Impact of Adoption of Sustainable Supply Chain Management Practices on a Firm's Performance

by

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Abstract

Increasing awareness of the importance of ecological and social aspects of effects of business operations has led to a growing interest in sustainability. To this end, many firms are adopting supply chain management practices that are expected to foster sustainability along their supply chains. This research studies the effect of drivers on adoption of sustainable supply chain management (SSCM) practices and impact of this adoption on the performance of a firm. Effect of size on the latter impact is also studied. For this, we follow Elkington's (1997, 1999, 2006) triple bottom line model of a firm's sustainability comprising of economic, environmental and social aspects. After an exhaustive literature review, the hypotheses proposed in this study were tested by an empirical study. Survey data was gathered and analyzed using multiple regression analysis and structural equation modeling. The results of this study provide substantial insights into the effects of SSCM practices and their relation to firm performance.

Acknowledgements

Era. noun \ ˈer-ə , ˈe-rə , ˈir-ə \ a : A long and distinct period of history with a particular feature or characteristic. b : A stage in development (as of a person or thing).

Epoch. noun \ ˈe-pək , ˈe-ˌpäk \ An extended period of time usually characterized by a distinctive development or by a memorable series of events.

If we were to measure a lifetime in events, a significant one in my life is represented by the document that lies beneath this page. The completion of this degree has perhaps taken a bit longer than it should have. At the end of this era, I want to take this opportunity to thank the people in my life who have had patience to rival saints.

I would like to thank my supervisor, Dr. Vinod Kumar, whose constant guidance and efforts made this a reality despite his busy schedule.

I would like to extend my gratitude to a very diligent committee, Dr. Uma Kumar, Dr. David Cray and Dr. Alan Cai; a special thank you to Dr. Balbinder Deo.

With eternal gratitude to my parents, and with thanks to my daughter and son, I would like to dedicate this thesis to my wife.

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Chapter 1 Introduction

1.1 Preamble

This thesis deals with the study of the impact of adoption of sustainable supply chain practices on the performance of a firm. For this research, we follow Elkington's (1997, 1999, 2006) triple bottom line model of a firm's sustainability which comprises of economic, environmental and social aspects of sustainability, and wherein all three "pillars" are assumed to be essential for a firm's long-term sustainability or success.

Various pressures, or drivers, are assumed to make a firm adopt management practices which can lead the organization to sustainable existence and survival over long-term in harmony with the ecological environment and society. These management practices are expected to have an impact on the economic, ecological and social performance of the organization. They are also expected to affect its operational performance.

For this research, we use the definition of Seuring and Muller (2008) for defining the term sustainable supply chain management (SSCM). They define SSCM as "The management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements" (Seuring & Muller, 2008, p. 1700).

1.2 Motivation for this research

Supply chain management and sustainability and have become important or even critical topics of research in the area of a firm's operations and its effect on ecological environment and society (Corbett & Kleindorfer, 2003; Kleindorfer *et al*., 2005; Linton *et al.,* 2007; Meixell & Luoma, 2015;). In business practice, environmental and social issues increasingly are a part of - and are dovetailed into - a business's competitive and operational strategies (Porter & Van der Linde, 1995; Shrivastava, 1995; Hart, 1995, 1997; Sharma & Vredenburg, 1998; Angel & Klassen, 1999; Hart & Milstein, 1999; Bansal & Roth, 2000; Matos & Halt, 2007; Beske & Seuring, 2014). At the same time, as supply chains expand across national boundaries, driven by the rising outsourcing and globalization requirements (Mann *et al*., 2008) the focus of research in sustainability shifts from firms to the supply chains in entirety (Linton *et al*., 2007; Seuring *et al*., 2008; Ortas *et al*., 2014). Examining the nature of historical growth trends, while the research focus has grown from that on the economic aspect to encompass environmental and social aspects, all three aspects are not yet treated equally. Environmental issues in supply chain management have been attracting a lot of interest recently. A substantial part of the previous research has focussed on environmental aspects and reverse logistics (Mann *et al*., 2008), but the incorporation of social issues is relatively sparse (Carter& Easton, 2011; Seuring & Muller, 2008).

As the field evolves, a number of names have been used to denote, what are, sometimes overlapping areas of study. Some of the areas that have attracted substantial

attention over the past two decades are reverse logistics (RL), closed loop supply chain management (CLSCM), green supply chain management (GSCM) and sustainable supply chain management (SSCM) and corporate social responsibility (CSR).

Figure 1.1 below offers a diagrammatic representation of the inter-relationship between terms RL/CLSCM/GSCM/SSCM, as used by researchers in this field. It indicates various areas of study that are evolving and the overlap of various knowledge domains.

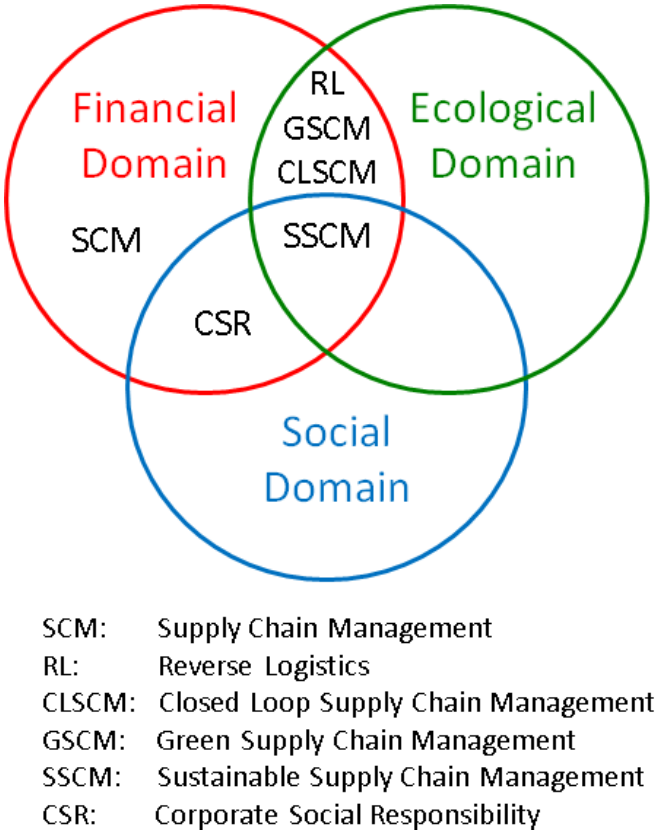

Figure 1.1 Research Domains of RL/CLSCM/GSCM/SSCM and their overlap (Adapted from Xu & Gursoy, 2015; Carter & Rogers, 2008)

The relative interest in some of these areas can be inferred from academic research papers published and listed by some popular electronic databases.

Table 1.1 below provides an insight into the level of research interest in these topics

Table 1.1 *Number of Published Academic Research Papers Indicating Research Interest in Reverse logistics/ CLSCM/GSCM/SSCM*

Area of Study	Definition	Number of Scholarly Articles Listed on Business Source Complete in March 2014 (where title includes the words)	Number of Scholarly Articles Listed on Business Source Complete in March 2015 (where title includes the words)	Number of Scholarly Articles Listed on Business Source Complete in Feb. 2018 (where title includes the words)	Number of Scholarly Articles Listed on Scholars Portal in March 2014 (where title includes the words)	Number of Scholarly Articles Listed on Scholars Portal in March 2015 (where title includes the words)	Number of Scholarly Articles Listed on Scholars Portal in Feb. 2018 (where title includes the words)
Supply Chain Management	SCM "encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers"(Shi & Yu, 2013)	**1600**	**2095**	**2746**	**1338**	**1776**	**1929**

Corporate Social Responsibility	CSR is defined as "the notion that corporations have an obligation to constituent groups in society other than stockholders and beyond that prescribed by law or union contract, indicating that a stake may go beyond mere ownership" (Jones, 1980). However, recent definitions have been trying to enlarge the scope, with some encompassing economic, and ecological spheres as well (Dahlsrud, 2008).	**1895**	**2473**	**3315**	**1113**	**1891**	**2519**
Reverse Logistics	that is, "Reverse logistics is a process in which a manufacturer systematically accepts previously shipped products or parts from the point of consumption for possible recycling, remanufacturing, or disposal.", Dowlatshahi (2000)	**229**	**349**	**363**	**203**	**276**	**312**
Green Supply Chain Management	"Integrating environmental thinking into supply-chain management,including product design, material sourcing and selection, manufacturing	**81**	**96**	**166**	**77**	**105**	**147**

	processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life." (Srivastava, 2007, p 54)						
Closed Loop Supply Chain Management	"a closed-loop supply chain includes the returns processes and the manufacturer has the intent of capturing additional value and further integrating all supply-chain activities. Therefore, closed loop supply chains include traditional forward supply-chain activities and the additional activities of the reverse supply chain. These additional activities include product acquisition, reverse logistics…testing, sorting, and disposition… refurbishing to enable the most economically attractive of the options: direct reuse, repair, remanufacture, recycle, or disposal, and remarketing…" Guide *et al.*, (2003b, p3)	**8**	**3**	**8**	**9**	**14**	**16**

Sustainable Supply Chain Management	"The management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements." (Seuring & Muller, 2008, p. 1700)	**56**	**71**	**146**	**54**	**76**	**132**

In addition to overlapping research areas, sustainability research is also affected by the use of different definitions of sustainability by different researchers who often bring the construct of "sustainable development" (e.g. Seuring & Muller, 2008) into the discussion. With environmental concerns gaining ascendance with the general populace as well as the political class, different terminology is used by them at various *fora* adding to the complexity. Boundaries are made further fuzzier as the field is multi-disciplinary with considerable overlaps as well as specializations. On environmental and social issues, the relative claims and pressures of various 'stakeholders' do not lend themselves to overall clarity; and verifying or validating the miscellaneous *locus standi* becomes a complex process with countervailing views bearing in.

All these complexities do not deter researchers, and sustainable supply chain management is gathering attention of both practitioners and researchers (Corbett & Kleindorfer 2003; Corbett & Klassen 2006), to the extent that the research question "whether it pays to be green" (e.g., Russo and Fouts 1997; Pagell, Yang, Krumwied and Sheu 2004) is *passé* and seems to have become outdated (Pagel & Wu, 2009; Pagell & Shevchenko, 2014). This question has now been replaced by issues beyond, and researchers increasingly assume that adoption of SSCM practices is *fait accompli* (Kleindorfer, *et al*., 2005; Corbett & Klassen 2006). Pagell and Shevchenko (2014) go to the extent of stating that now SSCM should not be a separate research field. Instead, sustainability issues should form an integral part of every research on SCM.

The seeming progression of the field apart, unless a clear case can be made out that it is in the long-term interest of the firm to adopt SSCM practices, the interest in SSCM may be difficult to sustain. Introducing sustainability issues into board-room discussions without a definite idea of the impacts on performance cannot create traction. Various drivers like legislation or stakeholder pressures may make firms to adopt sporadic steps to 'keep ahead of the law,' but it may not lead to a long-term attitudinal change. Strategic decision-making would need clearly-defined sustainability objectives backed by validated research on the impact of sustainable practices on performance. Specific research to cover these concerns is needed in the sustainability area, which has now become important and relevant for the long-term future of business. This insight has motivated the current research.

1.3 Research Objective

The objective of this research was to study the effect of drivers on adoption of sustainable supply chain management practices, and further, to study the impact of adoption of sustainable supply chain management practices on the performance of the focal firm. The moderating effect of the size of a firm on the impact of adoption of SSCM practices on performance was also studied.

1.4 Outline of the Thesis

The current chapter first provides an introduction to the research topic, then briefly introduces the research objective of this study and lastly describes the organization of this document. In chapter two, recent research on the topic is discussed, which covers a review of the academic literature on sustainable supply chain management including green supply chain management. The gaps in current research in the area are also identified. In chapter three, research questions are framed, keeping in mind the identified gap in research, and a theoretical framework is developed to address the research questions. In chapter four, the research methodology adopted for the study is presented. Chapter five describes data preparation and is followed by descriptive statistics in chapter six. Data analysis using multiple regression is presented in chapter seven, while path analysis using structural equation modeling is presented in chapter eight. Chapter nine presents the research findings followed by a discussion on the findings. Chapter ten provides a conclusion to the research by summarising the salient findings of the thesis. The thesis is appended with a list of references and the survey instrument used for the research.

Chapter 2 Literature Review

In this chapter, the relevant etymology and definition of sustainability are discussed followed by a brief introduction to supply chain management. Extant literature on sustainable supply chain management and green supply-chain management is then reviewed to ascertain the state of research in the area and to identify the gaps therein.

2.0 Etymology and Definition of Sustainability

The construct 'sustainable supply chain management' raises different images in the minds of practitioners and academics alike, to a great extent, due to different meanings ascribed to the word "sustainable". Being a relatively recent construct, it would be useful to begin by examining the etymological roots of this concept. The Compact Oxford English Dictionary (Oxford, 2010) defines the word "sustainable" and "sustain" as follows:

"sustainable

• **adjective** **1** able to be sustained.

2 (of industry, development, or agriculture)

avoiding depletion of natural resources.

— DERIVATIVES **sustainability** noun **sustainably** adverb.

sustain

• **verb** **1** strengthen or support physically or mentally.

2 bear (the weight of an object).

3 suffer (something unpleasant).

4 keep (something) going over time or continuously.

5 confirm that (something) is just or valid.

— DERIVATIVES **sustainer** noun **sustainment** noun.

— ORIGIN Latin **sustinere**, from **tenere** 'hold'."

In a close parallel, Cambridge Advanced Learner's Dictionary (Cambridge, 2010) defines "sustainable" as follows:

"sustainable

/səˈsteɪ.nə.bl/ adj

•**adjective** **1** able to continue over a period of time

2 causing little or no damage to the environment and therefore able to continue for a long time”

It would appear that the general public or practitioners are more attuned to the first meaning of “sustainable” and the fourth meaning of “sustain”. Such an understanding might be the reason that the first five practitioners consulted about the topic “sustainable supply chain” interpreted the phrase as: a supply chain that can be sustained over the years, or where suppliers and distributors of a focal company have the capacity to sustain business fluctuations over an extended period. An inquiry into the origin of the word “sustainable” supplants the fact that this impression is not without a basis (Table 2.1):

Table 2.1 *Etymology of words “sustain” and “sustainable”*

Sr.	Word	Etymology	Source
1	**sustain**	**late 13c**., from O.Fr. sustenir "hold up, endure," from L. sustinere "hold up, support, endure," from sub "up from below" + tenere "to hold" (see tenet).	Harper (2010)
2	**sustainable**	**1610s**, "bearable," from sustain + -able. Attested from 1845 in the sense "defensible;" **from 1965** with the meaning "capable of being continued at a certain level." Sustainable growth is recorded from **1965**. Related: Sustainability (**1972**).	Harper (2010)

Note. Source: Harper (2010)

It is observed that the second meaning of "sustainable" (in Table 2.1 above) started evolving only as recently as 1965, and the use of "sustainability" was recorded as late as 1972. Allowing some time for diffusion of the new usage, it is understandable that managers at senior positions would still be retaining the original (or the first) meaning of "sustainable" in their mental *schemas*. This has important implications for the questionnaire used in this study. This change of use can be mapped in tandem with the rising prominence of environmental protection in the political agenda in the late 1960s and 1970s (Vermeulen & Seuring, 2009) when "producers of commodities originally were addressed on the externalities connected to their products by national and local governments, with regulative approaches" (p. 269). Considering these concerns a decision was made not to use the term sustainability in the questionnaire.

The first known definition of "sustainability" (in the context of development) appeared in the *Brundtland Report* (WECD, 1987) also known as *Our Common Future.* In this report, sustainability is defined as "using resources to meet the needs of the present without compromising the ability of future generations to meet their own needs", without addressing the related questions about future needs of resources, the levels of pollutants that can be safely released, the possibilities of finding new resources, the degree of "renewability" of renewable resources, the role of market forces and technology, and the need for new policies and life styles (Linton *et al*., 2007). This has led to an ongoing discourse on 'sustainability' and the need for change in lifestyle and other issues (Hart, 1997; Myers; 1997; Vincent & Panayatou, 1997; Kemp, 1994),

sometimes without even addressing the questions relating to "future needs". This underlines the need to crystallize the domain of sustainability over time.

2.1 Supply Chain Management

The rise of competition in market, the need to protect margins, cross-border trade growing into globalized trade has made it imperative to focus on the supply chain phenomenon over the last four decades (Houlihan, 1985; Gunasekaran *et al*., 2001). Older supply chains were 'lean and mean' and effective, given the limited infrastructure and communication facilities available in those times. Using camel convoys via overland "Silk Route" from China to Europe and using "Old Spice" sea route around Cape of Good Hope, these supply chains spawned numerous business and political empires and involved hundreds of thousands of people. They sustained over a long time, braving dangers and high "taxation" *en route*. These supplier-manufacturer-distributor-retailer-customer chains worked in "free markets," reaching customers across national boundaries, functioning 'at arm's length,' a concept that is still in vogue.

With the rise of bigger businesses and corporations, it became expedient to take control of the entire supply chain, right from the mines to the market; US Steel and Shell are leading examples of this phenomenon. Henry Ford wrote in 1926, "Our production cycle is about eighty-one hours from the mine to the finished machine in the freight car…" (Morgan, 2004 p. 529), underlining his thinking, which was far ahead of his times. In the face of competition, and to face bigger corporations, smaller organizations were seen to forge long-term associations upstream with their suppliers and downstream with

their distributors; on the other hand, some larger monolith organizations faced 'downsizing' in the name of 're-engineering' and took to 'outsourcing'. Focussing on their core business was cited to be the "*mool mantra*" or the key to success, as opposed to the monolithic business model that targeted the mopping up of all the profit margins from "mines to market." This gave rise to supply chains of "intermediate" maturity, closely knit but still rooted in paper-based manual systems. With the exchange of information becoming "real time," supported by low-priced easily-available information systems and the Internet, electronic data interchange started becoming the norm and information became actionable. This resulted in seamless inter-linkage of the members of a supply chain, which became "mature" or "advanced" with an efficient triple-flow system, that of information, goods, and finance. Acting as a 'single entity,' these supply chains can be seen competing globally (Mann *et al*., 2008), even though some of the dominating partners in the chain (e.g., Walmart) may have an overarching lead role to play. It cannot be ruled out that in the future, some of these chains may merge to form 'multi-national' organizations having a 'global control system' (Morgan, 2004) completing the cycle of becoming monolithic organizations once again, though with a different character and ownership structure. Also, pressures of interoperability and cooperation push members of a supply chain towards isomorphism, with the need for "synchronization and standardization of practices of business processes" (Blanc *et al*., 2007 p.720) catalyzing this change.

The increasing importance of supply chains has ignited research interest in supply chain management (SCM). Simchi-Levi *et al*. (2003, p1) define supply chain

management as "a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system-wide costs while satisfying service level requirements". Despite the above definition being almost all-encompassing, it stands to reason that different types of supply chains, from small triads to transnational chains, need different types of systems and management styles for efficient management. It is, however, generally assumed that the goal of SCM is to ensure that the final customer gets quality goods and services at a competitive price (Ellram & Cooper, 2014).

In recent decades, with rising environmental awareness, supply chains have come under scrutiny for their impact on the environments and societies where they operate. Also, anecdotal news reports create a feeling that some of the supply chains that operate trans-nationally escape regulations by working their way across various jurisdictions and thus can adopt supply chain management practices that may not be sustainable. This makes research in the sustainability of supply chains much more interesting, a brief overview of which is presented in the next section.

2.2 Sustainable Supply Chain Management

From the mid-1990s, social and environmental impacts of supply chains started evincing the keen interest of researchers (Drumwright, 1994; Murphy *et al.,* 1994). This interest saw a rise in research activities in a number of sub-areas. Table 2.2 below

provides a brief list of sub-areas demarcated for study by early researchers in this field (Seuring & Muller, 2008; Rajeev *et al.,* 2017).

Table 2.2 *Research Focus of Some Early Studies in SSCM Area*

Sr.	Research Focus	Authors
1	Closed Loop Supply Chain	Agrawal *et al*., 2015; Govindan *et al.* 2015a; Tao and Yin, 2014; Sheriff *et al.,* 2012; Hazen *et al.,* 2012; Hazen, 2011; Chan *et al*., 2010; Setaputra and Mukhopadhyay, 2010; Melo *et al.,* 2009; Pokharel and Mutha, 2009; Rubio *et al*., 2008; Atasu *et al.,* 2008; Meade *et al*., 2007; Prahinski and Kocabasoglu, 2006; Chu and Song, 2004.
2	Cost management	Seuring, 2001
3	Decision making	Sarkis, 2003
4	Drivers	Paulraj *et al*., 2017; Esfahbodi *et al.,* 2017; Mann *et al*., 2010
5	Dyadic relationships	Carter, 2000
6	Environmental issues	Lamming & Hampson, 1996; Preuss, 2005
7	Environmental issues in logistics	Abkhader & Jönson, 2004
8	Ethical issues	Carter, 2000; Davies and Crane, 2003; Roberts, 2003
9	General Review	Rajeev *et al*., 2017; Sambrani and Pol , 2016; Fahimnia *et al.*, 2015; Brandenburg *et al*., 2014; Bhatia and Chand, 2014; Winter and Knemeyer, 2013; Seuring, 2013; Tang and Zhou, 2012; Abbasi and Nilsson, 2012; Ashby *et al*., 2012; Gupta and Palsule-Desai, 2011; Carter and Liane Easton, 2011; Gold *et al.,* 2010; Linton *et al.,* 2007
10	Green Design	Baumann *et al*., 2002
11	Green Distribution	Lin *et al.,* 2014; Demir *et al.,* 2014; Dekker *et al*., 2012; Foulds and Luo, 2006
12	Green Manufacturing	Paul *et al.,* 2014; Chu *et al*., 2014

13	Green Marketing	Kanonuhwa and Chimucheka, 2014; Chamorro *et al.,* 2009
14	Green product-based green supply	Handfield *et al*., 1997
15	Green product design	Wolters *et al*., 1997; Baumann *et al*., 2002.
16	Green Purchasing	Govindan *et al.,* 2015b; Igarashi *et al.,* 2013; Chun and Bidanda, 2013
17	Green Strategy	Touboulic and Walker, 2015; Wong *et al.,* 2015; Patala *et al.,* 2014; Chin *et al.,* 2014; Gaussin *et al*., 2013; Kronborg Jensen, 2012
18	Greening the supply process	Bowen *et al.,* 2001
19	Governance	Bush *et al*., 2014; Bostrom *et al.,* 2014
20	Impact of cooperative supply chain environmental management	Vachon & Klassen, 2006; Simpson *et al.,* 2007
21	Integration of sustainability issues into supply (chain) management	Koplin *et al.,* 2007
22	Leadership	Gosling *et al*., 2014
23	Life-cycle assessment based criteria	Lamming & Hampson, 1996; Pesonen, 2001; Seuring, 2004
24	Manufacturing Strategy	Chatha & Butt, 2015
25	Operations	Kleindorfer *et al.,* 2005
26	Metrics development	Das, 2017; Ahi and Searcy, 2015; Hassini *et al*., 2012
27	Performance management	Geng *et al*., 2017; Rao & Holt, 2005; Zhu *et al.,* 2005
28	Performance measurement	Tseng *et al*., 2018; Wang and Dai, 2018; Beske-Janssen *et al*., 2015; Taticchi *et al*., 2013; Pullman *et al.,* 2009; Hervani *et al*., 2005
29	Purchasing	Green *et al.,* 1996; Min & Galle, 2001; Zsidisin & Siferd, 2001
30	Social issues	Zorzini *et al*., 2015; Zhang *et al.,* 2014; Carter, 2005; Drumwright, 1994

31	Supply chain management	Rao & Holt, 2005; Zhu *et al*., 2005
32	Supply management	Bowen *et al.,* 2001
33	Sustainable Strategy	Meixell and Luoma, 2015; Beske *et al*., 2014; Alexander *et al.,* 2014, Tachizawa and Yew Wong, 2014
34	Sustainable supply chain management	Srivastava, 2007; Carter & Rogers, 2008; Seuring & Muller, 2008.
35	Sustainable Supply Chain Management Practices	Hong *et al.,* 2018; Wang and Dai, 2018; Das, 2017; Pullman *et al*., 2009
36	Use of environmental management systems	Darnall *et al*., 2008

Note. Source: Seuring & Muller (2008); Rajeev *et al*. (2017) & literature under review.

As seen from the Table 2.2 above, the early research that created a seminal base, spanned over multiple disciplines. These sub-areas are coalescing under the umbrella of SSCM. This interest in sustainable supply chains is now tending to become a mainstream phenomenon (Corbett & Kleindorfer 2003; Corbett & Klassen 2006). While earlier, a substantial part of research was to ascertain 'whether it pays to be sustainable' (Russo & Fouts, 1997; Pagell, *et al*., 2004), a number of researchers now feel that sustainability issues are *fait accompli* and that firms now have to come to terms to environmental and social issues (Kleindorfer *et al*., 2005; Corbett & Klassen, 2006; Pagell & Wu, 2009). Linton *et al.* (2007 p.1080) posit that "sustainability stretches the concept of supply chain management to look at optimizing operations from a broader perspective - the entire production system and postproduction stewardship as opposed to just the production of a specific product." In their discussion on SSCM, Krausse *et al.,* (2009, p.18) underline the

prime importance of supply chain in the overall sustainability of a firm by emphasizing that "a company is no more sustainable than its supply chain".

Kleindorfer *et al.* (2005) have reviewed papers published in *Production and Operations Management*, while Seuring and Müller (2007) analyze papers published in German to review the research therein. Webster and Mitra (2007), using mathematical modeling, try to analyse competitive strategy in remanufacturing and the impact of take-back laws, considering the environment in which the firms operate and the legislation changes. Kocabasoglu *et al.,* (2007) consider issues involved in linking forward and reverse supply chain investment in an environment of external business uncertainty. The authors underline the need for change in existing practices in operations management to create new systems, effectively integrating reverse supply chains into forward supply chains. Using the Delphi method, Seuring & Muller (2008) have conducted an expert survey with the aim to find issues in SSCM that impact firms and society. They posit that with the rising emphasis on the impacts of operations of firms on the environment and society, close scrutiny of operations and supply chains of organisations becomes imminent. This has created demand for increased transparency in operations and its impact, an area covered by research in corporate governance, corporate social responsibility and sustainability (Seuring & Muller, 2008). Pullman *et al*., (2009) explore all three components of sustainability - social, environmental and economic - in their study using the data from the U.S. food and beverage industry. The authors use a set of performance measures (environmental, quality and cost). The authors find that managing the facets of sustainability is complex; social practices are directly linked to quality

performance but not to environmental performance; environmental performance has only an indirect effect on cost performance which is mediated by quality performance. Their findings "highlight the complexity of sustainability impacts on performance and suggest that performance benefits from sustainability programs may be difficult to recognize" (Pullman *et al*., 2009 p. 38). Seuring and Müller (2008); Gold, *et al.* (2010); Carter and Eaton (2011); Seuring and Gold (2012); Miemczyk *et al.* (2012); Hassini *et al.* (2012); Min (2013); Taticchi *et al.* (2013); Tachizawa and Wong (2014); Malviya and Kant (2015); Ho *et al.* (2015); Touboulic (2015); Wong *et al.* (2015) and Meixell, and Luoma (2015) have reviewed the literature on SSCM.

The field has seen some special issues of academic journals. Linton *et al.* (2007), in their introduction to the special issue of *Journal of Operations Management* on sustainable supply chains, focus on future research and stress that "it is critical to move forward to the systemic issues that exist at the intersection of sustainability, environmental management, and supply chains" (p.1075). Reflecting a rising interest in the area, the number of articles on 'sustainability' or 'sustainable development' had reached 1.5% of the total articles published in economics, business and management journals in 2006, a substantial rise from 0.3% in 1990 when sustainability is seen to have "migrated" into management literature (Linton *et al*., 2007). This interest has only increased. For example, in 2013, ten percent of papers published in the *Journal of Supply Chain Management* and twenty percent of the papers and presentations in 2013 EUROMA conference in Dublin, were on SSCM (Pagell & Shevchenko, 2014).

That the research in sustainability is necessarily interdisciplinary can be seen from the publication of research papers in journals belonging to the disciplines of earth and environmental sciences; social sciences; engineering; agriculture and biological sciences; economics, business and management; energy; medicine; chemical engineering; materials science; amongst others. Further, sustainability lies at the intersection of the social sciences and the natural sciences. While social sciences are needed to analyze the interaction of sustainability issues with society, culture, individual and group behavior, the government and people; natural sciences are needed to study the interactions of sustainability issues with environment and to develop the technologies needed to make business processes sustainable.

A number of drivers have underwritten the rising interest in SSCM, both in practice and in academic research. Mounting pressures from legislation, customers, stakeholders; and environmental concerns and requirements of internal business processes, and economic needs have made firms seriously consider the issue of sustainability; that is, what are the economic, environmental and social implications of their operations (Mann *et al*., 2010). Accordingly, in the academic field SSCM has become an "area of significant research activity" (Pagell & Shevchenko, 2014) and the core operational activities of procurement, production, distribution, and related logistics are now getting integrated into research on sustainable supply chain management (SSCM) (Morali & Searcy, 2015). But with an area this wide comes the challenge how to define it.

For the purposes of this study, we use the definition put forth by Seuring & Muller (2008) who define SSCM as "The management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements." (Seuring & Muller, 2008, p. 1700)

To have a clearer distinction, in this study we adopt the approach of Pagell & Wu (2009) and "…when we refer to a sustainable supply chain we are in essence referring to an outcome for that supply chain. When we discuss sustainable supply chain management we are referring to managerial decisions and/or behaviors" (Pagell & Wu, 2009, p.38). Further, when building on the research on SSCM, we view the term in its broadest sense, and include all research that studies the environmental and/or social impacts of a supply chain, including research on reverse logistics, green SCM, closed-loop SCM, and ethical/responsible SCM as sources for this research, as has been suggested by Pagell and Shevchenko (2014).

Having discussed the construct of sustainability in a broader perspective and sustainability's increasing relevance in supply chain management, the drivers that move firms to adopt sustainable SC practices are considered next.

2.3 Drivers That Move Firms to Adopt Sustainable Supply Chain Management Practices

With an increasing interest in the field, the emphasis on adoption of SSCM practices has increased both in practice and in academia. Seuring (2004) suggests that sustainability needs to be transformed into business practices as a guiding principle A number of studies on sustainable global supply chain management have identified motives that range from strategic to pragmatic (Hart, 1997; Gereffi *et al.*, 2005; Runhaar *et al.*, 2006; Vermeulen and Ras, 2006; Muller *et al.*, 2009). The discourse on sustainability, from its origins in environmental issues (WECD, 1987; Tibbs, 1991; Socolow, 1994), has evolved to include economic and social aspects (Elkington, 1998; Cramer *et al.*, 2004). Ras and Vermeulen (2009) posit that "profitability as part of the economic aspect is of extreme importance" (p.326). This is amply supported by common sense.

Seuring and Muller (2008) extract the core issues relating to SSCM in their Delphi study with experts (academics, practitioners and non-government organizations – NGOs). The authors find that "Efforts inside of companies have to match government regulation and customer demands, while also reacting to NGO pressure. Therefore, these forces can be identified as the most important pressures and incentives for sustainable supply chain management" (p. 461). Mann *et al.* (2010) have presented a composite list of drivers, extracted from the literature, that motivate the adoption of SSCM practices.

This study, for parsimony, takes up the three most important drivers for the adoption of SSCM practices, i.e., regulations, competitiveness and stakeholder pressures. Here, the construct competitiveness is assumed to envelop both the drive to meet customer demand and the drive to be economically successful (Seuring & Muller, 2008).

2.3.1 Regulations

As one of the most important drivers, the legislation leaves little option for an organization but to comply or to face business-disrupting penalties and other legal action. While in some locations even the exit option may require permission from regulators, in other countries a firm may have to deal with legacy problems even after it has left the business. Regulations may be in the form of environmental laws (Fleischmann *et al.,* 1997; van Nunen & Zuidwijk, 2004; Georgiadis & Vlachos, 2004; Paulraj *et al.*, 2017; Esfahbodi *et al*., 2017) which are general in nature, or they may be specific to the industry, for example mandating a specified recycled content in a new product (Krikke *et al*., 2004) or fixing end-of-life (EOL) take-back responsibility (Krikke *et al*., 2004). Regulatory acts in turn may be driven by concerns like a government's interest in preventing environmental degradation, public opinion, stakeholder pressure, lobbying by interest groups, scarcity of resources, preferred models of development, which in turn, may also act directly as drivers for an organization (Mann *et al*., 2010). Apart from environmental legislation, sustainability issues may also be activated by government-mandated product recalls (Johnson, 1998) or as a strategic decision to reduce penalty costs by a company (Ketzenberg, 2009).

Pointing this trend out in the context of the European Union, Linton *et al.,* (2007 p.1077) evidence that "The European Parliament views this concept as so critical to the future of the EU that current and future legislation must integrate sustainability into implementation orders (American Chamber of Commerce of Europe, 2004)." Thus, the search and adoption of sustainable supply chain management practices can be triggered by regulations and changes in regulatory policy (Linton *et al*., 2007). Change in policy for electrical and electronic equipment in Europe (EU, 2003) is one such instance. Esfahbodi *et al.,* (2017) find that governance pressures are necessary for the protection of the environment and they play an important role in the implementation of sustainable supply chain management practices.

Even in cases when these requirements are not mandatory, political or legal concerns (including existing regulations and economic requirements and any possible future regulations) (Dowlatshahi, 2005) and official campaigns for proper disposal of recycled or used products (Georgiadis & Vlachos, 2004) can prompt organisations to adopt sustainable practices that coalesce into the firm's supply chain management. Some industries, for example, the case of rechargeable battery industry in the United States, have been active in the take-back and recycling arena to pre-empt any such regulation (Toffel, 2004). Various researchers have also discussed the role of sustainable practices in enabling the firm to satisfy its social responsibilities (Nagel & Meyer, 1999; Presley *et al.,* 2007) even at the stage when these initiatives are voluntary.

There is a large number of social and ecological problems that cannot be simply legislated away. The other two drivers, i.e., competitiveness and stakeholder pressures become important in handling those scenarios. These drivers are discussed in the next two sub-sections.

2.3.2 Competitiveness

As brought out by literature, the drive to gain and retain competitiveness is an important consideration for the adoption of sustainable supply chain management practices. These comprise of internal and external environmental practices entailing implementation of internal business processes or operational considerations for the adoption of elements of reverse logistics, closing-the-loop, green supply chains and their integration into the forward supply chain. Issues like warranty, claims and recalls, periodical replacement of installed capacity and product lease (Krikke *et al*., 2004) necessitate effective and efficient reverse logistics and closed loop systems. Having a competitive reverse logistics is also essential for enhancing the following: operating level effectiveness (Richey *et al.,* 2005a), operational performance, i.e. responsiveness (Richey *et al.,* 2005b; Skinner *et al.,* 2008) and service quality (Daugherty *et al*., 2005; Richey *et al.,* 2005b; Skinner *et al.,* 2008); process performance (Langer *et al.,* 2007), processing effectiveness (Richey *et al.,* 2005a), production rate (Spengler & Schröter, 2003), recovery rate (Spengler & Schröter, 2003), collection of used products/ material (Flygansvaer *et al.,* 2008), and recycling (Johnson, 1998; Spengler & Schröter, 2003). All these activities are also *sine qua non* for any remanufacturing activity (Majumder &

Groenevelt, 2001) or 'closing the loop.' A properly managed SSC also helps in reduction of uncertainties (Ketzenberg *et al.,* 2006) and enables the return of unsuitable, defective or damaged merchandise to a supplier (Johnson, 1998). The strategic need to protect aftermarkets is also driving diverse companies like HP, Lexmark, Ford, and Mercedes into product recovery programs (Toffel, 2004).

Sustainable supply chain management practices also offer possibilities that lead to better financial performance (Langer *et al*., 2007), higher revenues (Tibben-Lembke, 2004; van Nunen & Zuidwijk, 2004; and Miemczyk, 2008) and higher profitability (Majumder & Groenevelt, 2001; Stock *et al*., 2002; Kulp *et al*., 2004; Fandel & Stammen, 2004). Chan, (2007) posits that "one of the driving forces for firms to adopt the reverse logistics practice is cost saving from reverse logistics activities" (p.350). This view is supported by a number of researchers who find that properly managed reverse logistics and closing the loop can lead to cost reduction /saving/benefits/ effectiveness (Matthews, 2004; Dhanda & Hill, 2005; Fassoula, 2005; Richey *et al*., 2005a; Langer *et al*., 2007; Efendigil, 2008; Miemczyk, 2008), energy cost reduction (Fassoula, 2005), reduction in the cost of disposal (Krikke et al., 2004; Hicks *et al*., 2004; Ketzenberg, 2009); reduction in the cost of quality (Fassoula, 2005); reduction in holding costs (Ketzenberg *et al*., 2006; Ketzenberg, 2009); reduction in waste (Goldsby & Closs, 2000; Matthews, 2004; Fassoula, 2005); reduction in penalty costs (Ketzenberg, 2009); reduction in shortage costs (Ketzenberg *et al*., 2006) and reduction in redundancy in operations (Goldsby & Closs, 2000). Dowlatshahi's 2005 paper discusses and supports the adoption of reverse logistics and closing the loop in light of the need to reduce

strategic costs (including life cycle and performance costs). The research of Richey *et al*. (2005b) has discussed the improvement of strategic performance by the adoption of the reverse logistics system. Georgiadis and Vlachos (2004) posit that "Economical…issues are the main driving forces for the development of closed-loop supply chains" (p.449). In the current literature under review, this view of the authors is supported by Nagel and Meyer, (1999); Spengler and Schröter, (2003); Matthews, (2004); Geyer and Jackson, (2004); Daugherty *et al*., (2005); Linton and Jayaraman, (2005); Presley *et al*., (2007); and Skinner *et al*., (2008): and this improved economic performance may arise from better acceptance by customers, lower penalty costs, better operational performance, and the recapture of value from recovered products, remanufacturing, reduction in costs, newer markets, higher revenue and improved profitability as posited by the authors listed above. Paulraj *et al*., (2017) sum up published literature to posit that close collaboration with supply chain partners can lead to creation of difficult to imitate dynamic capabilities which can become a source of sustained competitive advantage and, as per resource dependence theory, these capabilities can lead to improved firm performance.

2.3.3 Stakeholder Pressures

Wood (1991) surveys earlier (the 1980s) literature spanning the interactions of stakeholders and society *vis a vis* business. The traditional research areas concerning business and society covered "corporate philanthropy (Pasquero, 1990; Siegfried *et al*., 1983; Useem,1988); community relations (Burke *et al*., 1986); responses to activist pressures (Paul & Duffy, 1988); ethical investing (Massie, 1989; Wokutch, 1982) ;

international stakeholder management (Mahon & Kelley, 1988; Windsor & Preston, 1988); and business-government relations, including corporate political action (Buchholz, 1982; Epstein, 1969; Kelley & Agle, 1990 ; Maitland, 1983; Marcus *et al*., 1987; Mitnick, 1980; Stevens *et al*., 1986; Vogel, 1978; Wood, 1986)" (Wood, 1991, p.705).

Wolf (2014) draws from Parmigiani *et al*. (2011) to define stakeholder pressure as the "degree of accountability an organization perceives for the actions and decisions it takes regarding product design, sourcing, production, or distribution, to stakeholders (p.319)." Firms that are highly visible are constantly under stakeholder scrutiny, and this scrutiny extends to the partners of its supply chain (Parmigiani *et al*., 2011) which may penetrate through to numerous tiers.

As per stakeholder theory (Freeman, 1984), stakeholder pressures can arise from consumers, activists or even other external stakeholders, and can affect various tiers of a supply chain (Parmigiani *et al*., 2011) to move them to adopt sustainable supply chain management practices. Pagell and Wu (2009), Reuter *et al*., (2010) and Parmigiani *et al.* (2011) discuss and underline the importance of stakeholder and sustainable supply chain interactions. Stakeholders, such as the media, activists, and consumers can raise social and ecological issues and apply significant pressure or coercion on the focal firm and its supply chain (Hendry, 2006; Phillips and Caldwell, 2005; Parmigiani *et al*, 2011) using boycotts or by abstaining from purchase, which can appreciably affect the profitability and reputation of the firm. Firms may adopt the strategy of developing a collaborative relationship with external stakeholders, such as non-profit organizations or non-government organisations (NGOs) (Huegens *et al.,* 2002; Welcomer *et al.*, 2003;

Butterfield *et al*., 2004; King, 2007; Sangle, 2010) and be proactive in their approach, working towards stakeholder satisfaction, abating lenders and investors' concerns towards environmental liability, and addressing the concerns of the judiciary or media (Sangle, 2010).

Consumers may also exert significant pressure on the focal firm to adopt sustainable practices. European consumers are one of the biggest pressure groups that advocate for sustainability, and their concern about the ecological effects of products (Caniato *et al*., 2012) results in a significant impact on management decisions up and down the supply chain (Choi *et al*., 2015).

With progress in technology, better quality management, higher education in the population, a keener awareness of consumer rights, liberal return policies of businesses and increasing expectations, customers today are less ready to tolerate any defects or products that are less than perfect (Guide *et al*., 2003b; van Nunen & Zuidwijk, 2004; Krikke *et al*., 2004 and Avitathur & Shah, 2004). Customers tend to return products readily, leading to higher return ratios that create a direct pressure on a firm. Rising environmental awareness has led to amplified customer demand for a firm to have a "green image" (Georgiadis & Vlachos, 2004; Krikke *et al*., 2004). These consumer pressures may still be evolving (Zhu *et al*., 2005). While Chan and Lau (2001) found that American consumers have stronger green purchasing behavior, as compared to the Chinese, Lo and Leung (2000) find that the younger Chinese consumers are picking up this trend. Along with a similar line of research, Miemczyk (2008) discusses the need for improving (or maintaining) a firm's reputation. The need to cater to product returns

optimally translates into a need to adopt sustainable supply chain practices and create a robust SSCM system. Greater customer education regarding the potential economic and non-economic benefits of reverse logistics (Dowlatshahi, 2000), consumer rights (van Nunen & Zuidwijk, 2004) and specific customer requirements regarding quality, reliability, delivery (Dowlatshahi, 2000) and pressures for appropriate corporate social responsibility (CSR) (Li *et al*. 2014a) push for a sustainable supply chain system. Higher customer service, Just-in-Time deliveries (JIT), short-notice supplies, after-sale service and repairs (Dowlatshahi, 2005) and optimal customer satisfaction (Maslennikova & Foley, 2000; Fassoula, 2005; Langer *et al.,* 2007; Efendigil, 2008) all call for an efficient, effective and sustainable supply chain. Dowlatshahi (2005) has discussed the adoption of reverse logistics for improvement in reliability and conformance, a fundamental customer requirement now. Another factor considered by researchers in this regard is the improvement of a firm's reputation (Miemczyk, 2008) by the adoption of sustainable practices.

Meixell and Luoma (2015) find that various pressures from stakeholders lead to an increase in a firm's awareness, its adoption of sustainability practices and their effective implementation. And even though different sets of stakeholders may have a "dissimilar influence" they do have an appreciable overall influence on key decision areas, whether environmental or social.

There is also some evidence that virtuous organizations promote ethical behavior, and that moral motives and ethical pressures can be significant drivers for firms to "do good" and adopt of sustainability practices (Sekerka *et al.,* 2014; Paulraj *et al.,*

2017). Moral pressures can lead to closer adherence to corporate social responsibilities and have a high correlation with firm performance (Graafland & Van de Ven 2006; Fernando & Almeida 2012).

2.4 Sustainable Supply Chain Management Practices

Finding how to create a supply chain that is sustainable and what practices to adopt for that are important questions being raised for the past few decades (Kleindorfer *et al*., 2005).

Pagell & Wu (2009) conducted case studies of ten firms to arrive at a set of coherent management practices that need to be adopted for the successful creation of a sustainable supply chain. The authors find that exemplary companies "have internalized sustainability goals in such a way that their noneconomic performance is a critical factor for growth and financial performance. In other words, financial goals and environmental goals are aligned. Sustainability is then an integral part of their business and is incorporated in every aspect of their supply chain" (p.54). Wolf (2011) also examines various SSCM practices. These practices have been researched under various heads such as external and internal environmental practices (Zhu *et al*., 2008a; Zhu *et al*., 2008b; Paulraj, 2009), supplier selection (Zhu *et al*., 2008a; Paulraj, 2009), supplier evaluation (Vachon & Klassen, 2006; Vachon, 2007; Paulraj, 2009), cooperation with customers (Vachon, 2007; Zhu *et al*., 2007; Zhu *et al*., 2008a; Zhu *et al*., 2008b), and eco-design (Zhu *et al*., 2008a; Zhu *et al*., 2008b; Zhu & Sarkis, 2007) to achieve environmental sustainability objectives and are studied along with social sustainability practices

(Vachon & Mao, 2008). Researchers stress that to achieve sustainability objectives, a business is required to adopt innovative practices (Pagell & Wu, 2009) as it is a new way to think about the business (Hart & Milstein, 2003). Utterback (1996) feels that such "radical innovations" are more probable to come from the newer entrants in the field. This idea is supported by the rise of new types of entities like Interest Corporations or Community Interest Companies (Pagell & Shevchenko, 2014) that are focussed more on sustainability than profits.

Working under a regulatory mechanism or stakeholder pressures, or striving to gain a sustained competitive advantage, firms have tended to develop standardized practices to meet with the laid down requirements. These have been identified as "two sets of related yet independent" (Vachon, 2007, p.4359) activities or practices, namely 'external and internal environmental practices' (Field & Sroufe, 2007; Klassen, 1995; Logsdon, 1985). These are practices discussed in the sub-sections 2.4.1 and 2.4.2. This is followed by, in subsections 2.4.3 to 2.4.7, discussion on practices focussing on upstream, i.e. 'supplier selection' and 'supplier evaluation and monitoring,' followed by a discussion on 'cooperation with customers' on the downstream side. This is followed by a discussion on 'eco-design,' and 'social sustainability practices' that span entire supply chain activities.

2.4.1 External Environmental Practices

Practices that have been evolved and are being used for management of sustainability-related activities of a supply chain, which are external to an organization,

fall into this category. Vachon and Klassen (2006) suggest that an organization can use two alternative approaches to manage or influence the practices in other organizations along the supply chain: either the organization can invest its resources, or the organization can use 'arms-length' market mechanisms to influence the supply chain partners. The authors point out that the 'internalization/ externalization' theoretical lens (Buckley & Casson, 1976) has been beneficially used to view these practices by Krause *et al*. (2000) and others, even though Vachon and Klassen (2006) use terms that are different from those used by Buckley and Casson (1976). A derivative of transaction cost theory (Williamson, 1981) this internalization/externalization framework creates a distinction between activities conducted by the firm by deploying its resources (internalization) and the activities conducted by deploying market mechanisms (externalization) Krause *et al*., 2000). Krause *et al*., (2000) term "arm's length" transactions as "environmental monitoring"; while joint efforts of buyers and suppliers are termed as "environmental collaboration" (Vachon & Klassen, 2006). In contra-distinction to terms 'internalization/ externalization' used by Krause *et al*. (2000), we make use of the constructs external environmental practices and internal environmental practices in this research in the same way as by Paulraj (2009). While the author uses the construct internal environmental practices to include the aspects of waste reduction, reuse, and recycle (Paulraj, 2009, p.464), the external environmental practices includes cooperation with suppliers to achieve environmental objectives, to develop new source reduction strategies, to improve suppliers' waste reduction initiatives and those for cleaner production, basically focussing on "supply side of value chain" (Paulraj, 2009,

p.457). To complement this discussion, the demand side of the value chain is discussed in sub-sections 2.4.5 under the construct 'cooperation with customers'. Before that, in the next sub section, we discuss 'internal environmental practices.'

2.4.2 Internal Environmental Practices

Internal environmental practices are those practices that are used for the management of sustainability-related activities of a supply chain, which are internal to an organization. These have been identified as arising from the commitment to GSCM from senior managers and mid-level managers, and involves cross-functional cooperation for environmental improvements, working towards total quality environmental management, and institutionalization of environmental compliance and auditing programs and environmental management systems (Zhu *et al*., 2008a; Zhu *et al*., 2008b). Zhu and Sarkis (2007) and Zhu *et al*., (2007) also take into account ISO 14001 certification and eco-labelling of products as a part of internal environmental management.

2.4.3 Supplier Selection

Krausse, Vachon, and Klassen (2009, p.18) posit that "The underlying premise that structures our discussion is straightforward: 'a company is no more sustainable than its supply chain'" underlining the importance of supplier selection and supplier's continuing evaluation and monitoring. While Klassen and Vachon (2003) underline the importance of certification and supplier development as key practices for "green" sourcing, Ho *et al.* (2010), also find that environmental or sustainability concerns are being used as supplier selection criteria. Bowersox *et al*. (2000) underline the importance of careful selection of

suppliers in light of their important role in supply chain functioning and performance, which can also result in competitive advantage for the firm (Handfield *et al*., 2002). Walker and Philipps (2006) emphasize the use of sustainability criteria in the supplier selection process. These criteria also include whether the firm has been certified as ISO 14000 compliant.

Various practices that support the proper selection of suppliers who can meet the sustainability requirements of the organization are indicated by: selection of suppliers "based on their environmental competence; on their ability to support organisation's environmental objectives; on their environmental performance and on their ability to develop environmentally friendly goods" (Paulraj, 2009, p. 466). This appears very logical when we take a resource-based view of the supplier selection process. However, supplier selection may become more difficult when searching for an "alignment of social and environmental viewpoints" (Parmigiani *et al*., 2011, p. 221; Ageron *et al*., (2012). Maintaining an appropriate supplier portfolio is now considered a "standard tool" to meet sustainability expectations (Pagell *et al*., 2010). Turker and Altuntas (2014) find that the firms interested in sustainability tend to integrate those suppliers into their supply chain who are committed to achieving their sustainability goals. This focus carries within itself the risk of supply disruption when any one member of this select, but reduced, supplier base of "sustainable" suppliers fails (Das, 2017).

2.4.4 Supplier Evaluation and Monitoring

Even after integration of a supplier into supply chain, regular and ongoing supplier evaluation and monitoring is an important SSCM practice. Pagell & Wu (2009), in a case study of ten exemplar companies that had adopted SSCM practices, find that "the majority of the novel activities identified fall under the rubric of supplier management" (p.54). Supplier management also includes periodic or continuous evaluation and monitoring whether the supplier continues to meet the criteria which were set down at the time of his selection.

These supplier evaluation and monitoring practices take the form of, or are indicated by, "regular environmental audits into suppliers' internal operations; periodic evaluation of suppliers' environmentally friendly practices; site visits to suppliers' premises to help them improve their eco-performance; periodic evaluation of second-tier suppliers' environmentally friendly practices; asking suppliers to commit to waste reduction goals and sending environmental questionnaires to monitor their compliance" (Paulraj, 2009, p.466; Vachon, 2007; Vachon & Klassen, 2006). Turker and Altuntas (2014) find that the firms set sustainability criteria for their suppliers, set a code of conduct regarding sustainability goals and tend to ensure supplier compliance through rigorous auditing, this being more so for suppliers that are working out of developing countries where the risks of non-compliance are higher.

2.4.5 Cooperation with Customers

To be sustainable, cooperation with customers forms an important practice in the management of the downstream supply chain. Vachon (2007, p.4374); Zhu *et al.* (2007, p.1051); Zhu *et al*. (2008a, p.271) and Zhu *et al*. (2008b, p.9) highlight the importance of cooperation with customers "for cleaner production, for green packaging, for using less energy during product transportation, for developing a mutual understanding with customers of responsibilities regarding environmental performance, and to reduce the environmental impact of their activities". The aspects covering supply side have been discussed in subsection 2.4.1 and 2.4.2.

