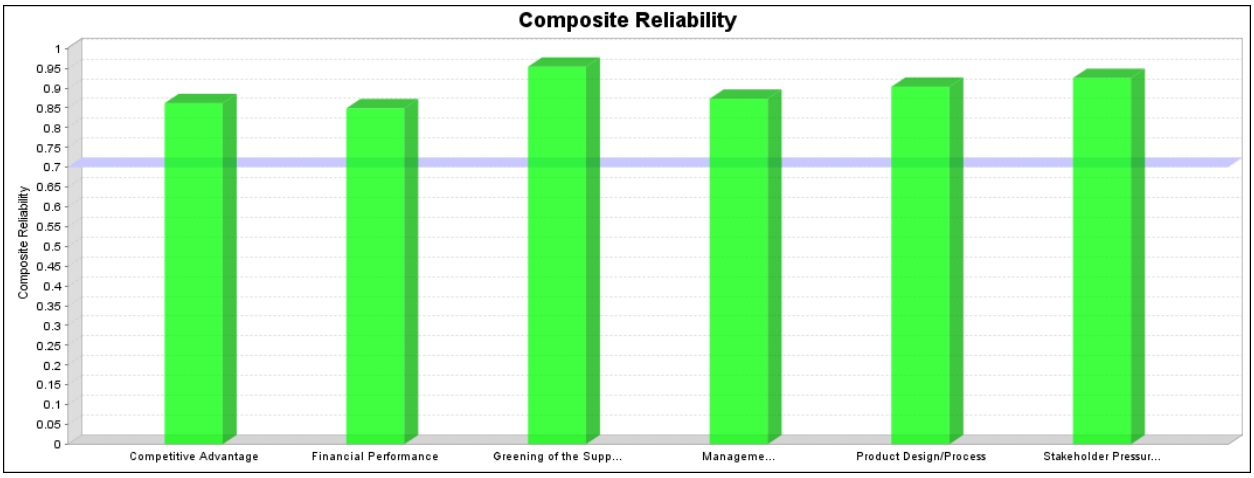


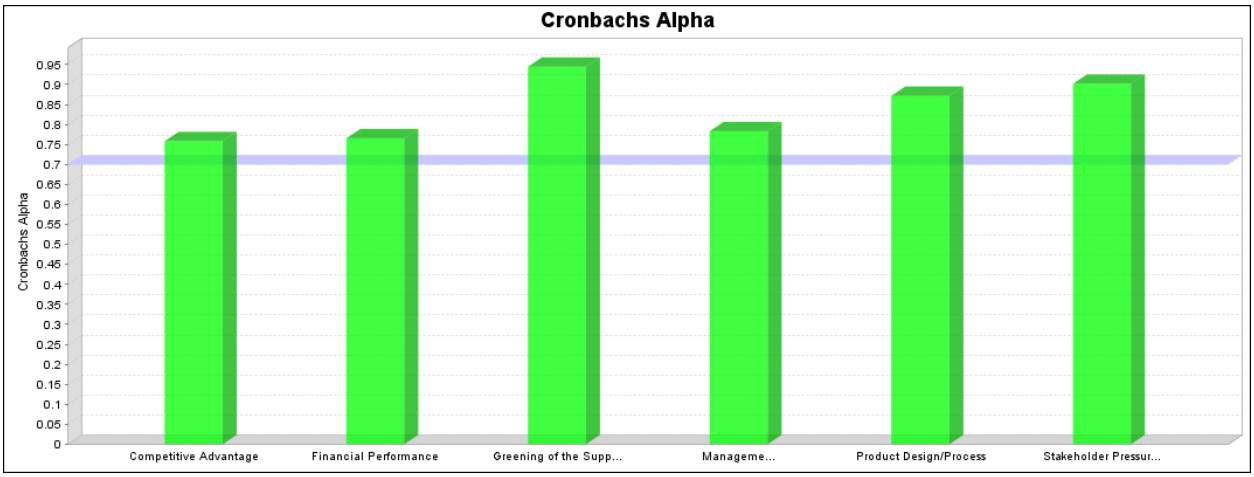


The 10 most frequently occurring patterns are shown in the chart.

Appendix D AVE, CR, Cronbach's Alpha






Cronbachs Alpha
Cronbachs Alpha
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Competitive Advantage
Financial Performance
Greening of the Supp...
Manageme...
Product Design/Process
Stakeholder Pressur...