2.4.6 Eco-design

Considering the fact that design for ecologically optimal products is an important SSCM practice, Chen *et al*., (2005); Zhu *et al*.(2008 a, p.271 & 2008b, p.9); Zhu & Sarkis (2007, p.2336) and Wu *et al.* (2012, p.627) outline practices towards eco-design that involve designing "products for reduced consumption of material/energy, for reuse, recycle, recovery of material, component parts and to avoid or reduce use of hazardous products and/or their manufacturing process". For eco-design not only eco-friendly raw materials or inputs are to be kept in mind (Rao & Holt, 2005), the sustainable product has to be amenable to easy disassembly, reuse, recycling, and biodegradability (Zhu *et al.,* 2012; Carter and Easton, 2011). Eco-friendly product design needs to be complemented by eco-friendly process design. This entails the adoption of processes that aim at significant reduction in air and water emissions, reduction in solid wastes, and reduction

in consumption of energy, materials, and resources. Achieving all this is expected to result in the improved environmental performance of the focal firm (Rao & Holt, 2005; De Giovanni, 2012; Paulraj *et al*., 2017).

2.4.7 Social Sustainability Practices

Elkington (1997) points out that businesses have "preferred to overlook" the aspect of social justice while working for economic prosperity or even for environmental quality. Kleindorfer *et al.* (2005) find that sustainability research has overlooked the social component of sustainability and that this component needs further research. An important component for achieving a healthy "triple bottom line" of economic prosperity, environmental protection and social justice (Elkington, 1997, 1999 & 2006), social sustainability practices focus on social aspects and try to ensure that impacts of the activities of an organisation on workers and society are positive or, at the very least, not negative. Corporate social responsibility is envisaged by some academics as a set of voluntary activities by a firm that span economic, social and environmental well-being of society (Blome & Paulraj 2013; Vlachos *et al.,* 2013). Vachon and Mao (2008) measure corporate social responsibility by measuring the organization's responsibility towards its workers and towards society, both at the level of local community and as a whole. The authors examine (p. 1556) whether the organization "frequently employs corporate codes of conduct and other aspects of corporate social responsibility**,** whether the organization commonly encourages workers to volunteer for social causes and has incentives that facilitate that involvement; whether the organization contributes to charitable causes;

whether the general approach of the organization to human resources is to invest heavily to attract, train and retain employees; whether the organization employment of women is limited and usually takes place in less important jobs, or is equal to that of men; and whether in the organization, for similar work, wages for women are significantly below those of men or equal to those of men." These are posited to indicate whether the organization is implementing social sustainability practices or not. Pagell and Shevchenko (2014) trace social sustainability practices such as commitment to employees (Pullman *et al*., 2009) back to the work of Deming (1986). Kolk (2016) argues that firms act between two boundaries of being ''economically profitable, law-abiding, ethical and socially supportive'' (Carroll, 1999, p. 286), and being proactive beyond mere compliance (Portney, 2008). However, both of these boundaries face challenges when viewed in the context of a supply chain that is operating across borders (Kolk, 2016) as to what does "law abiding" mean beyond borders, and how feasible is it for a firm to be pro-active across the globe. Most of the social sustainability practices that are adopted by firms focus internally, that is, at the actions being taken by the focal firm. There is sparse research on whether these criteria are used for, say, supplier selection or supplier monitoring.

2.5 Sustainable Supply Chain Performance

To be sustainable an organisation has to keep economic, ecological and social objectives in focus, also known as the "triple bottom line" approach (Johnson, 1991; Elkington, 1997, 1999 & 2006; Kleindorfer *et al.,* 2005). Accordingly, the measures of

performance of a supply chain need to cater to its environmental and social performance in addition to economic performance (Gladwin, Kennelly & Krause 1995; Starik & Rands 1995; Jennings & Zandbergen 2005). At the very least, operations of an organisation should not harm ecology or social systems, while still earning profits over a long period of time, ideally forever (Pagell & Wu 2009). With rise of global trade, performance of supply chains, including their economic, environmental & social aspects, is under increased focus (Schaltegger & Burritt, 2014).

The current study adopts these three performance dimensions (economic, environmental and social) to study the impact of adoption of SSCM practices. To these three dimensions a fourth dimension, operational performance, is also added, being the area of special interest to an operations manager.

Pagell & Wu (2009) find the empirically validated model of green supply chain management (GSCM) by Zhu and Sarkis (2004) and Zhu *et al.* (2008) "highly commendable" (p.38) that takes into account economic and environmental impacts of a supply chain. To 'green' research, a social dimension also needs to be added and studied. But stakeholders are not content if a firm is merely measuring or monitoring its social impact. With time, the bar is being raised for social performance as well. Now a number of researchers and stakeholders hold the opinion that zero worker accidents, or no harm (no social impact), merely forms the lower limit of expected social performance (Seuring & Muller, 2008; OXFAM, 2013; ECCJ, 2013), and the firms are actually expected to contribute positively to a society.

It can be argued that for long-term or 'sustainable' effect, this concern for the sustainability of supply chains has to be tied in with a firm's strategy. Li *et al*. (2014b) underline this and posit that even when concerned about sustainability issues, firms need to define proper strategic objectives explicitly, and then base their decision-making processes on specific performance indicators to ensure their long-term survival.

In subsections 2.5.1 to 2.5.4, which follow, we discuss economic performance, environmental performance, social performance and operational performance of focal firm (in light of its adoption of SSCM practices.)

2.5.1 Economic Performance

The primacy of positive economic performance is underlined by Friedman (1970) who goes to the extent of stating that being profitable is fundamental 'social responsibility' of a business. Arguably, a firm performing poorly on the economic front is very likely to be a self-limiting phenomenon and a drain on the resources of society and damaging to long-term interests of its employees and stakeholders. Carroll (1979) argues that economic performance has priority over environmental and social aspects of triple bottom line and is the "first and foremost social responsibility of business" (Carroll, 1979, p.500). This is supported by Carter and Dresner (2001) and Carter and Rogers (2008) who posit that a practice having a negative impact on economic performance is not sustainable over the long term. Carter and Rogers (2008) state that a firm should clearly recognize its economic goals and set environmental and social goals in line with them.

On similar lines, Russo and Fouts (1997) and Klassen and Whyback (1999) and others started out on their research on sustainability trying to find out whether being green pays. In their meta-analysis of such research, Golicic and Smith (2013) find that it does pay. It runs counter to earlier assumptions/views that are trying to be green is likely to harm profits (Walley & Whitehead, 1994). However, trade-offs exist in some instances between economic and non-economic performance (Lee, 2010; Wu & Pagell, 2011; Kolk, 2012) where hard decisions may have to be taken by the management. But sometimes, there may be a limited degree of freedom to take those decisions. Legislative constraints may preclude a firm the luxury of choosing between the trade-offs, and the firm may have to adopt sustainable practices perforce (Pinkse & Kolk, 2010; Hahn *et al*., 2010 Wu & Pagell, 2011; Winn *et al*., 2012). Similarly, researchers using a stakeholder theory lens may even suggest the adoption of supply chain management practices that may not have a positive impact on the economic performance of the firm (Clarkson, 1995; Mitchell *et al*., 1997; Eesley & Lenox, 2006).

In their Delphi study to discover the relative importance of the three dimensions of sustainability (economic, environmental and social), Seuring and Muller (2008) find that on a five-point Likert scale from 'not at all important' (=1) to 'extremely important' (=5), the "economic dimension is seen as the most important one (4.45). It can be argued that, without economic success, no supply chain can exist in the long run. The other scores are much closer together, with the environmental (4.12) and social (dimension) (3.95)" (Seuring & Muller, 2008 p. 460). A number of researchers have focussed on the questions such as: can a sustainable management practice result in a positive economic

outcome simultaneously along with a positive environmental impact (Zhu & Sarkis, 2004; King & Lenox, 2002)? Defining success in terms beyond economic performance (Wu & Pagell, 2011), some supply chains also focus on economic and social performance. These are briefly discussed in the following sub-sections.

2.5.2 Environmental Performance

Environmental concern underlines the green and sustainability movement. After the economic performance, environmental performance is expected to get the most attention of a firm, given the rising awareness of people and wide media coverage the phenomenon is receiving; an expectation that is confirmed by Seuring & Muller (2008a & 2008b). It derives that it is important to ensure that the firm's operations create the minimal environmental effect and cause no, or minimal, pollution. This would entail the minimal use of hazardous materials; control, monitoring and reduction of emissions; processing of effluents to render them non-damaging for the environment; reduction in the use of material and energy; recovery of process materials; reduction and recycling of waste; reuse, recycling, and remanufacturing. The successful integration of these and other processes in a firm's operations; and thereby, a reduction of the impact on the environment is a desirable outcome. Some researchers underline primacy of environmental concerns in monitoring performance of a supply chain (Keating *et al*., 2008). Reduction in use of inputs has found support in the research that has found that process improvement practices like TQM, JIT and Lean also improve environmental performance (e.g., Clark 1999; Curkovic *et al.,* 2000; King & Lenox 2001; King &

Lenox, 2002). Better coordination and cooperation with suppliers and customers and better environmental practices can lead to "better environmental performance" (Zhu & Sarkis, 2004; Seuring, 2004; Vachon & Klassen, 2006; Vachon & Mao, 2008 p.1553). Going a step further, Pagell and Shevchenko (2014) stress that researchers should go beyond making a supply chain less unsustainable and suggest how to have positive and regenerative effects on society and ecological environment.

2.5.3 Social Performance

Researchers' stance on social responsibility of a firm has shifted significantly in past five decades, from that of Friedman's (1970) view that the primary social responsibility of a firm is to make profits, to one that propounds that the reduction of negative social impact forms fundamental goal of a sustainable business (Hahn & Figgs, 2011; Figgs & Hahn, 2012). Pagell and Shevchenko (2014) go even further to suggest that graduating from 'reduction of negative social impacts', researchers should now work on how a firm can have a positive and regenerative impact on society. Burch *et al*., (2013) focus their research on the rural landscape and closely look at the impact of global sourcing on rural development. Maertens and Swinnen (2009) study impact of supplier certification on remuneration in developing countries, to ascertain whether it has positive or negative social impact.

A positive social performance of the focal firm is now one of the core goals in SSCM. This may be measured in various ways, including the development of formalized relations by a firm with the community where it operates; increasing its philanthropy

levels; increasing internships and vocational training offered by the firm for improving the lot of its employees (Muller & Kolk, 2010).

2.5.4 Operational Performance

Keating *et al*., (2008) suggest that companies can improve their operational performance by improving sustainable supply chain performance. Pagell and Wu (2009) indicate a strong relationship between sustainable supply chains and operational performance. The authors posit that a "supply chain that performs well on traditional operational metrics is a foundation of a sustainable supply chain" (p.52), which seems self-evident, as any supply chain that fails to perform well operationally can hardly be expected to be sustainable over an extended period. Increased capacity utilization, on-time delivery, the decline in inventory levels, decrease in scrap rate and increase in quality and product line may be used as measures for operational performance (Zhu *et al*., 2008).

2.6 Size of Firm

Size of a firm, which may range from small to large, is an important consideration for managing its supply chain operations. A firm's size is also likely to affect the impact that firm's adoption of SSCM practices may have on its performance. Gooding and Wagner III (1985) in their meta-analytic review of thirty-one field studies on the relationship between size and performance found that while productivity in absolute

terms increased with increased in size of the organization, the same was not true about the efficiency of organizations, which did not increase with size. Further, the subunits of organizations did not show an increase in productivity with an increase in size. The authors suggested that it could be probably due to free-rider effect. Swamidass and Kotha (1998) find that relationship between adoption of advance manufacturing technology and performance of a firm is moderated by the size the firm. This is also supported by Cagliano *et al*. (2001). Bowen *et al*. (2001) use the resource-based view (RBV) to study the relationship of a firm's resources to its triple-bottom-line performance. Drawing from the use of resource dependence theory (RDT) and resource-based view (RBV) by Svensson (2007) it follows that a large organization would have greater resources to deploy for the adoption of SSCM practices and is therefore likely to positively affect its performance. Leal-Rodríguez *et al*. (2015) find that firm size has a moderating effect on organizational unlearning on firm's performance. Benito-Osorio *et al*. (2015) analyzed the role of firm size on relationship between product diversification and performance and found that large firms can perform better with a higher level of diversification.

However, smaller firms have their advantages. Camis´on-Zornoza *et al*. (2004) find that number of employees, as a measure of size, do not increase innovation performance. Gong *et al*. (2013) in their research on the relationship between employee creativity and firm performance find that creativity is positively related to performance in smaller firms. Bourlakis *et al*. (2014) in their research on the relationship between firm size and performance in Greek food supply chains find small firms as "top performers." Vithessonthi and Tongurai (2015) in their research on the effect of firm size on the

leverage–performance relationship examined 170,013 Thai firms and found that for small firms leverage is positively related to performance, while it is negative for large firms. The above literature suggests that firm size does matter and it would be interesting to study the effect of firm size on the relationship of adoption of SSCM practices by a firm and its performance. That is likely to provide an insight whether small and medium-sized firms (SMEs) are also joining this "new wave" and adopting sustainable SCM practices.

2.7 Theories Used in SSCM

While Cooper *et al*., (1997), Croxton *et al*., (2001), Chen and Paulraj (2004), and Carter *et al.,* (2015) use a conceptual approach to identify constructs, processes and to develop frameworks; Lambert *et al*., (1998) and Mena *et al*., (2013) use the case study path to attempt developing theory for supply chain management, theory building for SSCM is still scarcer. Being a nascent field, SSCM is naturally dependent upon existing theories; its own theoretical underpinnings are yet to evolve (Moralli, 2015; Gold *et al*. 2010; Svensson 2007; Carter and Rogers 2008; Seuring and Muller 2008b). Touboulic and Walker (2015) argue that even efforts to build theories in the field of SSCM are "scarce", and most efforts revolve around importing and using some common theories; and the authors cite stakeholder theory, institutional theory and resource-based view as examples.

Bowen *et al*. (2001) draw from the resource-based view (RBV) to develop an SSCM framework linking triple-bottom-line performance to an organization's resources. Gold *et al*. (2010), use this framework to posit that SSCM provides leverage for inter-

firm resources and inter-firm competitive advantage while confirming the positive effect of SSCM on a firm's performance. Svensson (2007) bases his conceptual framework on RDT (resource dependence theory) and RBV to present a conceptual framework taking first and second order supply chains into consideration. Font *et al*. (2008) state that theories of SSCM start from the fundamental that for a supply chain to be sustainable upstream and downstream, components of the chain need to be sustainable. Carter and Rogers (2008) propose a theoretical framework where, along with the entire supply chain, sustainability focussed long-term strategies are embedded to achieve a competitive advantage while integrating the three fundamentals of sustainability, i.e. economic, environmental and social. The authors derive theories from sociology/political science (Resource Dependence Theory - RDT), economics (Transaction Cost Theory), biology (Population Ecology) and strategic management (Resource-Based View of the firm - RBV), which they find complementary, to posit their theoretical framework (Carter & Rogers, 2008). The proposed theoretical framework suggests that firms that integrate all three aspects, economic, environmental & social, will achieve better performance than those who focus on two or less. But this is yet to be tested. Paulraj *et al*., (2017) use utilitarianism and stakeholder theory to explain the effect of relational motives, arising from the pressures of stakeholders, on adoption of SSCM practices. The authors also posit that ethics based moral issues also serve as strong drivers in their own right, but for this research, we subsume ethical pressures into stakeholder pressures for the sake of parsimony.

The organisational theoretic review of literature by Sarkis *et al.* (2011) brings out nine distinct organizational theories used in SSCM literature: "complexity theory, ecological modernization theory, information theory, institutional theory, resource-based view (RBV), resource dependence theory (RDT), social network theory, stakeholder theory, and transaction cost economics" (Sarkis *et al.*, 2011 p.4-5). Further, the authors suggest a possibly useful adaptation of other theories like diffusion of innovation theory, path dependency theory, social embeddedness theory, structuration theory and agency theory in theoretical frameworks of SSCM. Pagell & Wu (2009) follow a case study method towards building a theory of SSCM.

Touboulic and Walker (2015) suggest a three-pronged action plan that would help theory building: adoption of methodologies that are original, testing of frameworks that have already been developed in the SSCM field and further investigation of different aspects of SSCM where gaps exist in research.

Chapter 3 Theoretical Framework

3.1 Investigative Questions

With rising interest in the field of sustainability, what to investigate in this developing field at the current stage becomes an important question. Some researchers have addressed this question. Linton *et al.* (p.1077) argued in 2007 that "it may be premature and/or just an academic curiosity to consider the operationalization of sustainability" and that it may be a "passing fad", but the authors then go on to confirm that "it is worthwhile for operations management researchers and practitioners to consider the implications and impacts of sustainability...". Confirming this, Seuring and Muller, (2008), in their research to extract the core issues relating to SSCM identify "four dimensions that can be used to structure the overall debate on sustainable supply chains: (1) pressures and incentives, (2) measuring impacts, (3) supplier management and (4) supply chain management" (p.464). These are very interesting dimensions for study. But for this research, it is required that the focus of the study be narrowed for parsimonious reasons.

For the current study, we decided to research Adoption of Sustainable Supply-Chain Management Practices: Impact on Firm's Performance. This topic, in light of the literature reviewed in Chapter 2 above, raises the following research questions:

1. Do the key drivers, as identified in the literature, affect the adoption of SSCM practices by a firm?

2. Does the adoption of SSCM practices impact the economic, environmental, social and operational performance of a firm?

3. Does the size of a firm have a moderating effect on the impact that a company's adoption of SSCM practices may have on the company's economic, environmental, social and operational performance?

As these questions are both important and interesting, we need to crystallize them into a research framework. In an endeavor to encompass the core dimensions identified by Seuring and Muller (2008) above, an in light of extant literature reviewed, a theoretical framework is developed, which is presented in the next section.

3.2 Theoretical Framework

In this section, we present the theoretical framework which would be used as a basis for this study. Paulraj (2009), Sangle (2010), Paulraj *et al*., (2017), and Esfahbodi *et al*., (2017) have studied drivers for the adoption of sustainable supply chain practices, which form the first core dimension "pressures and incentives" as researched by Seuring and Miller (2008). From the literature, it is apparent that the three most important drivers that lead to the adoption of SSCM practices by firms are (1) regulations by governments; (2) the drive to be competitive in the market, or to emulate the competitors to work

towards sustainability; and (3) the pressures of stakeholders. These are grouped as drivers in the first group of Figure 3.1 below.

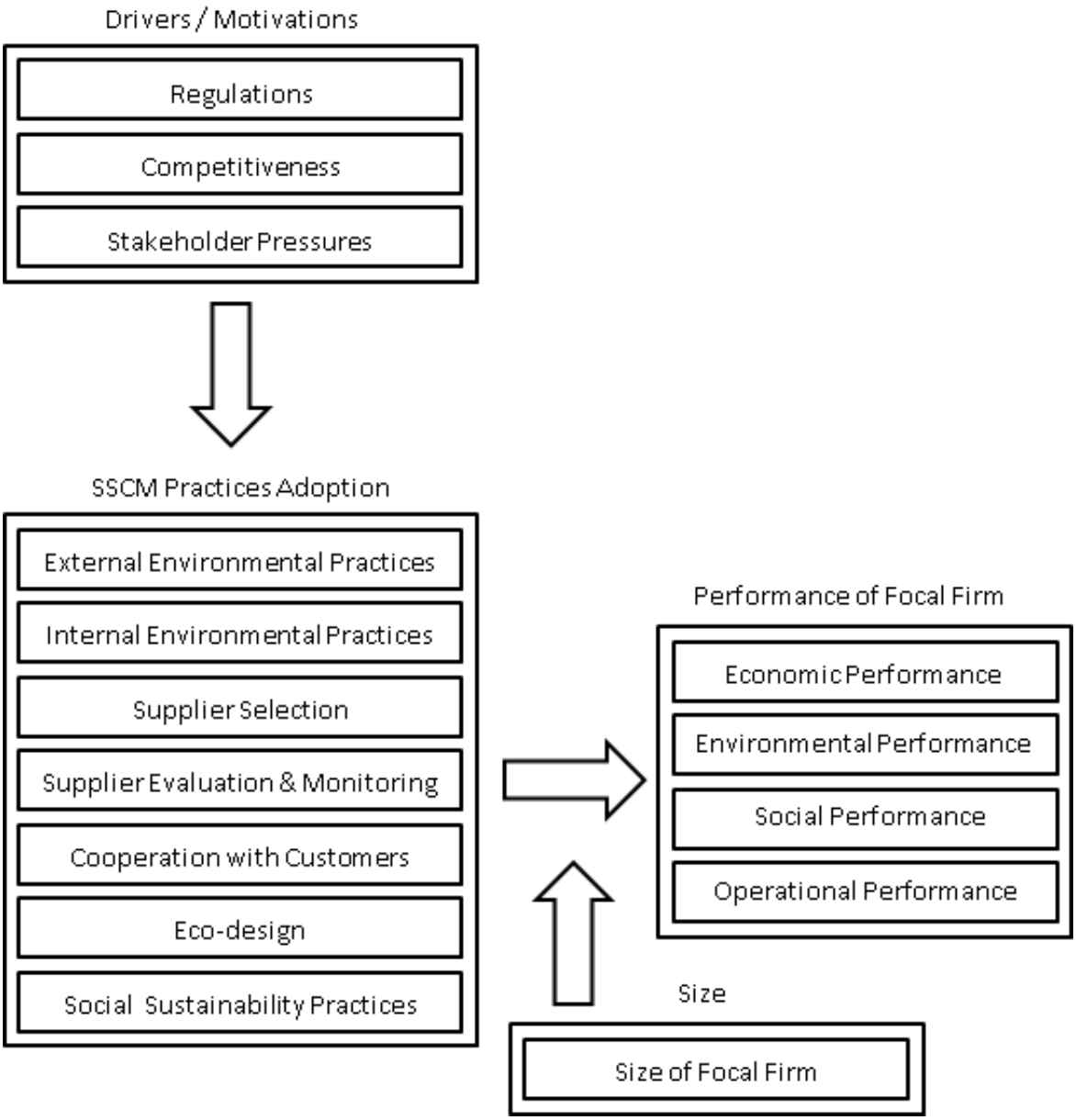

Figure 3.1 Theoretical Framework

The second group broadly covers the important or 'core' dimensions "supplier management" and "supply chain management" identified by Seuring and Miller (2008), being SSCM practices that help "cooperation and communication between supply chain members", practices that help in "risk management", with a "proactive approach", taking into account the "total life cycle" approach (e.g. through eco-design), enabling better performance on environmental and social fronts (Seuring & Miller, 2008, p. 461). This group covers SSCM practices adopted by the focal firm including external environmental practices, internal environmental practices, supplier selection, supplier evaluation and monitoring, cooperation with customers to build sustainable products; eco-design of products, packaging, and processes; and social practices leading to sustainability.

The third group covers the "measuring impact" dimension where the impact of SSCM practices on a firm's performance is sought to be studied. For this, we plan to find the impact on economic performance, environmental performance and social performance of the firm, as well as to find out the impact on the operational performance of the firm.

The first group, i.e., the drivers, may have some direct impact on the third group, i.e., the performance of a firm. For example, it could be argued that some regulations may impact the economic performance of a firm in a negative way, or competitiveness may impact economic performance of a firm directly. It needs to be emphasised here that these drivers are not being studied in this research as independent concepts, but within the context of their relationship with adoption of SSCM practices. Also, the possible

direct effect is not supported or suggested by the reviewed academic literature, or by theory. The drivers have to make their impact through some action, or through some practice undertaken by the focal firm. For example, it is unconceivable how stakeholder pressures can improve performance of a firm directly, without any action by the firm. So direct effect of drivers on performance, if any, was not considered in the current research as it did not meet the contextual theoretical considerations.

The research framework is discussed in detail in the following sections.

3.3 Drivers for Firms to Adopt Sustainable Supply Chain Practices

The first step in this research is to understand the drivers that impel firms to adopt sustainable supply chain management practices. As discussed in Chapter 2, the extant literature suggests the existence of a number of motivators for adoption. For parsimony, the drivers/motivators are grouped into three broad categories: regulations, competitiveness, and stakeholder pressures. These are presented in the sub-sections below.

3.3.1 Regulations

Regulations are prime movers for a firm since these cannot be ignored without running a major risk of significant fines, penalties or disruption of business. Thus they comprise a major factor for the adoption of sustainable supply chain management practices, at least to the extent prescribed in the regulations in question. As Cosimato and Troisi (2015) state, “the respect of environmental regulations is fundamental” (p.256).

This motivator is becoming very important in the developed countries, more so in the countries that are members of the European Union. Indicating this trend, Linton *et al.,* (2007 p.1077) point out that "The European Parliament views this concept as so critical to the future of the EU that current and future legislation must integrate sustainability into implementation orders (American Chamber of Commerce of Europe, 2004)."

Changes in policy or regulations can trigger the search for sustainable supply chain management practices and their adoption (Linton *et al*., 2007). Policy on electrical and electronic equipment in Europe (EU, 2003) is one such example of a change in policy.

3.3.2 Competitiveness

Firms have to be competitive in their field of operation in the face of competition, or when there is more than one player in the market. The discourse on what is known to be "win-win sustainability" is increasingly making firms veer around the idea that adopting of SSCM practices is likely to make them more competitive in the market (Cucculelli & Goffi, 2016; Tan *et al*., 2015; Melewar *et al*., 2013). This is truer in the fields where customers are more aware of sustainability issues, or where competition is bringing out increasingly sustainable products or services into the market. It could be argued that all firms want to be competitive, and how competitiveness can act a driver for some firms and not others. It is true that all firms aim for sustainable competitive advantage, not all firms focus on competitiveness to adopt such SSCM practices that lead to a better performance. Some firms merely aim to comply with the regulations and may

adopt such SSCM practices that are barely adequate and just enough for such purposes. Hence in this research competitiveness has been selected as a distinct driver construct for study.

3.3.3 Stakeholder Pressures

Meixell and Luoma (2015), in their systematic review, find stakeholders pressures are very important in changing the behavior of a supply chain. They state that such pressures increase awareness about sustainability issues, the adoption of goals that are sustainable by the supply chain participants, and the adoption of practices that make the supply chain sustainable. Sangle (2010) suggests that stakeholder pressures work through stakeholder relationships, concern for stakeholder satisfaction, stakeholders' concerns for liability, customers' wishes to protect the environment, and inquiries from stakeholders about environmental and other impacts of a supply chain's operations.

3.4 Sustainable Supply Chain Management Practices

3.4.1 External Environmental Practices

External environmental practices encompass working and cooperating with suppliers on practices which are external to the firm. Even when these practices do not fall within the focal organization's operations, the firm still tries to influence its suppliers to engage in sustainable practices relating to the environment. This entails cooperating in areas of cleaner production, reduction in waste, new source reduction and achieving objectives relating to the environment (Paulraj, 2009).

3.4.2 Internal Environmental Practices

Internal environmental practices relate to practices that reduce the environmental impacts of operations of the focal firm and are internal to the organization; and for that reason more in its control (Paulraj, 2009; Zhu *et al.*, 2008a; Zhu *et al.*, 2008b). These cover practices such as the sale of excess inventory and scrap, the use of packaging that is returnable/reusable, trying to use lesser resources for same operations, documentation practices, and the elimination of physical waste (Paulraj, 2009; Zhu *et al.*, 2008a; Zhu *et al.*, 2008b).

3.4.3 Supplier Selection

Krausse *et al*., (2009) stress that "the purchasing function becomes central in a company's sustainability effort" (Krausse *et al*., 2009, p.18). This starts with the selection of suppliers that can fit with the sustainability objectives of the focal firm. Paulraj (2009) and other authors underline that suppliers be selected on the basis of their environmental competence, their ability to support focal firm's environmental objectives, their having a performance track record in environmental practices and their following a rating system and ISO 4000 certification (Paulraj, 2009; Vachon, 2007; Zhu *et al*., 2008a).

3.4.4 Supplier Evaluation and Monitoring

Even after the selection of suppliers for the purchase of material and services, it is important that a system for regular and periodic evaluation of suppliers be put into place to monitor whether they are in continuous compliance with their commitments, and

continue to follow the SSCM practices expected of them. This evaluation can be implemented by regular examination of their internal operations and by conducting sustainability audits; monitoring their environmentally friendly practices and ensuring that they adhere to their waste reduction goals; looking into the practices of their (second tier) suppliers - including using questionnaires and site visits to help the process (Vachon & Klassen, 2006; Vachon, 2007; Paulraj, 2009).

3.4.5 Cooperation with Customers

Firms practice cooperation with customers to achieve their sustainability objectives. This includes cooperating for eco-design, for cleaner production, environmentally friendly packaging, energy saving in transportation & distribution activities, reducing environmental impact and arriving at a mutual understanding to achieve environmental objectives (Vachon, 2007; Zhu *et al.*, 2007; Zhu *et al*., 2008a; Zhu *et al*., 2008b).

3.4.6 Eco-design

Designing products for sustainability, or eco-design, involves designing the products in such a way that they consume less material and energy during manufacturing and distribution, permit the use of reusable, recycled parts, using a process that enables recovery of materials used in process, using recycled components as well as permitting avoidance or reduction of hazardous products in manufacturing and ensuring that the products are amenable to be reused, recycled or remanufactured (Zhu & Sarkis, 2007;

Zhu *et al*., 2008a; Zhu *et al*., 2008b). It would stand to reason that this may be best done in close cooperation with customers, as discussed in 3.4.5 above.

3.4.7 Social Sustainability Practices

McKone-Sweet (2004) in his research has underlined the need to practice gender equality and pay fair wages. Vachon and Mao (2008) have studied social sustainability practices of various firms. The practices in vogue are in the format of use of corporate social responsibility codes that ensure socially responsible action, encouragement of volunteer activity in firm, contribution to charitable causes, enforcement of human resource policies for training employees and managing their retention and the employment of women and paying of fair wages (Vachon & Mao, 2008).

3.5 Firm Performance

3.5.1 Economic Performance

Firms can witness improvement in economic performance due to the adoption of SSCM practices. This can be indicated by reduction in material purchase cost, reduction in consumption of energy, savings in fees paid for waste treatment or waste discharge and reduction in fines for environmental accidents (Zhu & Sarkis, 2007; Zhu *et al*., 2008a). These economic impacts are generally measurable in money terms.

3.5.2 Environmental Performance

Environmental performance is generally measured in terms of environmental impacts of the operations of the focal firm. These can be in terms of reduction in generation of waste water and solid waste, reduction in polluting air emissions, decreasing the use of materials that are environmentally harmful or toxic, improving the firm's overall position relating to the environment, and decreasing environmental accidents (Zhu *et al*., 2008).

3.5.3 Social Performance

Muller and Kolk (2010) posit that social performance of a firm can be measured by measuring the increase in vocational training and internships offered, the increase in philanthropy, and the extent of formalized relations with the community.

3.5.4 Operational Performance

Operational performance may be measured from on-time delivery of goods, fall in inventory levels and scrap rate, increase in the firm's product line and its quality, and increase in utilization of capacity (Zhu *et al*., 2008).

3.6 Size of Firm

Using a resource-based view (RBV) and resource dependence theory (RDT) (Svensson, 2007) it seems plausible that a large sized firm would have more resources to deploy. It follows that the size of the focal firm may affect the impact of adoption of SSCM practices on the firm's performance as, in most likelihood, a larger sized firm

would not be constrained by the paucity of resources. This is supported by research of Swamidass and Kotha (1998) who find that association between adoption of advanced technology and performance is moderated by the size the firm. This finding is also supported by research of Cagliano *et al*. (2001), Gong *et al*. (2013), Bourlakis *et al*. (2014), Leal-Rodríguez *et al*. (2015), Benito-Osorio *et al*. (2015), Vithessonthi and Tongurai (2015) and others. The size of a firm may be determined by its assets (Smith *et al*., 2015; Brighi & Venturelli 2014; Schaefer, 1998; Horst, 1972), revenue (Hwang, 2015; Schaefer, 1998; Cohen *et al*., 1987) market capitalization (Baker & Hall, 2004), number of employees (Bolotova, 2016; Benito-Osorio *et al*., 2015; Elhamma, 2015; Leal-Rodríguez, 2015; Chenhall, 2003), number of establishments (Bolotova, 2016), alliance portfolio (Lahiri & Narayanan, 2013) and other indicators. For this research, the size classification employed by Statistics Canada is used, which classifies firms having less than 100 employees as small, with 100 to 499 employees as medium and more than 500 employees as large (Statcan, 2018).

In this research we studied the effect of size, if any, on the impact that firm's adoption of SSCM practices may have on its performance. A firm's size may also affect the impact of drivers on SSCM Practices adoption. For example, a bigger firm may have more resources to adopt suitable SSCM practices to comply with regulations, leverage its competitiveness objectives by adoption of SSCM practices, or adopt the SSCM practices that handle stakeholder pressures in a better way, and these options may not be available to a resource constrained small company. However, this possible moderating effect of size was not studied in this research for the purposes of parsimony.

3.7 Constructs and Indicators

Table 3.1 below provides a list of the constructs and indicators as used in the proposed research model as well as the published academic sources they have been gleaned from.

Table 3.1 *Constructs and Indicators*

Composite Construct	**Construct**	**Source**	**Indicators** (adopted *verbatim*- please read with inverted commas " ")
Drivers	Regulation	Paulraj, 2009 Sangle, 2010	Environmental regulation is the primary driver for all our environmental activities. Our environmental activities are directed towards complying with institutional norms and/or regulations. Pre-empting future environmental regulation is the main driver for adoption of proactive environmental practices
	Competitiveness	Paulraj, 2009 Paulraj, 2009 Sangle, 2010	We believe that our environmental activities will differentiate us from our competitors. We believe that our ecological responsiveness will lead to long-term profitability. Protecting environment will improve long-term financial performance is the main driver for adoption of proactive environmental strategies

		Sangle, 2010 Sangle, 2010 Sangle, 2010 Sangle 2010	Improved profits is the main driver for adoption of proactive environmental strategies Access to overseas market is the main driver for adoption of proactive environmental strategies Improving efficiency is the main driver for adoption of proactive environmental strategies Cost saving and risk reduction is the main driver for adoption of proactive environmental strategies
	Stakeholder Pressures	Sangle, 2010 Sangle, 2010 Sangle, 2010 Sangle, 2010 Sangle, 2010	Stakeholder relationship is the main driver for adoption of proactive environmental strategies Stakeholder satisfaction is the main driver for adoption of proactive environmental strategies Lender and investors' concern toward environmental liability is the main driver for adoption of proactive environmental strategies Customer desire to protect environment is the main driver for adoption of proactive environmental strategies Non Profit Organizations /judiciary/media inquiries is the main driver for adoption of proactive environmental strategies
SSCM Practices	External Environment	Paulraj, 2009	We cooperate with our suppliers to achieve environmental objectives. We encourage our suppliers to develop new source reduction

Adoption	al Practices	Paulraj, 2009	strategies.
		Paulraj, 2009	We cooperate with our suppliers to improve their waste reduction initiatives.
		Paulraj, 2009	We work with our suppliers for cleaner production.
	Internal Environmental Practices	Paulraj, 2009	We support the inventory recovery (sale) of excess inventories/materials.
		Paulraj, 2009	We emphasize the use of reusable and returnable packaging for our products.
		Paulraj, 2009	We constantly strive to use lesser resources in getting the tasks done.
		Paulraj, 2009	We have well-documented waste reduction methodologies in place.
		Paulraj, 2009	We eliminate physical waste from our operations.
		Zhu *et al.,* 2008a & Zhu *et al.,* 2008b	We support the sale of scrap and used materials
	Supplier Selection	Paulraj, 2009	We select suppliers based on their environmental competence.
		Paulraj, 2009	Suppliers are selected based on their ability to support our environmental objectives.
		Paulraj, 2009	We select suppliers based on their environmental performance.
		Paulraj, 2009	We select suppliers based on their ability to develop environmentally friendly goods.
		Paulraj, 2009	Our organization has a thorough supplier environmental rating system

		Vachon, 2007; & Zhu *et al.,* 2008a	We select suppliers based on their ISO 14000 Certification
	Supplier Evaluation and Monitoring	Paulraj, 2009 Paulraj, 2009 Paulraj, 2009 Vachon, 2007; Vachon & Klassen, 2006 Vachon, 2007	We conduct regular environmental audits into our suppliers' internal operations. We periodically evaluate our suppliers' environmentally friendly practices. We make site visits to suppliers' premises to help them improve their eco-performance. We periodically evaluate our second-tier suppliers' environmentally friendly practices. We ask our suppliers to commit to waste reduction goals We send environmental Questionnaires to suppliers in order to monitor their compliance
	Cooperation with Customers	Zhu *et al.,* 2008a & b Zhu *et al.,* 2008a & b Zhu *et al.,* 2008a & b Zhu *et al*., 2007 Vachon, 2007	We cooperate with customers for eco-design We cooperate with customers for cleaner production We cooperate with customers for green packaging We cooperate with customers for using less energy during product transportation We develop a mutual understanding with our customers of responsibilities regarding

		Vachon, 2007	environmental performance We work together with our customers to reduce the environmental impact of our activities.
	Eco-Design	Zhu *et al.,* 2008 a & b; Zhu & Sarkis, 2007.	We design products for reduced consumption of material/energy. We design products for reuse, recycle, recovery of material, component parts. We design products to avoid or reduce the use of hazardous products and/or their manufacturing process.
	Social Sustainability Practices	Vachon & Mao, 2008. Vachon & Mao, 2008. Vachon & Mao, 2008. Vachon & Mao, 2008. Vachon & Mao, 2008. Vachon & Mao, 2008.	Our organization frequently employs corporate codes of conduct and other aspects of corporate social responsibility. Our organization commonly encourages workers to volunteer for social causes and has incentives that facilitate that involvement. Our organization contributes to charitable causes. The general approach of our organization to human resources is to invest heavily to attract, train and retain employees. In our organization employment of women is (1= limited and usually takes place in less important jobs, 7=is equal to that of men) In our organization, for similar work, wages for women are (1=significantly below those of

			men, 7= equal to those of men).
Performance	Economic Performance	Zhu, *et al.*, 2008a. Zhu & Sarkis, 2007.	In our organization, there has been a significant decrease in cost for materials purchasing over the past three years. In our organization, there has been a significant decrease in cost for energy consumption over the past three years. In our organization, there has been a significant decrease in fee for waste treatment over the past three years. In our organization, there has been a significant decrease in fee for waste discharge over the past three years. In our organization, there has been a significant decrease of fine for environmental accidents over the past three years.
	Environmental Performance	Zhu *et al.,* 2008.	In our organization, there has been a significant reduction of air emission over the past three years. In our organization, there has been a significant reduction of wastewater over the past three years. In our organization, there has been a significant reduction of solid wastes over the past three years. In our organization, there has been a significant decrease in consumption of hazardous/ harmful/toxic materials over the past three years.

			In our organization, there has been a significant decrease in frequency for environmental accidents over the past three years. There has been a significant improvement of our organization's environmental situation over the past three years.
	Social Performance	Muller & Kolk, 2010.	In our organization, there has been a significant increase in days of vocational training over the past three years. In our organization, there has been a significant increase in philanthropy as a share of profit over the past three years. In our organization, there has been a significant increase in the formalization of community relations over the past three years. In our organization, there has been a significant increase in a number of internships offered over the past three years.
	Operational Performance	Zhu *et al.*, 2008.	Increase amount of goods delivered on time Decrease inventory levels Improve capacity utilization Decrease scrap rate Promote products' quality Increase product line
Size	Size of Firm	Swamidass & Kotha, 1998.	Number of employees

Note. Source: Literature reviewed.

3.8 Hypotheses

Based on the discussions above, the following hypotheses are put forth in this study:

H1a: Companies that face a higher level of regulations are more likely to adopt SSCM practices.

H1b: Companies that aim to achieve a higher level of competitiveness are more likely to adopt SSCM practices.

H1c: Companies that face higher pressures from stakeholders are more likely to adopt SSCM practices.

H2a: A company's economic performance is positively associated with the company's adoption of SSCM practices.

H2b: A company's environmental performance is positively associated with the company's adoption of SSCM practices.

H2c: A company's social performance is positively associated with the company's adoption of SSCM practices.

H2d: A company's operational performance is positively associated with the company's adoption of SSCM practices.

H3a: The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company’s economic performance.

H3b: The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's environmental performance.

H3c: The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's social performance.

H3d: The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's operational performance.

Table 3.2 below presents the research questions discussed in section 3.1 and the hypotheses that map on to the specific research questions.

Table 3.2 *Research Questions & Hypotheses*

Research Question	**Hypothesis**
Do the key motivators, as identified in the literature, affect the adoption of SSCM practices by a firm?	H1a: Companies that face a higher level of regulations are more likely to adopt SSCM practices. H1b: Companies that aim to achieve a higher level of competitiveness are more likely to adopt SSCM practices. H1c: Companies that face higher pressures from stakeholders are more likely to adopt SSCM practices.
Does the adoption of SSCM practices impact the economic, environmental, social and operational performance of a firm?	H2a: A company's economic performance is positively associated with the company's adoption of SSCM practices. H2b: A company's environmental performance is positively associated

	with the company's adoption of SSCM practices. H2c: A company's social performance is positively associated with the company's adoption of SSCM practices. H2d: A company's operational performance is positively associated with the company's adoption of SSCM practices.
Does the size of a firm affect the impact that a company's adoption of SSCM practices may have on the company's economic, environmental, social and operational performance?	H3a: The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's economic performance. H3b: The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's environmental performance. H3c: The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's social performance. H3d: The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's operational performance.

Chapter 4 Research Methodology

4.0 Overall Approach

As previously discussed in Chapter 3, the objective of this study was to address the following research questions:

1. Do the key drivers, as identified in the literature, affect the adoption of SSCM practices by a firm?

2. Does the adoption of SSCM practices impact the economic, environmental, social and operational performance of a firm?

3. Does the size of a firm have a moderating effect on the impact that a company's adoption of SSCM practices may have on the company's economic, environmental, social and operational performance?

A research framework (Figure 3.1) was proposed based on an extensive review of academic literature published in this area. The measurement items for the factors being used in the framework have been taken from published research (Table 3.1). This chapter presents the research design, research sample, unit of analysis and data collection techniques used for the empirical survey.

4.1 Research Design

This research examines sustainable supply chain practices and performance from the perspective of the focal firm. The '*a priori'* research model (seen in Chapter 3) was developed, and measurement items and factors were determined based on the literature review in Chapter 2. The study conducted was cross-sectional in nature, for which the primary data was collected through an online survey. Since the focus and objectives of the study required responses on a large-scale with little personal variation or exception, the most amenable mode of data collection was using an empirical survey. The decision was made to utilize an online survey since most formal, and business interactions in this age are conducted via email or online. The survey instrument and data collection are presented in the next few sub-sections.

4.2 Survey Instrument and Pre-Test

The survey instrument or questionnaire was developed based on the research design. The survey instrument used for this study is appended to this thesis as Appendix III.

Both constructs and measurement items (or indicators) were based on previously validated and published research to ensure that they are well grounded in theory. As discussed in section 2.0, the use of concepts of "sustainable" and "sustainability" are recent (Harper, 2010), especially with reference to ecology in the context of economy, business, and development (WECD, 1987). It was, therefore, considered prudent to avoid the use of these words in the instrument. Since the mental schemas of these words and

concepts are still evolving and diffusing through our target group, it was understood that the use of these concepts may give erroneous results.

the concept of "sustainability" (in the context of development) appeared in the *Brundtland Report* (WECD, 1987)

Before beginning data collection, the questionnaire was pre-tested with five practitioners and five academicians for their comments. The pre-test was conducted in person along with semi-structured conversations to collect their feedback and suggestions on (a) the instructions attached with the survey, (b) the questions themselves and (c) any other aspect of the questionnaire. This feedback was used to make the required adjustments to the survey instrument. Suggestions received, and action taken on them is presented in Table 4.1 below:

Table 4.1 *Pre-Test Feedback and Action Taken Thereon*

Sr.	**Feedback**	**Action Taken**
1.	Reduce the size of introductory email	The size of the email was reduced significantly to minimal length, while still covering the salient aspects mandated by the Carleton University Research Ethics Board.
2.	Add item to cover "equal opportunity employment" in measuring social performance	Item was added to the questionnaire.
3.	Make questionnaire a little shorter	In view of the research undertaken, it was not possible to reduce the length of questionnaire

Data from pre-test surveys were not included in the final sample. The revised covering letter and questionnaire were used for final data collection.

4.3 Research Sample

This study investigates the impact of the adoption of sustainable supply chain management practices on a firm's performance. Hence, the unit of analysis for this research is a (for-profit) business organization. To empirically test the theoretical framework proposed, data was collected from the managers knowledgeable about supply chain activities in the organization. The population and sampling frame are presented in Section 4.4.

The information about potential respondent companies was collected from Scotts Directory of Canadian firms, Hoover's database for US firms, and similar other online sources. A snowball effect was used to enroll potential respondents. Respondents were requested to forward the questionnaire to their colleagues using the following language:

> *"I would greatly appreciate if you could further send this email to your colleagues at the senior manager or executive levels in other firms who are knowledgeable about supply chain processes so that they may participate as well by completing the questionnaire. Your help in this regard is highly appreciated."*

To collect data on firm size, this study divided firms into three classes. The organizational size was defined as per Statistics Canada, which bases the size of a firm on

the number of employees working in the firm. Number of employees is a generally accepted proxy for firm size in academic research. Accordingly, firms with fewer than 100 employees were classified as small, with 100 to 499 employees were classified as medium and organisations with 500 or more than 500 employees were classified as large.

Sample size is usually dictated by the level of accuracy and confidence required in the research results, but it is constrained by costs in terms of money, effort and time. While no standard guidelines for sample size for using structural equation modelling (SEM), or even multiple-regression, are available (Tanaka, 1987), it is generally accepted that sample size close to 200 may provde reasonably good estimates using Maximum Likelihood method (Boomsma, 1987; Gerbing & Anderson, 1985). Since this research used both multiple regression and SEM methods, it was considered that the sample size should be ideally more than 200. There were 14 constructs or variables being analysed in the study. From this it was estimated that a sample size of 210 would be adequate for the research. This was based on a heuristic of 15 respondents per construct to be analysed (Austin & Steyerberg, 2015). This estimate also satisfied the 200 number discussed above. This estimate of sample size was validated after data collection by statistical tests like Barlett's Test and Kaiser-Meyer-Oklin Test for sampling adequacy.

4.4 Survey Administration / Data Collection

The data for the study was collected from managers who are knowledgeable of their organization's supply chain activities. These managers were assumed to be knowledgeable of supply chain activities such as purchasing, procurement, operations,

logistics, and other related activities that are directly connected with internal or external supply chain management of the firm. A covering letter, containing a link to survey questionnaire was emailed to the appropriate managers of each of the firms identified for data collection.

Chandy and Tellis (1998) provide some approaches to increase response rates. These include pre-survey phone calls, hand-written and personalized cover letter /notes, professional appearance of the survey package, reminder letters with the original copy of the survey instrument. This follow-up was done in the form of sending a reminder email after three weeks. As mentioned earlier, the snow-balling technique was also used to increase response rates.

To put potential respondents' concerns about confidentiality to rest, a confidentiality statement was incorporated, as suggested by the Carleton University Research Ethics Board. This statement formed part of the covering letter:

> *"All information provided by you will be processed anonymously and in an aggregate manner only. It will not be identifiable and will not be attributed to your name or that of your company."*

A copy of the covering letter sent by email is attached as Appendix I to the thesis.

On approval from the Carleton University Research Ethics Board, the survey was hosted on a website, along with the online consent form for participation as suggested by the board (Appendix II). A database of potential respondents was created using various

sources including online databases, professional associations, personal sources and search engines. The instrument was administered through a Web-based survey host Survey Monkey through Blueline surveys to collect data from Supply Chain Management practitioners. This online method was found to be cost-effective and efficient. The potential respondents were sent emails soliciting their participation in the survey. A total of 2512 emails were sent over forty days. 261 emails were received back due to email addresses being inoperative. This reduced total survey communication to 2251. Three weeks after mailing the questionnaire to the respondents, one follow-up email was sent to the potential respondents. A total of 227 responses were received after which the data collection was terminated.

Whereas the methods used to create database of potential respondents and the use of snowballing method to garner responses were successful to gather data, the data-set does not purport to be the ideal random-sample. It can also be argued that a random-sample may provide significantly different results. However, since the research area is new, and the target population is restricted to professionals that specialise in SCM field, this method of sampling was considered adequate, effective and expedient for this exploratory research.

In this chapter overall research design, survey instrument and its pre-test, research sample, administration of the survey, and data collection were discussed. This is followed by data preparation for statistical analysis which is presented in Chapter 5.

Chapter 5 Data Preparation

5.1 Screening of Data

Use of survey services available on the Web-enabled direct download of data as excel file. This prevented any errors that may arise from manual data-entry by the researcher. On receipt of an adequate number of responses (numbering 227) on the 20th October 2017, the data was downloaded onto the researcher's computer and deleted from the web host. The data was manually screened for completeness and any apparent errors such as unengaged responses.

5.1.1 Data Coding and Cleaning Operations

Out of a total of 227 responses received nine were considered to be unusable. Out of these nine responses, six were substantially incomplete and had to be discarded. Three were adjudged to be unengaged responses as they contained only "strongly disagree" selection and the general questions at the end, that is questions 26 to 33, were incomplete.

As all measurement items were worded in a unidirectional manner, there was no requirement for reverse coding before analysis.

5.1.2 Missing Values

A web-based survey using online questionnaire limits the control of researcher on completion of the survey by the participants. This can potentially result in incomplete surveys, loss of data, reduction of sample size, and missing values in case of marginally

incomplete surveys. Missing values can be a result of a confusing question where the respondent is unable to select a proper answer, a partially-engaged participant, a lengthy questionnaire, an error in keying in response, a defective mouse button/touchscreen, or other reasons.

The pattern of missing data, if any, needs to be analyzed. Randomly missing data is less of a problem (Rubin, 1976). In the data collected for this research, no specific pattern in the missing data was found. One value each was missing in three cases. These missing values were small in number and seemed random. The missing data was completed by using the method of mean substitution. For this the mean of the item was used to substitute missing value, rounding it off to the nearest whole number. The missing data imputed is presented in Appendix V.

5.2 Response Rate and Non-Response Bias

As reported in Section 4.4 above, a total of 2512 emails were sent over a period of forty days, out of which, 261 emails rebounded due to different reasons. A total of 227 responses were received after which the data collection was terminated. The overall response rate was 227/(2512-261) or 10.1%. Out of 227 responses received, nine were unusable and were discarded, and only 218 were used.

Non-response can result from inaccurate, old or inoperative email addresses, non-availability of the respondent, or his/her inability or unwillingness to respond due to

various reasons. Non-response bias may be viewed as a continuum from early responders to late responders (Armstrong & Overton, 1977) tailing into non-responders. Assuming that the non-responders were akin to the late responders, we compared the data collected from the late responders with the data collected from the early responders. A significant difference in these two sets of data, would lead to an inference that non-response bias existed in the collected data. Our data collection lasted for forty days. We sent one reminder email after three weeks. When the characteristics of responses of responders who responded during the first twenty days were compared with responses of those who responded in the second half of collection period, a non-significant independent t-test indicated that there was no significant difference between the two groups. This was inferred as the absence of non-response bias in the sample. Results of the independent samples t-Test for Equality of Means and Levene's Test for Equality of Variances conducted are placed as Appendix VII.

5.3 Common Method Variance

One of the main sources of error of measurement (Podsakoff *et al*., 2003) common method variances are those variances that are caused by measurement method (Bagozzi & Yi, 1990) rather than due to the construct being measured. Such errors of measurement affect the research findings. These common method variances can arise from item characteristics, item context, common source, measurement context and other sources.

A number of steps were taken to reduce this common method bias. A web-based survey was used, in place of face to face interviews, which tends to reduce bias (Richman *et al*., 1999). However, this takes away any control over the time and location of measurement. Keeping the respondents anonymous helped reduce the bias based on social desirability of responses (Podsakoff *et al*., 2003). Similarly, anonymity also takes away the pressure to be lenient or consistent. The survey instrument was carefully drafted and pre-tested to remove any vagueness and double-barrelled questions and to remove item characteristics bias.

Harman's single factor test was used for assessing common method bias. Using Principal Component Analysis method in SPSS only single factor was extracted, using no rotation, to ascertain if one single factor emerges that accounts for most of the variance in the variable (Verhoef & Leeflang, 2009). If a single factor, such extracted, explains a majority of variance it may be an indication that common method may be introducing this bias. Table 5.1 provides the result of Harman's single factor test.

Table 5.1 *Harman's Single Factor Test*

Total Variance Explained						
Factor or Component	**Initial Eigenvalues**			**Extraction Sums of Squared Loadings**		
	Total	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	21.496	29.048	29.048	21.496	29.048	29.048

Since the single factor extracted accounts for only 29.048 % of the variance, out of a total of 86.547 % variance explained by all the factors extracted which had eigenvalues above 1, it indicated that common method bias was probably not a significant problem in the dataset.

5.4 Normality Tests

A collected sample of data should ideally be distributed normally. However, that may not always be the case in real life (Stigler, 1977; Micceri, 1989). Using data that is not normally distributed and has a large number of outliers can lead to results that are not generalizable (Stevens, 1996; Tabachnick & Fidell, 2007). Normality tests help in ascertaining whether the underlying assumption of normal data is well founded. For this, visual inspection of data spread and characteristics is very helpful. Visual inspection of graphs like histogram is a time-tested procedure to check for normal distribution and the level of its skewness and kurtosis. Other methods include statistical tests like Shapiro Wilk and Kolmogorov-Smirnov test. Comparison of means with a 5% trimmed mean is another method used for checking if outliers are affecting an analysis or not. These analyses are dealt with in the next sub-sections.

5.4.1 Shapiro Wilk and Kolmogorov-Smirnov Tests

Shapiro Wilk and Kolmogorov-Smirnov tests were conducted using SPSS software. The results are placed in Appendix IV. It was found that the scores were

significant (sig. or p-value less than 0.05) which indicated that the distribution of indicator data was not normally distributed. The null hypothesis that all the data was not normally distributed could not be rejected. For this research, the data was collected using a 7-point Likert scale. A perfectly normal distribution may not be possible with questions eliciting answers on a Likert scale (University of Northern Iowa, 2017).

In the book "Statistics for Management and Economics" Mendenhall *et al*., (1989) write: "It is important to note that the Student's t and the corresponding tabulated critical values are based on the assumption that the sampled population possesses a normal probability distribution."…"Fortunately, this point is of little consequence, as it can be shown that the distribution of the t statistic possesses nearly the same shape as the theoretical t distribution for populations that are non-normal but possess a mound-shaped probability distribution" (University of Northern Iowa, 2017).

The distribution pattern of each indicator was scrutinized visually for this 'mound-shaped' distribution before the analysis and is explained in the next sub-section.

5.4.2 Visual Inspection of Graphs

The data collected was analyzed by creating histograms which were visually inspected. On visual analysis of the histograms, it was found that the distribution was mound-shaped and was suitable for further analysis. The histograms generated are placed in Appendix VI. Sample data collected for the indicators presented a mound-shaped distribution in histograms with a clear indication that the data showed a tendency towards normal distribution.

5.4.3 Skewness and Kurtosis

The data collected was checked for normality by testing for skewness and kurtosis. The test for skewness focuses on symmetry in the distribution of data points. A symmetric distribution indicates normality. When scores are clustered to the left and the tail extends to the right, the data is said to be positively skewed. A negatively skewed data set is mirror image of the above. Stevens (1996) and West *et al.* (1996) posit that when statistic values of skewness are outside the range of -2 to +2 it indicates that there is substantial departure from normality. No excessive skewness was found in the data collected. However negative skewness was seen in the data which was found to be within the acceptable range.

Kurtosis focuses on peaks in the distribution of data. The normal distribution shows a bell-shaped curve. A positive kurtosis is said to exist when an accentuated peak is there. A flat distribution is said to show a negative kurtosis (Stevens, 1996). For a normal bell-shaped curve, the kurtosis value is 0. When the test values for kurtosis are outside the range of -7 to +7, excessive kurtosis is said to occur (West *et al.,*1996). The test for kurtosis indicated that no excessive kurtosis existed in the collected data. The skewness and kurtosis statistic of the collected data are placed in Appendix VIII.

5.4.4 Outliers

Statistical analysis results can be affected by outliers. Outliers are those data points that are very different from the data set. In a correlation and regression, analysis outliers can affect results and its interpretation. The data set was checked for outliers. For

this F scores of all the 74 observed variables were computed. The computed F scores ranged from -2.773 to 2.436, which were well within the range of -3 to 3, indicating that there were no univariate outliers in the collected data. Dataset was also checked for multivariate outliers. These outliers were checked by computing Mahalanobis Distance, which is the distance of the specific score from the cluster center (Stevens, 1996). Mahalanobis Distance was computed for all indicators in data, along with chi-square probability values. The dataset was found to be free from multivariate outliers. The top ten cases with high Mahalanobis distances are presented in Table 5.2 below, and none of these cases were identified as outliers, as none of them had probability values lower than 0.001.

Table 5.2 *Top Ten Cases with High Mahalanobis Distances with Probability Values*

Case ID	**Mahalanobis Distance**	**Chi-Square Probability**
145	116.754	0.001
58	112.228	0.003
12	108.480	0.006
8	105.560	0.009
203	102.306	0.016
15	101.810	0.018
171	100.448	0.022
6	100.252	0.023
134	98.487	0.030
82	98.191	0.032

Each of these cases was also checked manually and was found to be a reasonable response with nothing to indicate that it was an unengaged response or in any other way not in order. The decision was made to retain all these cases in the dataset.

5.5 Reliability

5.5.1 Cronbach's Alpha

This research uses latent constructs and depends on indicators for measuring those latent constructs or variables. These indicators or items or measures must show internal consistency and homogeneity to form a reliable scale that can then be used for measurement. It is recommended to start with a well-grounded theory for the scientific development of measures. Once the scale is developed a number of methods are available to check for its reliability. Reliability of a scale may be judged by the degree of consistency in respondents' replies across the items measuring the same construct (Schwab, 1999). Verifying substantive meanings and statistical methods like finding eigenvalues and factor loadings are important and relevant criteria to check for reliability (Tabachnick & Fidell, 2007). Finding Cronbach's Alpha coefficient statistically is a valuable and is widely used tool to test for reliability, especially for new measures (Nunnally, 1978). Cronbach's Alpha coefficient indicates the percentage of total variance that is caused by true (systematic) variance in the data used for the test.

For testing reliability, Cronbach's Alpha coefficients were calculated for all the constructs used in the study. The value of Cronbach's Alpha calculated ranged from 0.779 to 0.986 for these constructs. As all these calculated values were found to be higher than the recommended level of 0.70 (Nunnally, 1978) it was interpreted that scale had high reliability. For newer constructs, a level of 0.60 may be considered adequate (Nunnally, 1978; Malhotra, 2004), but the constructs used in this study had been duly tested earlier in published research, so a higher cut-off of 0.70 was adopted. No Cronbach's Alpha values were found to be below 0.70. Table 5.3 below provides Cronbach's Alpha values for all the multi-item constructs that were used in the study.

Table 5.3 *Reliability of Constructs: Cronbach's Alpha Values*

Composite Construct	**Construct**	**Cronbach's Alpha**	**Number of Indicators**
Drivers	REG Regulations	.910	3
	COMP Competitiveness	.961	7
	PRES Stakeholder Pressures	.935	5
SSCM Practices Adoption	EEP External Environmental Practices	.897	4
	IEP Internal Environmental Practices	.958	6
	SS Supplier Selection	.940	6
	SM Supplier Evaluation & Monitoring	.976	6
	CC Cooperation with Customers	.968	6
	ED Eco-Design	.767	3
	SSP Social Sustainability Practices	.969	6
Performance	EP Economic Performance	.956	5
	ENVP Environmental Performance	.983	6
	SP Social Performance	.943	5
	OP Operational Performance	.950	6

5.5.2 Composite Reliability

While Cronbach's Alpha has been widely used in research, researchers have suggested that use of Composite Reliability, which uses both standardized loadings and measurement error for calculation, may be a preferred indicator of reliability (Ping, 2003; Wang *et al*., 2006). Fornell & Larcker (1981) provide a formula to calculate CR, which is presented as Equation 5.1 below, where ρ_η represents Composite Reliability, λ_{yi} represents standardized loading, and $Var(\varepsilon_i)$ represents the variance of measurement error.

$$\rho_\eta = \frac{\left(\sum_{i=1}^{\rho} \lambda_{yi}\right)^2}{\left(\sum_{i=1}^{\rho} \lambda_{yi}\right)^2 + \left(\sum_{i=1}^{\rho} Var(\varepsilon_i)\right)}$$

Equation 5.1 Composite Reliability (Fornell & Larcker, 1981)

The CR values calculated for the constructs using the above formula is presented in Table 5.4 below.

Table 5.4 *Composite Reliability of Constructs*

Construct	**Composite Reliability CR**
REG	0.914

COMP	0.961
PRES	0.929
EEP	0.888
IEP	0.955
SS	0.934
SM	0.976
CC	0.969
ED	0.772
SSP	0.966
OP	0.946
EP	0.954
ENVP	0.983
SP	0.936

It was seen that CR values for all the latent constructs were above 0.70 indicating that the scales were reliable (Fornell & Larcker, 1981).

It was seen that the above measures are reliable, and therefore it was assumed that they measure the same thing. While measures maybe reliable when they measure the same thing, but they may not measure the right thing (Cascio, 1991). Measuring the right thing is a validity issue. In the next section, we discuss tests conducted to check for validity of measures.

5.6 Validity

A measure should correctly represent the construct (in content), and should measure it correctly; these two aspects of validity are covered by content validity and construct validity (Nunnally, 1978).

5.6.1 Content Validity

Content validity of a measure would reflect in how well it measures the dimension of the construct being measured. A traditional way has been to take help of experts in the domain, both in academia and in practice. As explained in Section 4.2 above, the survey instrument was pre-tested with five practitioners and five academicians for their comments. Feedback was solicited on the questions themselves and on any other aspect of the survey instrument that the experts may offer. This feedback was used to make adjustments to the survey. This was done in addition to the fact that all the constructs and indicators were taken from previously published research (please see Table 3.1: Constructs and Indicators) and these had been duly tested and validated by the researchers earlier.

5.6.2 Construct Validity

Construct validity is the degree to which a measure or a metric does its work or the extent to which it measures what it claims to measure (Davis, 2005). For this the measures of a construct should relate to one another in a theoretically sound and systematic way (Cronbach & Meehl, 1955), that is, the measures should relate to one another both theoretically and statistically. Extending this logic, the measures that are not related theoretically should not relate statistically. This provides convergent (when similar measures relate to each other statistically) and divergent (when dissimilar measures do not relate to each other statistically) construct validity. It stands to reason

that only by demonstrating both convergent and divergent validity one can be sure that the construct validity exists (Stevens, 1996; Trochim, 2002).

5.6.2.1 Convergent Validity

When different indicators are measuring the same construct and are in agreement, it is said that convergent validity is present. Researchers commonly report reliability measures as indicators of convergent validity (Ping, 2004). Fornell and Larcker (1981) suggest the use of average variance extracted (AVE) to test for convergent validity using the formula presented as Equation 5.2 below. In the equation $\rho_{vc(\eta)}$ is the AVE for the construct, λ_{yi} represents standardized loading, and $Var(\varepsilon_i)$ represents the variance of measurement error (Fornell & Larcker, 1981).

$$\rho_{vc(\eta)} = \frac{\left(\sum_{i=1}^{\rho} \lambda^2{}_{yi}\right)}{\left(\sum_{i=1}^{\rho} \lambda^2{}_{yi}\right) + \left(\sum_{i=1}^{\rho} Var(\varepsilon_i)\right)}$$

Equation 5.2 Average Variance Extracted (Fornell & Larcker, 1981)

Table 5.5 below presents the AVE of all the constructs calculated using the above formula.

Table 5.5 *Average Variance Extracted of Constructs*

	Average Variance Extracted AVE
REG	0.780
COMP	0.778
PRES	0.724
SSP	0.825
EEP	0.669
IEP	0.781
SS	0.705
SM	0.872
CC	0.840
ED	0.548
OP	0.748
EP	0.806
ENVP	0.906
SP	0.750

Ping (2004) posits that when AVE is 0.50 or higher (along with Composite Reliability of 0.80 or higher) convergent validity is said to be present. It was observed that AVE values for all the constructs were well above 0.50 (Table 5.5). We had observed in Table 5.4 above that the CR values of all these constructs were above 0.80. Hence it was inferred that the scale had convergent validity.

5.6.2.2 Discriminant Validity

While convergent validity looks for similarity in indicators in a scale, discriminant validity searches for dissimilarity between variables. Constructs that are too similar to each other tend to overlap in the various aspects or dimensions and are said to have failed in discriminant validity. Discriminant validity examines the extent to which a variable in a model differs from the other variables in the model (Churchill, 1979). A low

correlation with other constructs may indicate a good discriminant validity and is commonly used to indicate the same (Ping, 2004). Fornell and Larcker (1981) who arrived at the formulae to calculate CR and AVE (Equations 5.1 and 5.2) suggest that for a good discriminant validity the shared variance between any two constructs should be lower than AVE of each construct. Table 5.6 below compares these two values for the constructs under study.

Table 5.6 *Average Variance Extracted and Maximum Shared Variance of Constructs*

Constructs	**Average Variance Extracted AVE**	**Maximum Shared Variance MSV**
REG	0.780	0.233
COMP	0.778	0.094
PRES	0.724	0.233
EEP	0.669	0.251
IEP	0.781	0.251
SS	0.705	0.277
SM	0.872	0.226
CC	0.840	0.162
ED	0.548	0.277
SSP	0.825	0.162
OP	0.748	0.699
EP	0.806	0.699
ENVP	0.906	0.068
SP	0.750	0.027

It was seen from the comparison between Average Variance Extracted (AVE) and Maximum Shared Variance (MSV) of the constructs that for all the constructs under review, AVE was greater than MSV indicating good discriminant validity.

Yang *et al.* (2008) suggest that we should check if the correlation between any two constructs has a value lower than the square root of AVE of each of the construct to assess discriminant validity. Table 5.7 below presents the values of coefficient of correlation between the constructs, and values of the square root of AVE on the diagonals for constructs Regulations (REG), Competitiveness (COMP), and Stakeholder Pressures (PRES) for comparison.

Table 5.7 *Discriminant Validity Check for Driver Constructs*

	REG	**COMP**	**PRES**
REG	**0.883****		
COMP	-0.273*	**0.882****	
PRES	-0.483*	0.307*	**0.851****

Note. ***.** Correlation between constructs
****.** The bold figures on the diagonals are the square roots of the respective AVE.

It may be seen from above that the constructs show a good discriminant validity as the coefficient of correlation between any two of them is lower than the square root of EVA of each.

Table 5.8 below presents the values of coefficient of correlation between the constructs, and the values of square root of AVE on the diagonals, for the constructs External Environmental Practices (EEP), Internal Environmental Practices (IEP), Supplier Selection (SS), Supplier Evaluation and Monitoring (SM), Cooperation with Customers (CC), Eco-Design (ED) and Social Sustainability Practices (SSP) for comparison.

Table 5.8 *Discriminant Validity Check for SSCM Practices Constructs*

	SSP	EEP	IEP	SS	SM	CC	ED
SSP	**0.908****						
EEP	0.091*	**0.818****					
IEP	0.093*	0.501*	**0.884****				
SS	0.229*	0.119*	0.136*	**0.840****			
SM	0.122*	0.444*	0.475*	0.235*	**0.934****		
CC	0.403*	-0.095*	-0.088*	0.307*	0.012*	**0.917****	
ED	0.171*	0.054*	0.053*	0.526*	0.097*	0.220*	**0.740****

Note. ***.** Correlation between constructs
****.** The bold figures on the diagonals are the square roots of the respective AVE.

It was observed from Table 5.8 above that the constructs showed a good discriminant validity as the coefficient of correlation between any two was lower than the square root of EVA of each of them.

Table 5.9 below presents the values of coefficient of correlation between the constructs, and the values of the square root of AVE on the diagonals, for constructs Economic Performance (EP), Environmental Performance (ENVP), Social Performance (SP) and Operational Performance (OP) for comparison.

Table 5.9 *Discriminant Validity Check for Performance Constructs*

Constructs	OP	EP	ENVP	SP
OP	**0.865****			
EP	0.836*	**0.898****		
ENVP	-0.189*	-0.261*	**0.952****	
SP	0.103*	0.165*	-0.068*	**0.866****

Note. ***.** Correlation between constructs
****.** The bold figures on the diagonals are the square roots of the respective AVE.

It was observed from Table 5.9 above that the constructs showed a good discriminant validity as the coefficient of correlation between any two was lower than the square root of EVA of each of them.

In summation, after considering observations elicited from all the statistical tests and calculations, all the latent variables showed a high level of construct validity.

In this chapter we presented data preparation operations and the tests conducted before data analysis, including data screening, data coding, and cleaning operations, missing value imputation, response rate and non-response bias, common method bias, normality tests, Shapiro Wilk and Kolmogorov-Smirnov Tests, use of graphs for outliers and normality, skew and kurtosis, and tests for reliability and validity. In the next chapter, descriptive statistics are presented.

Chapter 6 Descriptive Statistics

This chapter presents descriptive statistics including organizational characteristics and respondent characteristics.

6.1 Organizational Characteristics

The survey instrument was sent to senior management that would be knowledgeable about supply chain management of the focal firm. Survey question number 5 asked for descriptive information about the respondent and the firm including type of industry, number of employees, ISO 14000 certification, duration of this certification, the title of the respondent, years of experience, geographical location of the firm, and whether the firm is publicly or privately owned. The data collected comprised of a sample of 218 respondents who spanned senior management of public and privately-owned companies over different countries and industries.

6.1.1 Location

Out of the companies that participated in the survey 105 (48.2%) were Canadian companies, while 41 (19%) were from the United States; 18 (8.3%) were located in Mexico; 19 (18.9%) in Europe; 16 (7.3%) in South America; 17 (7.8%) in Asia; and one each in Africa and Oceania. The details by country are given in Table 6.1 and are presented in Fig. 6.1.

Table 6.1 *Location of Respondent Companies*

Country	Number of Companies	Percent
Canada	105	48.2
United States	41	18.8
Mexico	18	8.3
South America	16	7.3
Europe	19	8.7
Oceania	1	.5
Asia	17	7.8
Africa	1	.5
Total	**218**	**100.0**

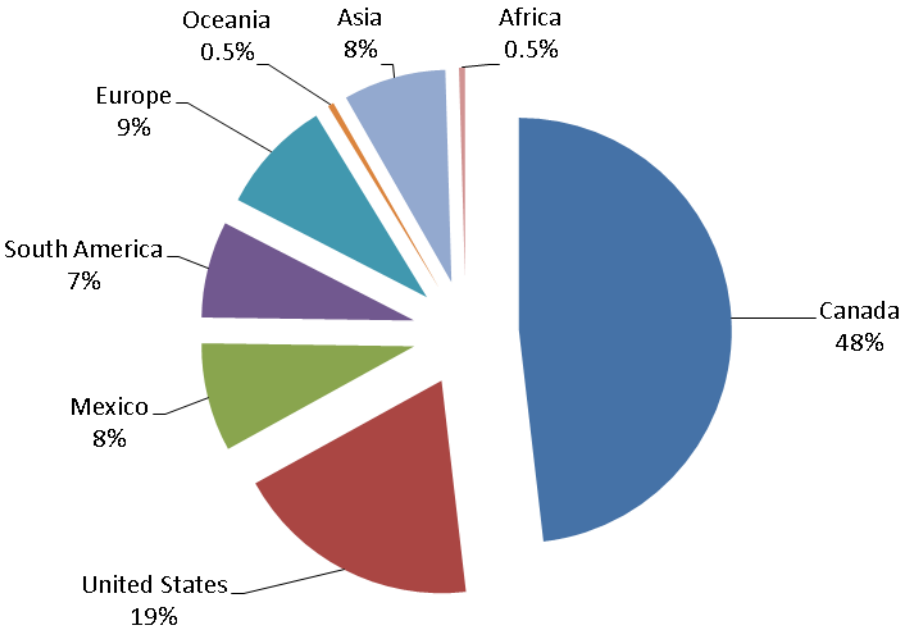

Figure 6.1 Location of Respondent Companies

It was seen that Canada, United States of America and Mexico accounted for most of the respondents (75.3%), there was a good representation from South America (7.3%), Europe (8.7%) and Asia (7.8%). Africa and Oceania accounted for one respondent each. The distribution has implications for this research. While the results of this research are expected to hold true for Canada and USA, it would be preferable to collect data from other regions, like developing countries, Europe, and Australia for better generalizability.

6.1.2 Industry

Industry-wise distribution of the respondent companies is presented in Table 6.2 and Figure 6.2 below.

Table 6.2 *Industry Type*

Type of Industry	Number of Firms	Percent
1 General manufacturing	58	26.6
2 Electrical equipment, appliance, & component manufacturing	6	2.8
3 Food Industry	28	12.8
4 Chemical manufacturing	12	5.5
5 Primary metal manufacturing	9	4.1
6 Fabricated metal product manufacturing	21	9.6
7 Machinery manufacturing	12	5.5
8 Computer & electronic product manufacturing	13	6.0
9 Transportation equipment manufacturing	14	6.4
10 Other	45	20.6
Total	**218**	**100.0**

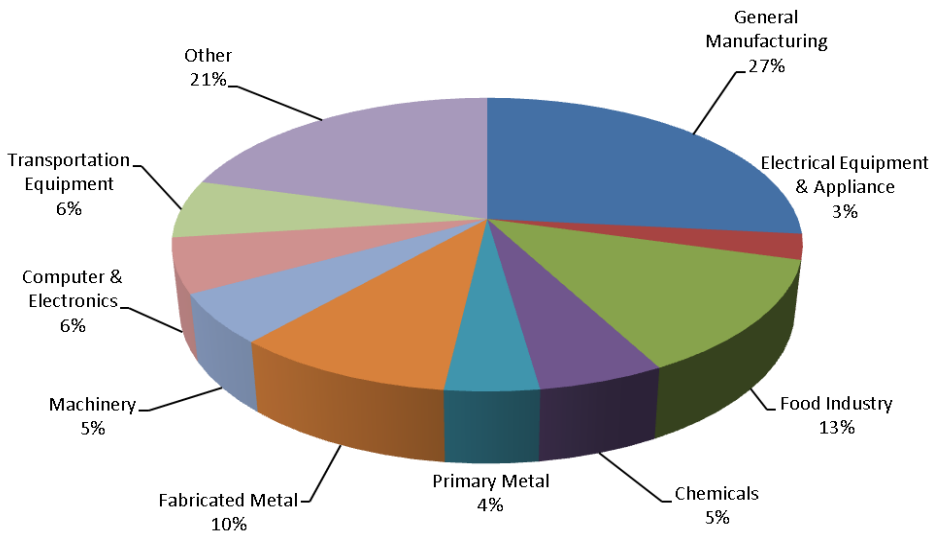

Figure 6.2 Distribution of Respondent Companies by Industry Type

The biggest participant group in the survey belonged to General manufacturing (26.6%) followed by "Others" group of unspecified industries (20.6%). Other big groups were Food Industry (12.8%), Fabricated Metal Product Manufacturing (9.6%), Transportation Equipment Manufacturing (6.4%), Computer & Electronic Product Manufacturing (6.0%), Machinery Manufacturing (5.5%), Chemical Manufacturing (5.5%), Primary Metal Manufacturing (4.1%), and Electrical Equipment, Appliance, & Component Manufacturing (2.8%). The respondents represented a wide range of industries and were fairly spread over them, indicating that there is a growing interest in sustainability issues across a large number of industries. It may be construed that given a wide representation from a number of industries the results of this research are likely to be generalizable across various industries, barring any industry-specific variations.

6.1.3 Size

For this study, we adopted classification of Statistics Canada for size. Statistics Canada defines the size by number of employees as follows.

The size wise distribution of respondent companies is shown in Table 6.3 and Figure 6.3 below.

Table 6.3 *Distribution of Respondent Companies by Size*

Size of Firm	Number	Percent
1 Small	173	79.4
2 Medium	28	12.8
3 Large	17	7.8
Total	218	100

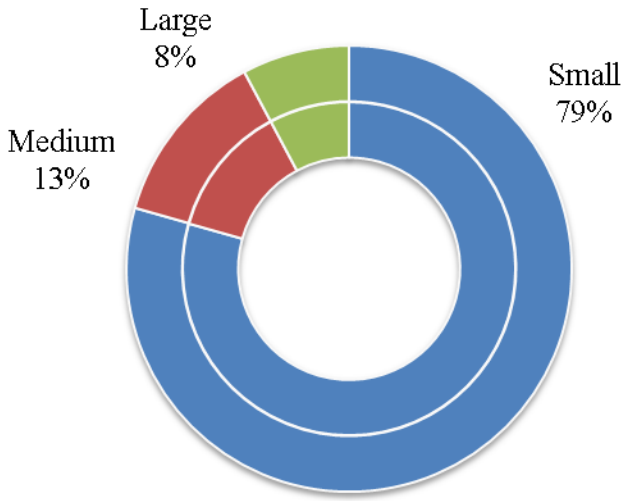

Figure 6.3 Distribution of Respondent Companies by Size

It was seen that about 79% of respondents belonged to small-sized firms (employing under 100 employees), medium-sized firms (having between 100 and 499 employees) accounted for 12.8% of respondents, and large-sized firms (with 500 employees or more) accounted for 7.8% of respondents. This was considered a fair distribution of respondents considering that small firms account for a majority of firms in North America. However, the distribution indicated lower participation from large size firms which, to some extent, limits the generalizability of this research.

6.1.4 Ownership

The distribution of the companies by ownership is given in Table 6.4 and Fig. 6.4 below.

Table 6.4 *Distribution of Respondent Companies by Ownership Type*

Ownership	Number of Companies	Percent
Privately Owned	200	91.7
Publicly Owned	18	8.3
Total	**218**	**100.0**

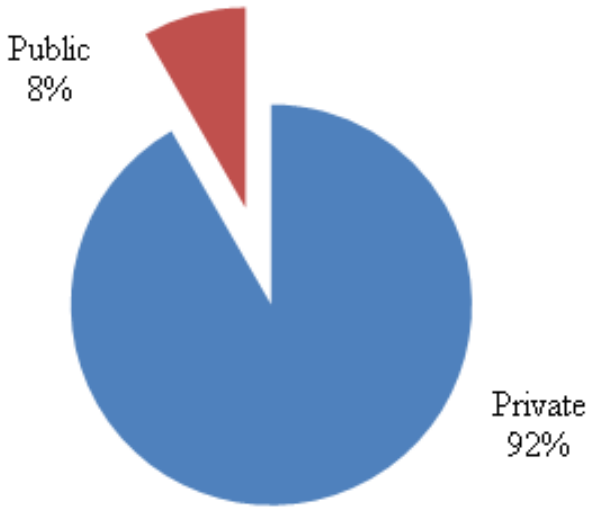

Figure 6.4 Distribution of Respondent Companies by Ownership Type

It was seen from the above distribution of ownership structure that about 8% firms belonged to the public sector, while a large majority (92%) of firms were owned privately. It was considered a fair representation. It was heartening to note that a large number of public sector companies are actively interested in sustainability issues and spent significant time and care to respond.

6.1.5 ISO14000 Certification

Out of total 218 companies that responded, a majority had ISO14000 Certification. The distribution of the companies by ISO14000 Certification is given in Table 6.5 and Fig. 6.5 below.

Table 6.5 *Distribution of Respondent Companies by ISO14000 Certification*

Certification Status	Number of Companies	Percent
ISO14000 Certified	178	81.7
Not Certified	40	18.3
Total	**218**	**100.0**

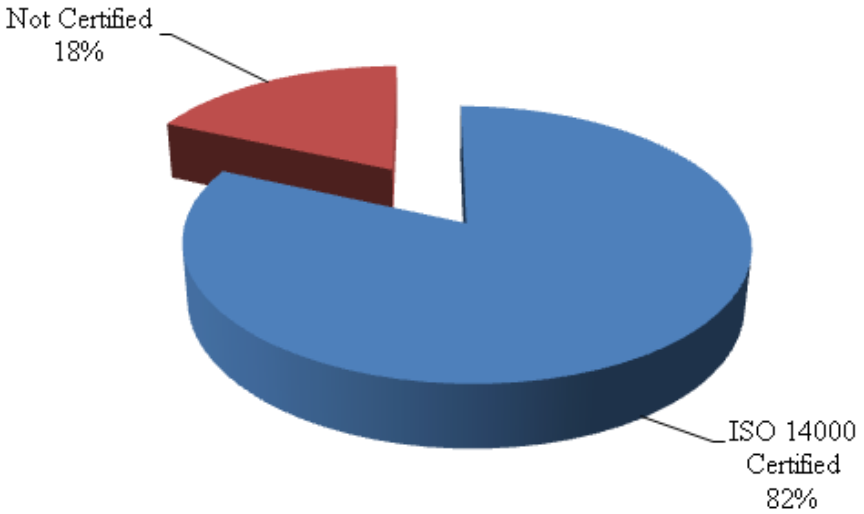

Figure 6.5 Distribution of Respondent Companies by ISO14000 Certification

It was observed that about 82% of the firms that responded are ISO14000 certified and are keenly interested in environment/sustainability issues.

6.1.6 ISO Certification Duration

Out of the 178 respondent companies that were ISO14000 certified, 117 (53.7%) were holding ISO14000 certification for more than three years. The distribution is presented in Table 6.6 and Figure 6.6 below.

Table 6.6 *Duration of ISO14000 Certification held by Respondent Companies*

Period	Number of Companies	Percent
Less than three yrs.	61	28.0
3 or more yrs.	117	53.7
Not applicable	40	18.3
Total	**218**	**100.0**

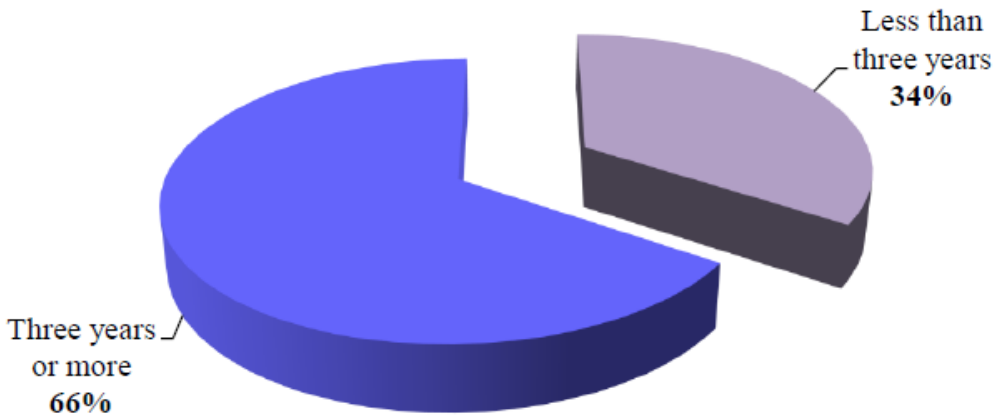

Figure 6.6 Duration of ISO14000 Certification Held by Respondent Companies

It was seen that while 66%, that is two-thirds of the certified firms, have been certified for three years or longer 34% of them have been ISO14000 certified for less than three years, This indicates rising interest in ISO14000 certification and environmental/sustainability concerns.

6.2 Respondent Characteristics

6.2.1 Designation

While the majority of the respondents (64%) held the post of Senior Managers, 16% were General Managers, 10% were Vice Presidents; the respondents also included consultants, partners, owners, board members, and presidents. Table 6.7 and Figure 6.7 below presents the designation levels of respondents.

Table 6.7 *Designation of Respondents*

Designation	Number of Respondents	Percent
Senior Manager	140	64.2
General Manager	35	16.1
Vice President	23	10.6
President	4	1.8
Board Member	2	.9
Owner	5	2.3
Partner	6	2.8
Consultant	3	1.4
Total	218	100.0

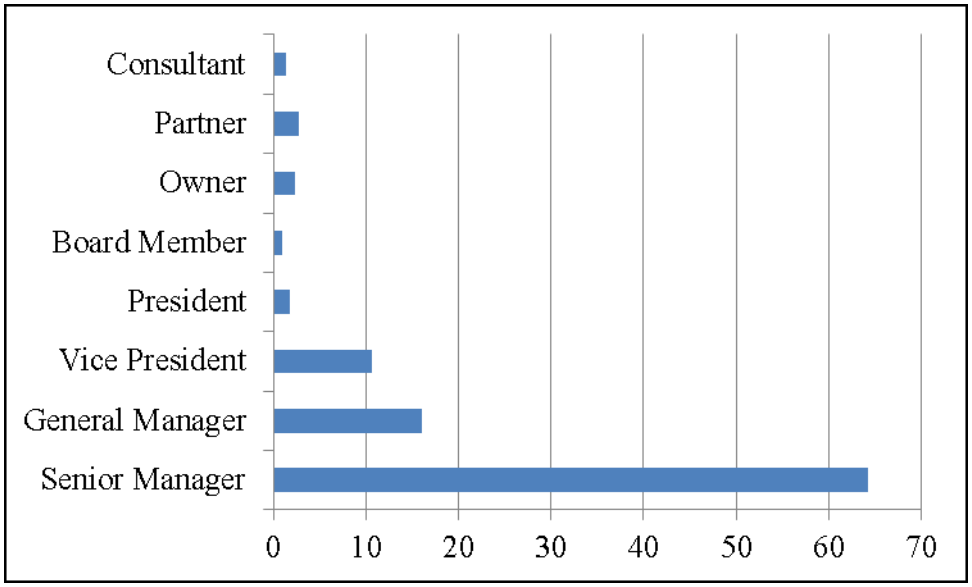

Figure 6.7 Designation of Respondents

It was seen that while Senior Managers formed the majority of respondents, who are expected to have a hands-on kind of information about sustainability issues, a large number of senior executives also responded to the survey. This made evident that there was a significant level of interest in the sustainability issues at higher echelons of the responding firms.

6.2.2 Experience in the industry

Duration of experience of the respondents ranged from less than one year to more than ten years. The distribution of experience is presented in Table 6.8 and Figure 6.8.

Table 6.8 *Years of Experience of Respondents*

Years of Experience	Number of Respondents	Percent
Less than one yr.	7	3.2
1 to less than three yrs.	18	8.3
3 to less than five yrs.	89	40.8
5 to less than ten yrs.	38	17.4
Ten yrs. or more	66	30.3
Total	218	100.0

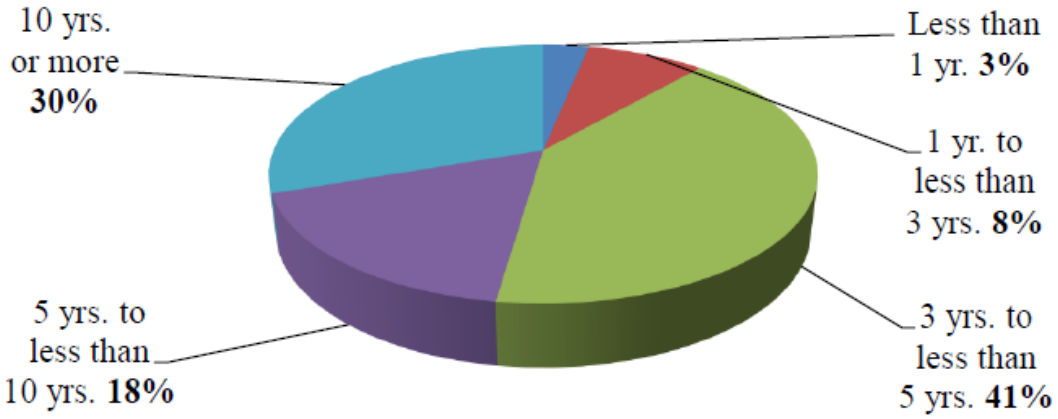

Figure 6.8 Years of Experience of Respondents

It was noticed that about 48% of the respondents had an experience of 5 years or more in their respective field, and only 11.5% had less than three years' experience. It was inferred from this that the respondents were adequately knowledgeable about their respective fields and the data collected would reflect their knowledge and experience.

In this chapter, we dealt with the descriptive statistics of data and briefly analyzed sample characteristics, organizational characteristics including location, industry type, size of firms, firm ownership, ISO certification, and respondent characteristics including designation and experience of respondents. In the next chapter, we deal with the further analysis of data.

Chapter 7 Data Analysis

This chapter presents further analysis of data to determine whether the hypotheses formulated in section 3.8 are supported. As a first step, a Principal Component Analysis (PCA) was conducted to extract principal components that were expected to be orthogonal variables (Abdi, 2010). As the second step multivariate regressions were conducted to examine which variables significantly contribute to the variances in the dependent variables. In each regression run, R^2 (the coefficient of determination) was observed to interpret the proportion of variance that the Independent Variables (IVs) jointly account for in the Dependent Variables (DVs). Allison (1999) suggests that even though a higher R^2 is preferable, a smaller R^2 should also be considered and interpreted. The overall significance of model was interpreted by the F statistic (Lewis-Beck, 1980). Section 7.1 below presents principal component analysis.

7.1 Principal Component Analysis

All the constructs and indicators that were used in the current exploration were taken from and validated by previously published research. However, as these constructs and indicators had not been used in the current context, Principal Component Analysis (PCA) was conducted to confirm that the principal components can be extracted from indicator data as expected. PCA analysis elicited how the indicators loaded on a reduced number of factors with which these indicators shared a correlation (Stevens, 1996). Kim and Mueller (1978a) suggest that before a PCA is conducted the matrix should be examined for correlations to see if the matrix is factorable. Tabachnick and Fidell (2007)

also emphasize that a matrix that can be factored must include sizeable correlations (correlations > 0.30). Whether the variables were correlated or not was tested by using Bartlett's test which is presented in the next sub-section.

7.1.1 Kaiser-Meyer-Oklin and Bartlett's Test

Stevens (1996) suggests that null hypothesis that the variables are not correlated may be checked by using Bartlett's Test of Sphericity. Bartlett's test assesses whether the correlation matrix created from the data collected is significantly different from zero, or whether is it an identity matrix (which forms the null hypothesis H_0 here). Using SPSS, we conducted Bartlett's Test of Sphericity. The test statistic was found to be significant (sig. or p-value of .001) leading to the inference that the correlation matrix is not an identity matrix. Kaiser-Meyer-Oklin (KMO) test elicited a value of 0.957 which was higher than the cutoff of .500. This indicated that the sample size was adequate for the analysis. Results of KMO Measure of Sampling Adequacy and Bartlett's Test of Sphericity are presented in Table 7.1 below:

Table 7.1 *Kaiser-Meyer-Oklin (KMO) and Bartlett's Test*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.929
Bartlett's Test of Sphericity	Approx. Chi-Square	26525.424
	df	2701
	Sig.	0.001

Principal Component Analysis (PCA) may provide interpretable results directly, or an oblique or orthogonal rotation may be used to improve interpretability of PCA (Rummel, 1970; Kim & Mueller, 1978; Tabanick & Fidell, 1989; Stevens, 1996). While oblique rotation is generally used for variables that are correlated as it allows for correlation, an orthogonal rotation is used where the variables are not expected to be correlated. An orthogonal rotation (Varimax) was used to achieve uncorrelated clusters of indicators that load on various factors.

Those indicators which had a loading of more than 0.50 were retained for further analysis. At factor level, those factors that had an eigenvalue of higher-than-one were retained after the analysis using Kaiser's criterion (Stevens, 1996). Cronbach's alpha was used to measure the reliability of each construct.

7.1.2 Grouping of constructs for analysis

The variables were divided into four groups for Principal Component Analysis (Table 7.2)

Table 7.2 *Variable Groups for Principal Component Analysis*

Type of Variable	Composite Group	Construct	Acronym
Independent Variables	Drivers	Regulations	REG
		Competitiveness	COMP
		Stakeholder Pressures	PRES
Dependent Variables for the first group, and Independent Variables for the	SSCM Practices Adoption	External Environmental Practices	EEP
		Internal Environmental Practices	IEP
		Supplier Selection	SS

third group		Supplier Evaluation & Monitoring	SM
		Cooperation with Customers	CC
		Eco-Design	ED
		Social Sustainability Practices	SSP
Dependant Variables	Performance	Economic Performance	EP
		Environmental Performance	ENVP
		Social Performance	SP
		Operational Performance	OP
Moderating Variable	Size	Size	SIZE

7.1.3 Drivers

All indicators pertaining to the three driver constructs viz. Regulations (REG1 to REG3), Competitiveness (COMP1 to COMP7), and Stakeholder Pressures (PRES1 to PRES5) were entered into SPSS and PCA was conducted. Varimax rotation was used for Principal Component Analysis as the variables were expected to be not highly correlated. Table 7.3 below presents the total variance explained by the principal components or factors that elicited eigenvalues over 1.

Table 7.3 *Total Variance Explained by Principal Components: Drivers*

	Initial Eigenvalues			**Extraction Sums of Squared Loadings**			**Rotation Sums of Squared Loadings**		
Comp o-nent	**Tota l**	**% of Varianc e**	**Cumu -lative %**	**Total**	**% of Varianc e**	**Cumu -lative %**	**Total**	**% of Varia nce**	**Cumu -lative %**
1	6.93	46.201	46.201	6.930	46.201	46.201	5.727	38.183	38.183
2	3.64	24.264	70.464	3.640	24.264	70.464	4.022	26.814	64.997
3	1.97	13.134	83.599	1.970	13.134	83.599	2.790	18.602	83.599

Table 7.4 below presents rotated component matrix showing the loading of indicators on the extracted principal components or factors, which were interpreted as REG, COMP, and PRES.

Table 7.4 *Rotated Component Matrix: Drivers*

Indicators	**Component**		
	1 REG	**2 COMP**	**3 PRES**
REG1	.902		
REG2	.902		
REG3	.886		
COMP1		.925	
COMP2		.915	
COMP3		.847	
COMP4		.895	
COMP5		.902	
COMP6		.905	
COMP7		.838	
PRES1			.920
PRES2			.848
PRES3			.881
PRES4			.847
PRES5			.832

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Table 7.5 presents loading of indicators of on the Driver constructs Regulations (REG), Competitiveness (COMP), and Stakeholder Pressures (PRES), and their Cronbach's Alpha.

Table 7.5 *Principal Component Analysis of Drivers and Cronbach's Alpha*

Principal Components and their Indicators	Loading
Regulations (REG) **Cronbach's Alpha = .910**	
REG1. Environmental regulation is the primary driver for all our environmental activities.	0.902
REG2. Our environmental activities are directed towards complying with institutional norms and/or regulations.	0.902
REG3. Preempting future environmental legislation is the main driver for adoption of proactive environmental practices.	0.886
Competitiveness (COMP) **Cronbach's Alpha = .961**	
COMP1. We believe that our environmental activities will differentiate us from our competitors.	0.925
COMP2. We believe that our ecological responsiveness will lead to long-term profitability.	0.915
COMP3. Protecting environment will improve long-term financial performance is the main driver for adoption of proactive environmental strategies	0.847
COMP4. Improved profits is the main driver for adoption of environmental practices	0.895
COMP5. Access to overseas market is the main driver for adoption of proactive environmental strategies	0.902
COMP6. Improving efficiency is the main driver for adoption of proactive environmental strategies.	0.905
COMP7. Cost saving and risk reduction is the main driver for adoption of environmental practices.	0.838
Stakeholder Pressures (PRES) **Cronbach's Alpha = .935**	
PRES1. Stakeholder relationship is the main driver for adoption of proactive environmental practices.	0.920
PRES2. Stakeholder satisfaction is the main driver for adoption of environmental practices.	0.848
PRES3. Lender and investors' concern toward environmental liability is the main driver for adoption of environmental practices.	0.881
PRES4. Customer desire to protect the environment is the main driver for adoption of environmental practices.	0.847
PRES5. Non Profit Organizations/judiciary/media inquiries is the main driver for adoption of environmental practices	0.832

7.1.4 SSCM Practices Adoption

All indicators pertaining to the seven SSCM Practices constructs viz. External Environmental Practices, Internal Environmental Practices, Supplier Selection, Supplier Evaluation and Monitoring, Cooperation with Customers, Eco-Design, and Social Sustainability Practices, were entered into SPSS and PCA was conducted using Varimax rotation. Table 7.6 below presents the total variance explained by the principal components or factors that elicited eigenvalues over 1.

Table 7.6 *Total Variance Explained by Principal Components: SSCM Practices Adoption*

	Initial Eigenvalues			**Extraction Sums of Squared Loadings**			**Rotation Sums of Squared Loadings**		
Component	**Total**	**% of Variance**	**Cumu-lative %**	**Total**	**% of Variance**	**Cumu-lative %**	**Total**	**% of Variance**	**Cumu-lative %**
1	10.638	28.751	28.751	10.638	28.751	28.751	5.813	15.710	15.710
2	7.485	20.229	48.980	7.485	20.229	48.980	5.350	14.460	30.170
3	3.615	9.770	58.750	3.615	9.770	58.750	5.315	14.366	44.535
4	3.161	8.545	67.295	3.161	8.545	67.295	5.104	13.795	58.331
5	2.713	7.332	74.627	2.713	7.332	74.627	4.809	12.998	71.328
6	2.197	5.937	80.564	2.197	5.937	80.564	2.988	8.076	79.405
7	1.595	4.310	84.874	1.595	4.310	84.874	2.023	5.469	84.874

Table 7.7 below presents the rotated component matrix and loading of indicators on the principal components or factors extracted. These components were interpreted as EEP, IEP, SS, SM, CC, ED and SSP.

Table 7.7 *Rotated Component Matrix: SSCM Practices Adoption*

	Component						
	1 SM	**2 CC**	**3 SSP**	**4 IEP**	**5 SS**	**6 EEP**	**7 ED**
EEP1						.823	
EEP2						.788	
EEP3						.849	
EEP4						.853	
IEP1				.878			
IEP2				.883			
IEP3				.885			
IEP4				.863			
IEP5				.881			
IEP6				.848			
SS1					.898		
SS2					.872		
SS3					.899		
SS4					.834		
SS5					.827		
SS6					.692		
SM1	.920						
SM2	.891						
SM3	.922						
SM4	.920						
SM5	.909						
SM6	.888						
CC1		.758					
CC2		.937					
CC3		.933					
CC4		.874					
CC5		.935					
CC6		.925					
ED1							.801
ED2							.757
ED3							.774
SSP1			.939				

SSP2			.933				
SSP3			.946				
SSP4			.935				
SSP5			.787				
SSP6			.798				

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 6 iterations.

Table 7.8 below presents loading of indicators on the SSCM Practices constructs and the calculated Cronbach's Alpha for the constructs.

Table 7.8 *Principal Component Analysis of SSCM Practices Adoption and Cronbach's Alpha*

Principal Components and their Indicators	**Loading**
External Environmental Practices (EEP) Cronbach's Alpha = .897	
EEP1. We cooperate with our suppliers to achieve environmental objectives.	.823
EEP2. We encourage our suppliers to develop new source reduction strategies.	.788
EEP3. We cooperate with our suppliers to improve their waste reduction initiatives.	.849
EEP4. We work with our suppliers for cleaner production.	.853
Internal Environmental Practices (IEP) Cronbach's Alpha = .958	
IEP1. We support the inventory recovery (sale) of excess inventories/materials.	.878
IEP2. We emphasize the use of reusable and returnable packaging for our products.	.883
IEP3. We constantly strive to use lesser resources in getting the tasks done.	.885
IEP4. We have well-documented waste reduction methodologies in	.863
	.881
	.848

place. IEP5. We eliminate physical waste from our operations. IEP6. We support the sale of scrap and used materials.	
Supplier Selection (SS) Cronbach's Alpha = .940	
SS1. We select suppliers based on their environmental competence.	.898
SS2. Suppliers are selected based on their ability to support our environmental objectives.	.872
SS3. We select suppliers based on their environmental performance.	.899
SS4. We select suppliers based on their ability to develop environmentally friendly goods.	.834
SS5. Our organization has a thorough supplier environmental rating system.	.827
SS6. We select suppliers based on their ISO 14000 Certification.	.692
Supplier Evaluation & Monitoring (SM) Cronbach's Alpha = .976	
SM1. We conduct regular environmental audits into our suppliers' internal operations.	.920
SM2. We periodically evaluate our suppliers' environmentally friendly practices.	.891
SM3. We make site visits to suppliers' premises to help them improve their eco-performance.	.922
SM4. We periodically evaluate our second-tier suppliers' environmentally friendly practices.	.920
SM5. We ask our suppliers to commit to waste reduction goals.	.909
SM6. We send environmental questionnaires to suppliers in order to monitor their compliance.	.888
Cooperation with Customers (CC) Cronbach's Alpha = .968	
CC1. We co-operate with customers for eco-design.	.758
CC2. We co-operate with customers for cleaner production.	.937
CC3. We co-operate with customers for green packaging.	.933
CC4. We co-operate with customers using less energy during product transportation.	.874
CC5. We develop a mutual understanding with our customers of responsibilities regarding environmental performance.	.935
CC6. We work together with our customers to reduce the environmental impact of our activities.	.925
Eco-Design (ED) Cronbach's Alpha = .767	
ED1. We design products for reduced consumption of material/energy.	.801
ED2. We design products for reuse, recycle, recovery of material,	.757

component parts. ED3. We design products to avoid or reduce use of hazardous products and/or their manufacturing process.	.774
Social Sustainability Practices (SSP) Cronbach's Alpha = .969	
SSP1. Our organization frequently employs corporate codes of conduct and other aspects of corporate social responsibility.	.939
SSP2. Our organization commonly encourages workers to volunteer for social causes and has incentives that facilitate that involvement.	.933
SSP3. Our organization contributes to charitable causes.	.946
SSP4. The general approach of our organization to human resources is to invest heavily to attract, train and retain employees.	.935
SSP5. In our organization employment of women is (1= limited and usually takes place in less important jobs, 7=is equal to that of men)	.787
SSP6. In our organization, for similar work, wages for women are (1=significantly below those of men, 7= equal to those of men).	.798

7.1.5 Performance

All indicators pertaining to the four performance constructs viz. Economic Performance, Environmental Performance, Social Performance, and Operational Performance were entered into SPSS and PCA was conducted using Varimax rotation Table 7.9 below presents the total variance explained by the principal components or factors that elicited eigenvalues above 1.

Table 7.9 *Total Variance Explained by Principal Components: Performance*

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	9.135	41.523	41.523	9.135	41.523	41.523	8.526	38.755	38.755
2	5.452	24.784	66.307	5.452	24.784	66.307	5.774	26.245	65.000
3	4.005	18.203	84.509	4.005	18.203	84.509	4.149	18.860	83.861

Table 7.10 below presents rotated component matrix and the loading of indicators on respective principal component or factors.

Table 7.10 *Rotated Component Matrix*

	Components		
Indicators	**1**	**2**	**3**
EP1	.887		
EP2	.883		
EP3	.898		
EP4	.890		
EP5	.874		
ENVP1		.878	
ENVP2		.879	
ENVP3		.879	
ENVP4		.867	
ENVP5		.895	
ENVP6		.872	
SP1			.908
SP2			.914
SP3			.919
SP4			.762
SP5			.803
OP1	.826		
OP2	.804		

OP3	.875		
OP4	.724		
OP5	.906		
OP6	.902		

Table 7.11 below presents loading of indicators of Performances, i.e., Economic Performance (EP), Environmental Performance (ENVP), Social Performance (SP), and Operational Performance (OP) and their Cronbach's Alpha for the factors.

Table 7.11 *Principal Component Analysis: Performance and Cronbach's Alpha*

Component/Indicators	Loading
Economic Performance (EP) Cronbach's Alpha = .956	
EP1. In our organization, there has been significant decrease in cost for materials purchasing over the past three years.	.887
EP2. In our organization, there has been significant decrease in cost of energy consumption over the past three years.	.883
EP3. In our organization, there has been a significant decrease in fee for waste treatment over the past three years.	.898
EP4. In our organization, there has been a significant decrease in fee for waste discharge over the past three years.	.890
EP5. In our organization, there has been a significant decrease of fine for environmental accidents over the past three years.	.874
Environmental Performance (ENVP) Cronbach's Alpha = .983	
ENVP1. In our organization, there has been a significant reduction of air emission over the past three years.	.878
ENVP2. In our organization, there has been a significant reduction of wastewater over the past three years.	.879
ENVP3. In our organization, there has been a significant reduction of solid wastes over the past three years.	.879
ENVP4. In our organization, there has been a significant decrease in consumption of hazardous/harmful/toxic materials over the past three years.	.867 .895

ENVP5. In our organization, there has been significant decrease in frequency for environmental accidents over the past three years. ENVP6. There has been a significant improvement of our organization's environmental situation over the past three years.	.872
Social Performance (SP) Cronbach's Alpha = .943	
SP1. In our organization, there has been a significant increase in days of vocational training over the past three years.	.908
SP2. In our organization, there has been a significant increase in philanthropy as a share of profit over the past three years.	.914
SP3. In our organization, there has been a significant increase in the formalization of community relations over the past three years.	.919
SP4. In our organization, there has been significant increase in equal opportunity employment over the past three years.	.762
SP5. In our organization, there has been a significant decrease in employee turnover over the past three years.	.803
Operational Performance (OP) Cronbach's Alpha = .950	
OP1. In our organization, there has been a significant increase in the amount of goods delivered on time over the past three years.	.826
OP2. In our organization, there has been a significant decrease in inventory levels over the past three years.	.804
OP3. In our organization, there has been a significant improvement in capacity utilization over the past three years.	.875
OP4. In our organization, there has been a significant decrease in scrap rate over the past three years.	.724
OP5. In our organization, there has been a significant increase in products' quality over the past three years.	.906
OP6. In our organization, there has been a significant increase in product line over the past three years.	.902

7.1.6 Summary of Principal Component Analysis

The principal component analysis is a psychometrically sound technique (Stevens, 1996) to reduce the number of variables for parsimony and to keep the model compact. It is expected that logical and small number of components would help in running a

regression in a meaningful way and would have enough power to detect significant relationships. These components have to both make practical sense and be grounded in theory as well. The data was analyzed to identify these components by conducting PCA as a dimension reduction process using Varimax rotation in SPSS. The aim was to identify principal components, which have little or no correlations between themselves to minimize the problem of multicollinearity in multiple regression analysis.

All the items or indicators loaded well on components and elicited loading values of above 0.70, which was commendable when compared to the benchmark of 0.50 (Fornell & Larcker, 1981). None of the items was removed from the scale after PCA. Values for constructs were computed by calculating the mean of all the items indicating a single construct, ignoring their relative weights, or their level of loading on the components. These computed construct values were then used for conducting multiple regression analyses.

7.2 Regression Analyses

Figure 7.1 below reproduces the *a-priori* theoretical framework and the relationships hypothesized between the variables for ready reference.

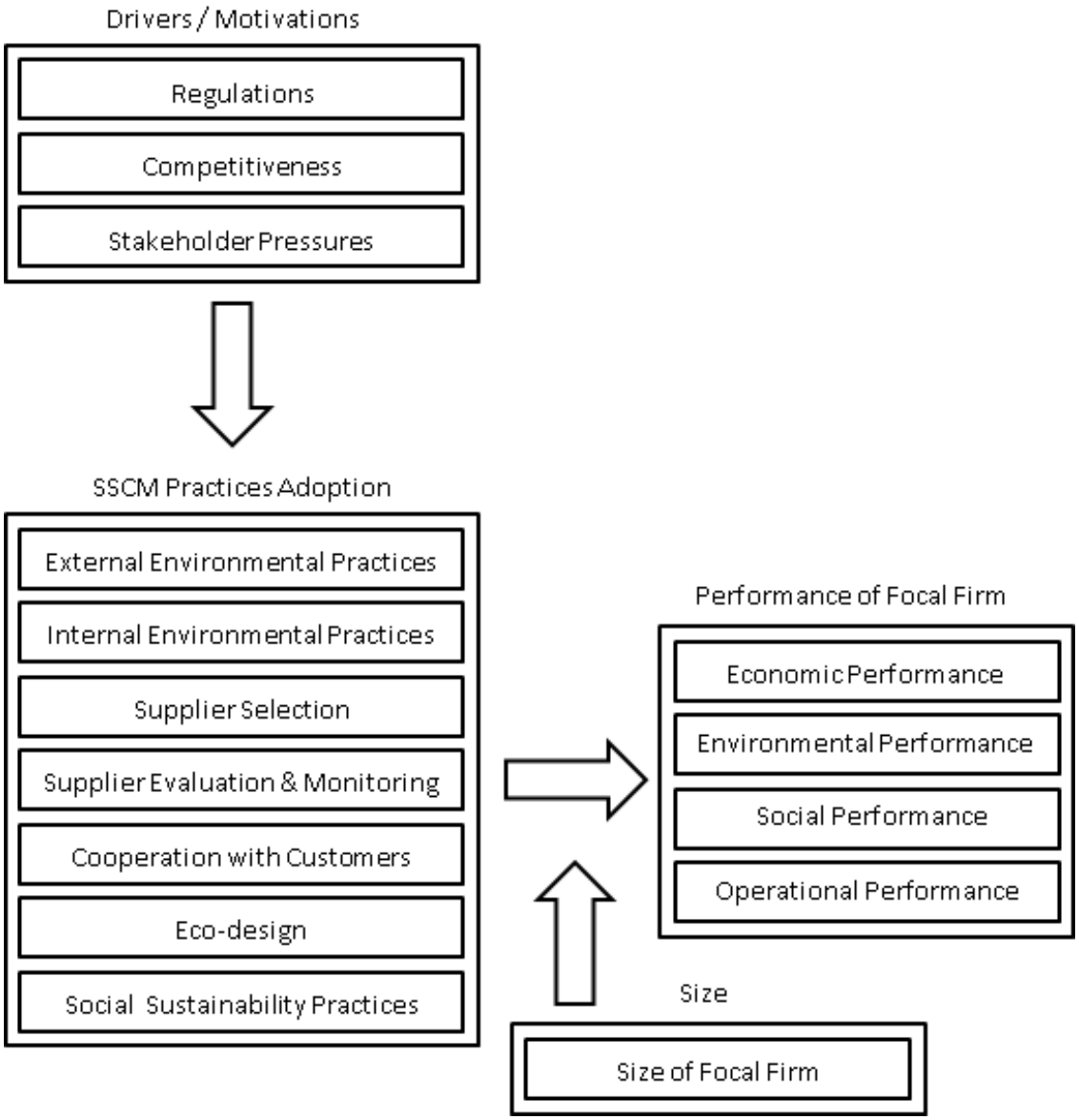

Figure 7.1 Theoretical Framework

The conceptual framework is formed of three distinct groups or composite constructs, theoretically. These constructs are Drivers, SSCM Practices Adoption, and Performance of focal firm. These groups form a logical basis for analysis and discussion.

Accordingly, the relationships between these groups, which were derived from literature review, and were used for planning regressions, are summarised in Table 7.12 below.

Table 7.12 *Composite Constructs, Constructs and Acronym Used*

Composite Construct or Group	Constructs	Acronym Used in Analysis
Drivers	Regulations	REG
	Competitiveness	COMP
	Stakeholder Pressures	PRES
SSCM Practices Adoption	External Environmental Practices	EEP
	Internal Environmental Practices	IEP
	Supplier Selection	SS
	Supplier Evaluation & Monitoring	SM
	Cooperation with Customers	CC
	Eco-Design	ED
	Social Sustainability Practices	SSP
Performance	Economic Performance	EP
	Environmental Performance	ENVP
	Social Performance	SP
	Operational Performance	OP

Note. Source: Literature review

Keeping these groups in view, the effects hypothesized were classified as given in Table 7.13 below.

Table 7.13 *Hypothesised Effects of Variables*

Independent	Dependent	Hypotheses
Drivers	SSCM Practices Adoption	H1a: Companies that face a higher level of regulations are more likely to adopt SSCM practices. H1b: Companies that aim to achieve a higher level of competitiveness are more likely to adopt SSCM practices. H1c: Companies that face higher pressures from stakeholders are more likely to adopt SSCM practices.
SSCM Practices Adoption	Performance	H2a: A company's economic performance is positively associated with the company's adoption of SSCM practices. H2b: A company's environmental performance is positively associated with the company's adoption of SSCM practices. H2c: A company's social performance is positively associated with the company's adoption of SSCM practices. H2d: A company's operational performance is positively associated with the company's adoption of SSCM practices.
Size	Posited to Moderate Impact of SSCM Practices Adoption on Performance.	H3a: The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's economic performance. H3b: The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's environmental performance. H3c: The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's social performance. H3d: The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's operational performance.

Note. Source: Literature review

To examine these effects, various runs of multiple regressions were planned in three sets for analysis. These three sets are summarised in Table 7.14 below.

Table 7.14 *Independent and Dependent Variables for Regressions*

Set	Regression	Independent Variables	Dependent Variables	Hypothesis
1	1	REG, COMP, PRES	EEP	H1a, H1b, H1c
	2	REG, COMP, PRES	IEP	H1a, H1b, H1c
	3	REG, COMP, PRES	SS	H1a, H1b, H1c
	4	REG, COMP, PRES	SM	H1a, H1b, H1c
	5	REG, COMP, PRES	CC	H1a, H1b, H1c
	6	REG, COMP, PRES	ED	H1a, H1b, H1c
	7	REG, COMP, PRES	SSP	H1a, H1b, H1c
2	8	EEP, IEP, SS, SM, CC, ED,SSP	EP	H2a
	9	EEP, IEP, SS, SM, CC, ED,SSP	ENVP	H2b
	10	EEP, IEP, SS, SM, CC, ED,SSP	SP	H2c
	11	EEP, IEP, SS, SM, CC, ED,SSP	OP	H2d
3	12	Moderator variable SIZE, Independent variables EEP, IEP, SS, SM, CC, ED,SSP	EP	H3a
	13	Moderator variable SIZE, Independent variables EEP, IEP, SS, SM, CC, ED,SSP	ENVP	H3b
	14	Moderator variable SIZE, Independent variables EEP, IEP, SS, SM, CC, ED,SSP	SP	H3c
	15	Moderator variable SIZE, Independent variables EEP, IEP, SS, SM, CC, ED,SSP	OP	H3d

A general regression equation representing these regressions is

$$\hat{Y} = b_0 + b_1(x1) + b_2(x2) + b_3(x3) + \ldots + b_K(xK)$$

Equation 7.1 **General Multiple Regression**

7.2.1 Impact of Drivers on Adoption of SSCM Practices: Multiple Regression Runs 1 through 7

In literature, a positive relationship has been posited between drivers and adoption of SSCM practices. First set of multivariate regressions numbered 1 through 7 (please see Table 7.14) were run to test for this relationship. That is, REG, COMP, PRES were regressed on variable EEP as the first regression, then the same independent variables were regressed on variable IEP, and so on. The results of these regressions are detailed in Table 7.15 below.

Table 7.15 *Standardised Regression Coefficients: Regressions 1 to 7*

Regression No.		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Ind. Var.	**Dependent Variables>**	**EEP**	**IEP**	**SS**	**SM**	**CC**	**ED**	**SSP**
REG	Std. Beta	.654***	.732***	.400***	.729***	.178***	.380***	.310***
	Partial	.599	.668	.446	.662	.211	.421	.586
COMP	Std. Beta			.590***		.506***	.591***	
	Partial			.612		.542	.606	
PRES	Std. Beta	.129**	.202***	.298***.	.250***	.397***	.270***	.999***
	Partial	.146	.242	.350	.291	.435	.315	.920
R^2		.369	.452	.468	.439	.437	.448	.848
Adjusted R^2		.360	.444	.460	.431	.429	.440	.846
F Statistics		41.67	58.79	62.68	55.85	55.29	57.85	398.95
F sig.		.001	.001	.001	.001	.001	.001	.001

Note. 1.This table only shows significant Betas.
2. Standardised regression coefficients are shown: *p<.10; **p<.05; ***p<.01

It was observed from the above results that the driver Regulations displayed a statistically significant positive impact on adoption of all the seven SSCM Practices; the driver Competitiveness showed a statistically significant positive impact on adoption of supplier selection practices, cooperation with customer practices and eco-design practices; and the driver Stakeholder Pressures showed a statistically significant positive impact on adoption of all seven SSCM Practices.

Table 7.16 below summarises the inference from the above findings concerning the support they lend to hypotheses H1a to H1c.

Table 7.16 *Inference from the Findings of Multiple Regression Analysis: Regression of Drivers on SSCM Practices*

Independent Variables	**Dependent Variables**	**Hypotheses**	**Inference**
Drivers REG, COMP, PRES	SSCM Practices Adoption EEP, IEP, SS, SM, CC, ED, SSP	H1a: Companies that face a higher level of regulations are more likely to adopt SSCM practices.	Supported
		H1b: Companies that aim to achieve a higher level of competitiveness are more likely to adopt SSCM practices.	Partially Supported
		H1c: Companies that face higher pressures from stakeholders are more likely to adopt SSCM practices.	Supported

The results of regressions 8 through 11 are detailed in the next sub-section.

7.2.2 Impact of SSCM Practices Adoption on Performance: Multiple Regression Runs 8 through 11

In literature, a positive relationship has been posited between adoption of SSCM practices and performance of a firm. The second set of regressions numbered 8 through 11 (please see Table 7.14) were run to test for this relationship. That is, variables EEP, IEP, SS, SM, CC, ED, and SSP were regressed first on variable EP as the first regression, and then the same independent variables were regressed on variable ENVP, and so on. The results of these regressions are detailed in Table 7.17 below.

Table 7.17 *Standardised Regression Coefficients: Regressions 8 to 11*

Regression		**8**	**9**	**10**	**11**
Ind. Var.	**Dependent Variables->**	**EP**	**ENVP**	**SP**	**OP**
EEP	Std. Beta		.256***		
	Partial		.411		
IEP	Std. Beta		.388***		
	Partial		.552		
SS	Std. Beta	.355***			.444***
	Partial	.488			.557
SM	Std. Beta	-.102**	.481***		-.101**
	Partial	-.161	.634		-.152
CC	Std. Beta	.509***			.362***
	Partial	.630			.484
ED	Std. Beta	.377***			.419***
	Partial	.533			.556
SSP	Std. Beta	-.269***	-.152***	.963***	-.285***

	Partial	-.400	-.255	.962	-.405
R^2		.711	.746	.943	.684
Adjusted R^2		.701	.738	.941	.674
F Statistics		73.67	88.22	492.39	65.08
F sig.		.001	.001	.001	.001

Note. 1.This table only shows significant Betas.

2. Standardised regression coefficients are shown: *p<.10; **p<.05; ***p<.01

From the above results, we observe that adoption of Supplier Selection Practices, Cooperation with Customer Practices and Eco-Design Practices have a high and statistically significant positive impact on Economic Performance and Operational Performance. On the other hand, adoption of Social Sustainability Practices and Supplier Evaluation and Monitoring practices has a statistically significant negative impact on Economic Performance and Operational Performance. External Environmental Practices and Internal Environmental Practices do not show any statistically significant impact on Economic Performance or Operational Performance.

Adoption of External Environmental Practices, Internal Environmental Practices and Supplier Evaluation and Monitoring practices have a high and statistically significant positive impact on Environmental Performance. Adoption of the other four SSCM Practices does not have any statistically significant impact on Environmental Performance.

Adoption of Social Sustainability Practices has a high and statistically significant positive impact on Social Performance. Adoption of other six SSCM Practices does not have any statistically significant impact on Social Performance.

Table 7.18 below summarises the inference from the above findings concerning the support they lend to hypotheses H2a to H2d.

Table 7.18 *Findings of Multiple Regression Analyses: Regression of SSCM Practices on Performance*

Independent Variable	**Dependent Variables**	**Hypotheses**	**Findings**
SSCM Practices Adoption EEP, IEP, SS, SM, CC, ED, SSP	Economic Performance EP	H2a: A company's economic performance is positively associated with the company's adoption of SSCM practices.	Partially Supported
	Environmental Performance ENVP	H2b: A company's environmental performance is positively associated with the company's adoption of SSCM practices.	Partially Supported
	Social Performance SP	H2c: A company's social performance is positively associated with the company's adoption of SSCM practices.	Partially Supported
	Operational Performance OP	H2d: A company's operational performance is positively associated with the company's adoption of SSCM practices.	Partially Supported

7.2.3 Moderator Effect of Size on Impact of SSCM Practices Adoption on Performance: Multiple Regression Runs 12 through 15

In literature, it is posited that size of a firm may significantly moderate the impact of different factors on the performance of a firm (Swamidass & Kotha, 1998). In sub-section 6.1.3 we noticed that the respondents in data collected represented firms which were of three sizes: small, medium and large, classified on the basis of the number of

their employees. As a first step, we tested whether there was indeed a difference between performances of firms of different sizes. Checking for differences in means is a valid way to determine whether there is a difference in performance of the firms belonging to different sizes. From graphical comparison, it was seen that the means of performance of firms from the three sizes differed from one another. Figures 7.2 to 7.5 below present a visual representation of this comparison.

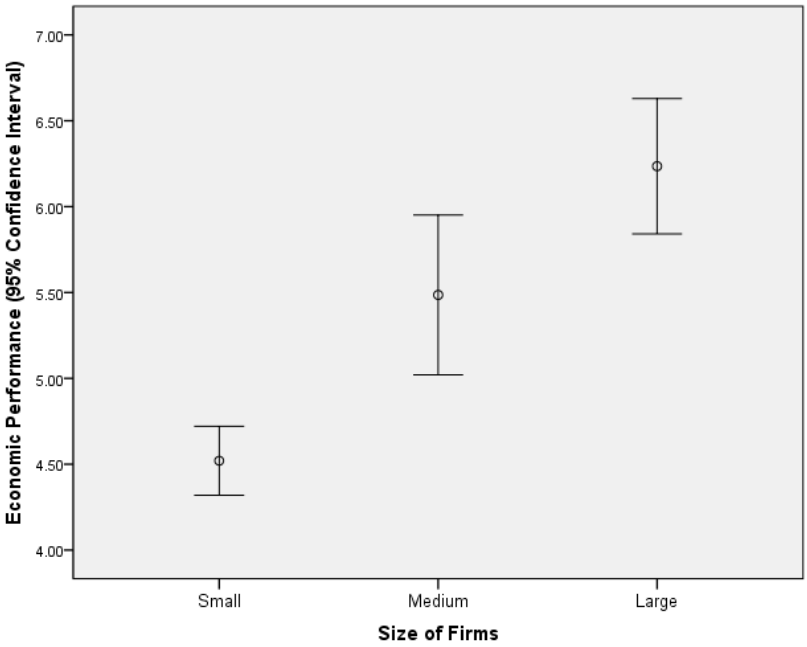

Figure 7.2 Comparison of Economic Performance of Small, Medium and Large Size Firms

It was observed from the Figure 7.2 that the mean economic performance of medium size firms was higher than that of small firms, and the mean economic performance of large size firms was higher than that of medium firms.

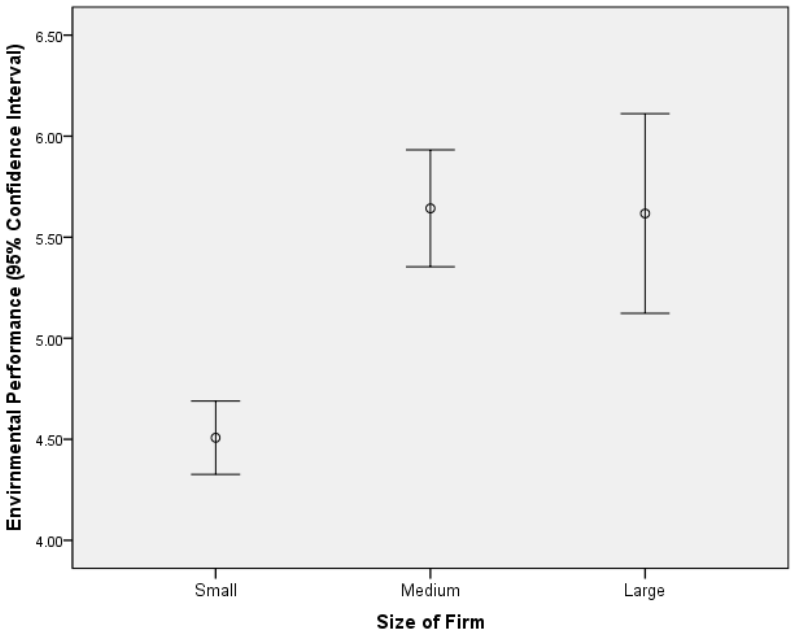

Figure 7.3 Comparison of Environmental Performance of Small, Medium and Large Size Firms

The Figure 7.3 above displayed that the mean environmental performance of medium size firms was higher than that of small firms and the mean environmental performance of large size firms was roughly about same as that of medium firms. Figure 7.4 below shows the mean social performance of small, medium and large size firms.

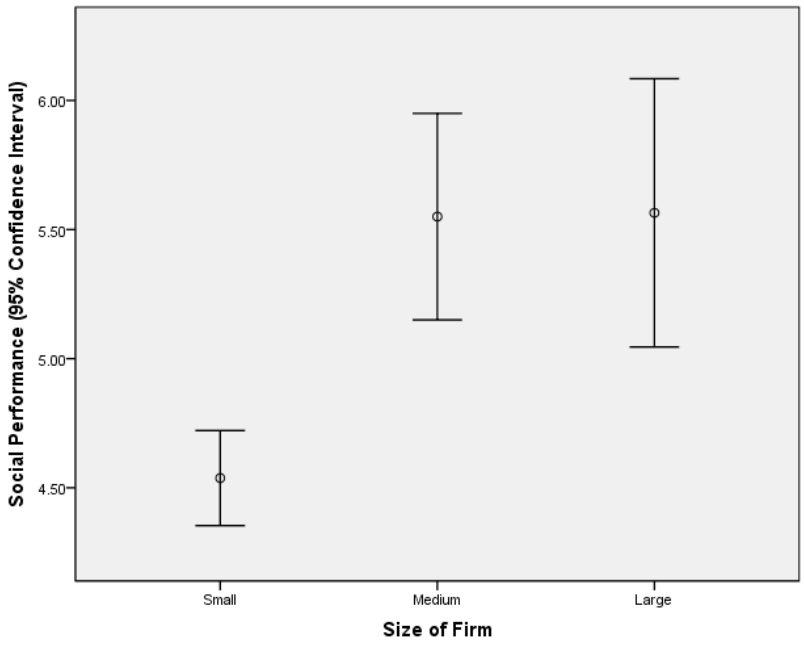

Figure 7.4 Comparison of Social Performance of Small, Medium and Large Size Firms

It was observed from the Figure 7.4 that the mean social performance of medium size firms was higher than that of small firms, and the mean social performance of large size firms was roughly about same as that of medium firms. Figure 7.5 below shows the operational performance of small, medium and large size firms.

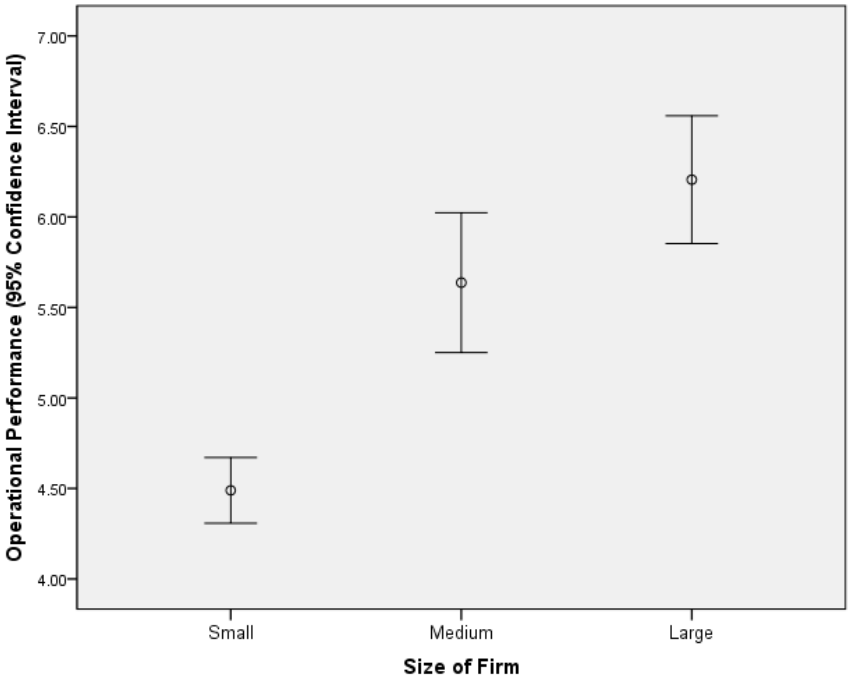

Figure 7.5 Comparison of Operational Performance of Small, Medium and Large Size Firms

It was seen from the Figure 7.5 above that the mean operational performance of medium size firms was higher than that of small firms, and the mean operational performance of large size firms was higher than that of medium firms.

It was inferred from the above graphical analyses that there was a difference in the means of economic, environmental, social and operational performance of the firms belonging to the three size groups. The next step was to determine whether this difference was statistically significant. For this, we conducted t-test for equality of means. As the sample consisted of 173 small size firms, 28 medium-size firms, and 17 large size firms,

the decision was made to combine both medium and large firms (for a better N) and compare them with small firms.

The result of t-Test performed is presented in Table 7.19 below.

Table 7.19 *t-Test for Equality of Means of Performance of Small and Medium+Large Firms*

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
EP	EVA*	4.247	.04	-5.762	216	.000	-1.248	.216	-1.675	-.821
	EVNA**			-6.427	80.589	.000	-1.248	.194	-1.635	-.862
ENVP	EVA*	11.567	.00	-5.895	216	.000	-1.125	.190	-1.501	-.749
	EVNA**			-7.342	99.250	.000	-1.125	.153	-1.429	-.821
SP	EVA*	5.490	.02	-5.126	216	.000	-1.017	.198	-1.409	-.626
	EVNA**			-5.740	81.111	.000	-1.017	.177	-1.370	-.665
OP	EVA*	3.852	.05	-7.041	216	.000	-1.362	.193	-1.743	-.981
	EVNA**			-8.213	87.135	.000	-1.362	.165	-1.692	-1.032

Note. *. EVA Equal Variances Assumed
**. EVNA: Equal Variances Not Assumed
N: Small = 173, Medium+Large = 45

Levene's Test for Equality of Variances and t-test for Equality of Means elicited a p-value of less than 0.05 for all the four types of performance. It was inferred from test results

above that there was a significant difference between all four types of performance of small firms and of the firms that are larger (medium+large firms).

This difference in performance could be through the direct effect of the size of a firm or due to size acting as a moderator on the impact of SSCM Practices Adoption on performance. In this research, we were only testing for moderator effect of the size of the focal firm (Table 3.2). To test for this relationship, the third set of multivariate regressions were conducted which were numbered 12 through 15 in accordance with Table 7.14 above. Separate multiple regressions were run for small firms and larger firms, with each of the performance types as the dependent variable and the seven SSCM Practices as predictor variables. For example, the seven SSCM Practices EEP, IEP, SS, SM, CC, ED and SSP were regressed on EP, first for small firms (N=173) and then for larger firms (Medium + Large, N=45) and so on. In total eight regression runs were conducted for this test, which are presented in Table 7.20 below.

Table 7.20 *Regression Runs Conducted for Testing for Moderator Effect of Size*

No.	**Dependent Variable**	**Predictor Variables**	**Size of Firm**	**N**
12a	EP	EEP, IEP, SS, SM, CC, ED, SSP	Small	173
12b	EP	EEP, IEP, SS, SM, CC, ED, SSP	Medium + Large	45
13a	ENVP	EEP, IEP, SS, SM, CC, ED, SSP	Small	173
13b	ENVP	EEP, IEP, SS, SM, CC, ED, SSP	Medium + Large	45
14a	SP	EEP, IEP, SS, SM, CC, ED, SSP	Small	173
14b	SP	EEP, IEP, SS, SM, CC, ED, SSP	Medium + Large	45
15a	OP	EEP, IEP, SS, SM, CC, ED, SSP	Small	173
15b	OP	EEP, IEP, SS, SM, CC, ED, SSP	Medium + Large	45

The results from regression runs 12a and 12b are placed in Table 7.21 and are discussed below.

Table 7.21 *Results of Regression Runs Conducted for Testing Moderator Effect of Size on Impact of Adoption of SSCM Practices on Economic Performance of Firms*

Coefficients					
Dependent Variable=EP	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
Size Small N=173	**B**	**Std. Error**	**Beta**		
(Constant)	1.404	0.434		3.235	0.001
EEP	-0.183	0.055	-0.133	-3.321	**0.001**
IEP	-0.024	0.06	-0.016	-0.402	0.688
SS	0.367	0.054	0.267	6.730	**0.000**
SM	-0.198	0.059	-0.136	-3.363	**0.001**
CC	0.648	0.046	0.567	14.026	**0.000**
ED	0.484	0.052	0.356	9.355	**0.000**
SSP	-0.302	0.038	-0.306	-7.983	**0.000**

Dependent Variable=EP	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
Size Medium + Large N=45	**B**	**Std. Error**	**Beta**		
(Constant)	0.031	1.495		0.021	0.984
EEP	0.445	0.163	0.366	2.722	**0.010**
IEP	-0.092	0.155	-0.076	-0.596	0.555
SS	0.349	0.119	0.380	2.932	**0.006**
SM	0.097	0.15	0.083	0.644	0.524
CC	0.157	0.143	0.161	1.095	0.281
ED	0.401	0.131	0.428	3.052	**0.004**
SSP	-0.214	0.179	-0.21	-1.193	0.240

It was seen from the above regression results that while the impact of adoption of six SSCM Practices (EEP, SS, SE, CC, ED, and SSP) on EP was significant in small firms, for larger firms this impact was significant only for EEP, SS, and ED.

It can be argued that if size acts as a moderator, for a larger sized firm the slope of regression line representing the impact of SSCM Practices Adoption on Performance would be significantly different than the slope of regression line representing the corresponding impact in case of small firms. For testing this, we compared the slopes of the regression lines for small and larger firms for the impacts of adoption of EEP, SS and ED practices on EP, because they were found to have a significant impact both in small firms and in larger firms. The results are presented in Table 7.22 below.

Table 7.22 *Comparison of Slopes of the Regression Lines for Small and Larger Firms for EP*

	N		**B**		**Standard Error**		**t**	**Df**	**Probability**
	Line 1	**Line 2**	**Line 1**	**Line 2**	**Line 1**	**Line 2**			
EEP	173	45	-0.183	0.445	0.055	0.163	3.651	214	0.000
SS	173	45	0.367	0.349	0.054	0.119	0.138	214	0.890
ED	173	45	0.484	0.401	0.052	0.131	0.589	214	0.557

Note. Dependent Variable = EP
Line 1 = Small Size Firms Line 2 = Medium + Large Firms

From the above results, it was found that only for EEP the difference in slopes was significant (t = 3.651, Df = 214, Probability = less than 0.001). A probability value of less than 0.05 indicated that the two slopes significantly differed from each other. We inferred

from the above results that for EEP's impact on EP, a firm's size acted as a significant moderator and this effect was positive.

Next, we examined the impact on Environmental Performance. Table 7.23 presents results of regression runs 13a and 13b for identifying the impact of adoption of SSCM Practices on Environmental Performance of small firms and larger firms.

Table 7.23 *Results of Regression Runs Conducted for Testing Moderator Effect of Size on the Impact of Adoption of SSCM Practices on Environmental Performance of Firms*

Coefficients					
Dependent Variable =ENVP	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
Size Small N=173	**B**	**Std. Error**	**Beta**		
(Constant)	-0.710	0.401		-1.772	0.078
EEP	0.408	0.051	0.328	8.011	**0.000**
IEP	0.487	0.055	0.370	8.832	**0.000**
SS	0.025	0.050	0.020	0.492	0.623
SM	0.554	0.054	0.423	10.203	**0.000**
CC	-0.068	0.043	-0.066	-1.602	0.111
ED	-0.047	0.048	-0.039	-0.991	0.323
SSP	-0.104	0.035	-0.117	-2.986	**0.003**

Dependent Variable= ENVP	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
Size Medium + Large N=45	**B**	**Std. Error**	**Beta**		
(Constant)	2.042	1.214		1.682	0.101
EEP	-0.030	0.133	-0.033	-0.223	0.824
IEP	0.370	0.126	0.412	2.940	**0.006**
SS	0.070	0.097	0.103	0.729	0.471

SM	0.399	0.122	0.460	3.273	**0.002**
CC	0.038	0.116	0.053	0.327	0.745
ED	0.077	0.107	0.111	0.721	0.475
SSP	-0.238	0.146	-0.315	-1.634	0.111

It was seen from the above regression results that while the impact of adoption of four SSCM Practices (EEP, IEP, SM, and SSP) on ENVP was significant in small firms, for larger firms this impact was significant only for adoption of IEP and SM practices.

If size acted as a moderator on the impact of adoption of the above SSCM Practices on ENVP, the slope of regression line representing the impact of SSCM Practices Adoption on Environmental Performance for a larger sized firm would be significantly different from the slope of the corresponding impact in case of small firms. For testing this, we compared the slopes of the above regression lines for small and larger firms for the impact of IEP and SM practices adoption as they were found to have a significant impact on ENVP both in small firms and in larger firms. The results are presented in Table 7.24 below.

Table 7.24 *Comparison of Slopes of the Regression Lines for Small and Larger Firms for ENVP*

	N		**B**		**Standard Error**		**t**	**Df**	**Probability**
	Line 1	**Line 2**	**Line 1**	**Line 2**	**Line 1**	**Line 2**			
IEP	173	45	0.487	0.370	0.055	0.126	3.273	214	0.001
SM	173	45	0.554	0.399	0.054	0.122	1.162	214	0.247

Note. Dependent Variable = ENVP
Line 1 = Small Size Firms Line 2 = Medium + Large Firms

From the results above it was found that only for IEP the difference in slopes of regression lines was significant (t = 3.273, Df = 214, Probability = 0.001). A probability value of less than 0.05 indicated that the two slopes significantly differed from each other. We inferred from this that for IEP's impact on ENVP, a firm's size acted as a significant moderator and this effect was positive.

Next, we examined the impact on Social Performance. Table 7.25 presents the results of regression runs 14a and 14b for identifying the impact of adoption of SSCM Practices on Social Performance of small firms and larger firms.

Table 7.25 *Results of Regression Runs Conducted for Testing Moderator Effect of Size on Impact of Adoption of SSCM Practices on Social Performance of Firms*

Coefficients					
Dependent Variable =SP	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
Size Small N=173	**B**	**Std. Error**	**Beta**		
(Constant)	0.939	0.209		4.502	0.000
EEP	-0.009	0.027	-0.007	-0.355	0.723
IEP	-0.029	0.029	-0.022	-1.02	0.309
SS	0.011	0.026	0.009	0.411	0.682
SM	0.008	0.028	0.006	0.289	0.773
CC	-0.010	0.022	-0.009	-0.429	0.668
ED	-0.061	0.025	-0.049	-2.439	**0.016**
SSP	0.881	0.018	0.976	48.536	**0.000**

Dependent Variable= SP	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
Size Medium +	**B**	**Std. Error**	**Beta**		

Large N=45					
(Constant)	-0.187	0.523		-0.357	0.723
EEP	0.020	0.057	0.018	0.343	0.734
IEP	0.081	0.054	0.074	1.502	0.141
SS	-0.028	0.042	-0.034	-0.681	0.500
SM	0.091	0.053	0.085	1.732	0.092
CC	0.071	0.050	0.080	1.414	0.166
ED	-0.016	0.046	-0.018	-0.342	0.735
SSP	0.833	0.063	0.897	13.289	**0.000**

From the above regression results, it was elicited that while the impact of adoption of two SSCM Practices (ED and SSP) on SP was significant in small firms, for larger firms this impact was significant only for SSP.

In case firm size acted as a moderator on this impact of adoption of the above SSCM Practices on SP, for a larger sized firm the slope of the regression line representing the impact of SSCM Practices Adoption on Social Performance would be significantly different than the slope the regression line representing the corresponding impact in case of small firms. For testing this, we compared the slopes of the two regression lines for small and larger firms for the impact of SSP adoption on SP as these practices were found to have a significant impact both in small firms and in larger firms. Table 7.26 presents the results of this comparison.

Table 7.26 *Comparison of Slopes of the Regression Lines for Small and Larger Firms for SP*

	N		B		Standard Error		t	Df	Probability
	Line 1	Line 2	Line 1	Line 2	Line 1	Line 2			
SSP	173	45	0.881	0.833	0.018	0.063	0.733	214	0.465

Note. Dependent Variable = SP
Line 1 = Small Size Firms Line 2 = Medium + Large Firms

It was found that for SSP the difference in slopes was not significant (t = 0.733, Df = 214, Probability = 0.465). A probability value of more than 0.05 indicated that the two slopes did not significantly differ from each other. We inferred from this that for SSP's impact on SP, a firm's size did not act as a significant moderator.

Next, we examined the impact on Operating Performance. Table 7.27 presents results of regression runs 15a and 15b for identifying the impact of adoption of SSCM Practices on Operational Performance of small firms and larger firms.

Table 7.27 *Results of Regression Runs Conducted for Testing Moderator Effect of Size on Impact of Adoption of SSCM Practices on Operational Performance of Firms*

Coefficients					
Dependent Variable =SP	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
Size Small N=173	**B**	**Std. Error**	**Beta**		
(Constant)	1.427	0.460		3.105	0.002

EEP	-0.146	0.058	-0.117	-2.500	**0.013**
IEP	0.059	0.063	0.045	0.932	0.353
SS	0.447	0.058	0.361	7.755	**0.000**
SM	-0.209	0.062	-0.160	-3.353	**0.001**
CC	0.417	0.049	0.405	8.530	**0.000**
ED	0.490	0.055	0.399	8.946	**0.000**
SSP	-0.277	0.040	-0.312	-6.937	**0.000**

Dependent Variable= SP	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
Size Medium + Large N=45	**B**	**Std. Error**	**Beta**		
(Constant)	0.880	1.213		0.725	0.473
EEP	0.328	0.133	0.323	2.470	**0.018**
IEP	0.035	0.126	0.034	0.276	0.784
SS	0.348	0.097	0.454	3.605	**0.001**
SM	0.093	0.122	0.096	0.766	0.449
CC	0.100	0.116	0.122	0.857	0.397
ED	0.403	0.107	0.516	3.781	**0.001**
SSP	-0.315	0.145	-0.370	-2.164	**0.037**

It was seen from the above regression results that while the impact of adoption of six SSCM Practices (EEP, SS, SE, CC, ED, and SSP) on OP was significant in small firms, for larger firms this impact was significant only for EEP, SS, ED, and SSP.

If size acts as a moderator on the impact of adoption of SSCM Practices on OP, for a larger sized firm, the slope of regression line representing the impact would be significantly different from the slope of regression line representing the corresponding impact in case of small firms. For testing this, we compared the slopes of the above

regression lines for small and larger firms for the impacts of adoption of EEP, SS, ED, and SSP on OP, because these four practices were found to have a significant impact both in small firms and in larger firms. The results are presented in Table 7.28 below.

Table 7.28 *Comparison of Slopes of the Regression Lines for Small and Larger Firms for OP*

	N		**B**		**Standard Error**		**t**	**Df**	**Probability**
	Line 1	**Line 2**	**Line 1**	**Line 2**	**Line 1**	**Line 2**			
EEP	173	45	-0.146	0.328	0.058	0.133	3.267	214	0.001
SS	173	45	0.447	0.348	0.058	0.097	0.876	214	0.382
ED	173	45	0.490	0.403	0.055	0.107	0.723	214	0.470
SSP	173	45	-0.277	-0.315	0.040	0.145	0.253	214	0.801

Note. Dependent Variable = OP
Line 1 = Small Size Firms Line 2 = Medium + Large Firms

It was found that only for EEP the difference in slopes was significant (t = 3.267, Df = 214, Probability = 0.001). A probability value of less than 0.05 indicated that the two slopes significantly differed from each other. We inferred from the above tests that for EEP's impact on OP, a firm's size acted as a significant moderator and this effect was positive.

In summary, from the results of regression runs 12a through 15b, and the subsequent t-tests, it was inferred that size had a significant and positive moderator effect on the impact of adoption of EEP on EP and OP. Size also had a significant and positive moderator effect on the impact of adoption of IEP on ENVP. In all other cases, the effects were found to be not significant.

Table 7.29 below summarises the support these test results lend to the hypotheses H3a to H3d.

Table 7.29 *Findings of Multiple Regression Analyses and t-Tests: Effect of Size as a Moderator*

Independent Variable	**Effect**	**Hypotheses**	**Inference**
Size	Posited to Moderate Impact of SSCM Practices Adoption on Performance	**H3a**: *The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's economic performance.*	Partially Supported
		H3b: *The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's environmental performance.*	Partially Supported
		H3c: *The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's social performance.*	Not Supported
		H3d: *The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's operational performance.*	Partially Supported

In this chapter, we analyzed data using principal component analysis. We then conducted multiple regression analysis to test the impact of Drivers on SSCM Practices Adoption and presented their results. We further examined the impact of SSCM Practices Adoption on Performance of a firm, and we also analyzed the moderation effect of size on this impact.

While the regression analyses, which were conducted to test for the impact of the Drivers on SSCM Practices Adoption and to test for the impact of adoption on

Performance, have confirmed these impacts, their strength, and their direction. To get a better insight into these relationships a decision was made to conduct path analysis and also to test whether the structure of the *a priori* theoretical framework was supported by the structural model using structural equation modeling as suggested by Das (2017). This is presented in the next chapter.

Chapter 8 Analysis Using Structural Equation Modeling

In this chapter, we introduce structural equation modeling (SEM), test for validation of measures and present the results of these tests. It is followed by testing of measurement models and structural model and a discussion on the test results.

8.1 Introduction

A multivariate analysis technique, structural equation modeling (SEM) is used to test the relationship between independent variables and dependent variables. SEM can assess measurement (i.e., the relationship between indicators or observed variables and the construct they purport to measure) and the model structure (i.e., how the constructs are related, or the "paths" among them). As a result, SEM may be used to test both measurement models and structural models. It allows the researcher to develop measurement models which relate the measures to a construct that is latent and cannot be measured directly, providing an alternate analytical technique to multiple regression analysis and factor analysis to estimate coefficients within the structural model along with error terms.

Anderson and Gerbing (1988) and Ping (2004) recommend that measurement model be properly specified before the structural model can be inferred to be meaningful. Once the measurement model is specified, the constructs are tested for their relationship with other constructs. In this research, the same sequence is followed. First measurement models are specified, and then the structural models are tested using SEM techniques.

Previously, LISREL has been extensively used for SEM analysis by researchers (Joreskog, 1973, 1996, 2001; Chin *et al.,* 1997; Agarwal & Karahanna, 2000; Sabherwal & Fernandez, 2003). For this research, IBM AMOS software version 25 was used.

8.2 Measurement Model Assessment

Ping (2004) stresses the importance of "demonstrating the adequacy of the study measures" (p.126) before proceeding to data analysis. Accordingly, in the following sub-sections, we present the results of Confirmatory Factor Analysis (CFA) conducted using SEM to assess the measurement models of all our constructs. These measurement models of the constructs are created as reflective models, and this includes both independent and dependent variables. This is followed by CFA for the three groups of constructs, which are: the Drivers, SSCM Practices Adoption, and Performance. We also assess and discuss uni-dimensionality, reliability, and validity of different measures and constructs.

8.2.1 Confirmatory Factor Analysis of Constructs

To test if the proposed measurement model derived from literature fits the sample data we conducted CFA of the constructs. For a measurement model fit that is acceptable usual norms indicate that the tests should ideally generate scores of CMIN/Df (minimum discrepancy divided by the degrees of freedom) of 5 or less, comparative fit index (CFI) and other goodness of fit indices, like normed fit index (NFI), values of 0.9 or more, and root mean square error of approximation (RMSEA) value less than 0.08 (Baldwin, 1989). Each of these indices has limitations and are affected by a number of factors including

sample size, degrees of freedom and model characteristics. For example, while CMIN is affected by sample size and Df is affected by model characteristics, the CFI and RMSEA "relatively independent of sample size" (Bagozzi, 2012, p.29). For structural equation modeling (SEM) the index Root mean square error of approximation (RMSEA) is "currently one of the most popular measures of goodness-of-model fit" (Kenny *et al*., 2014, p.486). For models with small degrees of freedom, fit indices may be problematic and may not be computed (Kenny *et al*., 2014). For purposes of parsimony, we use CMIN/Df, RMSEA and the CFI for reporting the model fit.

8.2.1.1 Regulations

Regulations (REG) was posited as a latent construct measured by three indicators (REG1 to REG3, please see Table 3.1). On testing with the data collected the measurement model elicited the standardized loadings of indicators and their Squared Multiple Correlation R2 as presented in Table 8.1 below.

Table 8.1 *Loadings on the Construct Regulations*

Item	**Standardised Loading λ**	**Squared Multiple Correlations R^2**
REG1	.881	.776
REG2	.868	.754
REG3	.799	.639

The measurement model for the construct Regulations is presented in Figure 8.1.

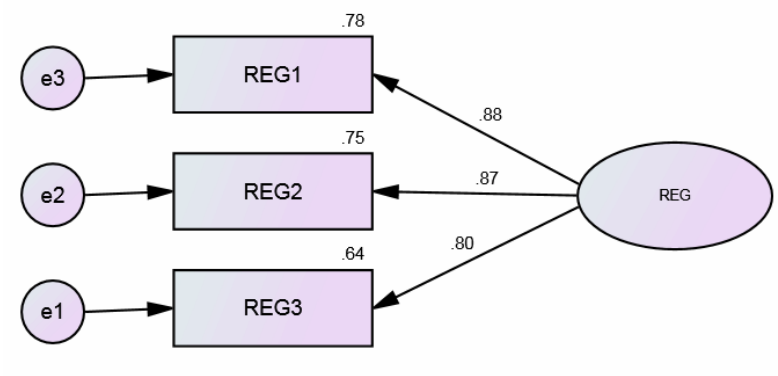

Figure 8.1 Measurement Model for the Construct Regulations

When tested, the measurement model for Regulations generated the following values of model fit indices.

Table 8.2 *Fit Indices for the Construct Regulations*

Index	Value
CMIN/Df	10.870
CFI	.978
RMSEA	.213
NFI Delta1	.976
IFI Delta2	.978
Cronbach's Alpha	.910

It was observed that fit indices CFI, NFI and IFI were good (above 0.9), while CMIN/Df and RMSEA were high. On inspection of modification indices in AMOS results, it was observed that no modifications to the model were recommended. This measurement model was considered parsimonious and was theoretically supported in published literature; hence a decision was made to retain it for further analysis.

8.2.1.2 Competitiveness

Competitiveness (COMP) was posited as a latent construct measured by seven items (COMP1 to COMP7, please see Table 3.1). The measurement model is presented in Figure 8.2 below.

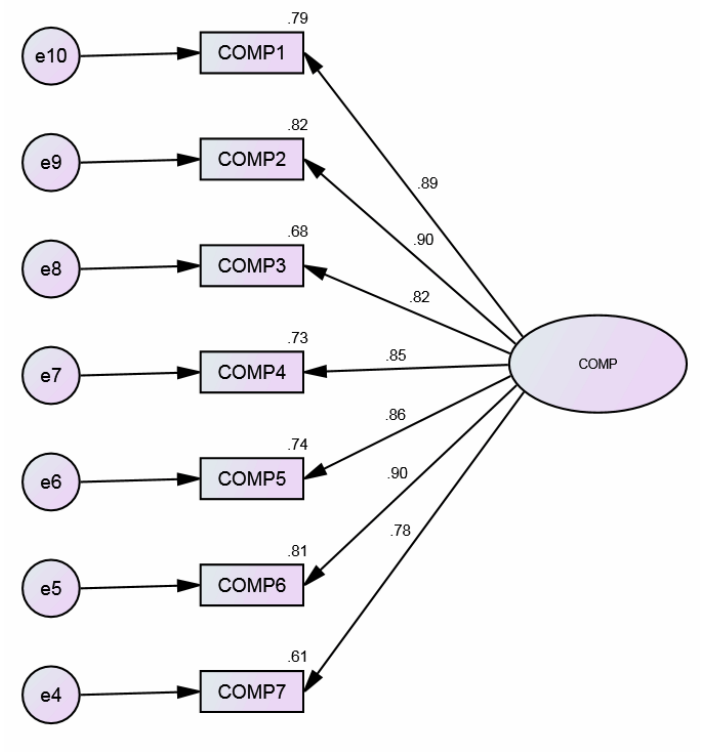

Figure 8.2 Measurement Model for the Construct Competitiveness

. When tested using the collected data it elicited the following standardized loadings of indicators on the construct and their Squared Multiple Correlation R^2 (Table 8.3).

Table 8.3 *Loadings on the Construct Competitiveness*

Item	Standardised Loading λ	Squared Multiple Correlations R^2
COMP1	0.887	0.787
COMP2	0.905	0.819
COMP3	0.824	0.680
COMP4	0.855	0.731
COMP5	0.862	0.743
COMP6	0.899	0.808
COMP7	0.780	0.608

The measurement model for Competitiveness generated the following values of model fit indices:

Table 8.4 *Fit Indices for the Construct Competitiveness*

Index	Value
CMIN/Df	3.678
CFI	0.976
RMSEA	0.111
NFI Delta1	0.967
IFI Deta2	0.976
Cronbach's Alpha	0.961

It was observed that fit indices CFI, NFI and IFI were good, being higher than 0.9, CMIN/Df was below 5, but RMSEA was a bit higher than 0.08. On inspection of modification indices in AMOS results, it was observed that no modifications to the model were recommended. This measurement model was considered parsimonious and was theoretically supported in published literature; hence a decision was made to retain it for further analysis.

8.2.1.3 Stakeholder Pressures

Stakeholder Pressures (PRES) was posited as a latent construct measured by five items (PRES1 to PRES5, please see Table 3.1). When tested, the measurement model for Stakeholder Pressures provided the following values of model fit indices (Table 8.5).

Table 8.5 *Fit Indices for the Construct Stakeholder Pressures*

Index	Value
CMIN/Df	15.534
CFI	0.910
RMSEA	0.259
NFI Delta1	0.904
IFI Deta2	0.910
Cronbach's Alpha	0.935

On further analysis, it was observed that modification indices in AMOS results indicated that introducing covariance arrows between the error terms e13 and e15 may improve model fit. The modified model is presented in Figure 8.3 below.

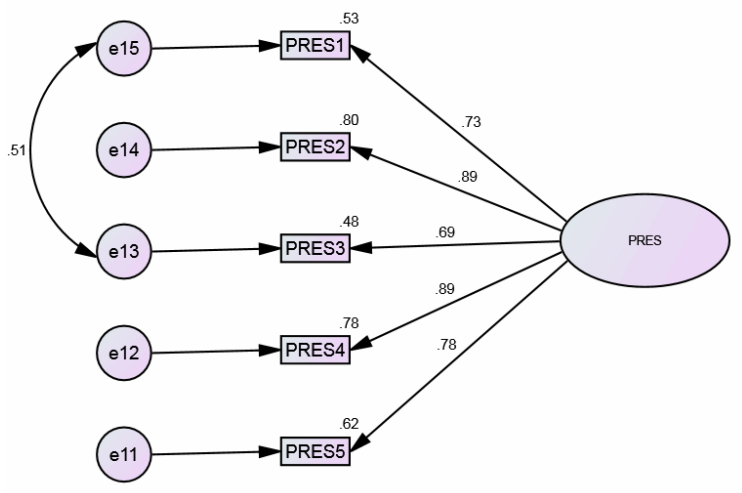

Figure 8.3 Measurement Model for the Construct Stakeholder Pressures (Modified)

Table 8.6 below presents the standardized loadings of indicators on the construct stakeholder pressures (PRES) and their Squared Multiple Correlation R^2.

Table 8.6 *Loadings on the Construct Stakeholder Pressures*

Item	**Standardised Loading λ**	**Squared Multiple Correlations R^2**
PRES1	0.731	0.534
PRES2	0.894	0.799
PRES3	0.691	0.478
PRES4	0.885	0.784
PRES5	0.784	0.615

The fit indices for a modified model of the construct improved to those as under (Table 8.7).

Table 8.7 *Fit Indices for the modified Construct Stakeholder Pressures*

Index	Value
CMIN/Df	7.680
CFI	0.965
RMSEA	0.175
NFI Delta1	0.961
IFI Deta2	0.966

It was observed that fit indices CFI, NFI and IFI were good, being higher than 0.9, CMIN/Df was higher than 5, and RMSEA was higher than 0.08. However, This measurement model is theoretically supported in the published literature and being parsimonious; a decision was made to retain it for further analysis without any further modifications.

8.2.1.4 External Environmental Practices

External Environmental Practices (EEP) was posited as a latent construct measured by four items (EEP1 to EEP4, please see Table 3.1). When tested, the measurement model for External Environmental Practices elicited the following values of model fit indices:

Table 8.8 *Fit Indices for the Construct External Environmental Practices*

Index	Value
CMIN/Df	6.453
CFI	0.971
RMSEA	0.159
NFI Delta1	0.966
IFI Delta2	0.971
Cronbach's Alpha	0.897

On further analysis, modification indices suggested introducing covariance arrows between the error terms e18 and e19. The modified model is presented in Figure 8.4 below.

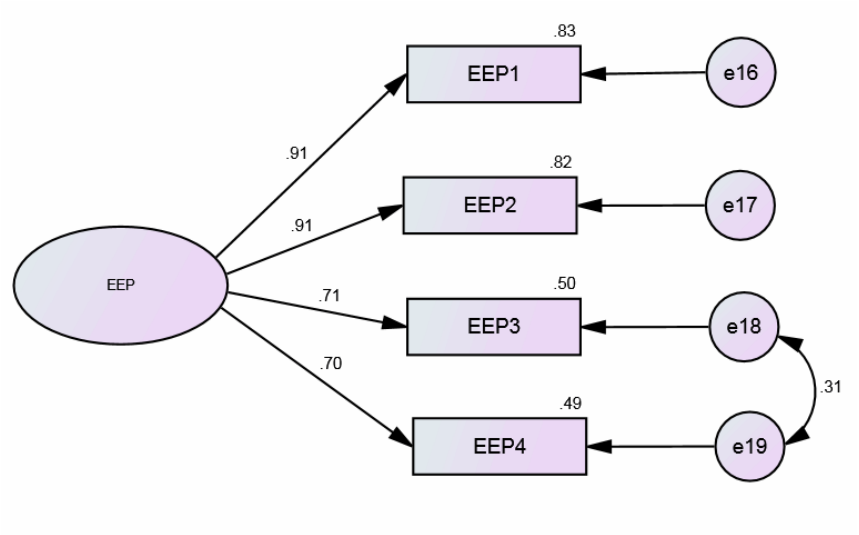

Figure 8.4 Measurement Model for the Construct External Environmental Practices (Modified)

Table 8.9 below shows the standardized loadings of indicators on the construct External Environmental Practices (EEP) and their Squared Multiple Correlations R^2.

Table 8.9 *Loadings on the Construct External Environmental Practices*

Item	**Standardised Loading** λ	**Squared Multiple Correlations** R^2
EEP1	0.913	0.833
EEP2	0.908	0.824
EEP3	0.709	0.500
EEP4	0.702	0.492

The goodness of fit indices for modified measurement model of the construct were as under (Table 8.10).

Table 8.10 *Fit Indices for the modified Construct External Environmental Practices*

Index	Value
CMIN/Df	0.440
CFI	1.000
RMSEA	0.000
NFI Delta1	0.998
IFI Delta2	1.000

It was observed that fit indices CFI, NFI and IFI were good, being higher than 0.9, CMIN/Df was below 5, and RMSEA was a bit lower than 0.08. This measurement model was considered parsimonious and was theoretically supported in published literature; hence a decision was made to retain it for further analysis.

8.2.1.5 Internal Environmental Practices

Internal Environmental Practices (IEP) was posited as a latent construct measured by six items (IEP1 to IEP6, please see Table 3.1). When tested, the measurement model for Internal Environmental Practices elicited the following values of model fit indices (Table 8.11).

Table 8.11 *Fit Indices for the Construct Internal Environmental Practices*

Index	Value
CMIN/Df	20.615
CFI	0.892
RMSEA	0.301
NFI Delta1	0.887
IFI Delta2	0.892
Cronbach's Alpha	0.958

On further analysis, modification indices suggested introducing covariance arrows between e23 and e25 to improve the fit. The measurement model was modified accordingly and is presented in Figure 8.5 below.

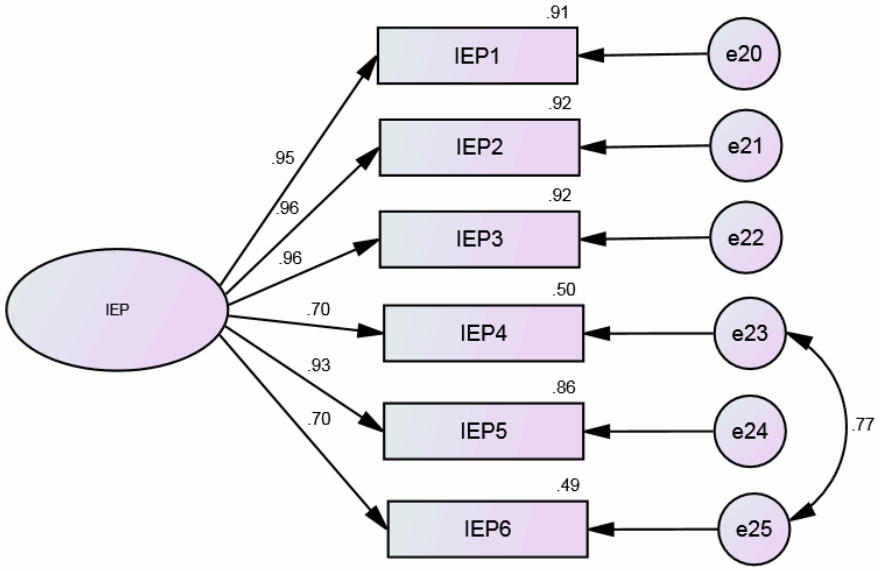

Figure 8.5 Measurement Model for the Construct Internal Environmental Practices (Modified)

Table 8.12 below presents the standardized loadings of indicators on the construct Internal Environmental Practices (IEP) and their Squared Multiple Correlations R^2.

Table 8.12 *Loadings on the Construct Internal Environmental Practices*

Item	Standardised Loading λ	Squared Multiple Correlations R^2
IEP1	0.953	0.908
IEP2	0.960	0.922
IEP3	0.958	0.918
IEP4	0.704	0.496
IEP5	0.929	0.863
IEP6	0.698	0.487

The fit indices for the modified model of the construct were as under (Table 8.13).

Table 8.13 *Fit Indices for the modified Construct Internal Environmental Practices*

Index	Value
CMIN/Df	1.343
CFI	0.998
RMSEA	0.040
NFI Delta1	0.993
IFI Delta2	0.998

It was observed that fit indices CFI, NFI and IFI were good, being higher than 0.9, CMIN/Df was below 5, and RMSEA was lower than 0.08. This measurement model was considered parsimonious and was theoretically supported in published literature; hence a decision was made to retain it for further analysis.

8.2.1.6 Supplier Selection

Supplier Selection (SS) was posited as a latent construct measured by six items (SS1 to SS6), please see Table 3.1). When tested, the measurement model for Supplier Selection elicited the following values of model fit indices (Table 8.14).

Table 8.14 *Fit Indices for the Construct Supplier Selection*

Index	Value
CMIN/Df	26.067
CFI	0.824
RMSEA	0.340
NFI Delta1	0.819
IFI Delta2	0.825
Cronbach's Alpha	0.940

On further analysis, modification indices suggested introducing covariance arrows between the error terms e29 and e30 to improve the fit. The measurement model was modified accordingly and is presented in Figure 8.6 below.

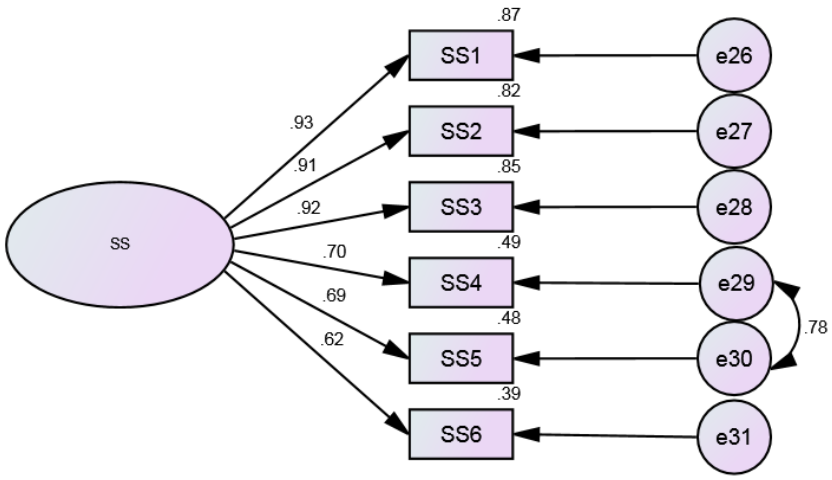

Figure 8.6 Measurement Model for the Construct Supplier Selection (Modified)

Table 8.15 below presents the standardized loadings of indicators on the construct Supplier Selection (SS) and their Squared Multiple Correlations R^2.

Table 8.15 *Loadings on the Construct Supplier Selection*

Item	**Standardised Loading λ**	**Squared Multiple Correlations R^2**
SS1	0.931	0.867
SS2	0.906	0.820
SS3	0.921	0.848
SS4	0.699	0.489
SS5	0.693	0.481
SS6	0.621	0.386

The fit indices for modified measurement model of the construct were as under (Table 8.16).

Table 8.16 *Fit Indices for the modified Construct Supplier Selection*

Index	**Value**
CMIN/Df	7.234
CFI	0.961
RMSEA	0.169
NFI Delta1	0.955
IFI Delta2	0.961

It was observed that fit indices CFI, NFI and IFI were good, being higher than 0.9, CMIN/Df was a little higher than 5, and RMSEA was higher than 0.08. This measurement model was considered parsimonious and was theoretically supported in

published literature; hence a decision was made to retain the modified measurement model for further analysis.

8.2.1.7 Supplier Evaluation and Monitoring

Supplier Evaluation and Monitoring (SM) was posited as a latent construct measured by six items (SM1 to SM6, please see Table 3.1). When tested, the measurement model for Supplier Evaluation and Monitoring elicited the following values of model fit indices (Table 8.17).

Table 8.17 *Fit Indices for the Construct Supplier Evaluation and Monitoring*

Index	Value
CMIN/Df	2.853
CFI	0.990
RMSEA	0.092
NFI Delta1	0.985
IFI Delta2	0.990
Cronbach's Alpha	0.976

It was observed that fit indices CFI, NFI and IFI were good, being higher than 0.9, CMIN/Df was below 5, but RMSEA was a little higher than 0.08. On inspection of modification indices in AMOS results, it was observed that no modifications to the model were recommended. This measurement model was considered parsimonious and was theoretically supported in published literature; hence a decision was made to retain it without any modifications for further analysis.

The measurement model is presented in Figure 8.7 below.

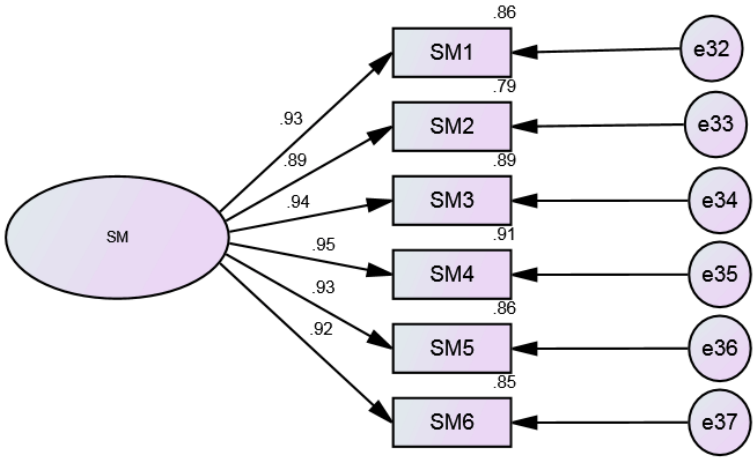

Figure 8.7 Measurement Model for the Construct Supplier Evaluation and Monitoring

Table 8.18 below presents the standardized loadings of indicators on the construct Supplier Evaluation and Monitoring (SM) and their Squared Multiple Correlations R^2.

Table 8.18 *Loadings on the Construct Supplier Evaluation and Monitoring*

Item	**Standardised Loading** λ	**Squared Multiple Correlations** R^2
SM1	0.929	0.862
SM2	0.888	0.789
SM3	0.942	0.887
SM4	0.951	0.905
SM5	0.930	0.864
SM6	0.924	0.854

8.2.1.8 Cooperation with Customers

Cooperation with Customers (CC) was posited as a latent construct measured by six items (CC1 to CC6, please see Table 3.1). When tested, the measurement model for

Cooperation with Customers generated the following values of model fit indices (Table 8.19).

Table 8.19 *Fit Indices for the Construct Cooperation with Customers*

Index	Value
CMIN/Df	1.313
CFI	0.998
RMSEA	0.038
NFI Delta1	0.993
IFI Delta2	0.998
Cronbach's Alpha	0.968

It was observed that fit indices CMIN/Df was lower than 5, and RMSEA was lower than 0.08. CFI, NFI, and IFI were above 0.9. This measurement model fitted the data well and was considered parsimonious, was theoretically supported in published literature; hence a decision was made to retain it for further analysis. The measurement model is presented in Figure 8.8 below.

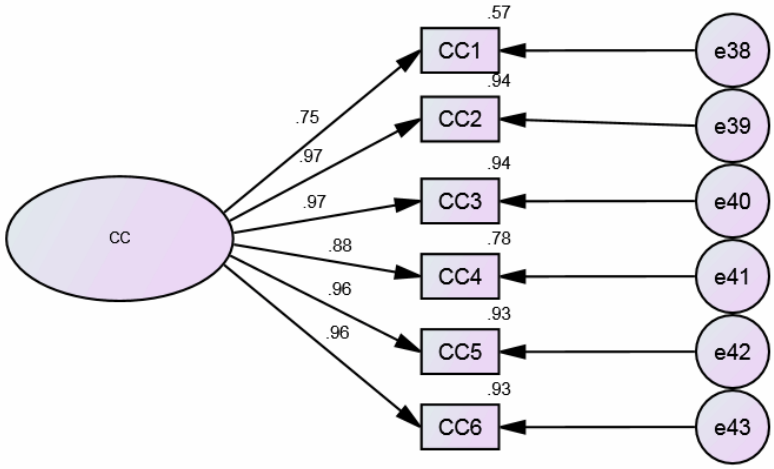

Figure 8.8 Measurement Model for the Construct Cooperation with Customers

Table 8.20 below presents standardized loadings of indicators on the construct Cooperation with Customers (CC) and their Squared Multiple Correlations R^2.

Table 8.20 *Loadings on the Construct Cooperation with Customers*

Item	Standardised Loading λ	Squared Multiple Correlations R^2
CC1	0.754	0.569
CC2	0.968	0.937
CC3	0.969	0.939
CC4	0.880	0.775
CC5	0.964	0.930
CC6	0.964	0.930

8.2.1.9 Eco-Design

Eco-Design (ED) was posited as a latent construct measured by three items (ED1 to ED3, please see Table 3.1). When tested, the measurement model for Eco-Design elicited the following values of model fit indices (Table 8.21).

Table 8.21 *Fit Indices for the Construct Eco-Design*

Index	Value
CMIN/Df	0.699
CFI	1.000
RMSEA	0.000
NFI Delta1	0.996
IFI Delta2	1.002
Cronbach's Alpha	0.767

It was observed that fit indices CFI, NFI and IFI were good, being higher than 0.9, CMIN/Df was below 5, and RMSEA was lower than 0.08 indicating a good fit. This measurement model was considered parsimonious and was theoretically supported in published literature; hence a decision was made to retain it for further analysis.

The measurement model is presented in Figure 8.9 below.

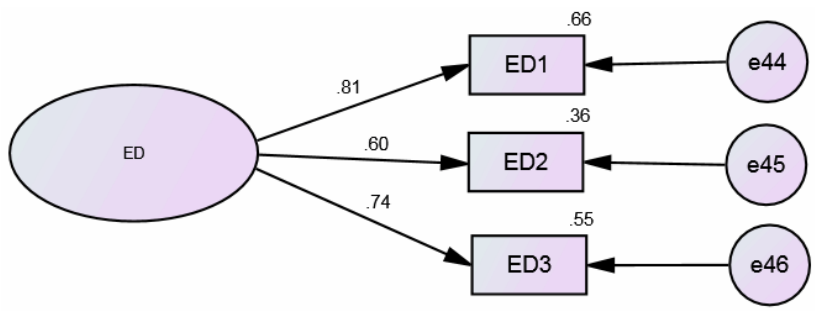

Figure 8.9 Measurement Model for the Construct Eco-Design

Table 8.22 below presents the standardized loadings of indicators on the construct Eco-Design (ED) and their Squared Multiple Correlations R^2.

Table 8.22 *Loadings on the Construct Eco-Design*

Item	**Standardised Loading λ**	**Squared Multiple Correlations R^2**
ED1	0.813	0.661
ED2	0.600	0.360
ED3	0.744	0.553

8.2.1.10 Social Sustainability Practices

Social Sustainability Practices (SSP) was posited as a latent construct measured by six items (SSP1 to SSP6, please see Table 3.1). When tested, the measurement model for Social Sustainability Practices elicited the following values of model fit indices (Table 8.23).

Table 8.23 *Fit Indices for the Construct Social Sustainability Practices*

Index	Value
CMIN/Df	33.519
CFI	0.856
RMSEA	0.387
NFI Delta1	0.853
IFI Delta2	0.857
Cronbach's Alpha	0.969

On further analysis, modification indices suggested introducing covariance arrows between the error terms e51 and e52 to improve the fit. The modified measurement model is presented in Figure 8.10 below.

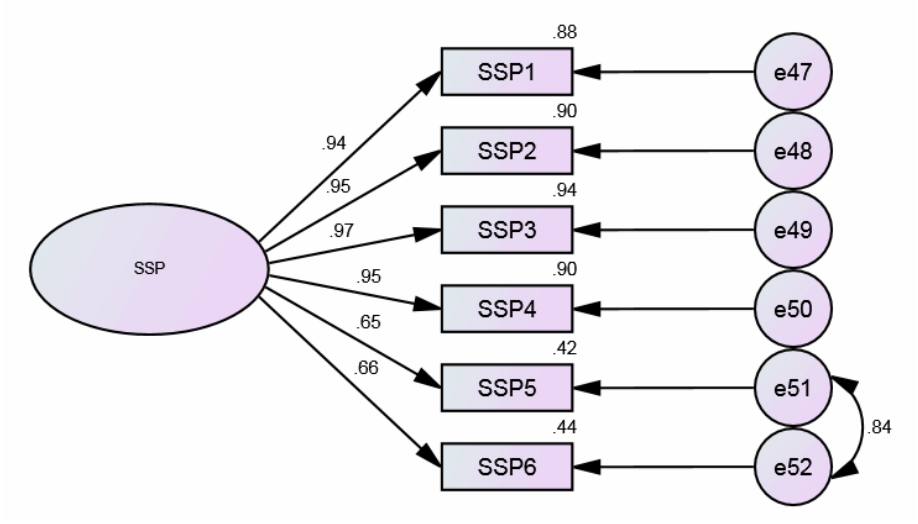

Figure 8.10 Measurement Model for the Construct Social Sustainability Practices (Modified)

Table 8.24 below presents the standardized loadings of indicators on the construct Social Sustainability Practices (SSP) and their Squared Multiple Correlations R^2.

Table 8.24 *Loadings on the Construct Social Sustainability Practices*

Item	**Standardised Loading** λ	**Squared Multiple Correlations** R^2
SSP1	0.936	0.876
SSP2	0.946	0.896
SSP3	0.970	0.941
SSP4	0.947	0.896
SSP5	0.649	0.421
SSP6	0.664	0.441

The fit indices for modified model of the construct were as under:

Table 8.25 *Fit Indices for the modified Construct Social Sustainability Practices*

Index	Value
CMIN/Df	7.554
CFI	0.974
RMSEA	0.174
NFI Delta1	0.970
IFI Delta2	0.974

It was observed that fit indices CFI, NFI and IFI were good, being higher than 0.9, CMIN/Df was a little higher than 5, and RMSEA was higher than 0.08. This measurement model was considered parsimonious and was theoretically supported in published literature; hence a decision was made to retain it for further analysis.

8.2.1.11 Economic Performance

Economic Performance (EP) was posited as a latent construct measured by five items (EP1 to EP5, please see Table 3.1). When tested, the measurement model for Economic Performance elicited the following values of model fit indices (Table 8.26).

Table 8.26 *Fit Indices for the Construct Economic Performance*

Index	Value
CMIN/Df	15.788
CFI	0.937
RMSEA	0.261
NFI Delta1	0.933
IFI Delta2	0.937
Cronbach's Alpha	0.956

On further analysis, modification indices suggested introducing covariance arrows between the error terms e53 and e57 to improve the fit. The measurement model was modified accordingly and is presented in Figure 8.11 below.

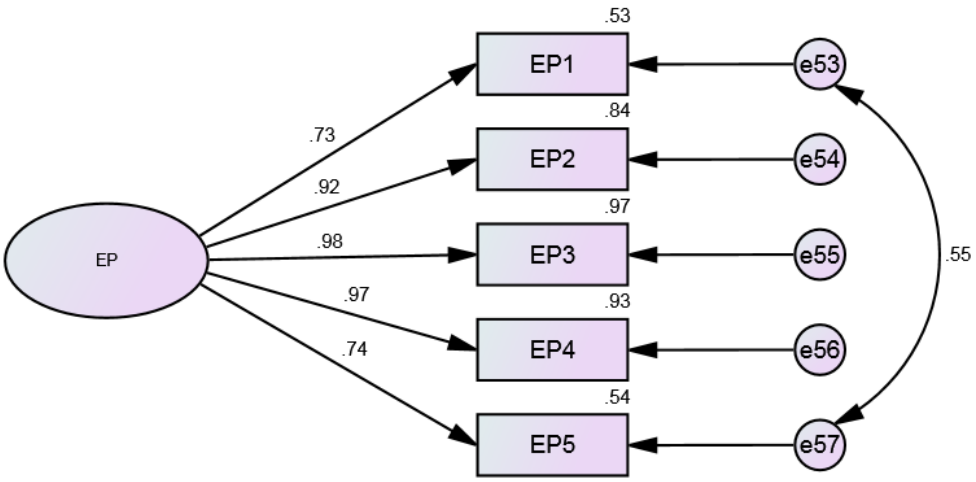

Figure 8.11 Measurement Model for the Construct Economic Performance (Modified)

Table 8.27 below presents the standardized loadings of indicators on the construct Economic Performance (EP) and their Squared Multiple Correlations R^2.

Table 8.27 *Loadings on the Construct Economic Performance*

Item	**Standardised Loading λ**	**Squared Multiple Correlations R^2**
EP1	0.729	0.531
EP2	0.917	0.840
EP3	0.982	0.965
EP4	0.965	0.932
EP5	0.735	0.541

The fit indices for the modified model of the construct were as under (Table 8.28).

Table 8.28 *Fit Indices for the modified Construct Economic Performance*

Index	Value
CMIN/Df	3.880
CFI	0.990
RMSEA	0.115
NFI Delta1	0.986
IFI Delta2	0.990

It was observed that for the modified model the fit indices CFI, NFI and IFI were good, being higher than 0.9, CMIN/Df was below 5, but RMSEA was a little higher than 0.08. This measurement model was considered parsimonious and was theoretically supported in published literature; hence a decision was made to retain it for further analysis.

8.2.1.12 Environmental Performance

Environmental Performance (ENVP) was posited as a latent construct measured by six items (ENVP1 to ENVP6, please see Table 3.1). The initial measurement model for Environmental Performance, when tested, elicited the following values of model fit indices (Table 8.29).

Table 8.29 *Fit Indices for the Construct Environmental Performance*

Index	Value
CMIN/Df	2.889
CFI	0.992
RMSEA	0.093
NFI Delta1	0.987
IFI Delta2	0.992
Cronbach's Alpha	0.983

It was observed that fit indices CFI, NFI and IFI were good, being higher than 0.9, CMIN/Df was below 5, but RMSEA was a little higher than 0.08. This model fitted well with data. This measurement model was considered parsimonious and was theoretically supported in published literature; hence a decision was made to retain it for further analysis without any modification. This measurement model is presented in Figure 8.12 below.

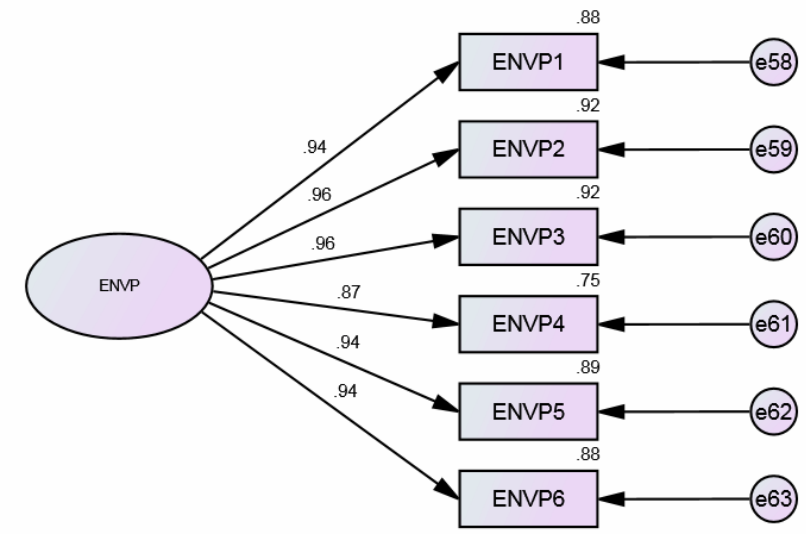

Figure 8.12 Measurement Model for the Construct Environmental Performance

Table 8.30 below shows standardized loadings of indicators on the construct Environmental Performance (ENVP) and their Squared Multiple Correlations R^2.

Table 8.30 *Loadings on the Construct Environmental Performance*

Item	Standardised Loading λ	Squared Multiple Correlations R^2
ENVP1	0.937	0.878
ENVP2	0.959	0.921
ENVP3	0.957	0.916
ENVP4	0.865	0.748
ENVP5	0.941	0.885
ENVP6	0.936	0.876

8.2.1.13 Social Performance

Social Performance (SP) was posited as a latent construct measured by five items (SP1 to SP5, please see Table 3.1). When tested, the measurement model for Social Performance elicited the following values of model fit indices (Table 8.31).

Table 8.31 *Fit Indices for the Construct Social Performance*

Index	Value
CMIN/Df	35.008
CFI	0.838
RMSEA	0.396
NFI Delta1	0.835
IFI Delta2	0.838
Cronbach's Alpha	0.943

On further analysis, modification indices suggested introducing covariance arrows between the error terms e67 and e68 to improve fit. The measurement model was modified accordingly and is presented in Figure 8.13 below.

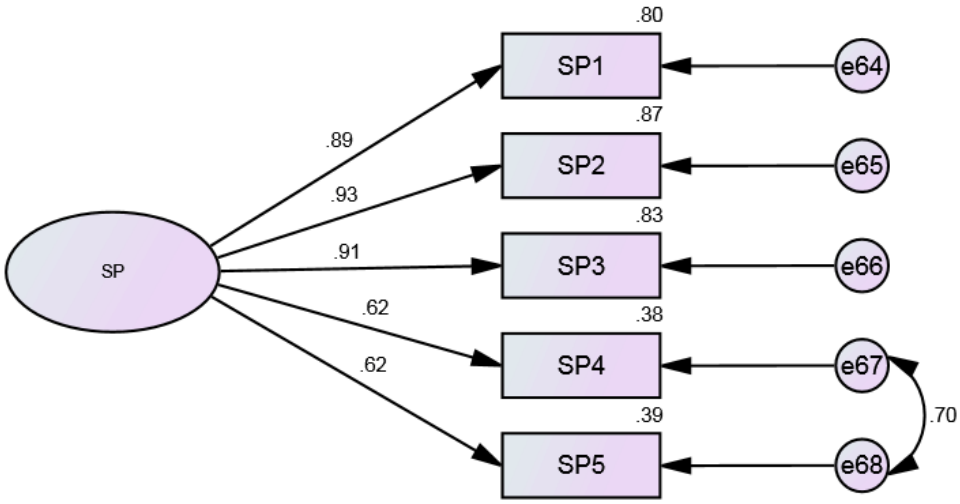

Figure 8.13 Measurement Model for the Construct Social Performance (Modified)

Table 8.32 below presents standardized loadings of indicators on the construct Social Performance (SP) and their Squared Multiple Correlations R^2.

Table 8.32 *Loadings on the Construct Social Performance*

Item	**Standardised Loading** λ	**Squared Multiple Correlations** R^2
SP1	0.892	0.796
SP2	0.934	0.872
SP3	0.912	0.833
SP4	0.619	0.383
SP5	0.625	0.390

The fit indices for the modified model of the construct were as under (Table 8.33).

Table 8.33 *Fit Indices for the modified Construct Social Performance*

Index	Value
CMIN/Df	13.541
CFI	0.950
RMSEA	0.240
NFI Delta1	0.947
IFI Delta2	0.950

It was observed that fit indices CFI, NFI and IFI were good, being higher than 0.9, CMIN/Df was above 5, and RMSEA was higher than 0.08. It was further observed that after modification of the measurement model the strength of loading of items SP4 and SP5 reduced from 0.644 and 0.651 to 0.619 and 0.625 respectively. It could be argued that the items SP5 and SP6 could be removed for a better model fit and a parsimonious model. However, on testing the measurement model with items SP4 and SP5 removed the fit indices deteriorated, as presented in Table 8.34 below.

Table 8.34 *Fit Indices for the modified Model of Social Performance after removing Items SP4 and SP5*

Index	Value with five indicators	Value after removing SP4 and SP5
CMIN/Df	13.541	52.042
CFI	0.950	0.936
RMSEA	0.240	0.485
NFI Delta1	0.947	0.935
IFI Delta2	0.950	0.936

When we conducted analyses using SPSS to determine whether the removal of the items SP4 and SP5 would add to reliability of the construct we got the following result (Table 8.35):

Table 8.35 *Cronbach's Alpha if Items SP4 or SP5 are deleted*

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
SP1	18.96	23.741	.899	.920
SP2	18.90	24.696	.884	.922
SP3	18.94	24.034	.891	.921
SP4	19.09	27.724	.778	.941
SP5	19.05	27.394	.786	.940

It was interpreted from the above results that deleting item SP5 from scale would reduce the Cronbach's Alpha's current value of 0.943 to 0.941; similarly deleting item SP6 from scale would reduce Cronbach's Alpha's current value of 0.943 to 0.940. Thus deletion of these items would not add to Cronbach's Alpha's current value of 0.943, i.e. it would not increase the reliability of the construct.

So, a decision was made to retain the items SP5 and SP6 in the measurement model because *firstly* they provide a richer insight into the construct and *secondly*, removing them does not improve its fit or add to the reliability of the model. Rather, the measurement model fit deteriorates, indicating that the measurement model as presented in Figure 8.13 is better supported. Therefore, this modified model (Figure 8.13) was considered appropriate, and the decision was made retain it for further analysis.

8.2.1.14 Operational Performance

Operational Performance (OP) was posited as a latent construct measured by six items (OP1 to OP6, please see Table 3.1). When tested, the measurement model for Operational Performance elicited the following values of model fit indices (Table 8.36).

Table 8.36 *Fit Indices for the Construct Operational Performance*

Index	Value
CMIN/Df	19.118
CFI	0.882
RMSEA	0.289
NFI Delta1	0.877
IFI Delta2	0.882
Cronbach's Alpha	0.950

On further analysis, modification indices suggested introducing covariance arrows between the error terms e69 and e70 to improve the fit. The measurement model was modified accordingly and is presented in Figure 8.14 below.

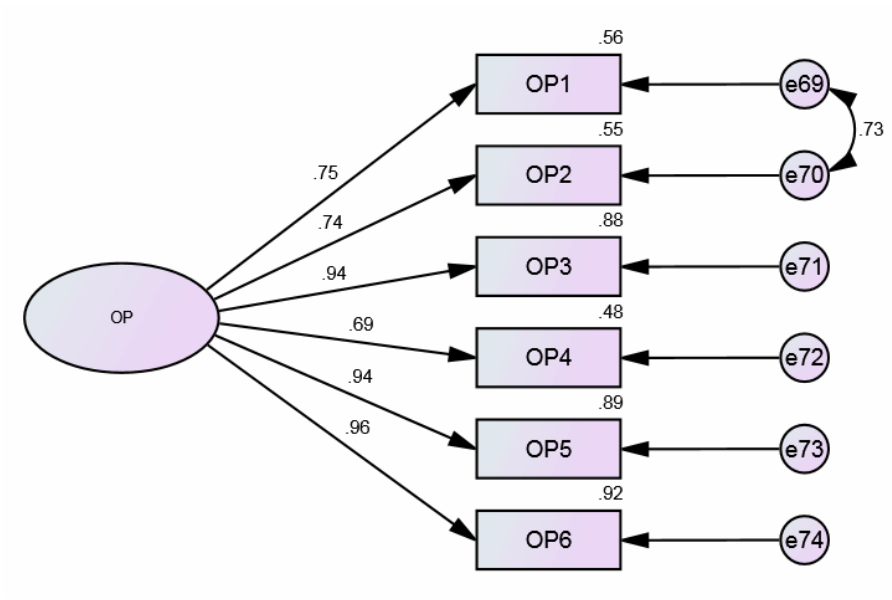

Figure 8.14 Measurement Model for the Construct Operational Performance (Modified)

Table 8.37 below presents the standardized loading of indicators on the construct Operational Performance (OP), and their Squared Multiple Correlations R^2.

Table 8.37 *Loadings on the Construct Operational Performance*

Item	**Standardised Loading λ**	**Squared Multiple Correlations R^2**
OP1	0.748	0.559
OP2	0.740	0.547
OP3	0.939	0.881
OP4	0.695	0.483
OP5	0.943	0.889
OP6	0.960	0.922

The fit indices for the modified model of the construct improved and are placed as under (Table 8.38).

Table 8.38 *Fit Indices for the modified Construct Operational Performance*

Index	Value
CMIN/Df	4.099
CFI	0.982
RMSEA	0.119
NFI Delta1	0.976
IFI Delta2	0.982

It was observed that fit indices CFI, NFI and IFI were good, being higher than 0.9, CMIN/Df was below 5, though RMSEA was a little higher than 0.08. It is seen that the modified model now fits the data well hence a decision was made to retain the modified model for further analysis.

8.2.2 Confirmatory Factor Analysis of Groups Drivers, SSCM Practices Adoption, and Performances

As the second step, groupings of constructs were analyzed using CFA. As discussed in sub-section 7.1.2 earlier, the following groups were formed for analysis (Table 8.39).

Table 8.39 *Groups Used for Confirmatory Factor Analysis in AMOS*

Group or Composite Construct	Constructs	Acronym Used in Analysis
Drivers	Regulations	REG
	Competitiveness	COMP
	Stakeholder Pressures	PRES
SSCM	External Environmental Practices	EEP

Practices Adoption	Internal Environmental Practices	IEP
	Supplier Selection	SS
	Supplier Evaluation & Monitoring	SM
	Cooperation with Customers	CC
	Eco-Design	ED
	Social Sustainability Practices	SSP
Performance	Economic Performance	EP
	Environmental Performance	ENVP
	Social Performance	SP
	Operational Performance	OP

These groups of constructs were used for testing the measurement model, which is discussed in the next sub-section.

8.2.2.1 Drivers

Measurement Model

Drivers Regulations (REG), Competitiveness (COMP), and Stakeholder Pressures (PRES) which have been posited as latent constructs were measured using a set of indicators (please see Table 3.1). When tested by conducting CFA using AMOS, the modification indices suggested introduction of covariance arrows between the error terms e4 and e8; e13 and e15 to improve the fit. The measurement model was modified accordingly and is presented in Figure 8.15.

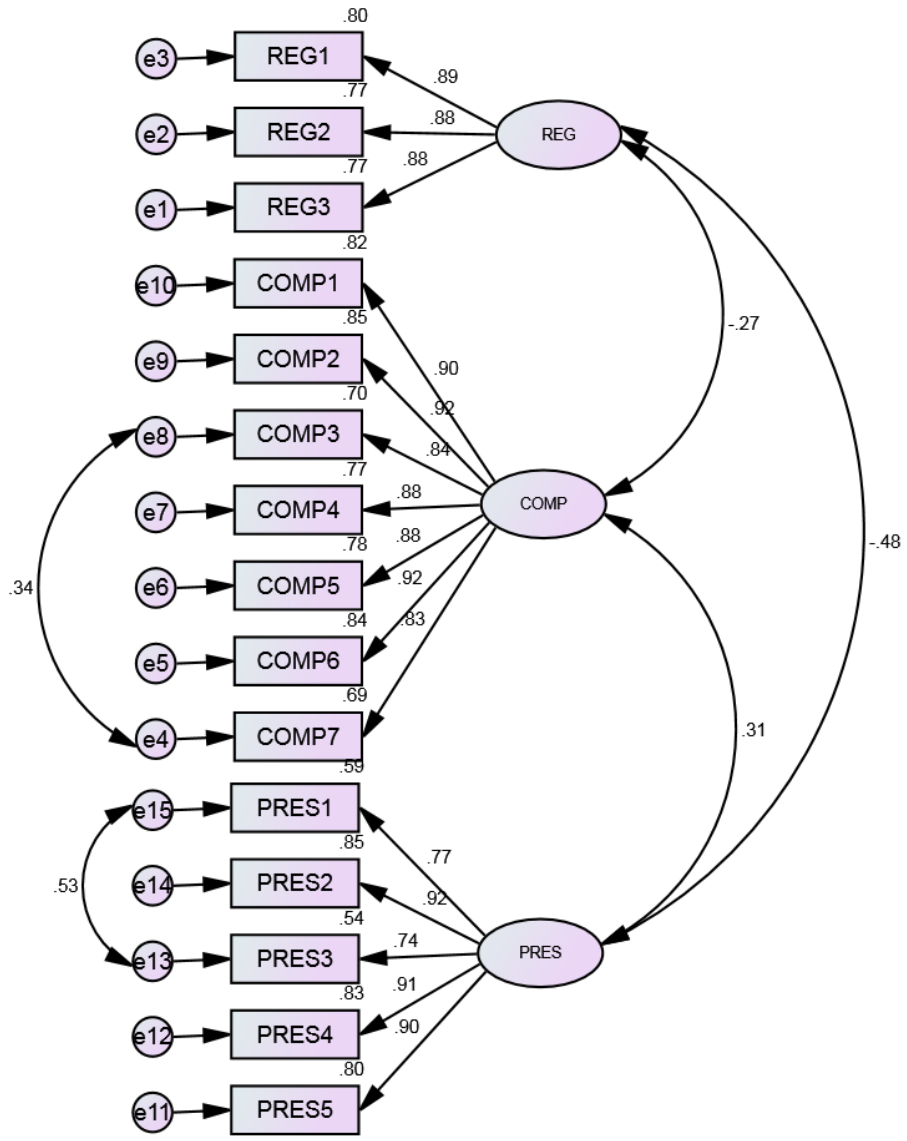

Figure 8.15 Measurement Model for the Constructs in the group Drivers (Modified)

The fit indices for the modified model for the Drivers improved as under (Table 8.40).

Table 8.40 *Fit Indices for the modified Drivers Model*

Index	Value
CMIN/Df	3.688
CFI	0.932
RMSEA	0.111
NFI Delta1	0.909
IFI Delta2	0.932

It was observed that fit indices CFI, NFI and IFI were good, being higher than 0.9, CMIN/Df was below 5, but RMSEA was a little higher than 0.08. It was seen that the modified model fitted the data better than before and the latter model was retained for analysis of results.

Table 8.41 below presents the standardized loadings of indicators on the constructs and their Squared Multiple Correlations R^2.

Table 8.41 *Standardised Loadings on the Drivers: Regulations, Competitiveness and Stakeholder Pressures With Composite Reliability, Square Multiple Correlations and Error Variance*

ITEMS	**REG**	**COMP**	**PRES**	**SQUARED MULTIPLE CORRELATIONS**	**ERROR VARIANCE**
CR	**0.914**	**0.961**	**0.929**		
	λ	**λ**	**λ**	**R^2**	**ε**
REG1	0.894			0.799	0.201
REG2	0.877			0.769	0.231
REG3	0.879			0.772	0.228
COMP1		0.904		0.817	0.183
COMP2		0.920		0.847	0.153
COMP3		0.839		0.704	0.296
COMP4		0.876		0.767	0.233
COMP5		0.881		0.776	0.224
COMP6		0.917		0.841	0.159
COMP7		0.833		0.693	0.307

PRES1			0.771	0.594	0.406
PRES2			0.921	0.848	0.152
PRES3			0.736	0.542	0.458
PRES4			0.912	0.832	0.168
PRES5			0.897	0.805	0.195

Assessing Reliability, and Convergent and Discriminant Validity

Reliability

Reliability may be assessed using Cronbach's Alpha, which was calculated in sub-section 5.5.1 and presented in Table 5.3. It was found that Cronbach's Alpha of each of the constructs in Drivers group was higher than 0.9 which showed high reliability of the scale being used.

Composite Reliability is also used for assessing reliability, and it can be calculated from CFA outputs. CR values of higher than 0.8 (Raykov, 1997) or 0.7 (Hair *et al*., 2010) are considered good to indicate the high reliability of a scale.

Validity

Convergent validity of the scale may be ascertained by inspecting the standardized loadings of items on the respective constructs. Table 8.42 shows that these loadings are robust and are all above 0.7, the lowest being 0.736 for PRES3 and can be interpreted to indicate a high convergent validity (Tabachnick & Fidell, 2007).

Another index used for convergent validity is Average Variance Extracted (AVE). AVE ranges from 0 to 1, and any value above 0.5 is considered to be good

indicator of convergent validity (Dillon & Goldstein, 1984; Fornell & Larcker, 1981). Malhotra and Dash (2011) state that "AVE is a more conservative measure than CR. On the basis of CR alone, the researcher may conclude that the convergent validity of the construct is adequate, even though more than 50% of the variance is due to error." (Malhotra & Dash, 2011, p.702).

Discriminant validity between constructs may be established by comparing the square root of AVE of each construct with its correlation with other constructs under analysis. The square root of AVE should be higher than the correlation values for good discriminant validity (Fornell & Larcker, 1981). Values for AVE may be compared with Maximum Shared Variance (MSV). AVE should be greater than MSV for good discriminant validity (Hair *et al*., 2010).

Composite Reliability (CR), Average Variance Extracted (AVE), Maximum Shared Variance (MSV), and the square root of AVE were calculated from the regression and correlation tables in the output of the CFA conducted on the Drivers constructs. Table 8.42 presents these indices.

Table 8.42 *Reliability and Validity Indices of Drivers Constructs*

	Composite Reliability CR	**Average Variance Extracted AVE**	**Maximum Shared Variance MSV**	**REG**	**COMP**	**PRES**
REG	0.914	0.780	0.233	**0.883****		
COMP	0.961	0.778	0.094	*-0.273**	**0.882****	
PRES	0.929	0.724	0.233	*-0.483**	*0.307**	**0.851****

Note. **. The bold figures on the diagonal are the square roots of the respective AVE.
* . The values in *italics* are coefficients of correlation.

The three constructs in the Drivers model displayed high Composite Reliability, i.e., Regulations (0.914), Competitiveness (0.961), and Stakeholder Pressures (0.929), which was much higher than the cut-off of 0.800 (Raykov, 1997), this indicated high reliability of the constructs.

The absolute values of AVE for the constructs REG (0.780), COMP (0.778), and PRES (0.724) were much higher than the recommended value of 0.500 (Fornell & Larcker, 1981) indicating the high convergent validity of the constructs. CR of each construct was higher than AVE indicating the high discriminant validity of the constructs.

Maximum Shared Variance MSV for the constructs was low: REG (0.233), COMP (0.094), and PRESS (0.233) and was lower than the corresponding AVE, thus indicating high discriminant validity (Hair et al., 2010).

Discriminant validity between constructs may be established by comparing the square root of AVE of each construct with its correlation with other constructs under analysis. The square root of AVE should be higher than the correlation values for good discriminant validity (Fornell & Larcker, 1981).

When the square root of the AVE of each construct (the bold figures placed on the diagonal in the Table above) was compared with its correlation with other constructs

under analysis, it was observed that the square root of AVE was higher than the correlation values, indicating good discriminant validity (Fornell & Larcker, 1981).

8.2.2.2 SSCM Practices Adoption

Measurement Model

The seven SSCM Practices Adoption constructs, viz. EEP, IEP, SS, SM, CC, ED SSP were posited as latent constructs measured by their indicators (please see Table 3.1). When tested by conducting CFA using AMOS, the modification indices suggested changes i.e., introduction of covariance arrows between the error terms e18 and e19; e23 and e25; e29 and e30; and e51 and e52. The measurement model was modified accordingly and is presented in Figure 8.16 below.

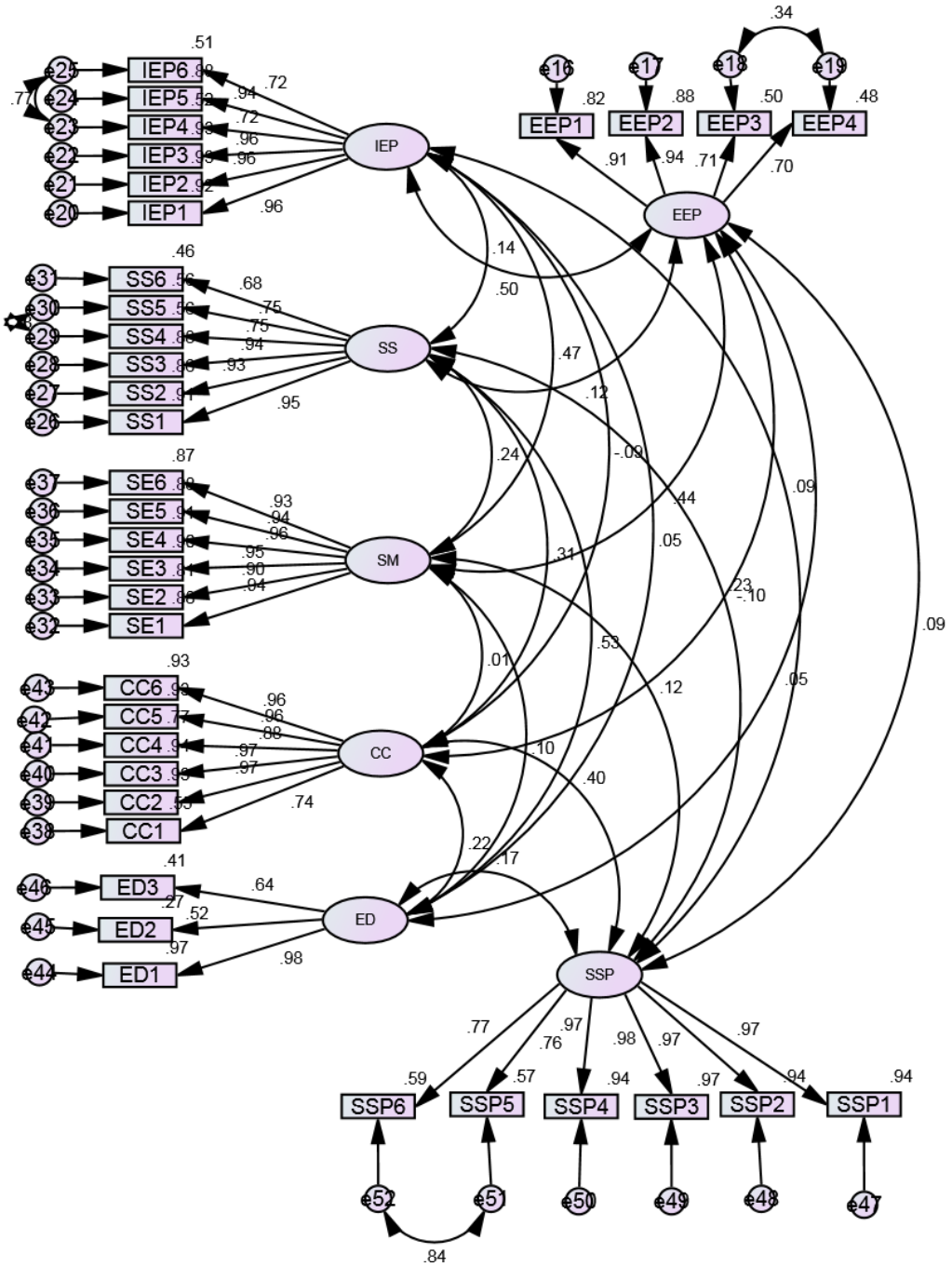

Figure 8.16 Measurement Model for SSCM Practices Adoption (Modified)

The fit indices for the modified measurement model for the SSCM Practices Adoption were as under (Table 8.46).

Table 8.43 *Fit Indices for the Modified SSCM Practices Adoption Measurement Model*

Index	Value
CMIN/Df	2.425
CFI	0.923
RMSEA	0.081
NFI Delta1	0.876
IFI Delta2	0.923

It was observed that CMIN/Df was below 5, and RMSEA was at 0.081, CFI and IFI were above 0.9 while NFI was a bit below 0.9. It is seen that the modified model (Figure 8.16) fitted the data well and was retained for analysis of results.

Table 8.44 below presents the standardized loadings (λ) of indicators on the constructs and their Squared Multiple Correlations R^2 and error variance **ε.**

Table 8.44 *Standardised Loadings (λ) on the SSCM Practices Adoption Constructs with Composite Reliability, Square Multiple Correlations and Error Variance*

	EEP	**IEP**	**SS**	**SM**	**CC**	**ED**	**SSP**	**Squared Multiple Correlations**	**Error Variance**
CR	**0.888**	**0.955**	**0.934**	**0.976**	**0.969**	**0.772**	**0.966**		
	λ	**λ**	**λ**	**λ**	**λ**	**λ**	**λ**	**R^2**	**ε**
EEP1	0.905							0.819	0.181
EEP2	0.936							0.877	0.123
EEP3	0.705							0.498	0.502
EEP4	0.696							0.485	0.515
IEP1		0.959						0.919	0.081
IEP2		0.964						0.928	0.072
IEP3		0.963						0.926	0.074
IEP4		0.721						0.520	0.480
IEP5		0.936						0.876	0.124
IEP6		0.715						0.511	0.489

SS1			0.954					0.911	0.089
SS2			0.930					0.864	0.136
SS3			0.936					0.877	0.123
SS4			0.751					0.564	0.436
SS5			0.745					0.555	0.445
SS6			0.679					0.461	0.539
SM1				0.936				0.875	0.125
SM2				0.897				0.805	0.195
SM3				0.946				0.895	0.105
SM4				0.955				0.913	0.087
SM5				0.935				0.875	0.125
SM6				0.932				0.869	0.131
CC1					0.739			0.546	0.454
CC2					0.967			0.935	0.065
CC3					0.968			0.937	0.063
CC4					0.877			0.769	0.231
CC5					0.963			0.927	0.073
CC6					0.963			0.928	0.072
ED1						0.983		0.966	0.034
ED2						0.522		0.272	0.728
ED3						0.637		0.406	0.594
SSP1							0.971	0.943	0.057
SSP2							0.969	0.939	0.061
SSP3							0.982	0.965	0.035
SSP4							0.970	0.941	0.059
SSP5							0.756	0.572	0.428
SSP6							0.770	0.593	0.407

Assessing Reliability, and Convergent and Discriminant Validity

Composite Reliability (CR), Average Variance Extracted (AVE), Maximum Shared Variance (MSV), and the square root of AVE were calculated from the regression and

correlation tables in the output of the CFA conducted on the SSCM Practices adoption. Table 8.45 presents these indices.

Table 8.45 *Reliability and Validity Indices of SSCM Practices Adoption*

	CR	**AVE**	**MSV**	**SSP**	**EEP**	**IEP**	**SS**	**SM**	**CC**	**ED**
SSP	0.966	0.825	0.162	**0.908****						
EEP	0.888	0.669	0.251	*0.091**	**0.818****					
IEP	0.955	0.781	0.251	*0.093**	*0.501**	**0.884****				
SS	0.934	0.705	0.277	*0.229**	*0.119**	*0.136**	**0.840****			
SM	0.976	0.872	0.226	*0.122**	*0.444**	*0.475**	*0.235**	**0.934****		
CC	0.969	0.840	0.162	*0.403**	*-0.095**	*-0.088**	*0.307**	*0.012**	**0.917****	
ED	0.772	0.548	0.277	*0.171**	*0.054**	*0.053**	*0.526**	*0.097**	*0.220**	**0.740****

Note. ****.** The bold figures on the diagonal are the square roots of the respective AVE.
*** .** The values in *italics* are coefficients of correlation.

Reliability

Reliability maybe assessed by Cronbach's Alpha, which was calculated in sub-section 5.5.1 and presented in Table 5.3. It was found that Cronbach's Alpha of each of the constructs in SSCM Practices Adoption group was higher than 0.9, except EEP (0.897) and ED (0.767). This represents high reliability of the scale being used.

As observed from Table 8.45 above, the seven constructs of the SSCM Practices Adoption displayed a high Composite Reliability. While six constructs elicited a CR of higher than the cut-off value of 0.800 and indicated high reliability of the constructs, ED had a CR of 0.772, which was slightly lower than the 0.8 cut off suggested by Raykov (1997) but was higher than 0.7, the cutoff suggested by Hair *et al*. (2010), and thus was not considered to be a cause of concern.

Validity

Convergent validity of the scale may be ascertained by inspecting the standardized loadings of items on the constructs. Table 8.44 exhibits that these loadings were robust and were all above 0.7, except in four cases (EEP4, 0.696; SS6, 0.679; ED2, 0.572; ED3, 0.637). All the loadings above 0.7 were interpreted to be excellent, while others ranged from very good to good (Tabachnick & Fidell, 2007) indicating convergent validity.

The absolute values of AVE of all the seven constructs were observed to be higher than the recommended value of 0.500 indicating the high convergent validity of the constructs (Fornell & Larcker, 1981).

Maximum Shared Variance values for the seven constructs were low and ranged from a low of 0.162 to a high of 0.277 and were lower than the corresponding AVE, again indicating the high discriminant validity of the constructs (Hair et al., 2010).

When the square root of the AVE of each construct (the bold figures placed on the diagonal in the Table above) was compared with its correlation with other constructs under analysis, it was observed that the square root of AVE was higher than the correlation values, indicating good discriminant validity (Fornell & Larcker, 1981). Also, CR of each construct was higher than AVE indicating the high discriminant validity of the constructs.

8.2.2.3 Performance

Measurement Model

The constructs relating to Performance types, i.e., EP, ENVP, SP, and OP were posited as latent constructs that were measured by their indicators (please see Table 3.1). When the measurement model for these four constructs was tested using AMOS, the modification indices suggested introduction of covariance arrows between the error terms e53 and e57; e67 and e68; and e69 and e70. The measurement model was modified accordingly and is presented in Figure 8.17 below.

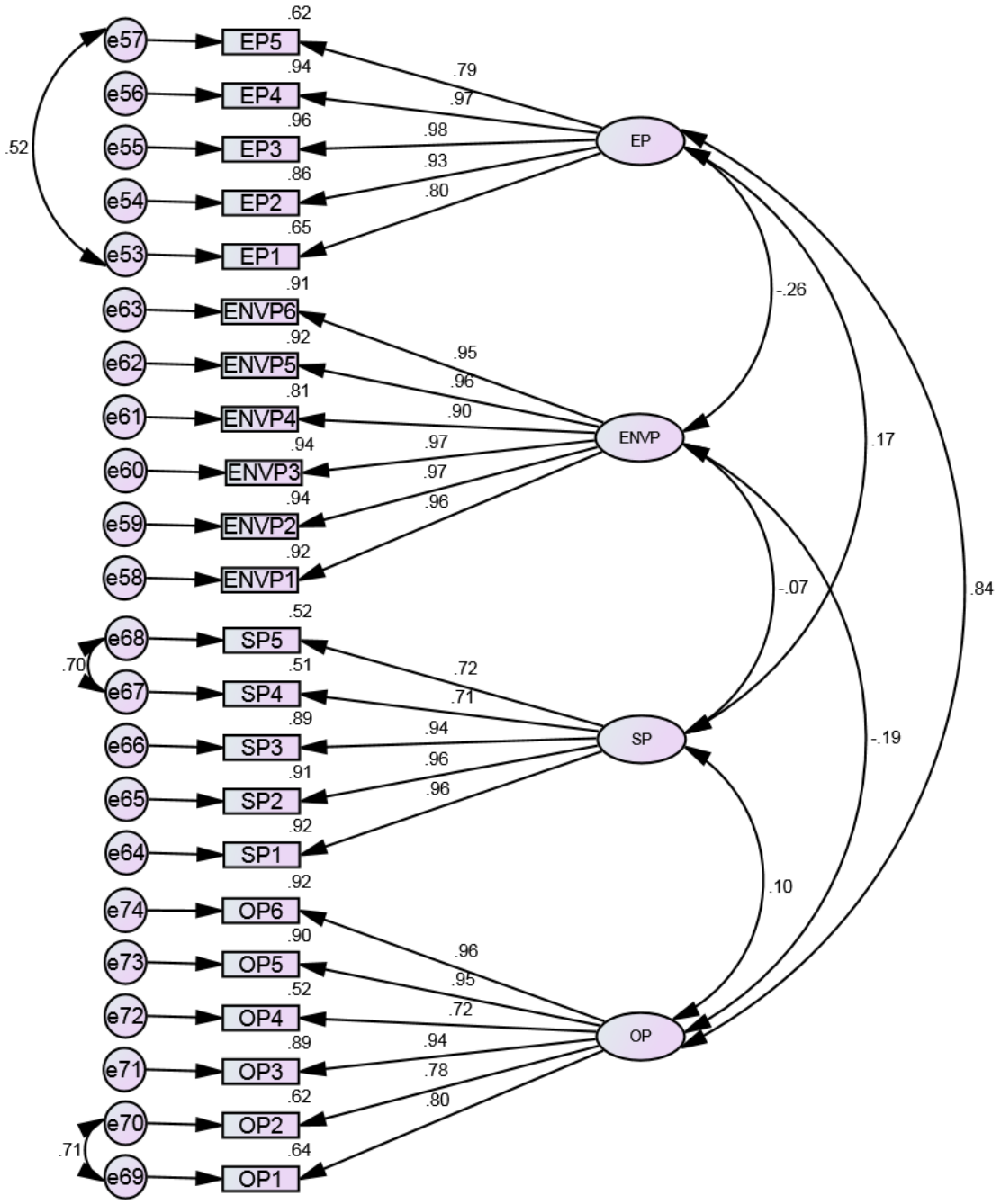

Figure 8.17 Measurement Model for Performance (Modified)

The fit indices for the modified Performance measurement model were elicited as under (Table 8.46).

Table 8.46 *Fit Indices for the Modified Performance Measurement Model*

Index	Value
CMIN/Df	3.845
CFI	0.921
RMSEA	0.115
NFI Delta1	0.897
IFI Delta2	0.922

It was seen that the CMIN/Df was below 5, RMSEA was a little higher than 0.08, the CFI and IFI were above 0.9 and NFI were a bit lower than 0.9, but now the modified measurement model fitted the data better. This measurement model was parsimonious and theoretically supported by published literature; hence a decision was made to retain it for further runs and analysis of results.

Table 8.47 below presents the standardized loadings (λ) of indicators on the Performance constructs EP, ENVP, SP and OP, their Squared Multiple Correlations R^2 and error variance ε.

Table 8.47 *Standardised Loadings (λ) on the Performance Constructs With Composite Reliability, Square Multiple Correlations and Error Variance*

	SP	**ENVP**	**EP**	**OP**	**Squared Multiple Correlations**	**Error Variance**
CR	**0.936**	**0.983**	**0.954**	**0.946**		
	λ	λ	λ	λ	R^2	ε
EP1			0.803		0.645	0.355
EP2			0.930		0.865	0.135

EP3			0.979		0.959	0.041
EP4			0.969		0.939	0.061
EP5			0.790		0.625	0.375
ENVP1		0.959			0.921	0.079
ENVP2		0.971			0.943	0.057
ENVP3		0.969			0.939	0.061
ENVP4		0.899			0.808	0.192
ENVP5		0.957			0.915	0.085
ENVP6		0.954			0.910	0.090
SP1	0.957				0.916	0.084
SP2	0.956				0.914	0.086
SP3	0.942				0.887	0.113
SP4	0.715				0.511	0.489
SP5	0.722				0.521	0.479
OP1				0.800	0.640	0.360
OP2				0.785	0.616	0.384
OP3				0.941	0.885	0.115
OP4				0.724	0.524	0.476
OP5				0.949	0.900	0.100
OP6				0.961	0.924	0.076

Assessing Reliability, and Convergent and Discriminant Validity

Composite Reliability (CR), Average Variance Extracted (AVE), Maximum Shared Variance (MSV), and the square root of AVE were calculated from the regression and correlation tables in the output of the CFA conducted on the Performance constructs. Table 8.48 below presents these indices.

Table 8.48 *Reliability and Validity Indices of Performance Constructs*

	CR	**AVE**	**MSV**	**OP**	**EP**	**ENVP**	**SP**
OP	0.946	0.748	0.699	**0.865****			
EP	0.954	0.806	0.699	*0.836**	**0.898****		

ENVP	0.983	0.906	0.068	*-0.189**	*-0.261**	**0.952****	
SP	0.936	0.750	0.027	*0.103**	*0.165**	*-0.068**	**0.866****

Note. ***.** The values in *italics* are correlation between constructs.
****.** The bold figures on the diagonal are the square roots of the respective AVE.

Reliability

Reliability maybe assessed by interpreting Cronbach's Alpha, which was calculated in sub-section 5.5.1 above and presented in Table 5.3. It was found that Cronbach's Alpha of each of the four constructs in Performance group (EP, ENVP, SP, and OP) was higher than 0.9. This represented high reliability of the scale being used.

These constructs also displayed robust CR values of over 0.93, which were well above the cut-off value of 0.8, and indicated a high reliability of the constructs (Raykov, 1997).

Validity

Convergent validity of the scale may be ascertained by inspecting the standardized loadings of items on the constructs. It was observed from Table 8.47 that these loadings were all well above 0.7 and were interpreted to be excellent (Tabachnick & Fidell, 2007) indicating high convergent validity.

The absolute values of AVE, of all the constructs, were higher than the recommended value of 0.500 indicating the high validity of the constructs.

Maximum Shared Variance MSV values for the four constructs were low and ranged from a low of 0.027 to a high of 0.699 and were lower than the corresponding

AVE indicating good discriminant validity between the constructs. Also, CR values of each construct were higher than AVE values, indicating high discriminant validity.

8.3 Structural Model Assessment

8.3.1 Drivers, SSCM Practices Adoption and Performance

After the establishment of measurement models, statistical tests were conducted for assessing relationships between independent and dependent variables by running structural model in AMOS. The structural model was created on the basis of *a priori* theoretical framework which was presented as Figure 7.1.

In the left half of structural model, the Drivers are treated as independent variables, and SSCM Practices are treated as dependent variables (Figure 8.18). All the dependent variables carry an error term as mandated by AMOS software. AMOS treats all indicators as observed endogenous variables, and all of them carry an error term. The SSCM Practices constructs, i.e. EEP, IEP, SS, SM, CC, ED and SSP are treated as unobserved endogenous variables, as they are dependent variables for analyzing this relationship. The three Driver constructs, i.e., REG, COMP, and PRES are treated as unobserved, exogenous variables.

In the right half of the structural model the adoption of SSCM Practices adoption EEP, IEP, SS, SM, CC, ED and SSP act as independent variables; whereas Performance constructs, i.e., EP, ENVP, SP and OP act as the dependent variables. The four dependent

variables are treated as unobserved endogenous variables by AMOS and carry error terms.

This makes a total or 173 variables in the model: 74 observed variables (consisting of the indicators), and 99 unobserved variables (consisting of the 14 latent constructs and 85 error terms that are connected to the indicators and the latent constructs).

The structural model constructed on the basis of the *a priori* theoretical framework was run in AMOS using Maximum Likelihood Estimation (MLE) method using the sample data collected in the survey. Figure 8.18 presents the structural model.

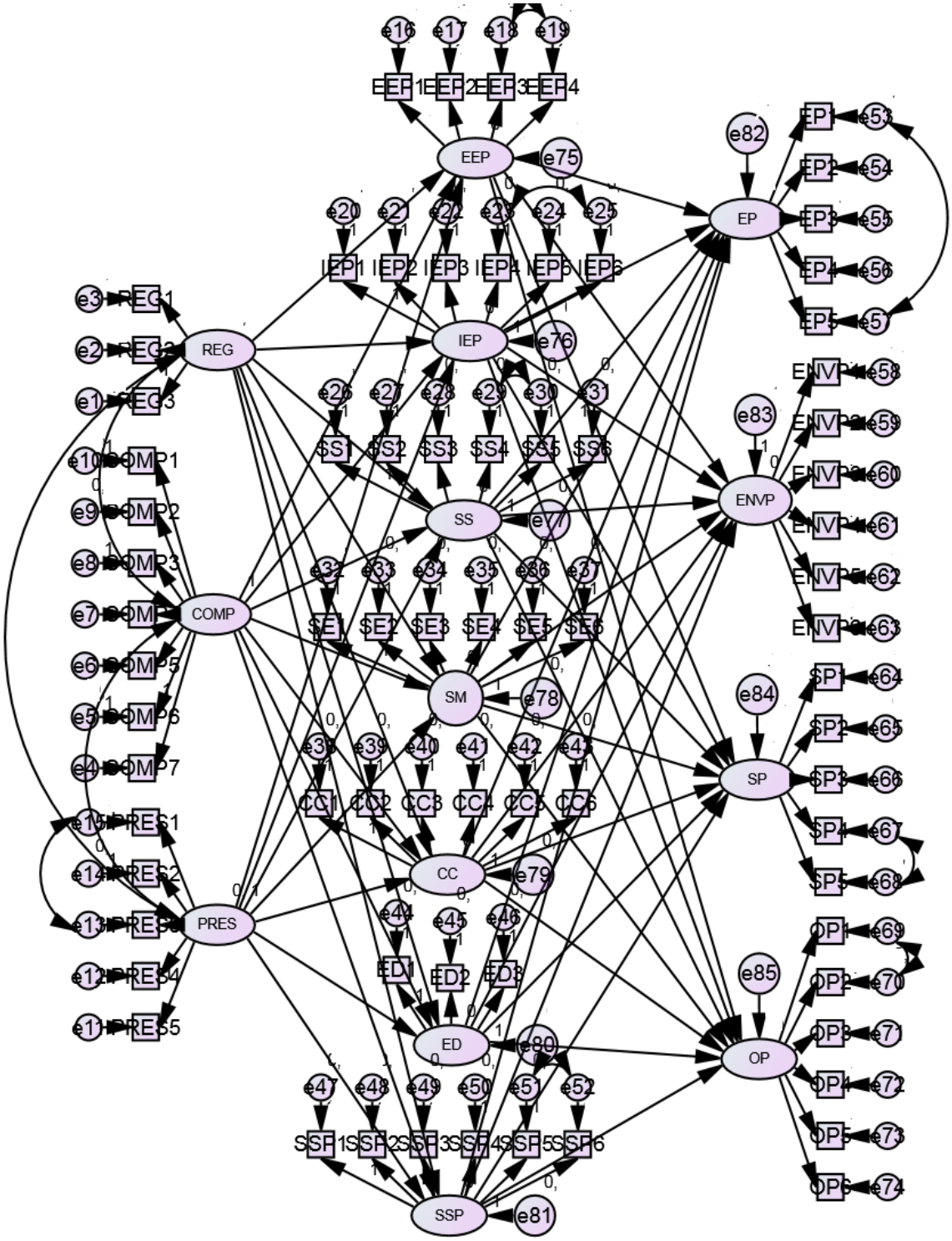

Figure 8.18 Structural Model

The structural model fit indices are presented in the Table 8.55, and they indicate a good overall fit to the data.

Table 8.49 *Fit Indices for the Structural Model*

Index	Value
CMIN/Df	1.378
RMSEA	0.042
CFI	0.936

The hypotheses ***H1a*** through ***H2d*** were examined in the light of the output from the run of the Structural Model in AMOS (attached as Appendix IX). It yielded the following findings.

H1a: *Companies that face a higher level of regulations are more likely to adopt SSCM practices.*

A statistically significant positive effect of Regulations on adoption of all seven SSCM Practices provided support for the hypothesis H1a. The statistically significant (p values ≥ 0.05) standardised coefficients of the paths that link Regulations to SSCM Practices were: EEP (0.711), IEP (0.766), SS (0.388), SM (0.812), CC (0.131), ED (0.234), and SSP (0.281).

H1b*: Companies that aim to achieve a higher level of competitiveness are more likely to adopt SSCM practices.*

A statistically significant positive effect of competitiveness of a firm on adoption of four out of seven SSCM Practices provided partial support for the hypothesis H1b. The statistically significant (p values ≥ 0.05) standardised coefficients of the paths that link firm competitiveness to SSCM Practices were: SS (0.554), SM (0.146), CC (0.433), and ED (0.704). Firm competitiveness had a statistically significant negative effect on adoption of social sustainability practices (SSP, -0.125), and the impact on the adoption of EEP and IEP were observed to be not statistically significant.

H1c: *Companies that face higher pressures from stakeholders are more likely to adopt SSCM practices.*

A statistically significant positive effect of stakeholder pressures on adoption of six out of seven SSCM Practices was observed which provided partial support for the hypothesis H1c. The statistically significant (p values ≥ 0.05) standardised coefficients of the paths that link firm stakeholder pressures to adoption of SSCM Practices were: IEP (0.133), SS (0.162), SM (0.166), CC (0.334), ED (0.142), and SSP (0.909). The impact of stakeholder pressures on adoption of EEP was observed to be not statistically significant.

H2a: *A company's economic performance is positively associated with the company's adoption of SSCM practices.*

A statistically significant positive effect on a firm's economic performance was shown by the adoption of two SSCM Practices, which provided partial support for the hypothesis H2a. The statistically significant (p values ≥ 0.05) standardized coefficients of the paths that link adoption of the two SSCM Practices to Economic Performance were

ED (0.674), and CC (0.422) and they displayed a positive impact on EP. Adoption of SSP (-0.147) elicited a statistically significant negative impact on economic performance. The other four SSCM practices, i.e., EEP, IEP, SS, and SM did not display any statistically significant impact on economic performance.

H2b: *A company's environmental performance is positively associated with the company's adoption of SSCM practices.*

A statistically significant positive effect on a firm's Environmental Performance was shown by the adoption of four SSCM Practices, which provided partial support for the hypothesis H2b. These were: SM (0.414), IEP (0.343), EEP (0.321), and SS (0.119), and they elicited statistically significant (p values $\geq$ 0.05) positive standardised coefficients. Adoption of SSP (-0.119) and ED (-0.214) showed a statistically significant negative impact on Environmental Performance. Adoption of CC practices did not elicit any statistically significant impact on the environmental performance.

H2c: *A company's social performance is positively associated with the company's adoption of SSCM practices.*

A statistically significant positive effect on a firm's Social Performance was shown by the adoption of SSP, which provided partial support for the hypothesis H2c. The path from SSP to Social Performance showed a statistically significant standardized coefficient (p-value $\geq$ 0.05) with a beta value of 0.754. Adoption of the rest of the six SSCM practices, i.e., EEP, IEP, SS, SM, CC, and ED, did not show any statistically significant impact on the Social Performance.

H2d: *A company's operational performance is positively associated with the company's adoption of SSCM practices.*

A statistically significant positive effect on a firm's operational performance was shown by the adoption of three SSCM Practices, which provided partial support for the hypothesis H2d. Adoption of ED (0.915), CC (0.151), and SS (0.078) showed a statistically significant (p values ≥ 0.05) positive impact on the Operational Performance of a firm. Figures in parenthesis are standardized coefficients of the paths that link adoption of the three SSCM Practices to Operational Performance. Adoption of EEP (-0.081), SM (-0.124), and SSP (-0.150) showed a statistically significant negative impact on Operational Performance of a firm. Adoption of the seventh SSCM practice, i.e., IEP (0.025), did not show any statistically significant impact on the Operational Performance.

8.3.2 Summary of Results

It was observed that while H1a was supported by the SEM results, H1b, H1c, H2a, H2b, H2c, and H2d were partially supported. The lack of full support was due to the findings that some factors had statistically insignificant impacts, and some others had a negative impact on dependent variables.

In the next chapter we discuss the results and implications of the research findings.

Chapter 9 Findings and Discussion

The objective of this research was to study the effect of drivers on adoption of sustainable supply chain management practices, and further, the impact of adoption of sustainable supply chain management practices on the performance of the focal firm. The moderating effect of the size of a firm on the impact of adoption of SSCM practices on performance was also studied.

The following research questions were addressed in the research:

1. Do the key drivers, as identified in the literature, affect the adoption of SSCM practices by a firm?
2. Does the adoption of SSCM practices impact the economic, environmental, social and operational performance of a firm?
3. Does the size of a firm have a moderating effect on the impact that a company's adoption of SSCM practices may have on the company's economic, environmental, social and operational performance?

The conceptual framework was formed based on an extensive literature review. The framework comprised of three distinct groups of theory-based constructs, which are: (1) Drivers, (2) SSCM Practices Adoption, and (3) Performance of the focal firm. In this chapter, first each sub-framework is discussed separately, and then their relationship with each other is discussed while interpreting the findings from the analyses presented in the previous chapters. The research framework with standardized regression coefficients is presented in Figure 9.1.

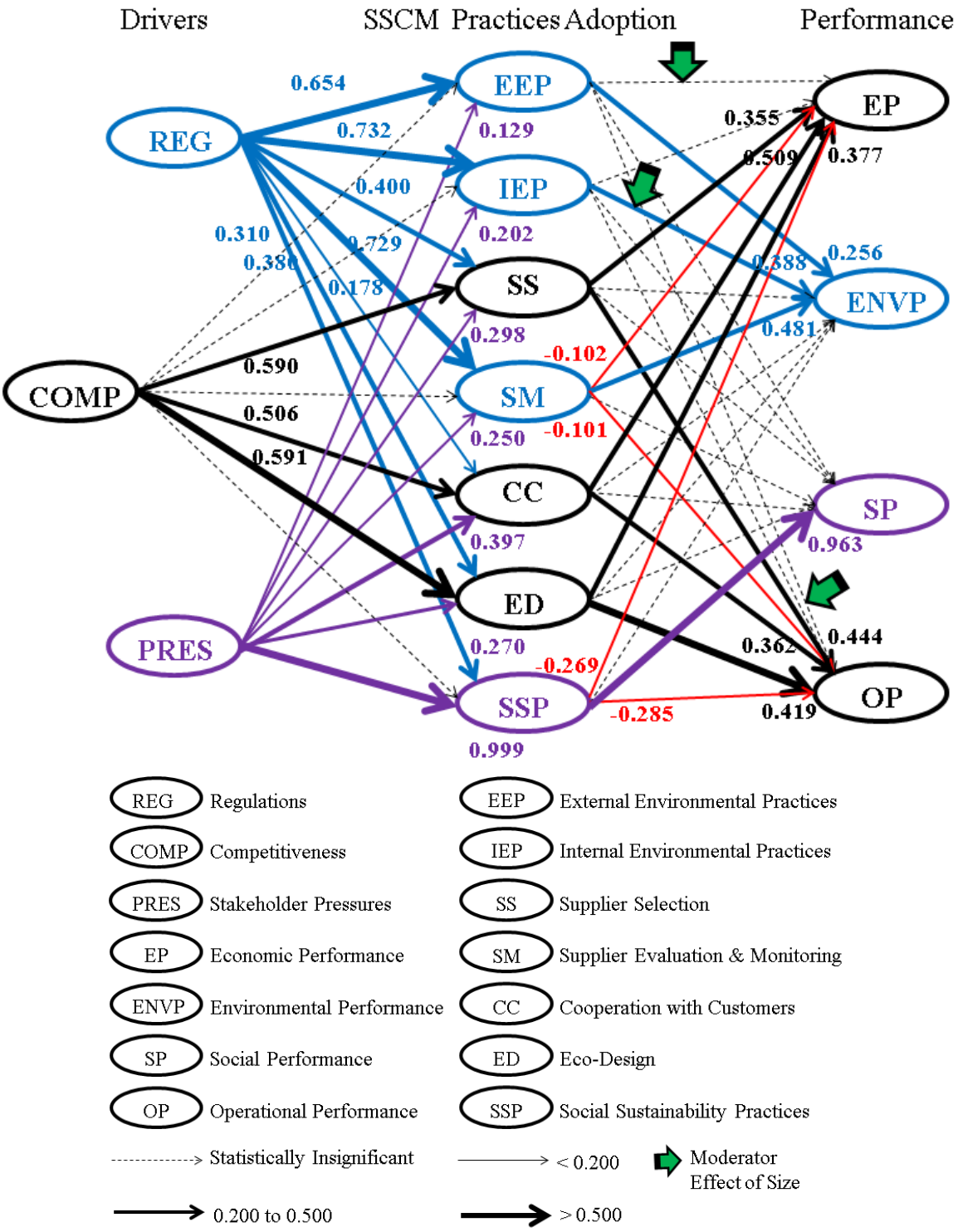

Figure 9.1 Research Framework with Standardized Regression Coefficients

9.1 Drivers, Sustainable Supply Chain Management Practices Adoption, and Performance

This research is one of the early works that study the impact of these drivers on SSCM practices adoption and the effect of adoption of such practices on the performance of the focal firm, while the firm is considered as a unit of analysis. Published research has not studied the specific impact issues that were explored in this research in a composite manner (Wang & Dai, 2018; Rajeev *et al*., 2017; Paulraj *et al.,* 2017). Drivers that motivate the adoption of SSCM practices have been discussed in Section 3.3. It was seen that the influence of these drivers on SSCM practices adoption had not been empirically tested yet in the literature in the current context. Impact of size as a moderator on the impact of adoption of SSCM practices on the performance of the focal firm has also not been studied earlier.

9.1.1 Drivers and SSCM Practices Adoption

All the three drivers dealt with by this study - that is Regulations, Competitiveness and Stakeholder Pressures - have been posited to influence SSCM practice adoption in theory. Essentially, each one of these three represents a group of drivers (Mann *et al.,* 2010), but based on underlying conceptual similarities; these multiple drivers have been grouped as three logical categories of drivers for parsimony, i.e., REG, COMP, and PRES. These driver constructs were regressed on SSCM practices adoption (section 7.2).

Regression analyses indicated that the driver Regulations displayed a statistically significant positive impact on all the seven SSCM Practices, with standardized Betas ranging from to 0.178 to 0.732 (please see Figure 9.1 / Table 7.15). Competitiveness displayed a statistically significant positive impact on supplier selection practices, cooperation with customer practices and eco-design practices with standardized Betas ranging from to 0.506 to 0.591. Stakeholder Pressure displayed a statistically significant positive impact on all the seven SSCM Practices, with the highest Beta for social sustainability practices. This was in line with findings Tate *et al*., (2010) and Carter and Easton (2011) who find that firms are under significant pressure from their stakeholders to adopt sustainable practices and reduce the environmental impact of their supply chains. Table 9.1 below presents the inference of the findings of the regression analyses referred above.

Table 9.1 *Inference from the Findings of Multiple Regression Analyses: Regression of Drivers on SSCM Practices Adoption*

Independent Variables	**Dependent Variables**	**Hypotheses**	**Inference**
Drivers: REG COMP PRES	SSCM Practices Adoption: EEP, IEP, SS, SM, CC, ED, SSP	**H1a:** *Companies that face a higher level of regulations are more likely to adopt SSCM practices.*	Supported
		H1b: *Companies that aim to achieve a higher level of competitiveness are more likely to adopt SSCM practices.*	Partially Supported
		H1c: *Companies that face higher pressures from stakeholders are more likely to adopt SSCM practices.*	Supported

9.1.2 SSCM Practices Adoption and Performance

Adoption of all the seven SSCM practices taken up for the study, that is, EEP, IEP, SS, SM, CC, ED, and SSP have been posited to influence a firm's performance in theory. We had taken four types of performances for the research model: EP, ENVP, and SP (these three make the "Triple Bottom Line" of sustainability) and OP. The second set of regressions numbered 8 through 11 (please see Table 7.14) were run to test for the posited relationship between SSCM Practices Adoption and firm performance. That is, the seven independent variables EEP, IEP, SS, SM, CC, ED, and SSP were regressed first on variable EP as the first regression, and then the same independent variables were regressed on variable ENVP, and so on (please see Figure 9.1 / Table 7.17).

From the regression results, we observed that adoption of three types of SSCM Practices, i.e., SS, CC, and ED had a statistically significant positive impact on EP and OP. On the other hand, adoption of SSP and SM practices had a statistically significant negative impact on EP and OP. EEP and IEP do not show any statistically significant impact on these two performance types.

Adoption of EEP, IEP and SM had a statistically significant positive impact on Environmental Performance. Adoption of the other four SSCM Practices did not display any statistically significant impact on the Environmental Performance.

Adoption of Social Sustainability Practices displayed a high and statistically significant positive impact on Social Performance. Adoption of other six SSCM

Practices did not have any statistically significant impact on Social Performance. Table 9.6 below presents the inference from the findings of the regression analyses referred above.

Table 9.2 *Inference from the Findings of Multiple Regression Analyses: Regression of SSCM Practices Adoption on Performance*

Independent Variable	**Dependent Variables**	**Hypotheses**	**Inference**
SSCM Practices Adoption: EEP, IEP, SS, SM, CC, ED, SSP	Economic Performance: EP	**H2a**: *A company's economic performance is positively associated with the company's adoption of SSCM practices.*	Partially Supported
	Environmental Performance: ENVP	**H2b:** *A company's environmental performance is positively associated with the company's adoption of SSCM practices.*	Partially Supported
	Social Performance: SP	**H2c:** *A company's social performance is positively associated with the company's adoption of SSCM practices.*	Partially Supported
	Operational Performance: OP	**H2d:** *A company's operational performance is positively associated with the company's adoption of SSCM practices.*	Partially Supported

9.1.3 Effect of Size

From the results of separate multiple regressions for small firms and larger firms, and from the subsequent t-tests conducted to detect whether the slopes of these regression lines were statistically different, it was inferred that size had a statistically significant and positive moderator effect on the impact of adoption of EEP on EP and OP. This indicated that for the larger firms the adoption of External Environmental Practices had a

significant and positive impact on economic and operational performance, while this impact was significant but negative in case of small firms. This moderator effect of size is supported by Resource-Based View according to which larger firms have greater resources and therefore can leverage these resources for better performance. Size also elicited a statistically significant and positive moderator effect on the impact of adoption of IEP on ENVP. In all the other cases the effects of size were found to be statistically not significant.

Table 9.3 below summarises the findings of the test results and the support they lend to the hypotheses H3a to H3d.

Table 9.3 *Findings of Multiple Regression Analyses and t-Tests: Effect of Size as a Moderator*

Independent Variable	**Effect**	**Hypotheses**	**Inference**
Size	Posited to Moderate Impact of SSCM Practices Adoption on Performance	**H3a**: *The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's economic performance.*	Partially Supported
		H3b: *The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's environmental performance.*	Partially Supported
		H3c: *The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's social performance.*	Not Supported
		H3d: *The bigger the firm size, the greater is the impact of company's adoption of SSCM practices on the company's operational performance.*	Partially Supported

9.2 Patterns in Results

A number of interesting insights were gained from the results discussed above. On viewing the results from a broader perspective, they seemed to present a specific pattern of relationships. The following subsections discuss the possible reasons and logic for the existence, strength, and direction of these relationships.

9.2.1 Different Drivers Impact Adoption of SSCM Practices Differently

It was observed from the results that different drivers impact the adoption of SSCM Practices differently. Regulations influence adoption of EEP, IEP, and SM positively to a greater extent; Competitiveness had a greater influence on adoption of SS, CC, and ED; and Stakeholder Pressures show the greatest influence on SSP. So while the SSCM Practices EEP, IEP and SM 'went together,' and such was again the case with SS, CC, and ED, while SSP was observed to be distinctly separate from these two groups.

9.2.2 What connects External Environmental Practices, Internal Environmental Practices and Supplier Evaluation and Monitoring

The dividing line between External Environmental Practices and Internal Environmental Practices is basically there for the purposes of classification. These two types of practices are complementary to each other, both being organizational environmental practices. The close association of Supplier Evaluation and Monitoring with these two constructs, EEP and IEP, observed in the results are easier to interpret when we view Supplier Evaluation and Monitoring in the context of being an ongoing

environmental practice. From that standpoint, SM spans both EEP and IEP and is expected to have a high level of association with them as seen in the results. Adoption of these three SSCM Practices is positively impacted by the driver Regulations, and these three practices, in turn, produce a significant positive impact on the environmental performance of the focal firm.

It is observed that with a rise in awareness of environmental degradation worldwide, firms are faced with an increasing number of regulations in the environmental domain. To ensure compliance with regulations, firms adopt a set of SSCM Practices that enable them to meet with the requisite norms because supply chain management plays a pivotal role in determining what impact a firm has on the environment (Handfield *et al*., 2005; Isaksson *et al*., 2010). The environmental norms, for example, may be a required percentage of recycled content in the paper, or it may be maximum emission or effluent level permitted for chemical industry. These are specific targets that have to be achieved by the firms in cooperation with their supply chains. The findings from this research indicate that in the face of regulations firms adopt a specific set of external environmental practices, and a set of internal environmental practices, along with close evaluation and monitoring of their suppliers. Adoption of these practices results in a better environmental performance which helps these firms in meeting the norms prescribed by those regulations. These results are in line with the findings of Esfahbodi *et al.,* (2017) who found that adoption of SSCM Practices leads to improved environmental performance.

9.2.3 What connects Supplier Selection, Cooperation with Customers and Eco-Design

The dividing line between Supplier Selection and Cooperation with Customers is normally thought to be distinct. One is related to the selection of suppliers and other to the diametrically opposite end-of-supply-chain, which is a customer. But when considering the objective of these two practices, they may be viewed as being closely related. For example, if a firm selects a supplier based on their environmental competence and performance, for supplier's ability to develop environmentally friendly products, to achieve its environmental objectives, and uses the ISO14000 documentation process and rating systems to achieve those objectives, the entire protocol is very akin to what the firm is conducting with its customers to attain its sustainability goals. In cooperation with its customers, the focal firm works to achieve cleaner production, eco-designs its products and processes to attain that, uses green packaging and transportation and creates a formally-articulated mutual understanding with its customers to accomplish its environmental objectives with the clear aim to reduce environmental impact. These two activities with both suppliers and customers are closely related, or even mirror image of each other, and aim to achieve the same sustainability objectives, especially from the point of view of a supply chain expert, who is trained to perceive every supply chain activity as an operationally connected un-broken chain. Eco-design weaves into this seamlessly as it requires close interaction with, and cooperation of, both the suppliers and the customers of the focal firm. From this standpoint, it is not surprising that these three constructs (SS, CC, and ED) are seen to be 'going together' in research findings.

A significant number of firms are oriented towards attaining a sustained competitive advantage for better economic performance. To gain this advantage, these firms are prone to adopt a set of SSCM Practices that enable them to have close cooperation with their suppliers and customers and to design their products and processes to meet with higher environmental standards. With the systematic adoption of SSCM Practices, the focal firm develops the embedded sustainable supplier management capabilities; and these path dependent dynamic capabilities of the focal firm are a critical source of sustained competitive advantage and superior firm performance (Reuter *et al.,* 2010). The findings from this research support this theory and indicate that competitiveness has a positive impact on the adoption of SSCM Practices and that adoption of SSCM Practices like supplier selection practices, cooperation with customers and eco-design of products and processes results in better economic performance. These findings are further supported by Resource-Based View; as by adopting these SSCM practices firm can attain a positive reputation which can lead to sustained competitive advantage and improved firm performance (McWilliams & Siegel 2011; Barney, 2012). These research findings are also supported by the theory of ethical egoism, which assumes that competitive firms are more likely to adopt suitable SSCM Practices if the adoption profits the focal firm (Paulraj *et al.,* 2017).

These research findings find an echo in the words of Montabon *et al.,* (2016) who note that, "the vast majority of research and practice regarding sustainable supply chains has followed an instrumental logic, which has led firms and supply chain managers to place economic interests ahead of environmental and social interests" (p.11). But we

would not view these findings in a pessimistic way. We would argue that these competitive firms embrace a positive perspective and that this perspective is supported by the theory of utilitarianism (Bentham, 1789). The firms that are driven by competitiveness, adopt SSCM Practices, and perform economically better are not only maximizing utility for the highest number of people, but they may also be found to be the 'last firms standing' when all others close their shop for being economically unviable. Being competitive and endeavoring to make healthy profits is a drive that powers businesses. Taking sustainability concerns in the stride is what we are aiming at. The research findings underscore the same very holistic perspective as we were hoping for. If carried on in the right earnest the drive to be competitive through adopting SSCM practices may be the 'light at the end of the tunnel' of ongoing sustainability discourse in finding the answer to the question: does it pay to be green? (Golicic & Smith 2013).

9.1.5 What makes Social Sustainability Practices stand alone

Social Sustainability Practices are not traditionally seen as related to hard-core supply chain management activities. SSP constitute preferred practices in the context of codes of conduct, corporate social responsibility, voluntary or charitable activities, staff welfare, and may sometimes also relate to regulations, institutional norms or stakeholder expectations. For example, in the sphere of equal opportunity, employment regulations play an important role, and in the sphere of social responsibility, CSR regulations play a key role. So, it is not expected that these practices have a high association with other SSCM practices, which is supported by our research findings. In our results, we found

that the SSP was seen to be not highly correlated with EEP, IEP, SS, SM, CC, or ED in the analyzed results. It was also observed that stakeholder pressures emerged to be the most important driver for SSP. This observation is supported by the research findings of Tate *et al*., (2010) and Carter & Easton (2011) that firms are under significant pressure from their stakeholders to adopt sustainable practices.

At the same time, while SSP was observed to be positively and statistically significantly affecting social performance, regression analyses results showed that it negatively impacted the operational and economic performance of a firm. A logical explanation for this is, considering other relationships materializing from the results, that firms incur additional costs for adopting SSP, and the operational processes that are needed to implement SSP are not perfectly aligned with operational and economic objectives of the firm, causing this negative impact on operational and economic performance. This negative impact is in line with the research of Hahn *et al.,* (2010) and Winn *et al*., (2012) who find that adoption of SSCM practices may have negative impacts on economic performance.

9.1.8 Significant findings

A number of interesting findings come to light on analysis of the data collected based on the theoretical model posited by this study. The most significant are enumerated and discussed below.

First, it may be noted that presently most manufacturing firms are significantly impacted by sustainability regulations to some extent at this point. The firms are seen to

select and implement those set of practices that best enable them to comply with the above-mentioned regulations. Since most sustainability regulations relate to the environment, firms tend to adopt external and internal environmental practices and closely evaluate and monitor the performance of their suppliers. As seen from the results of this study the adoption of these SSCM practices helps firms achieve their environmental performance objectives, as these three SSCM practices have highly positive and statistically significant impact on the environmental performance of the firm.

Second, we find that there are some important and significant regulations that cover the domain of corporate social responsibility and equal opportunity employment. The results of this study highlight the fact that regulations do have a positive and statistically significant impact on the adoption of social sustainability practices, with a high partial effect of 0.586. Adoption of these social sustainability practices has a positive and statistically significant impact on the social performance of the focal firm. Thus, it is seen that regulations play an important role in this arena.

Third, the driver Regulations drives firms to adopt those SSCM Practices (EEP, IEP, and SM) which help them to be compliant, but adoption of those practices has no significant impact on the economic and operational performance of the focal firm. This is in line with research findings of Esfahbodi *et al.,* (2017) and Wang and Dai (2018) who observe that while adoption of environmental management practices has a positive impact on environmental performance, they do not have any significant effect on economic performance.

Fourth, the strategic emphasis on the competitiveness of a firm drives it to focus on the economic performance, while taking the concerns of sustainability in its stride as a given. Such a firm leverages suitable SSCM practices as tools that will enable it to meaningfully exploit newer opportunities. They try to out-perform the competitors who are 'stuck in regulatory quagmire' by attaining dynamic capabilities that set them apart and bestow upon them the sustained competitive advantage arising from these dynamic capabilities (Reuter *et al.*, 2010). Thus, it is seen that indicators such as "we believe that our environmental activities will differentiate us from our competitors"; "we believe that our ecological responsiveness will lead to long-term profitability"; and "access to overseas market is the main driver for adoption of proactive environmental strategies" load well on the construct Competitiveness and show the orientation of the firm towards achieving better economic performance while, at the very same time, aligning the sustainability practices to achieve their sustainability goals. For this, the firms focus on SSCM practices encompassing the entire supply chain. These practices start right from those specific to suppliers, such as selecting suppliers based on their ability to support the firm's environmental objectives or their ability to develop environmentally friendly goods, to those that entail close cooperation with customers. These practices also cover eco-design which entails working closely with suppliers and customers alike for designing environmentally friendly products and processes. This holistic approach in adopting SSCM practices with the aim of achieving superior economic performance sets these firms apart from those that are focussed on merely complying with the regulations. These firms seem to follow the advice of Carter and Rogers (2008) to adopt those

environmental practices that are suited to superior economic performance. Such strategic positioning regarding competitiveness is expected to positively and statistically significantly affect the adoption of suitable SSCM practices, which in turn have a positive and significant impact on economic and operational performance; and this is supported by the results of this study. This is in line with the research findings of Paulraj *et al.* (2017) that those firms that go beyond mere compliance and are pro-active, and adopt SSCM practices like eco-design of products and processes, collaboration with suppliers and customers are likely to show a better financial performance.

Fifth, Stakeholder pressures on a firm arise from its customers, investors, lenders, employees, the social milieu it is embedded in, the media, lawmakers, judiciary, non-profit organizations and academia. These expectations channel firm activities toward a committed and responsible course of action, i.e., to "do the right thing" (Bronn & Vidaver-Cohen, 2009, p.87). Our study finds support for this argument. Stakeholder pressures motivate a firm to adopt various combinations of SSCM practices. The strongest effect of this pressure is seen to urge adoption of social sustainability practices (Beta=0.9). This result is supported by the research of Bronn and Vidaver-Cohen (2009) who found that a high majority (92%) of the respondents agreed that fulfilling stakeholder expectations was an important motive to undertake social initiatives.

But that is not the sole focus of such pressures. Stakeholder pressures impact positively and statistically significantly the adoption of the other six SSCM practices as well, right from supplier selection, supplier evaluation, and monitoring, through to

external and internal environmental practices, eco-design, and cooperation with customers. This impact of stakeholder pressures on adoption of SSCM Practices may be interpreted as the impact of a wide spectrum of stakeholders when viewed with an *Organization–Stakeholder Fit (O–S fit)* lens proposed by Bundy *et al.* (2018). Bundy *et al*., (2018) build upon stakeholder theory to posit the existence of an *Organization–Stakeholder Fit (O–S fit)* to emphasize the importance of "the supplementary fit of organizational and stakeholder values, and…the complementary fit of strategic needs and resources" (p.476). This is supported by the findings of our research where stakeholder pressures on a firm to act on values which the stakeholders hold dear (in this case, sustainability) are seen to positively influence the adoption of SSCM Practices by the focal firm, which in turn significantly impacts the firm performance. This is in line with the observations of Graafland and Van de Ven (2006) and Fernando and Almeida (2012) that moral pressures can lead to closer adherence to corporate social responsibilities and have a high correlation with the firm's performance.

Sixth, the impact of social sustainability practices is greatest on the social performance of the focal firm, borne out by the fact that this study has found a high positive and statistically significant relationship with the social performance of the firm. A significant but negative impact of SSP is seen on economic performance and operational performance. This may be interpreted as the cost of those practices, and that these social sustainability practices take attention away from the core operational functions. There is no significant impact of the adoption of social sustainability practices

on the environmental performance, and rightly so, because the social sustainability practices focus on social domain.

Seventh, the size of the focal firm acts as a moderator on the impact that adoption of SSCM practices has on performance. While this moderator effect has been found to be not significant on the impact of the other SSCM practices, this moderator effect has been found to be significant and positive on the impact of adoption of the External Environmental Practices on Economic Performance and Operational Performance, and also on the impact of adoption of IEP on Environmental Performance. It may be logical to conclude that larger firms have greater resources to leverage the adoption of these practices into dynamic capabilities for a sustainable competitive advantage for a better economic, operational, and environmental performance, while the small firms with the adoption of the same practices are not able to do as much. These findings are strongly supported by the Resource-Based View and Resource Dependence Theory (Barney, 2012; McWilliams & Siegel 2011; Reuter *et al.,* 2010). This moderator effect was not significant in the case of social performance. Drawing from the embeddedness theory (Granovetter, 1985) it may be argued that small firms seem to be equally effective in achieving its social performance goals, because the small firms are strongly embedded in the social milieu, and they gain an advantage out of this embeddedness which seems to offset the advantages of greater resources of larger firms.

Chapter 10 Conclusion

10.0 Conclusion

In this research, we examined the impact of various factors that motivate firms to adopt SSCM practices. Furthermore, we also studied whether adoption of these SSCM practices has an impact on the "triple bottom line" and operational performance of a firm. We also factored in the effect of the size of the firm within this context.

This chapter summarises the salient findings of the thesis by providing a conclusion to the research. We conclude this document by discussing academic contributions of this research, implications for practitioners, limitations of this study, and possible directions of future research.

10.1 Academic Contribution of this Research

We investigated the relationship between motivating factors and adoption of SSCM practices, first through an expansive literature review of the related areas and then through validation via an empirical study. Further, we studied the impact of the adoption of SSCM practices on the economic, environmental, social and operational performance of the firm. This empirical study fills the gap in the literature in this research area by demonstrating and elucidating nuanced paths of causality between the drivers and adoption of the practices of SSCM as well as the adoption of the practices and performances of the firm. This exploratory research has supported theory development in the area of adoption of different sustainable supply chain management practices. The

premise put forth consolidates and logically links some loosely connected theoretical aspects that were generated from the literature review, and tests them using empirical research. This data analysis and the results generated from this research enable an in-depth understanding of what drives the adoption of SSCM practices and what impact these practices have on the performance of firms. This research also studies the effect of the size of the focal firm as it relates to the relationship between the adoption of SSCM practices and firm performance.

This research presents a robust research framework which has been developed using the multiple needs theory (Maslow, 1954; Alderfer, 1969), which underlines that at any given time, multiple needs may be driving any actor (firm) at that point of time. The study explores these multiple needs in the form of main drivers of SSCM Practices Adoption, i.e., Regulations, Competitiveness, and Stakeholder Pressures, all of which drive or motivate the adoption of these practices to various extents. Though the impact of various drivers had been studied earlier, it had not been done in a comprehensive manner. Earlier researches have dealt with only select drivers individually and have lacked a comprehensive approach (Mann *et al*., 2010). In contrast, each of the drivers considered in this research in effect represents a composite group of drivers, and this method covers the drivers, and their impacts, comprehensively and not in piecemeal manner. This over-arching view was missing in the existing literature.

The majority of existing research on sustainability focuses on consequences rather than precursors of the sustainable practices, (Aguilera *et al*., 2007; Bronn & Vidaver-

Cohen, 2009; Paulraj *et al*., 2017) and research on drivers and their effect on a firm's performance has been sparse (Fresner,1998; Kjaerheim, 2005) in the area of cleaner production. Bronn and Vidaver-Cohen (2009, p.92) emphasize that "studying antecedents can make a particularly useful contribution to the literature." By incorporating the drivers of SSCM Practices Adoption into this research and by exploring these precursors or drivers in a comprehensive way, this study bridges this gap substantially and contributes to the existing literature in the sustainability field.

This study also adds significantly to quantitative SSCM research, as most researchers have studied these relationships using qualitative methods "and large-scale quantitative analyses remain very limited" (Paulraj *et al*., 2017, p.252).

Academically this research provides a tested framework for developing a theory on what drives firms to adopt SSCM practices, and what impact adoption of these practices has on the economic, environmental, social, and operational performance of the focal firm. Development of theory is the *sine qua non* for bringing the academics and practitioners on the same page about the theoretical connections between drivers, SSCM practices adoption, and performance. The contribution of this study is especially significant when viewed in light of the observations of Markman and Krause (2014) who explicitly state in their editorial on a special issue of *Journal of Supply Chain Management* on theory building in SSCM, "our own research of the 500 most cited studies on sustainability shows that scholars and managers often struggle with the concept and applications of sustainability." Thus, substantiating theoretical underpinnings

of what is happening in the field is what validates this research and its importance. This research framework presented here comprehensively incorporates the main drivers, practices, and performances, and their inter-relationships, which enables simultaneous and multi-level exploration of a complex network of factors (Aguilera *et al*., 2007, Paulraj *et al*., 2017) and academics will be able to use this model for future research.

10.2 Implications for Regulators and Managers

The results of this research have significant implications for practitioners, both within the government and industry.

This study will help regulators to gain a deeper insight into the impact of regulations in prompting firms to adopt sustainable supply chain management practices. It would also help them to understand what impact the adoption of these practices has in turn on the performance of those firms. That the regulations play an important role in "encouraging" firms to adopt SSCM practices has been confirmed by this study. The finding that the impact of adoption of some SSCM practices has a negative impact on the economic and operational performance of small firms, while at the same time the impact is positive for the larger firms, provides valuable insights. It strongly suggests that the regulators need to keep the impact of regulations in mind, especially for small firms. In light of the negative impact of adoption of some SSCM practices, regulators may need to look at a judicious mix of penalties and subsidies so that firms, particularly the small ones, do not go out of business. It is also important to note that firms are in the active

process of adopting these SSCM practices, as evident from the fact that ISO14000 certification is still growing, the regulations need to be actively and periodically reviewed to cater to the dynamically changing needs. Also required is close coordination with regulators in other countries, as while the sustainability concerns are being increasingly shared by a larger number of states as shown by the data, differential regulations may tend to shift supply chain operations to areas with softer regulations defeating the overall global objective. This research would thus help regulators to adapt regulations to real-life situations.

Business managers would be able to understand the different impacts of the drivers and the impact of adoption of SSCM practices on performance and tailor their long-term strategy and plans in light of this research. This study brings out that while focussing on competitiveness, adoption of suitable SSCM practices creates a positive impact on economic and operational performance. For attaining these performance objectives cooperation with customers, selection of appropriate suppliers, and eco-design of products and processes may be good SSCM practices to adopt. The focus on competitiveness stands out in contrast with solely aiming at complying with the regulations, where the adoption of SSCM practices leads to better environmental performance, but it has no significant impact on economic or operational performance. In the geek parlance, 'what you aim is what you get,' so firms should seek out and adopt those practices that, while meticulously meeting the sustainability requirements, also focus on a better economic and operational performance. The practitioners will also benefit from the findings that underline the importance of creating dynamic capabilities

that help in better management of a suitable supplier base and create a sustained competitive advantage for the focal firm. The appointment of sustainability officers in firms, responsible for monitoring sustainability issues, may be an idea worth considering; till such time that the firm's culture can truly absorb the resultant changes. The small firms will find it interesting to study what other things the larger firms are doing while adopting the same SSCM practices that make them perform better, their greater resources notwithstanding.

10.3 Limitations

The research is limited by the fact that the data sample has been obtained mainly from developed countries (specifically North America) which would imply that further research would be required in order to generalize the results to firms operating in EU or developing countries which have different socio-economic parameters due to vastly different market and growth trajectories as well as different set of driving motivations and restrictions that are tied to their specific contexts. Also, as sustainability is still an evolving field, there may be a possibility that the data that may initially be perceived as statistical outliers may actually be a useful source of different insight for evolving newer and innovative practices (Singhal & Singhal, 2012) rather than just statistical 'noise.' So, while studying a large number of "relatively unsustainable" supply chains to learn about sustainability, a small number of innovative supply chains may have been left out of focus which are doing things differently and are more sustainable (Pagell & Shevchenko, 2014). The study is also limited by some other sample characteristics. The sample was

not random, and the large size firms had a lower representation in the sample. A bigger and random sample would add value to any such future research.

Finally, the study by its design has utilised the focal firm as the unit of analysis, and its SSCM practices and while it may be reasonable to deduce from previously tested literature that the focal firm determines the behaviour and practices in the supply chain to a great extent; but there may be cases where their impact of may not necessarily mirror SSCM practices of entire supply chain and the resulting impact on performance.

10.4 Future Research

There are many possible extensions of this research, depending on the scope a scholar wishes to commit to. A natural extension of the study can be an endeavor to cross-check generalizability of this research. For comparative insights into the relationships investigated here, and to increase generalizability, the research can be conducted over other geographical areas not fully covered by this research. Such a study may yield an understanding of the contextual differences that stem from the socio-economic conditions of various geographies.

Further, there is potential for a larger number of sustainable supply chain management practices to be included in the study. It would be interesting to see whether the relationships hold true for other SSCM practices as well. Another possible direction is conducting a qualitative study, which would add further depth to the understanding of the relationships and may add newer theoretical dimensions. The richness of the interview data may lead to results that have not been considered in the literature thus far. Also,

area-expert interviews would produce thoughts or leads related to the future direction for sustainable supply chains or views on changes in regulations or even feedback on which performance measures are perceived useful in the field (and can be converted into key performance metrics) and which ones aren't.

Regulations that are stringent may adversely affect the businesses and their performance; work in this area is of critical importance. This aspect needs further research. Within the context of transnational supply chains, the regulations may differ from country to country, and various supply chain partners may actually be chosen because of lax regulations in some countries. That may be counter to the premise that the entire supply chain works towards sustainable supply chain management practices. The changing ideology within a single supply chain based on functionality is an underexplored yet fascinating topic. This is another area that requires substantial further research.

The presented research framework also has great potential to trigger qualitative as well as quantitative research in many critical areas of sustainability, once a standard scale is developed to assess the level of sustainability of organizations within various industries. Thus, a number of potential research questions can be worked upon as extensions of this study and the resultant findings.

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Appendices

Appendix I Letter of Invitation to Participate in the Study

September 9, 2017

Dear Sir/Madam,

SUBJECT: Carleton University Research Study – Impact of Adoption of Sustainable Supply Chain Management Practices On a Firm's Performance

My name is Dr. I.J. Mann. I am a Ph.D. Candidate at the Sprott School of Business, Carleton University. As a former executive, I have a keen interest in sustainability issues in supply chains. Under the guidance of my Thesis Supervisor, Dr. Vinod Kumar, I am conducting research on the impact of adoption of Sustainable Supply Chain Management Practices on a Firm's Performance. This research has been reviewed by and has received clearance from the Carleton University Research Ethics Board.

The data for the study is being collected from managers who are knowledgeable of their organization's supply chain activities in firms located in Canada and/or US. If you do not deal with supply chain activities in your organisation, may I request you to kindly forward it to the manager who does so. The link for Survey is https://www.surveymonkey.com/r/XTYEZ6O .

As you are aware, sustainability and green practices are becoming key concerns of consumers and the government. Working in that direction, an increasing number of firms are adopting sustainable supply chain practices and this adoption is expected to affect the performance of the firms- including their economic, social, ecological and operating performance.

This research should help companies better identify supply chain practices that are sustainable and can positively impact their performance.

I am writing to request your participation in the study by completing a brief SurveyMonkey® online questionnaire at: https://www.surveymonkey.com/r/XTYEZ6O (if the weblink does not take you directly to the survey, please copy and paste it into your browser). The questionnaire should take about 10 minutes to complete. Your responses will be anonymous and thus cannot be identified. Anonymity will be ensured both at the stage of data collection and also by aggregating the responses when presenting the research findings. Since your url will not be tracked, this means that you will need to complete the questionnaire in one "sitting" of ten minutes, i.e., you cannot complete it partially and go back at a later time to complete it.

There are no foreseen risks to the participants of this study. Please note that SurveyMonkey® servers on which the data will be stored are located in the U.S. and the data collected is subject to U.S. laws on privacy and security. The research findings from this study will be presented in the final PhD Thesis and in a series of academic papers that will be presented in academic research papers and/or at academic conferences. The data will be stored in electronic copy (in an aggregate manner) for a period of one year with only the researcher, the research supervisor and the survey company having access to it. You can withdraw from the study at any time before submission of the survey, if you wish to withdraw please do not click on the submit button.

Second, I would greatly appreciate if you could further send this email to your colleagues at the senior manager or executive levels in other firms who are knowledgeable about supply chain processes so that they may participate as well by completing the questionnaire. Your help in this regard is highly appreciated.

All information provided by you will be processed anonymously and in an aggregate manner only. It will not be identifiable and will not be attributed to your name or that of your company.

If you would like a summary of the results of this research, I would be pleased to provide it. Simply send me an email and I will send the summary as soon as the study is completed.

I will be happy to answer any questions you may have about this research. My email address is Inder.Mann@carleton.ca. Alternatively, you can contact my Thesis Supervisor, Dr. Vinod Kumar at the address given below. This study has been cleared by Carleton University Research Ethics Board (ethics clearance #106715). If you have any ethical concerns with the study, please contact Dr. Andy Adler, Chair, Carleton University Research Ethics Board-A (by phone at 613-520-2600 ext. 2517 or via email at ethics@carleton.ca).

Please note that we are NOT requesting any confidential or sensitive information in the questionnaire as this is a non-secure web-hosted survey. Further, as this is an anonymous survey no url or identifiers will be collected and your identity will not be known to the researcher.

Thank you for your time.
With best regards.

Dr. I. J. Mann
Ph.D Candidate

Dr. Vinod Kumar, Thesis Supervisor
Sprott School of Business
Carleton University
613-520-2600 ext. 2379
Vinod.Kumar@carleton.ca

Appendix II Copy of Online Survey Consent Form

Carleton UNIVERSITY
Canada's Capital University

Online Survey Consent Form

Title: Impact of Adoption of Sustainable Supply Chain Management Practices On a Firm's Performance.

Date of ethics clearance: June 16, 2017.

Ethics Clearance for the Collection of Data Expires: June 30, 2018.

This is a study on the Impact of Adoption of Sustainable Supply Chain Management Practices on a Firm's Performance. As you are aware, sustainability and green practices are becoming key concerns of consumers and the government. Working in that direction, an increasing number of firms are adopting sustainable supply chain practices and this adoption is expected to affect the performance of the firms- including their economic, social, ecological and operating performance. This research should help companies better identify supply chain practices that are sustainable and can positively impact their performance.

The researcher for this study is Dr. Inder Jit Singh Mann in the Sprott School of Business at Carleton University. He is working under the supervision of Prof. Vinod Kumar in the Sprott School of Business.

This study involves one 10 minute survey that will take place online.

You have the right to end your participation in the survey at any time, for any reason, up until you hit the "submit" button. You can withdraw by exiting the survey at any time before completing it. If you withdraw from the study, all information you provided will

be immediately destroyed. (As the survey responses are anonymous, it is not possible to withdraw after the survey is submitted.)

All research data will be collected anonymously and will be password protected. The company running the online survey is a US firm SurveyMonkey.com. The servers are located in the United States and the data collected is subject to U.S. laws on privacy and security.

The anonymous research data will be accessible by the researcher, the research supervisor and the survey company. No names or IP addresses will be linked to any of the data provided. The data will be retained for one year and will be used for Doctoral Research, for publications in academic journals, and in academic conference presentations.

If you would like a copy of the finished research project, you are invited to contact the researcher by email to request an electronic copy which will be provided to you as long as the safety of all participants will not be comprised by doing so. This request will not affect the anonymity of your responses as it is independent of anonymous survey response form submitted by you.

The ethics protocol for this project was reviewed by the Carleton University Research Ethics Board, which provided clearance to carry out the research.

CUREB-A:

If you have any ethical concerns with the study, please contact Dr. Andy Adler, Chair, Carleton University Research Ethics Board-A (by phone at 613-520-2600 ext. 2517 or via email at ethics@carleton.ca).

Researcher contact information:
Name Dr. Inder Jit Singh Mann
Sprott School of Business
Carleton University

Email: Inder.Mann@carleton.ca

Supervisor contact information:
Name: Prof.Vinod Kumar
Sprott School of Business
Carleton University
Tel: 613-520-2600 x 2379
Email: Vinod.Kumar@carleton.ca

By clicking “submit”, you consent to participate in the research study as described above.

Appendix III Survey Instrument Used for Research

ACADEMIC RESEARCH SURVEY

Impact of Adoption of Sustainable Supply Chain Management Practices On a Firm's Performance

SUMMARY OF RESEARCH FINDINGS

If you would like a copy of the finished research project, you are invited to contact the researcher by email to request an electronic copy which will be provided to you as long as the safety of all participants will not be comprised by doing so. This request will not affect the anonymity of your responses as it is independent of anonymous survey response form submitted by you.

MOTIVATIONS FOR SUSTAINABLE SUPPLY CHAIN MANAGEMENT PRACTICES

Please indicate ***the level of the following items*** in your organization over the past 3 years. (Please circle the number)

1. Regulations

	Strongly Disagree						Strongly Agree
1. Environmental regulation is the primary driver for all our environmental activities.	1	2	3	4	5	6	7
2. Our environmental activities are directed towards complying with institutional norms and/or regulations.	1	2	3	4	5	6	7
3. Preempting future environmental legislation is the main driver for adoption of proactive environmental practices.	1	2	3	4	5	6	7

2. Competitiveness

	Strongly Disagree						Strongly Agree
1. We believe that our environmental activities will differentiate us from our competitors.	1	2	3	4	5	6	7
2. We believe that our ecological responsiveness will lead to long-term profitability.	1	2	3	4	5	6	7
3. Protecting environment will improve long-term financial	1	2	3	4	5	6	7

performance is the main driver for adoption of proactive environmental strategies							
4. Improved profits is the main driver for adoption of environmental practices	1	2	3	4	5	6	7
5. Access to overseas market is the main driver for adoption of proactive environmental strategies	1	2	3	4	5	6	7
6. Improving efficiency is the main driver for adoption of proactive environmental strategies.	1	2	3	4	5	6	7
7. Cost saving and risk reduction is the main driver for adoption of environmental practices.	1	2	3	4	5	6	7

3. Stakeholder Pressures

	Strongly Disagree						Strongly Agree
1. Stakeholder relationship is the main driver for adoption of proactive environmental practices.	1	2	3	4	5	6	7
2. Stakeholder satisfaction is the main driver for adoption of environmental practices.	1	2	3	4	5	6	7
3. Lender and investors' concern toward environmental liability is the main driver for adoption of environmental practices.	1	2	3	4	5	6	7
Customer desire to protect environment is the main driver for adoption of environmental practices.	1	2	3	4	5	6	7
Non Profit Organizations/judiciary/media enquiries is the main driver for adoption of environmental practices	1	2	3	4	5	6	7

SUSTAINABLE SUPPLY CHAIN MANAGEMENT PRACTICES

Please indicate ***the level of the following items*** in your organization over the past 3 years. (Please circle the number)

1. External environmental practices

	Strongly Disagree						Strongly Agree
1. We cooperate with our suppliers to achieve environmental objectives.	1	2	3	4	5	6	7

2. We encourage our suppliers to develop new source reduction strategies.	1	2	3	4	5	6	7
3. We cooperate with our suppliers to improve their waste reduction initiatives.	1	2	3	4	5	6	7
4. We work with our suppliers for cleaner production.	1	2	3	4	5	6	7

2. Internal environmental practices

	Strongly Disagree						Strongly Agree
1. We support the inventory recovery (sale) of excess inventories/materials.	1	2	3	4	5	6	7
2. We emphasize the use of reusable and returnable packaging for our products.	1	2	3	4	5	6	7
3. We constantly strive to use lesser resources in getting the tasks done.	1	2	3	4	5	6	7
4. We have well-documented waste reduction methodologies in place.	1	2	3	4	5	6	7
5. We eliminate physical waste from our operations.	1	2	3	4	5	6	7
6. We support the sale of scrap and used materials.	1	2	3	4	5	6	7

3. Supplier Selection

	Strongly Disagree						Strongly Agree
1. We select suppliers based on their environmental competence.	1	2	3	4	5	6	7
2. Suppliers are selected based on their ability to support our environmental objectives.	1	2	3	4	5	6	7
3. We select suppliers based on their environmental performance.	1	2	3	4	5	6	7
We select suppliers based on their ability to develop environmentally friendly goods.	1	2	3	4	5	6	7
Our organization has a thorough supplier environmental rating system.	1	2	3	4	5	6	7
6. We select suppliers based on their ISO 14000 Certification.	1	2	3	4	5	6	7

4. Supplier Evaluation & Monitoring

	Strongly Disagree						Strongly Agree
1. We conduct regular environmental audits into our suppliers' internal operations.	1	2	3	4	5	6	7
2. We periodically evaluate our suppliers' environmentally friendly practices.	1	2	3	4	5	6	7
3. We make site visits to suppliers' premises to help them improve their eco-performance.	1	2	3	4	5	6	7
4. We periodically evaluate our second-tier suppliers' environmentally friendly practices.	1	2	3	4	5	6	7
5. We ask our suppliers to commit to waste reduction goals.	1	2	3	4	5	6	7
6. We send environmental questionnaires to suppliers in order to monitor their compliance.	1	2	3	4	5	6	7

5. Cooperation with Customers

	Strongly Disagree						Strongly Agree
1. We co-operate with customers for eco design.	1	2	3	4	5	6	7
2. We co-operate with customers for cleaner production.	1	2	3	4	5	6	7
3. We co-operate with customers for green packaging.	1	2	3	4	5	6	7
4. We co-operate with customers using less energy during product transportation.	1	2	3	4	5	6	7
5. We develop a mutual understanding with our customers of responsibilities regarding environmental performance.	1	2	3	4	5	6	7
6. We work together with our customers to reduce the environmental impact of our activities.	1	2	3	4	5	6	7

6. Eco-Design

	Strongly Disagree						Strongly Agree
1. We design products for reduced consumption of material/energy.	1	2	3	4	5	6	7
2. We design products for reuse, recycle, recovery of material, component parts.	1	2	3	4	5	6	7
We design products to avoid or reduce use of hazardous	1	2	3	4	5	6	7

products and/or their manufacturing process.

7. Social Sustainability Practices

	Strongly Disagree						Strongly Agree
1. Our organization frequently employs corporate codes of conduct and other aspects of corporate social responsibility.	1	2	3	4	5	6	7
2. Our organization commonly encourages workers to volunteer for social causes and has incentives that facilitate that involvement.	1	2	3	4	5	6	7
3. Our organization contributes to charitable causes.	1	2	3	4	5	6	7
The general approach of our organization to human resources is to invest heavily to attract, train and retain employees.	1	2	3	4	5	6	7
5. In our organization employment of women is (1= limited and usually takes place in less important jobs, 7=is equal to that of men)	1	2	3	4	5	6	7
In our organization, for similar work, wages for women are (1=significantly below those of men, 7= equal to those of men).	1	2	3	4	5	6	7

PERFORMANCE

Please indicate ***the level of the following items*** in your organization. (Please circle the number)

1. Economic Performance over the past 3 years

	Strongly Disagree						Strongly Agree
1. In our organization there has been significant **decrease of cost for materials purchasing** over the past 3 years.	1	2	3	4	5	6	7
2. In our organization there has been significant **decrease of cost for energy consumption** over the past 3 years.	1	2	3	4	5	6	7
3. In our organization there has been significant **decrease of fee for waste treatment** over the past 3 years.	1	2	3	4	5	6	7
4. In our organization there has been significant **decrease of fee for waste discharge** over the past 3 years.	1	2	3	4	5	6	7
5. In our organization there has been significant **decrease of fine**	1	2	3	4	5	6	7

for environmental accidents over the past 3 years.

2. Environmental performance over the past 3 years

	Strongly Disagree						Strongly Agree
1. In our organization there has been significant reduction of **air emission** over the past 3 years.	1	2	3	4	5	6	7
2. In our organization there has been significant reduction of **waste water** over the past 3 years.	1	2	3	4	5	6	7
3. In our organization there has been significant reduction of **solid wastes** over the past 3 years.	1	2	3	4	5	6	7
4. In our organization there has been significant **decrease in consumption for hazardous/harmful/toxic materials** over the past 3 years.	1	2	3	4	5	6	7
5. In our organization there has been significant **decrease in frequency for environmental accidents** over the past 3 years.	1	2	3	4	5	6	7
6. There has been significant **improvement of our organization's environmental situation** over the past 3 years.	1	2	3	4	5	6	7

3. Social Performance over the past 3 years

	Strongly Disagree						Strongly Agree
1. In our organization there has been significant **increase in days of vocational training** over the past 3 years.	1	2	3	4	5	6	7
2. In our organization there has been significant **increase in philanthropy as a share of profit** over the past 3 years.	1	2	3	4	5	6	7
3. In our organization there has been significant **increase in formalization of community relations** over the past 3 years.	1	2	3	4	5	6	7
4. In our organization there has been significant **increase in equal opportunity employment** over the past 3 years.	1	2	3	4	5	6	7
5. In our organization there has been **significant decrease in employee turnover** over the past 3 years.	1	2	3	4	5	6	7

4. Operational Performance over the past 3 years

	Strongly Disagree						Strongly Agree
1. In our organization there has been significant **increase in amount of goods delivered on time** over the past 3 years.	1	2	3	4	5	6	7
2. In our organization there has been significant **decrease in inventory levels** over the past 3 years.	1	2	3	4	5	6	7
3. In our organization there has been significant **improvement in capacity utilization** over the past 3 years.	1	2	3	4	5	6	7
4. In our organization there has been significant **decrease in scrap rate** over the past 3 years.	1	2	3	4	5	6	7
5. In our organization there has been significant **increase in products' quality** over the past 3 years.	1	2	3	4	5	6	7
6. In our organization there has been significant **increase in product line over** the past 3 years.	1	2	3	4	5	6	7

YOUR ORGANIZATION

1. ***What type of industry*** is your organization in?

- ☐ General manufacturing
- ☐ Food Industry
- ☐ Electrical equipment, appliance, and component manufacturing
- ☐ Chemical manufacturing
- ☐ Primary metal manufacturing
- ☐ Fabricated metal product manufacturing
- ☐ Machinery manufacturing
- ☐ Computer and electronic product manufacturing
- ☐ Transportation equipment manufacturing
- ☐ Other

2. ***How many employees*** do you have in your organization? _____ Approximately Or

☐ 1 to 99 ☐ Between 100 - 499 ☐ 500 or more

3. Has your organization obtained ***the ISO 14000 certification***?

☐ Yes ☐ No

4. If your answer to question 3 is YES, ***for the last how many years*** has your organization maintained the
ISO 14000 certification?

☐ Less than 3 years ☐ 3 years or more ☐ Not applicable

5. Choose the title which most closely reflects your current position?

☐ Senior Manager
☐ Vice President
☐ General Manager
☐ President
☐ CEO
☐ Board of Directors Member
☐ Owner
☐ Partner
☐ Consultant
☐ Other (please specify)

6. In which area is your organization headquartered?

☐ **Canada**
☐ **The United States**
☐ **Mexico**
☐ **South America**
☐ **Europe**
☐ **Oceania**
☐ **Asia**
☐ **Africa**
☐ **Other (please specify)**

7. Which of the following describes the firm used in your example?

☐ **Privately owned**
☐ **Publicly owned**

How many years experience do you have in the industry used in your example?

☐ Less than 1 year ☐ 1 to less than 3 yrs. ☐ 3 to less than 5 yrs. ☐5 to less than 10 yrs ☐ 10 yrs. or more

WITHDRAWING FROM SURVEY: You have the right to end your participation in the survey at any time, for any reason, up until you hit the "submit" button. If you withdraw from the study,

all information you provided will be immediately destroyed. (As the survey responses are anonymous, it is not possible to withdraw after the survey is submitted.)

CONSENT: By clicking "submit" button, I acknowledge that I consent to participate in the research study as described above.

[SUBMIT]

Appendix IV Kolmogorov-Smirnova and Shapiro-Wilk Tests of Normality

Tests of Normality

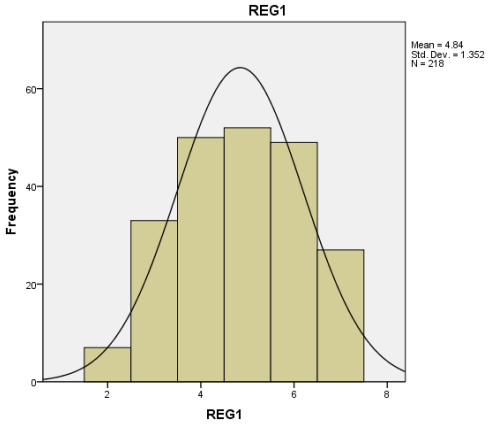
Indicators	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
REG1	.143	218	.000	.932	218	.000
REG2	.162	218	.000	.914	218	.000
REG3	.138	218	.000	.920	218	.000
COMP1	.136	218	.000	.930	218	.000
COMP2	.143	218	.000	.929	218	.000
COMP3	.160	218	.000	.923	218	.000
COMP4	.149	218	.000	.936	218	.000
COMP5	.145	218	.000	.943	218	.000
COMP6	.143	218	.000	.931	218	.000
COMP7	.139	218	.000	.939	218	.000
PRES1	.129	218	.000	.936	218	.000
PRES2	.157	218	.000	.940	218	.000
PRES3	.170	218	.000	.926	218	.000
PRES4	.166	218	.000	.936	218	.000
PRES5	.156	218	.000	.945	218	.000
EEP1	.159	218	.000	.928	218	.000
EEP2	.150	218	.000	.931	218	.000
EEP3	.161	218	.000	.913	218	.000
EEP4	.161	218	.000	.921	218	.000
IEP1	.155	218	.000	.931	218	.000
IEP2	.152	218	.000	.932	218	.000
IEP3	.163	218	.000	.930	218	.000
IEP4	.179	218	.000	.908	218	.000
IEP5	.174	218	.000	.921	218	.000
IEP6	.157	218	.000	.917	218	.000
SS1	.161	218	.000	.932	218	.000
SS2	.151	218	.000	.934	218	.000
SS3	.162	218	.000	.931	218	.000
SS4	.163	218	.000	.927	218	.000
SS5	.156	218	.000	.925	218	.000
SS6	.167	218	.000	.923	218	.000
SM1	.154	218	.000	.930	218	.000
SM2	.175	218	.000	.932	218	.000
SM3	.174	218	.000	.929	218	.000

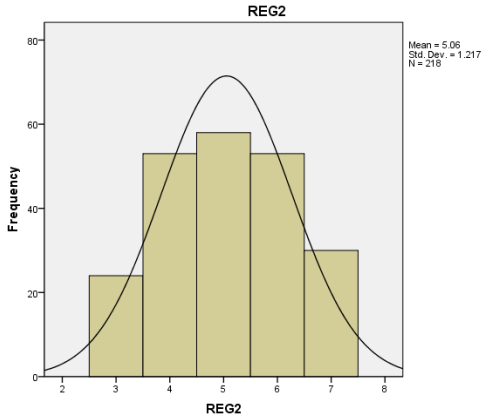
SM4	.153	218	.000	.930	218	.000
SM5	.147	218	.000	.932	218	.000
SM6	.147	218	.000	.933	218	.000
CC1	.146	218	.000	.925	218	.000
CC2	.174	218	.000	.924	218	.000
CC3	.170	218	.000	.925	218	.000
CC4	.127	218	.000	.941	218	.000
CC5	.159	218	.000	.926	218	.000
CC6	.175	218	.000	.922	218	.000
ED1	.141	218	.000	.933	218	.000
ED2	.135	218	.000	.930	218	.000
ED3	.130	218	.000	.937	218	.000
SSP1	.144	218	.000	.928	218	.000
SSP2	.139	218	.000	.938	218	.000
SSP3	.140	218	.000	.935	218	.000
SSP4	.171	218	.000	.932	218	.000
SSP5	.198	218	.000	.925	218	.000
SSP6	.184	218	.000	.927	218	.000
EP1	.157	218	.000	.925	218	.000
EP2	.126	218	.000	.942	218	.000
EP3	.153	218	.000	.932	218	.000
EP4	.160	218	.000	.931	218	.000
EP5	.171	218	.000	.931	218	.000
ENVP1	.156	218	.000	.932	218	.000
ENVP2	.157	218	.000	.933	218	.000
ENVP3	.172	218	.000	.921	218	.000
ENVP4	.169	218	.000	.921	218	.000
ENVP5	.165	218	.000	.930	218	.000
ENVP6	.170	218	.000	.926	218	.000
SP1	.167	218	.000	.932	218	.000
SP2	.150	218	.000	.935	218	.000
SP3	.156	218	.000	.932	218	.000
SP4	.190	218	.000	.923	218	.000
SP5	.162	218	.000	.924	218	.000
OP1	.159	218	.000	.932	218	.000
OP2	.158	218	.000	.933	218	.000
OP3	.163	218	.000	.931	218	.000
OP4	.238	218	.000	.914	218	.000
OP5	.136	218	.000	.937	218	.000
OP6	.142	218	.000	.937	218	.000

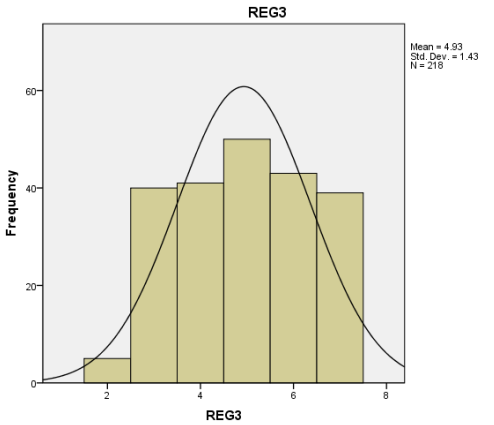
Appendix V Missing Data Imputation

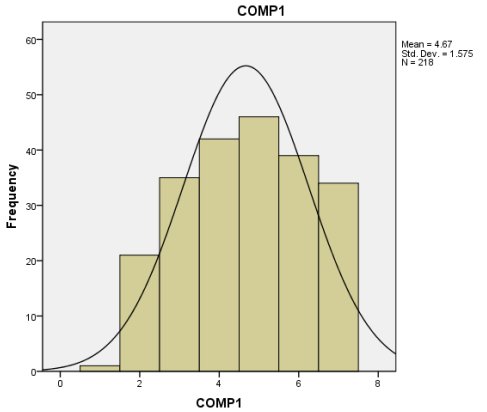
Case No.	Value Missing in Item	Value Substituted for Missing Value	Mean of Item
78	EP4	5	4.9
152	EEP3	5	5.0
208	IEP6	5	4.9

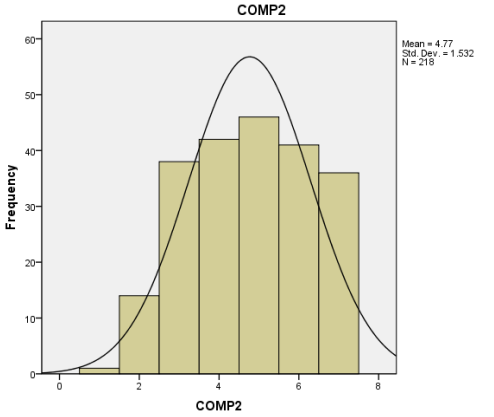
Appendix VI Histograms of Indicator Data

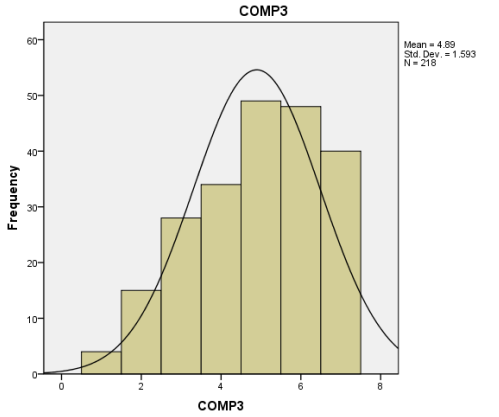


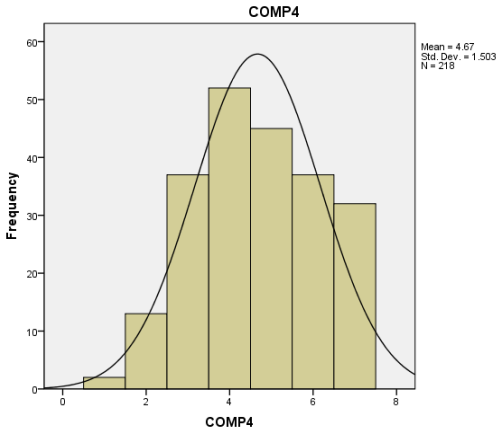


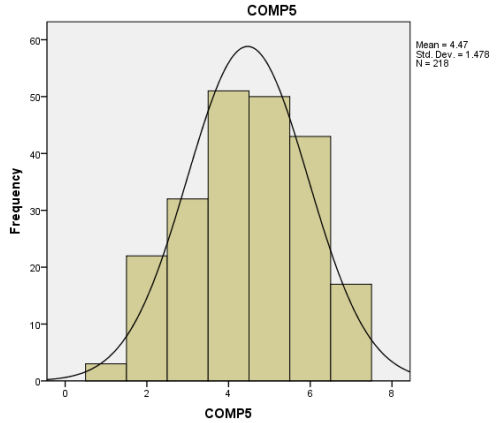


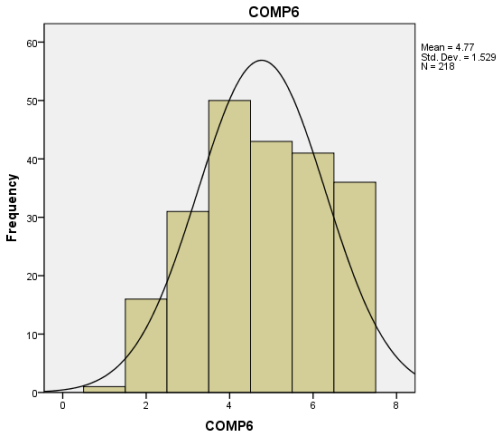


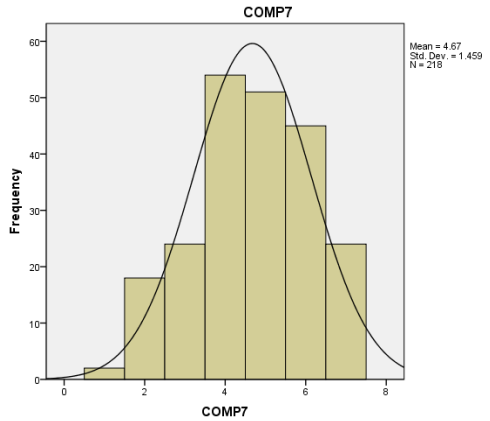


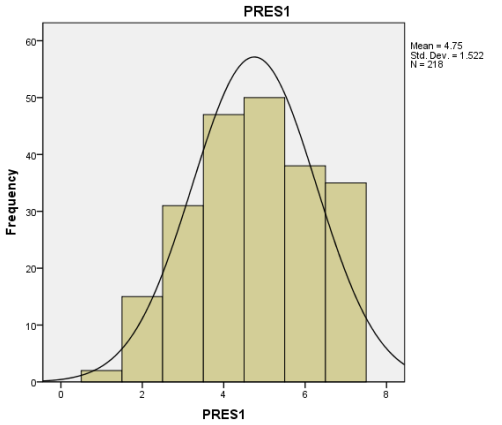


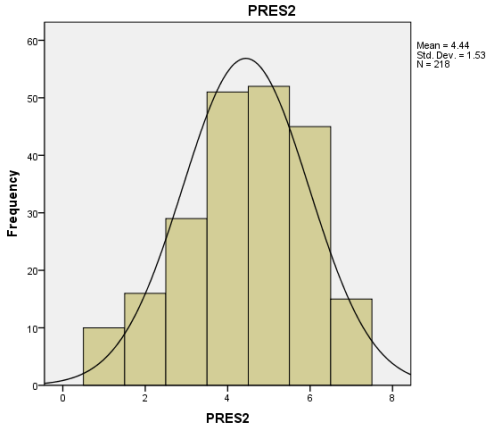

COMP4
Mean = 4.67
Std. Dev. = 1.503
N = 218
Frequency
COMP4

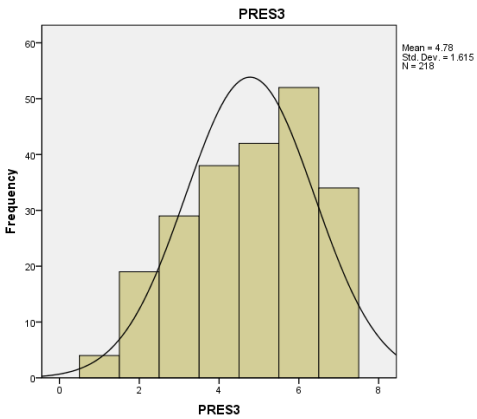

COMP5
Mean = 4.47
Std. Dev. = 1.478
N = 218
Frequency
COMP5

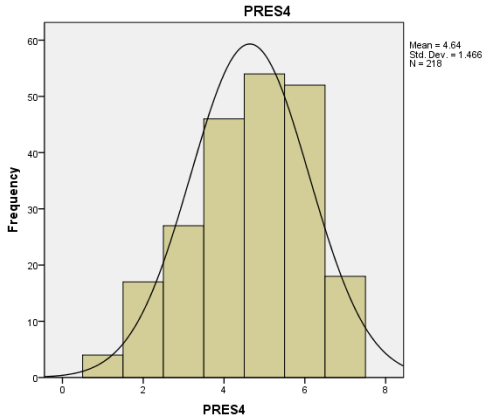

COMP6
Mean = 4.77
Std. Dev. = 1.529
N = 218
Frequency
COMP6

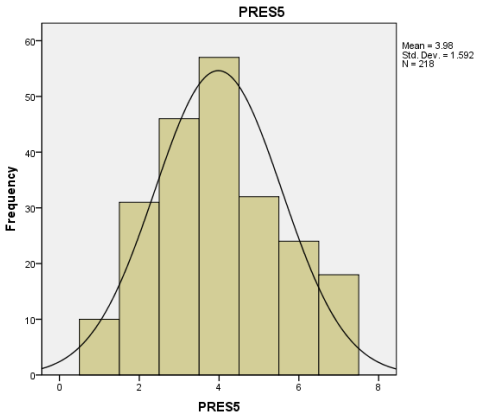

COMP7
Mean = 4.67
Std. Dev. = 1.459
N = 218
Frequency
COMP7

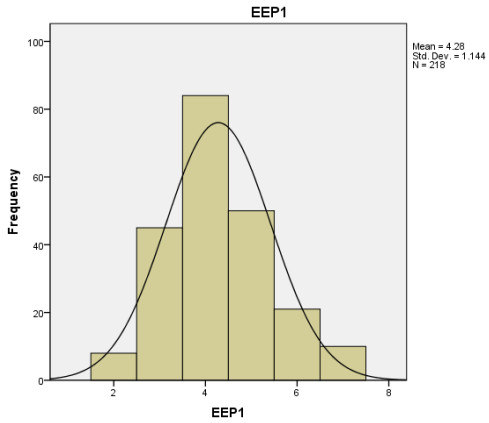

PRES1
Mean = 4.75
Std. Dev. = 1.522
N = 218
Frequency
PRES1

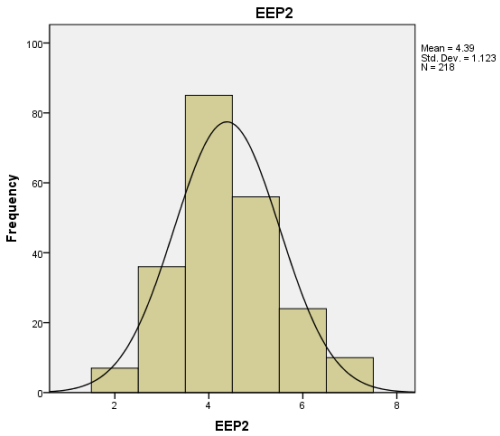

PRES2
Mean = 4.44
Std. Dev. = 1.53
N = 218
Frequency
PRES2

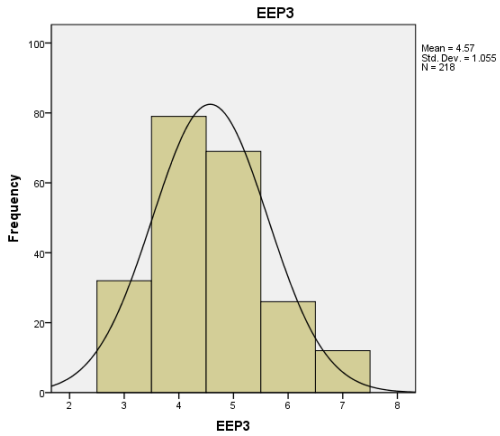

PRES3
Mean = 4.78
Std. Dev. = 1.615
N = 218
Frequency
PRES3

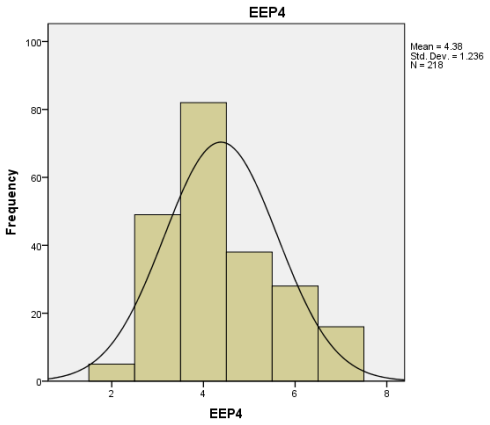

PRES4
Mean = 4.64
Std. Dev. = 1.466
N = 218
Frequency
PRES4

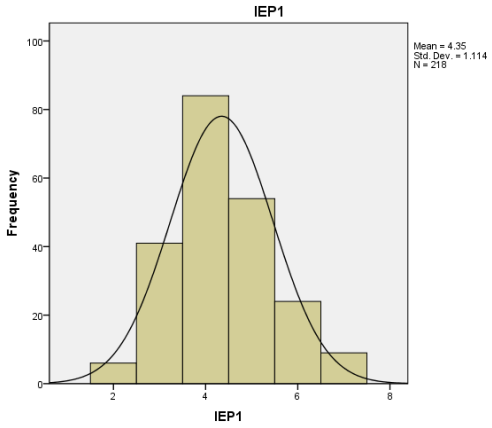

PRES5
Mean = 3.98
Std. Dev. = 1.592
N = 218
Frequency
PRES5

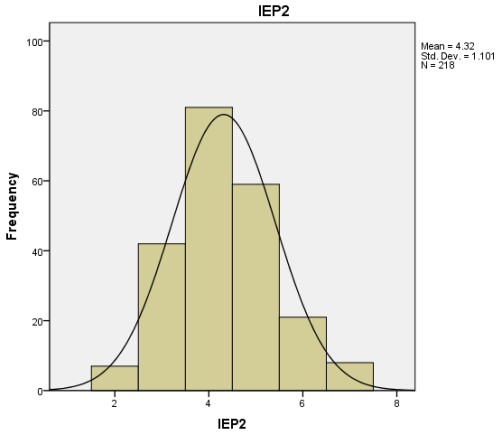

EEP1
Mean = 4.28
Std. Dev. = 1.144
N = 218
Frequency
EEP1

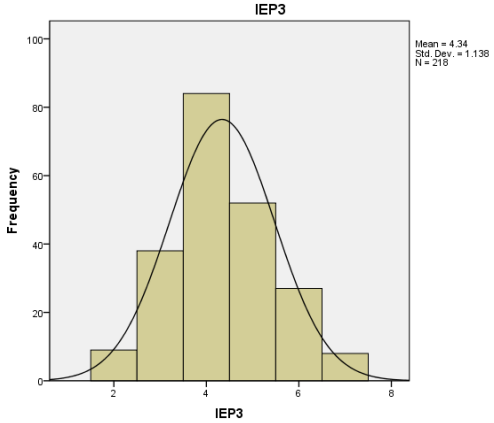

EEP2
Mean = 4.39
Std. Dev. = 1.123
N = 218
Frequency
EEP2

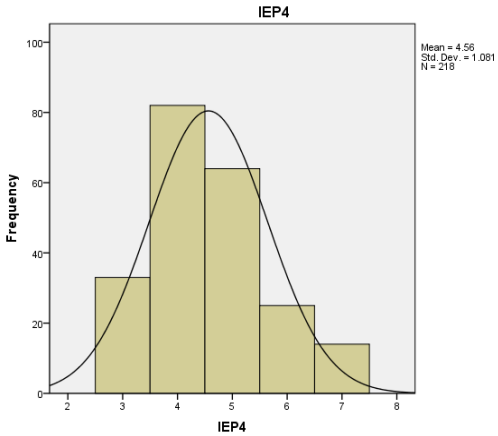

EEP3
Mean = 4.57
Std. Dev. = 1.055
N = 218
Frequency
EEP3

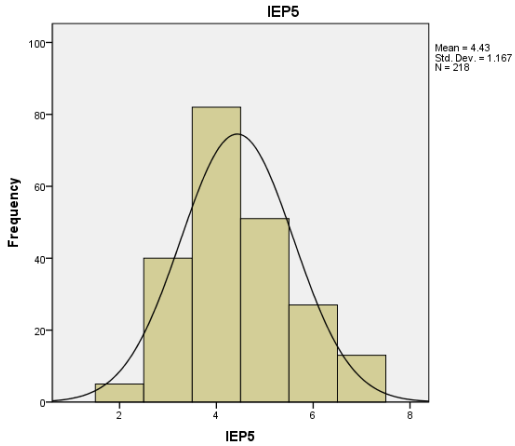

EEP4
Mean = 4.38
Std. Dev. = 1.236
N = 218
Frequency
EEP4

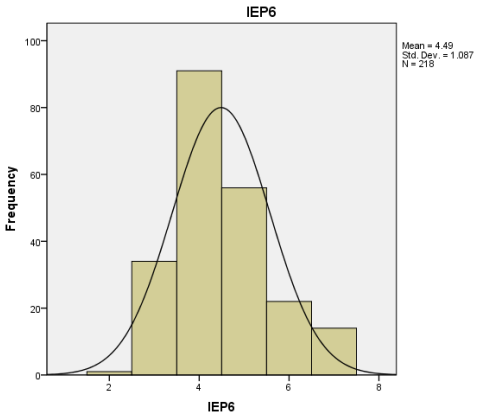

IEP1
Mean = 4.35
Std. Dev. = 1.114
N = 218
Frequency
IEP1

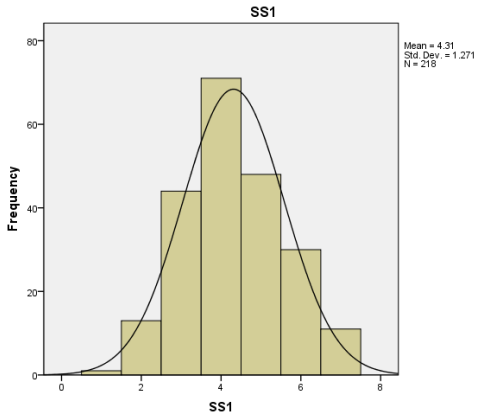

IEP2
Mean = 4.32
Std. Dev. = 1.101
N = 218
Frequency
IEP2

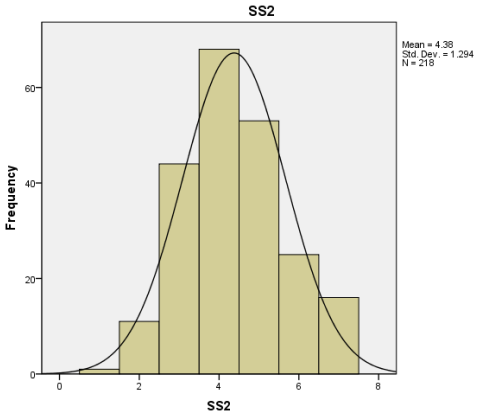

IEP3
Mean = 4.34
Std. Dev. = 1.138
N = 218
Frequency
IEP3

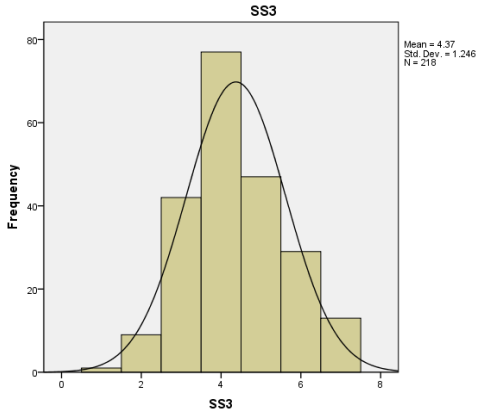

IEP4
Mean = 4.56
Std. Dev. = 1.081
N = 218
Frequency
IEP4

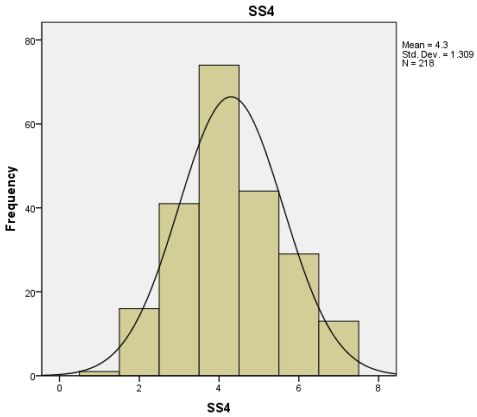

IEP5
Mean = 4.43
Std. Dev. = 1.167
N = 218
Frequency
IEP5

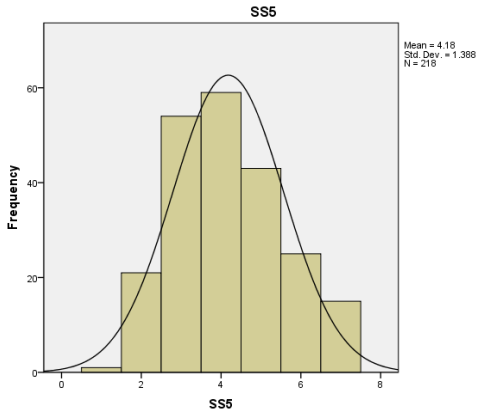

IEP6
Mean = 4.49
Std. Dev. = 1.087
N = 218
Frequency
IEP6

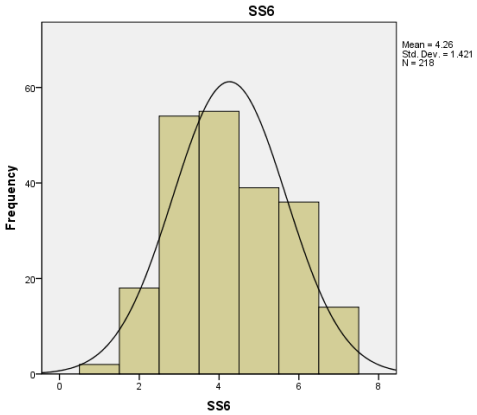

SS1
Mean = 4.31
Std. Dev. = 1.271
N = 218
Frequency
SS1

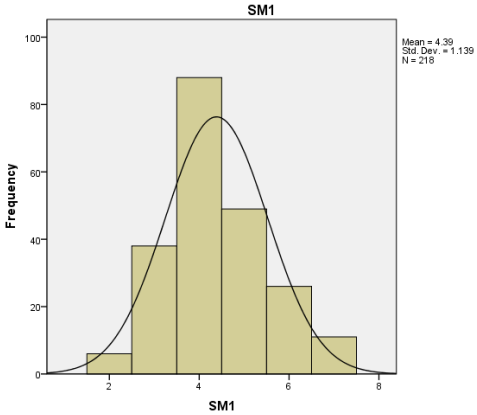

SS2
Mean = 4.38
Std. Dev. = 1.294
N = 218
Frequency
SS2

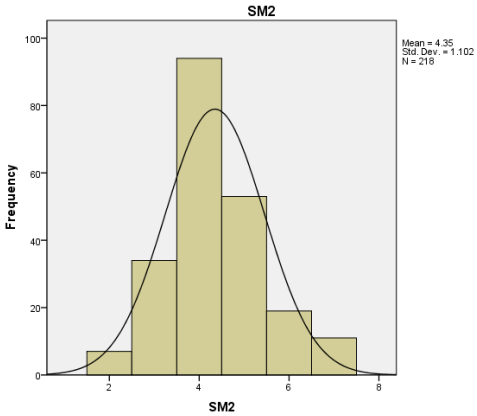

SS3
Mean = 4.37
Std. Dev. = 1.246
N = 218
Frequency
SS3

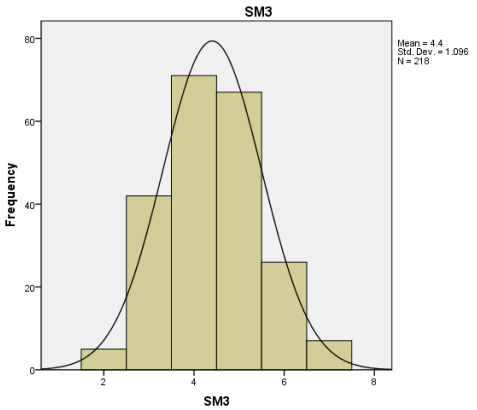

SS4
Mean = 4.3
Std. Dev. = 1.309
N = 218
Frequency
SS4

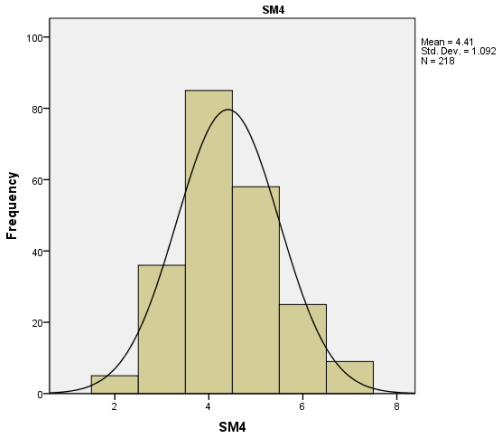

SS5
Mean = 4.18
Std. Dev. = 1.388
N = 218
Frequency
SS5

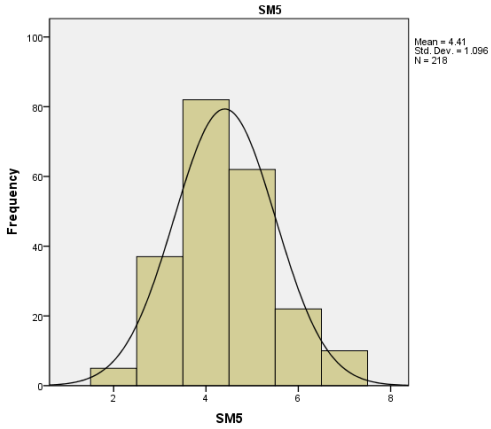

SS6
Mean = 4.26
Std. Dev. = 1.421
N = 218
Frequency
SS6

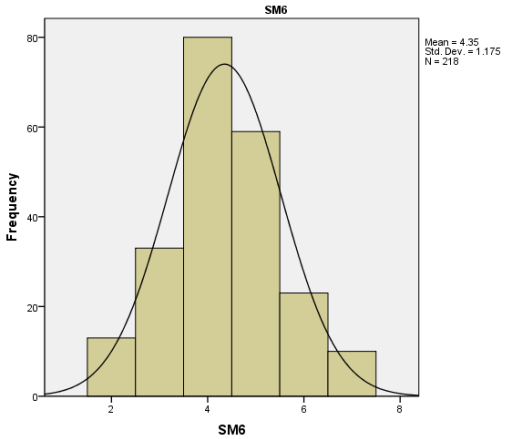

SM1
Mean = 4.39
Std. Dev. = 1.139
N = 218
Frequency
SM1

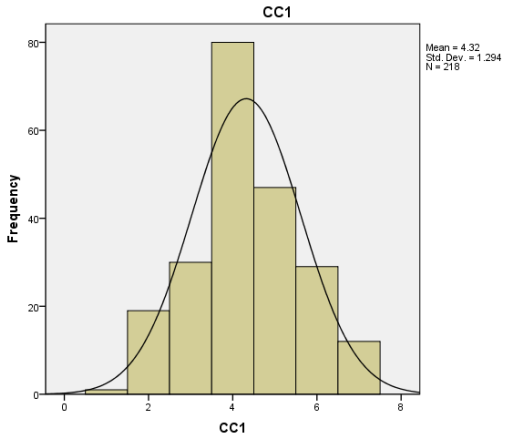

SM2
Mean = 4.35
Std. Dev. = 1.102
N = 218
Frequency
SM2

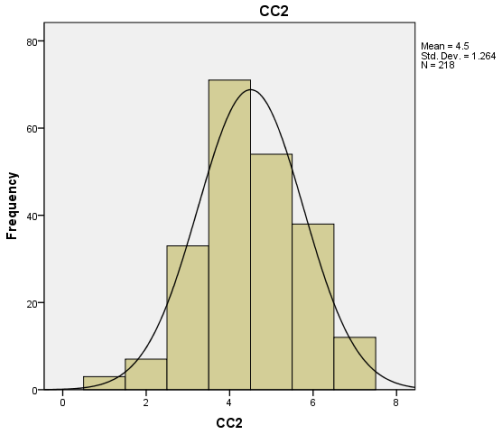

SM3
Mean = 4.4
Std. Dev. = 1.096
N = 218
Frequency
SM3

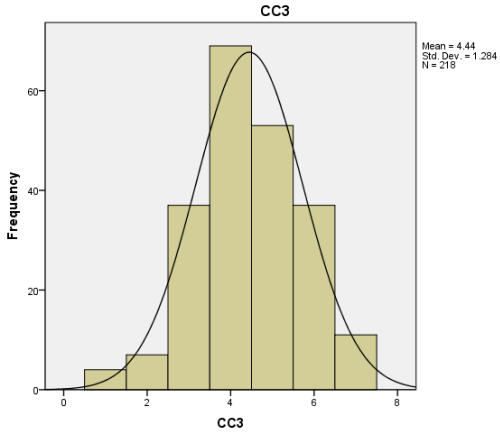

SM4
Mean = 4.41
Std. Dev. = 1.092
N = 218
Frequency
SM4

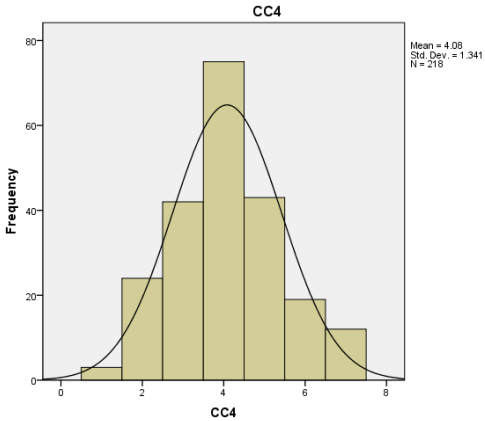

SM5
Mean = 4.41
Std. Dev. = 1.096
N = 218
Frequency
SM5

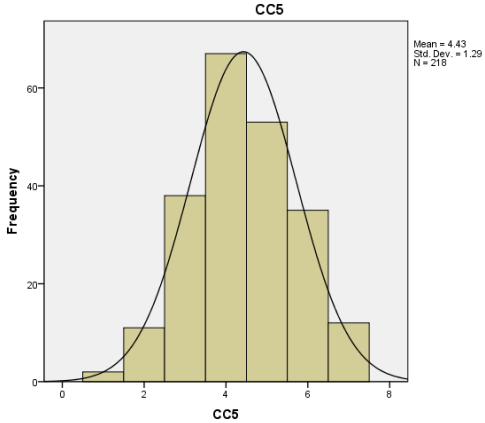

SM6
Mean = 4.35
Std. Dev. = 1.175
N = 218
Frequency
SM6

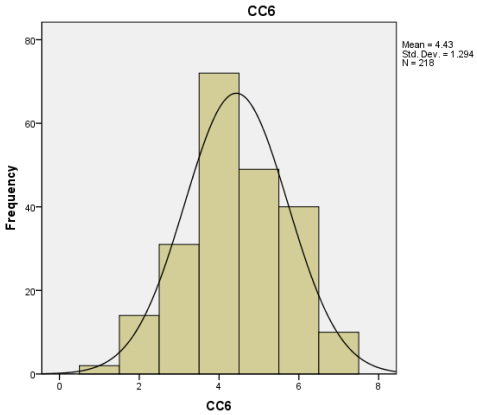

CC1
Mean = 4.32
Std. Dev. = 1.294
N = 218
Frequency
CC1

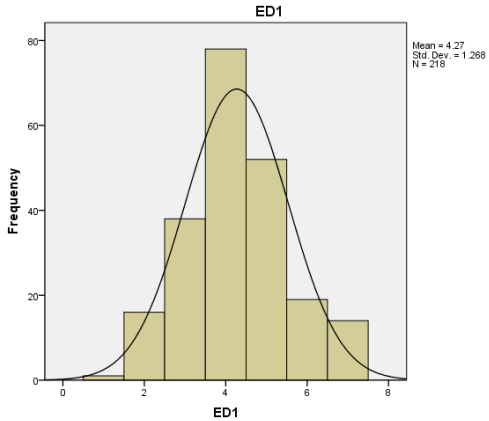

CC2
Mean = 4.5
Std. Dev. = 1.264
N = 218
Frequency
CC2

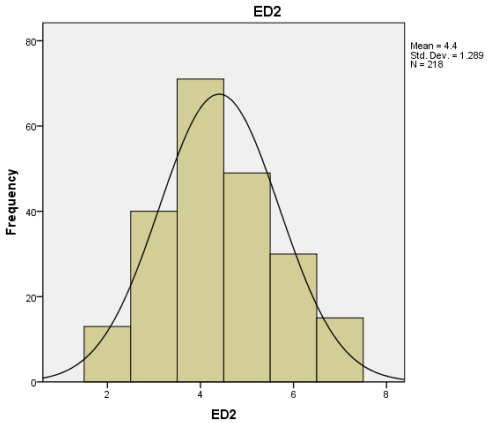

CC3
Mean = 4.44
Std. Dev. = 1.284
N = 218
Frequency
CC3

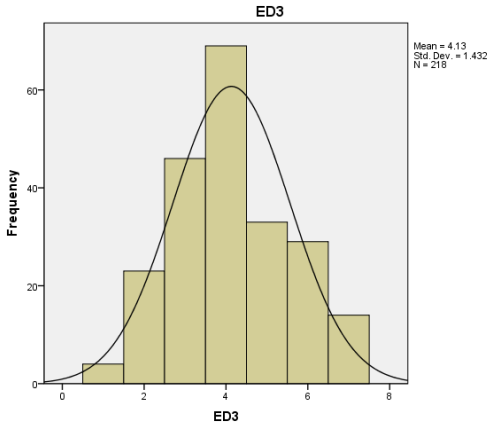

CC4
Mean = 4.08
Std. Dev. = 1.341
N = 218
Frequency
CC4

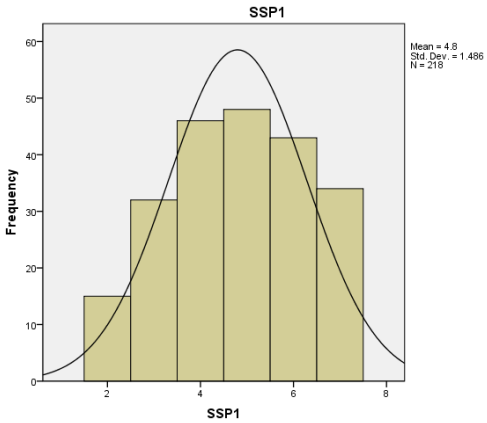

CC5
Mean = 4.43
Std. Dev. = 1.29
N = 218
Frequency
CC5

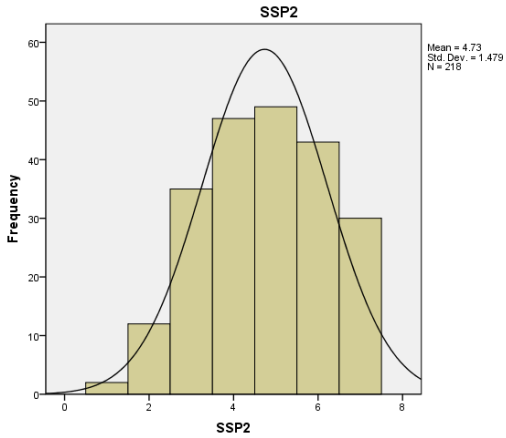

CC6
Mean = 4.43
Std. Dev. = 1.294
N = 218
Frequency
CC6

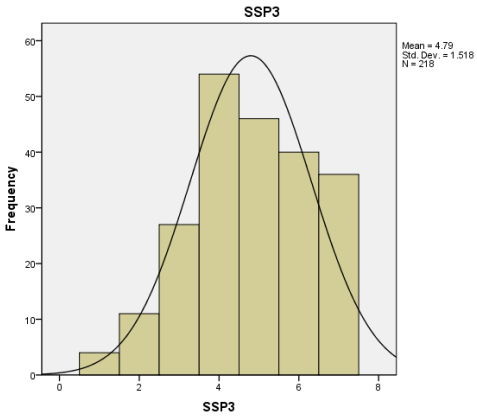

ED1
Mean = 4.27
Std. Dev. = 1.268
N = 218
Frequency
ED1

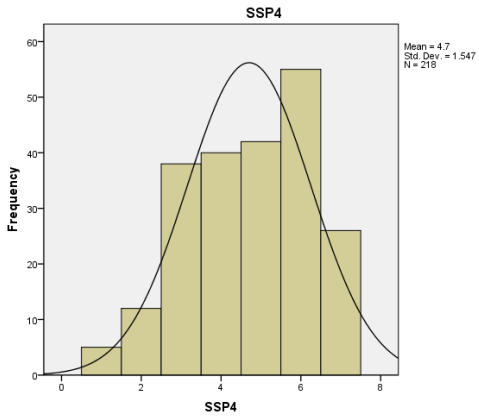

ED2
Mean = 4.4
Std. Dev. = 1.289
N = 218
Frequency
ED2

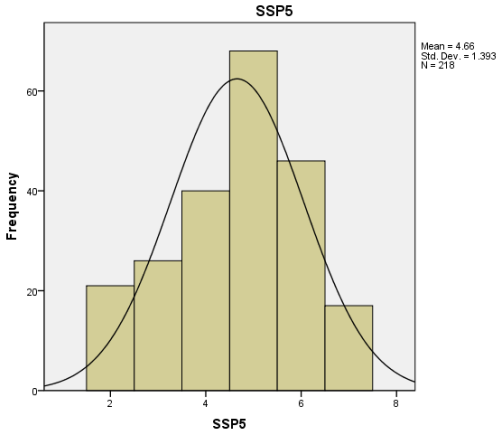

ED3
Mean = 4.13
Std. Dev. = 1.432
N = 218
Frequency
ED3

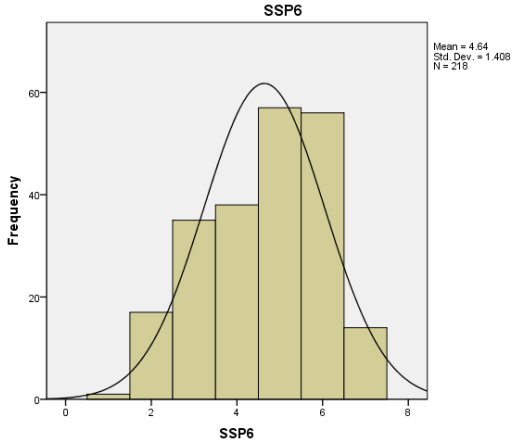

SSP1
Mean = 4.8
Std. Dev. = 1.486
N = 218
Frequency
SSP1

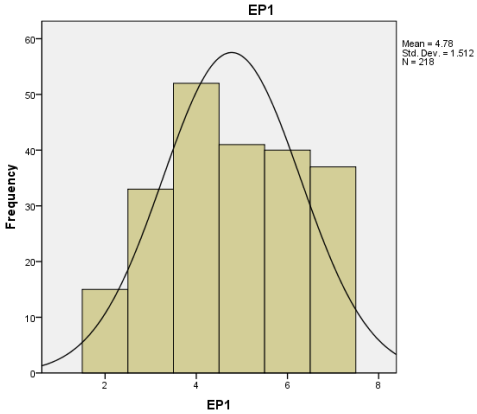

SSP2
Mean = 4.73
Std. Dev. = 1.479
N = 218
Frequency
SSP2

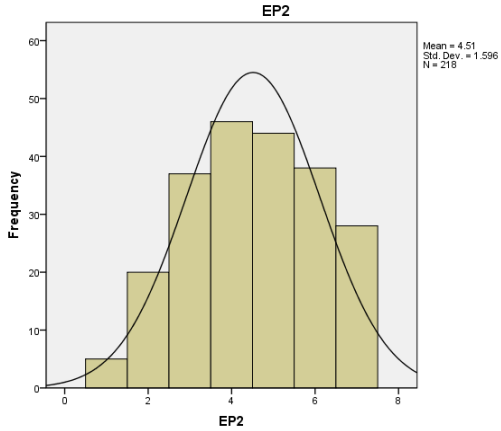

SSP3
Mean = 4.79
Std. Dev. = 1.518
N = 218
Frequency
SSP3

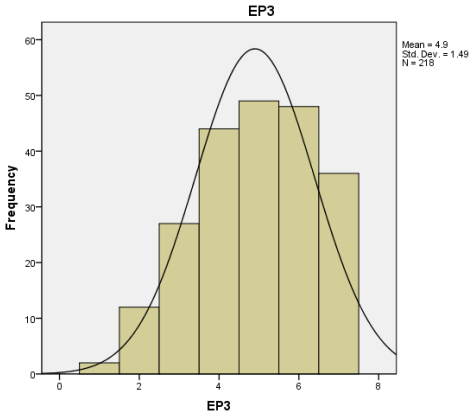

SSP4
Mean = 4.7
Std. Dev. = 1.547
N = 218
Frequency
SSP4

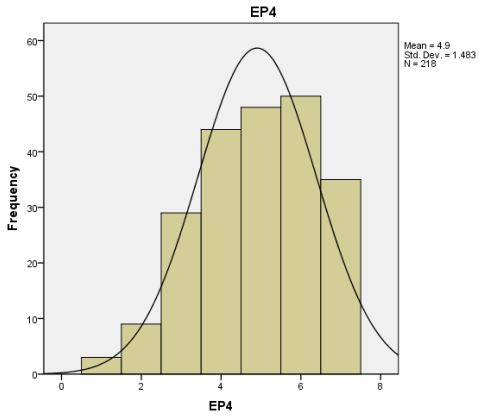

SSP5
Mean = 4.66
Std. Dev. = 1.393
N = 218
Frequency
SSP5

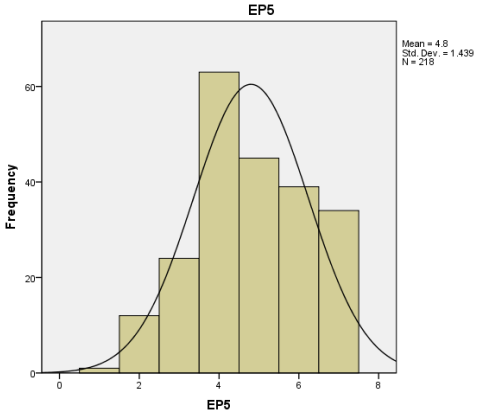

SSP6
Mean = 4.64
Std. Dev. = 1.408
N = 218
Frequency
SSP6

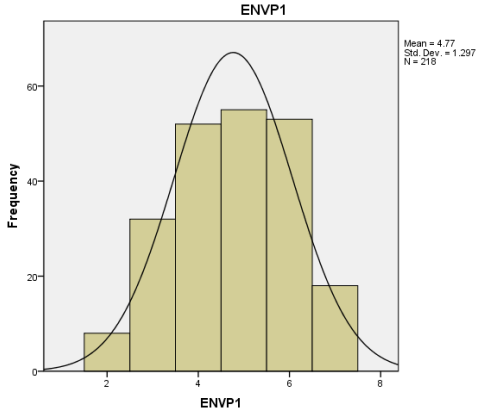

EP1
Mean = 4.78
Std. Dev. = 1.512
N = 218
Frequency
EP1

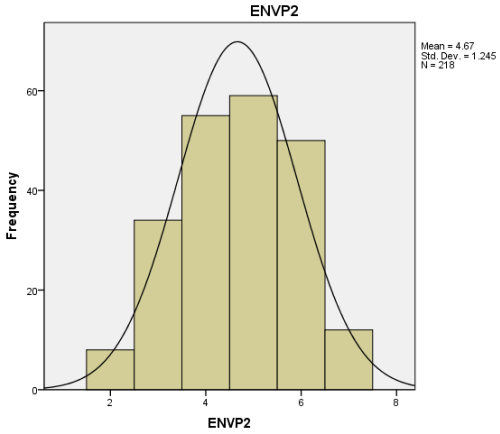

EP2
Mean = 4.51
Std. Dev. = 1.596
N = 218
Frequency
EP2

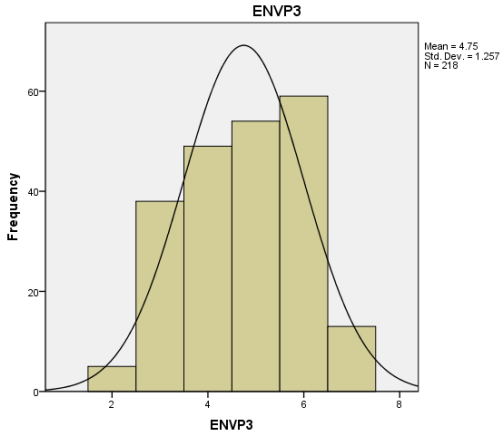

EP3
Mean = 4.9
Std. Dev. = 1.49
N = 218
Frequency
EP3

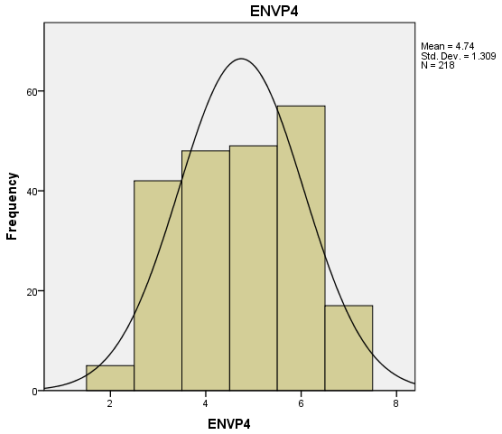

EP4
Mean = 4.9
Std. Dev. = 1.483
N = 218
Frequency
EP4

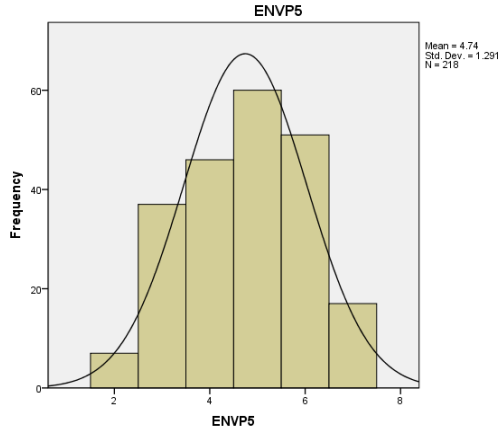

EP5
Mean = 4.8
Std. Dev. = 1.439
N = 218
Frequency
EP5

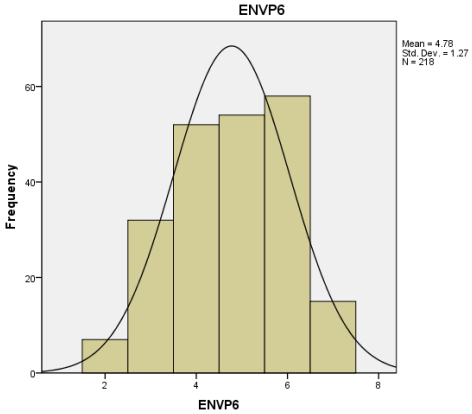

ENVP1
Mean = 4.77
Std. Dev. = 1.297
N = 218
Frequency
ENVP1

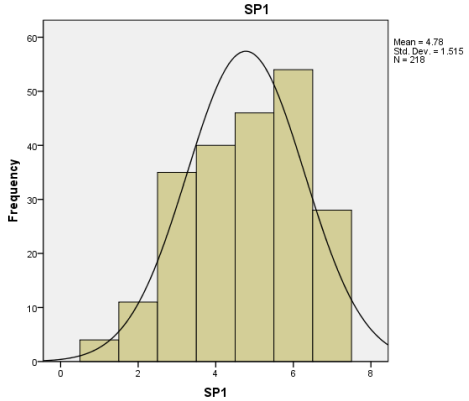

ENVP2
Mean = 4.67
Std. Dev. = 1.245
N = 218
Frequency
ENVP2

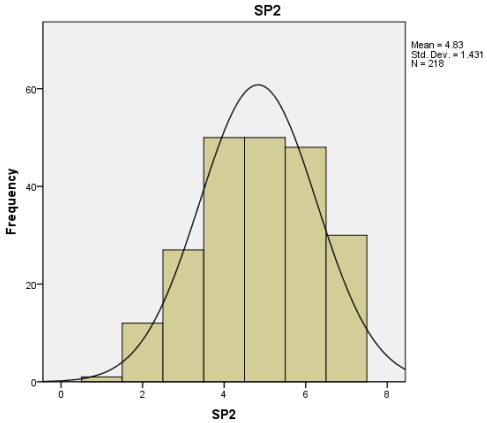

ENVP3
Mean = 4.75
Std. Dev. = 1.257
N = 218
Frequency
ENVP3

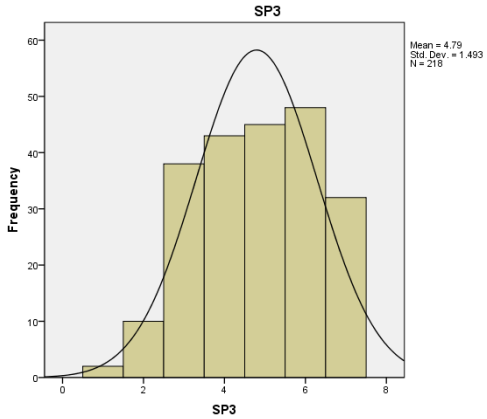

ENVP4
Mean = 4.74
Std. Dev. = 1.309
N = 218
Frequency
ENVP4

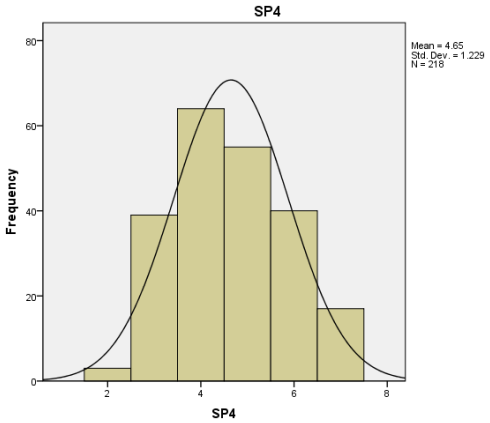

ENVP5
Mean = 4.74
Std. Dev. = 1.291
N = 218
Frequency
ENVP5

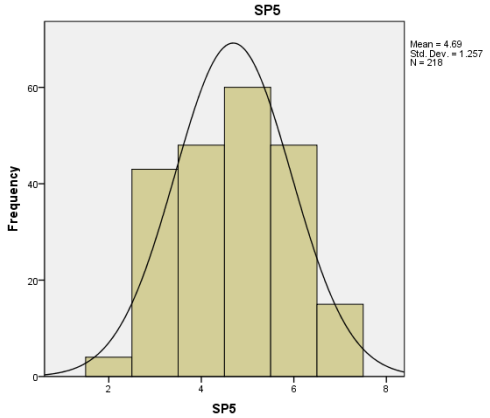

ENVP6
Mean = 4.78
Std. Dev. = 1.27
N = 218
Frequency
ENVP6

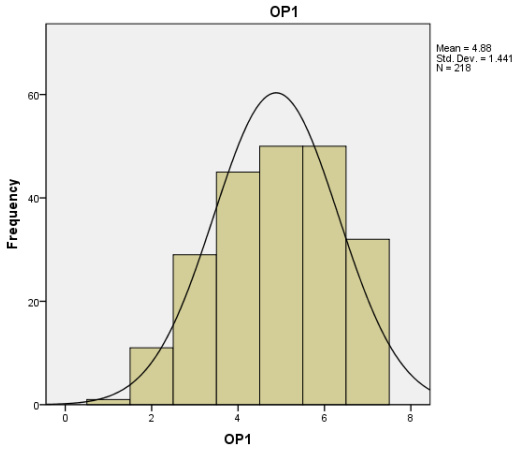

SP1
Mean = 4.78
Std. Dev. = 1.515
N = 218
Frequency
SP1

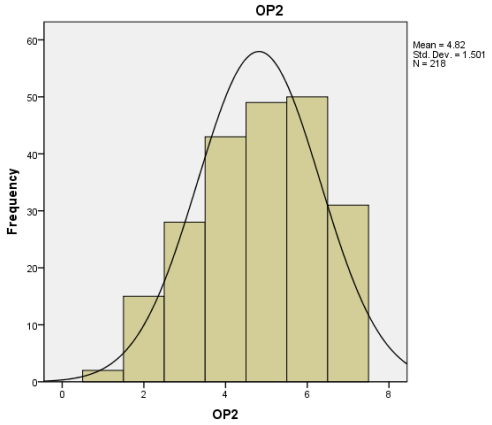

SP2
Mean = 4.83
Std. Dev. = 1.431
N = 218
Frequency
SP2

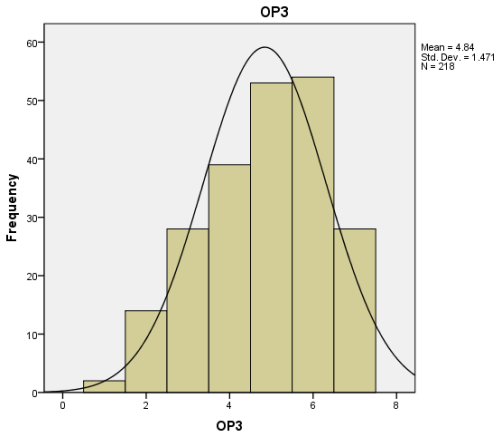

SP3
Mean = 4.79
Std. Dev. = 1.493
N = 218
Frequency
SP3

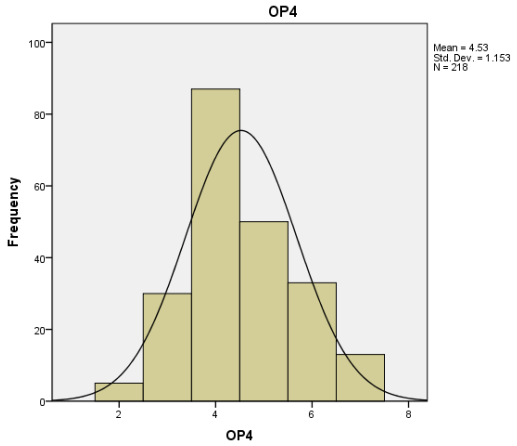

SP4
Mean = 4.65
Std. Dev. = 1.229
N = 218
Frequency
SP4

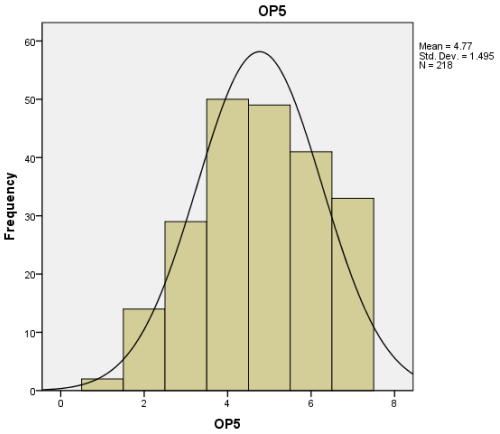

SP5
Mean = 4.69
Std. Dev. = 1.257
N = 218
Frequency
SP5

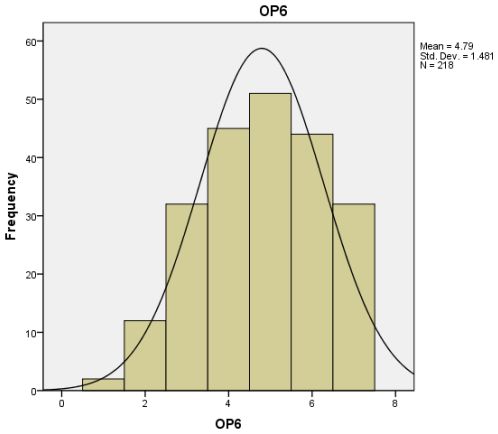

OP1
Mean = 4.88
Std. Dev. = 1.441
N = 218
Frequency
OP1


OP2
Mean = 4.82
Std. Dev. = 1.501
N = 218
Frequency
OP2


OP3
Mean = 4.84
Std. Dev. = 1.471
N = 218
Frequency
OP3


OP4
Mean = 4.53
Std. Dev. = 1.153
N = 218
Frequency
OP4


OP5
Mean = 4.77
Std. Dev. = 1.495
N = 218
Frequency
OP5


OP6
Mean = 4.79
Std. Dev. = 1.481
N = 218
Frequency
OP6

Appendix VII Levene's Test for Equality of Variances and t-Test for Equality of Means

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
Indicators	Assumption of Equal Variances	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
REG1	Equal variances assumed	0.466	0.495	0.354	216	0.724	0.064	0.182	-0.294	0.422
	Equal variances not assumed			0.354	215.776	0.724	0.064	0.182	-0.294	0.422
REG2	Equal variances assumed	2.022	0.156	-0.222	216	0.824	-0.037	0.165	-0.362	0.289
	Equal variances not assumed			-0.222	213.668	0.824	-0.037	0.165	-0.362	0.289
REG3	Equal variances assumed	1.673	0.197	-1.212	216	0.227	-0.229	0.189	-0.602	0.143
	Equal variances not assumed			-1.212	215.451	0.227	-0.229	0.189	-0.602	0.144
COMP1	Equal variances assumed	0.194	0.66	0	216	1	0	0.214	-0.421	0.421
	Equal variances not assumed			0	215.64	1	0	0.214	-0.421	0.421
COMP2	Equal variances assumed	0.419	0.518	0.397	216	0.692	0.083	0.208	-0.327	0.492
	Equal variances not assumed			0.397	215.962	0.692	0.083	0.208	-0.327	0.492
COMP3	Equal variances assumed	0.498	0.481	-0.297	216	0.767	-0.064	0.216	-0.49	0.362
	Equal variances not assumed			-0.297	214.401	0.767	-0.064	0.216	-0.49	0.362
COMP4	Equal variances assumed	0.47	0.494	-0.09	216	0.928	-0.018	0.204	-0.421	0.384
	Equal variances not assumed			-0.09	214.375	0.928	-0.018	0.204	-0.421	0.384
COMP5	Equal variances assumed	0.283	0.595	0	216	1	0	0.201	-0.396	0.396
	Equal variances not assumed			0	215.617	1	0	0.201	-0.396	0.396
COMP6	Equal variances assumed	0.079	0.78	0.664	216	0.508	0.138	0.207	-0.271	0.546
	Equal variances not assumed			0.664	215.139	0.508	0.138	0.207	-0.271	0.546
COMP7	Equal variances assumed	0.262	0.609	-0.232	216	0.817	-0.046	0.198	-0.436	0.344
	Equal variances not assumed			-0.232	215.223	0.817	-0.046	0.198	-0.436	0.345
PRES1	Equal variances assumed	0.148	0.701	-0.266	216	0.79	-0.055	0.207	-0.462	0.352
	Equal variances not assumed			-0.266	215.692	0.79	-0.055	0.207	-0.462	0.352
PRES2	Equal variances assumed	0.293	0.589	0.442	216	0.659	0.092	0.208	-0.317	0.501
	Equal variances not assumed			0.442	215.381	0.659	0.092	0.208	-0.317	0.501
PRES3	Equal variances assumed	0.631	0.428	0.042	216	0.967	0.009	0.219	-0.423	0.441
	Equal variances not assumed			0.042	215.716	0.967	0.009	0.219	-0.423	0.441
PRES4	Equal variances assumed	0.147	0.702	0.138	216	0.89	0.028	0.199	-0.365	0.42
	Equal variances not assumed			0.138	215.876	0.89	0.028	0.199	-0.365	0.42
PRES5	Equal variances assumed	0.511	0.476	-0.425	216	0.672	-0.092	0.216	-0.518	0.334
	Equal variances not assumed			-0.425	215.455	0.672	-0.092	0.216	-0.518	0.334
EEP1	Equal variances assumed	1.391	0.24	-0.051	216	0.959	-0.009	0.179	-0.362	0.344
	Equal variances not assumed			-0.051	214.853	0.959	-0.009	0.179	-0.362	0.344
EEP2	Equal variances assumed	0.148	0.701	0.453	216	0.651	0.083	0.182	-0.277	0.442
	Equal variances not assumed			0.453	215.945	0.651	0.083	0.182	-0.277	0.442
EEP3	Equal variances assumed	1.134	0.288	0.11	216	0.913	0.018	0.167	-0.312	0.348
	Equal variances not assumed			0.11	215.357	0.913	0.018	0.167	-0.312	0.348
EEP4	Equal variances assumed	1.981	0.161	-1.373	216	0.171	-0.257	0.187	-0.626	0.112
	Equal variances not assumed			-1.373	215.37	0.171	-0.257	0.187	-0.626	0.112
IEP1	Equal variances assumed	0.653	0.42	0.514	216	0.608	0.092	0.178	-0.26	0.444
	Equal variances not assumed			0.514	215.412	0.608	0.092	0.178	-0.26	0.444
IEP2	Equal variances assumed	1.876	0.172	0.664	216	0.508	0.119	0.18	-0.235	0.473
	Equal variances not assumed			0.664	215.185	0.508	0.119	0.18	-0.235	0.473
IEP3	Equal variances assumed	1.23	0.269	0.401	216	0.689	0.073	0.183	-0.287	0.434
	Equal variances not assumed			0.401	215.496	0.689	0.073	0.183	-0.287	0.434
IEP4	Equal variances assumed	3.088	0.08	0.16	216	0.873	0.028	0.172	-0.312	0.367
	Equal variances not assumed			0.16	213.562	0.873	0.028	0.172	-0.312	0.367
IEP5	Equal variances assumed	0.443	0.506	0.497	216	0.62	0.092	0.185	-0.272	0.455
	Equal variances not assumed			0.497	215.918	0.62	0.092	0.185	-0.272	0.455
IEP6	Equal variances assumed	5.875	0.016	0.105	216	0.917	0.018	0.175	-0.326	0.363
	Equal variances not assumed			0.105	210.546	0.917	0.018	0.175	-0.326	0.363

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
Indicators	Assumption of Equal Variances	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
SS1	Equal variances assumed	0.435	0.51	-0.046	216	0.963	-0.009	0.198	-0.4	0.381
	Equal variances not assumed			-0.046	215.051	0.963	-0.009	0.198	-0.4	0.381
SS2	Equal variances assumed	1.183	0.278	-0.236	216	0.814	-0.046	0.195	-0.429	0.338
	Equal variances not assumed			-0.236	214.119	0.814	-0.046	0.195	-0.429	0.338
SS3	Equal variances assumed	0.161	0.689	0.189	216	0.851	0.037	0.194	-0.347	0.42
	Equal variances not assumed			0.189	215.526	0.851	0.037	0.194	-0.347	0.42
SS4	Equal variances assumed	0.06	0.807	0.351	216	0.726	0.073	0.209	-0.339	0.486
	Equal variances not assumed			0.351	215.957	0.726	0.073	0.209	-0.339	0.486
SS5	Equal variances assumed	0.594	0.442	0.042	216	0.966	0.009	0.216	-0.417	0.435
	Equal variances not assumed			0.042	214.395	0.966	0.009	0.216	-0.417	0.435
SS6	Equal variances assumed	0.034	0.854	-0.083	216	0.934	-0.018	0.22	-0.453	0.416
	Equal variances not assumed			-0.083	215.354	0.934	-0.018	0.22	-0.453	0.416
SE1	Equal variances assumed	1.755	0.187	0.51	216	0.61	0.092	0.18	-0.263	0.446
	Equal variances not assumed			0.51	215.305	0.61	0.092	0.18	-0.263	0.446
SE2	Equal variances assumed	0.001	0.97	0	216	1	0	0.177	-0.349	0.349
	Equal variances not assumed			0	215.994	1	0	0.177	-0.349	0.349
SE3	Equal variances assumed	0.633	0.427	0.48	216	0.632	0.083	0.172	-0.257	0.422
	Equal variances not assumed			0.48	215.648	0.632	0.083	0.172	-0.257	0.422
SE4	Equal variances assumed	0.26	0.611	0.206	216	0.837	0.037	0.178	-0.314	0.387
	Equal variances not assumed			0.206	215.988	0.837	0.037	0.178	-0.314	0.387
SE5	Equal variances assumed	0.777	0.379	0.052	216	0.958	0.009	0.175	-0.336	0.354
	Equal variances not assumed			0.052	215.876	0.958	0.009	0.175	-0.336	0.354
SE6	Equal variances assumed	0.308	0.58	0.481	216	0.631	0.092	0.191	-0.285	0.468
	Equal variances not assumed			0.481	215.892	0.631	0.092	0.191	-0.285	0.468
CC1	Equal variances assumed	0.637	0.426	0.129	216	0.898	0.028	0.214	-0.394	0.449
	Equal variances not assumed			0.129	215.856	0.898	0.028	0.214	-0.394	0.449
CC2	Equal variances assumed	0.591	0.443	-0.269	216	0.788	-0.055	0.204	-0.458	0.348
	Equal variances not assumed			-0.269	213.658	0.788	-0.055	0.204	-0.458	0.348
CC3	Equal variances assumed	0.15	0.699	-0.352	216	0.725	-0.073	0.209	-0.484	0.338
	Equal variances not assumed			-0.352	214.654	0.725	-0.073	0.209	-0.484	0.338
CC4	Equal variances assumed	1.222	0.27	-0.543	216	0.588	-0.119	0.22	-0.552	0.314
	Equal variances not assumed			-0.543	212.787	0.588	-0.119	0.22	-0.552	0.314
CC5	Equal variances assumed	0.176	0.675	-0.486	216	0.627	-0.101	0.208	-0.51	0.308
	Equal variances not assumed			-0.486	215.62	0.627	-0.101	0.208	-0.51	0.308
CC6	Equal variances assumed	0.071	0.791	-0.043	216	0.965	-0.009	0.212	-0.426	0.408
	Equal variances not assumed			-0.043	215.442	0.965	-0.009	0.212	-0.426	0.408
ED1	Equal variances assumed	0.468	0.495	-0.134	216	0.894	-0.028	0.206	-0.434	0.379
	Equal variances not assumed			-0.134	215.447	0.894	-0.028	0.206	-0.434	0.379
ED2	Equal variances assumed	0.975	0.325	-0.138	216	0.89	-0.028	0.199	-0.421	0.366
	Equal variances not assumed			-0.138	215.089	0.89	-0.028	0.199	-0.421	0.366
ED3	Equal variances assumed	0.198	0.657	-0.789	216	0.431	-0.174	0.221	-0.61	0.261
	Equal variances not assumed			-0.789	215.788	0.431	-0.174	0.221	-0.61	0.261
SSP1	Equal variances assumed	0.011	0.917	-0.364	216	0.716	-0.073	0.202	-0.471	0.324
	Equal variances not assumed			-0.364	215.881	0.716	-0.073	0.202	-0.471	0.324
SSP2	Equal variances assumed	0.211	0.646	-1.008	216	0.315	-0.202	0.2	-0.597	0.193
	Equal variances not assumed			-1.008	215.362	0.315	-0.202	0.2	-0.597	0.193
SSP3	Equal variances assumed	0.042	0.838	-0.579	216	0.563	-0.119	0.206	-0.525	0.287
	Equal variances not assumed			-0.579	215.949	0.563	-0.119	0.206	-0.525	0.287
SSP4	Equal variances assumed	0.077	0.782	-0.656	216	0.513	-0.138	0.21	-0.551	0.276
	Equal variances not assumed			-0.656	215.885	0.513	-0.138	0.21	-0.551	0.276
SSP5	Equal variances assumed	0.623	0.431	0.243	216	0.809	0.046	0.189	-0.327	0.419
	Equal variances not assumed			0.243	215.776	0.809	0.046	0.189	-0.327	0.419
SSP6	Equal variances assumed	0.81	0.369	0.048	216	0.962	0.009	0.191	-0.368	0.386
	Equal variances not assumed			0.048	215.315	0.962	0.009	0.191	-0.368	0.386

Appendix VIII Skewness and Kurtosis of Collected Data

Descriptive Statistics

	N	Min.	Max.	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
REG1	218	2	7	4.84	1.352	-.097	.165	-.865	.328
REG2	218	3	7	5.06	1.217	-.013	.165	-.957	.328
REG3	218	2	7	4.93	1.430	-.078	.165	-1.088	.328
COMP1	218	1	7	4.67	1.575	-.120	.165	-.998	.328
COMP2	218	1	7	4.77	1.532	-.128	.165	-.979	.328
COMP3	218	1	7	4.89	1.593	-.433	.165	-.677	.328
COMP4	218	1	7	4.67	1.503	-.055	.165	-.832	.328
COMP5	218	1	7	4.47	1.478	-.179	.165	-.720	.328
COMP6	218	1	7	4.77	1.529	-.138	.165	-.918	.328
COMP7	218	1	7	4.67	1.459	-.246	.165	-.609	.328
PRES1	218	1	7	4.75	1.522	-.176	.165	-.790	.328
PRES2	218	1	7	4.44	1.530	-.389	.165	-.437	.328
PRES3	218	1	7	4.78	1.615	-.365	.165	-.819	.328
PRES4	218	1	7	4.64	1.466	-.389	.165	-.513	.328
PRES5	218	1	7	3.98	1.592	.203	.165	-.653	.328
EEP1	218	2	7	4.28	1.144	.422	.165	-.047	.328
EEP2	218	2	7	4.39	1.123	.319	.165	-.064	.328
EEP3	218	3	7	4.57	1.055	.447	.165	-.243	.328
EEP4	218	2	7	4.38	1.236	.528	.165	-.418	.328
IEP1	218	2	7	4.35	1.114	.366	.165	-.117	.328
IEP2	218	2	7	4.32	1.101	.307	.165	-.062	.328
IEP3	218	2	7	4.34	1.138	.251	.165	-.189	.328
IEP4	218	3	7	4.56	1.081	.518	.165	-.242	.328
IEP5	218	2	7	4.43	1.167	.405	.165	-.281	.328
IEP6	218	2	7	4.49	1.087	.611	.165	-.031	.328
SS1	218	1	7	4.31	1.271	.170	.165	-.411	.328
SS2	218	1	7	4.38	1.294	.225	.165	-.369	.328
SS3	218	1	7	4.37	1.246	.246	.165	-.299	.328

SS4	218	1	7	4.30	1.309	.193	.165	-.412	.328
SS5	218	1	7	4.18	1.388	.302	.165	-.585	.328
SS6	218	1	7	4.26	1.421	.171	.165	-.761	.328
SE1	218	2	7	4.39	1.139	.409	.165	-.134	.328
SE2	218	2	7	4.35	1.102	.442	.165	.239	.328
SE3	218	2	7	4.40	1.096	.185	.165	-.322	.328
SE4	218	2	7	4.41	1.092	.334	.165	-.088	.328
SE5	218	2	7	4.41	1.096	.342	.165	-.034	.328
SE6	218	2	7	4.35	1.175	.154	.165	-.103	.328
CC1	218	1	7	4.32	1.294	.079	.165	-.301	.328
CC2	218	1	7	4.50	1.264	-.093	.165	-.143	.328
CC3	218	1	7	4.44	1.284	-.114	.165	-.137	.328
CC4	218	1	7	4.08	1.341	.206	.165	-.209	.328
CC5	218	1	7	4.43	1.290	-.005	.165	-.371	.328
CC6	218	1	7	4.43	1.294	-.098	.165	-.371	.328
ED1	218	1	7	4.27	1.268	.231	.165	-.111	.328
ED2	218	2	7	4.40	1.289	.215	.165	-.512	.328
ED3	218	1	7	4.13	1.432	.201	.165	-.504	.328
SSP1	218	2	7	4.80	1.486	-.142	.165	-.941	.328
SSP2	218	1	7	4.73	1.479	-.163	.165	-.773	.328
SSP3	218	1	7	4.79	1.518	-.244	.165	-.597	.328
SSP4	218	1	7	4.70	1.547	-.319	.165	-.738	.328
SSP5	218	2	7	4.66	1.393	-.326	.165	-.637	.328
SSP6	218	1	7	4.64	1.408	-.324	.165	-.771	.328
EP1	218	2	7	4.78	1.512	-.065	.165	-1.017	.328
EP2	218	1	7	4.51	1.596	-.125	.165	-.837	.328
EP3	218	1	7	4.90	1.490	-.323	.165	-.676	.328
EP4	218	1	7	4.90	1.483	-.347	.165	-.596	.328
EP5	218	1	7	4.80	1.439	-.091	.165	-.718	.328
ENVP1	218	2	7	4.77	1.297	-.145	.165	-.751	.328
ENVP2	218	2	7	4.67	1.245	-.122	.165	-.694	.328
ENVP3	218	2	7	4.75	1.257	-.145	.165	-.892	.328
ENVP4	218	2	7	4.74	1.309	-.075	.165	-.992	.328
ENVP5	218	2	7	4.74	1.291	-.133	.165	-.789	.328
ENVP6	218	2	7	4.78	1.270	-.183	.165	-.765	.328
SP1	218	1	7	4.78	1.515	-.343	.165	-.672	.328
SP2	218	1	7	4.83	1.431	-.230	.165	-.701	.328

SP3	218	1	7	4.79	1.493	-.195	.165	-.855	.328
SP4	218	2	7	4.65	1.229	.190	.165	-.755	.328
SP5	218	2	7	4.69	1.257	-.011	.165	-.877	.328
OP1	218	1	7	4.88	1.441	-.264	.165	-.740	.328
OP2	218	1	7	4.82	1.501	-.319	.165	-.711	.328
OP3	218	1	7	4.84	1.471	-.386	.165	-.619	.328
OP4	218	2	7	4.53	1.153	.324	.165	-.311	.328
OP5	218	1	7	4.77	1.495	-.195	.165	-.730	.328
OP6	218	1	7	4.79	1.481	-.224	.165	-.730	.328
Valid N (listwise)	218								

Appendix IX AMOS Output For Structural Model

DV		IV	Estimate B	S.E.	C.R.	P	Standardised Beta
ENVP	<---	CC	-0.029	0.051	-0.567	0.571	-0.020
EP	<---	CC	0.618	0.077	8.012	***	0.422
OP	<---	CC	0.261	0.064	4.070	***	0.151
SP	<---	CC	0.025	0.091	0.271	0.786	0.014
CC	<---	COMP	0.388	0.062	6.240	***	0.433
ED	<---	COMP	1.000				0.704
EEP	<---	COMP	0.020	0.061	0.323	0.747	0.019
IEP	<---	COMP	0.080	0.056	1.434	0.152	0.075
SM	<---	COMP	0.154	0.053	2.908	0.004	0.146
SS	<---	COMP	0.653	0.075	8.699	***	0.554
SSP	<---	COMP	-0.138	0.049	-2.801	0.005	-0.125
ENVP	<---	ED	-0.190	0.033	-5.828	***	-0.214
EP	<---	ED	0.623	0.045	13.913	***	0.674
OP	<---	ED	1.000				0.915
SP	<---	ED	-0.002	0.059	-0.027	0.979	-0.001
ENVP	<---	EEP	0.386	0.051	7.557	***	0.321
EP	<---	EEP	-0.075	0.058	-1.293	0.196	-0.060
OP	<---	EEP	-0.120	0.061	-1.981	0.048	-0.081
SP	<---	EEP	0.008	0.088	0.089	0.929	0.005
ENVP	<---	IEP	0.408	0.049	8.242	***	0.343
EP	<---	IEP	-0.069	0.057	-1.217	0.223	-0.056
OP	<---	IEP	0.036	0.059	0.611	0.541	0.025
SP	<---	IEP	-0.011	0.086	-0.132	0.895	-0.008
CC	<---	PRES	0.299	0.061	4.937	***	0.334
ED	<---	PRES	0.202	0.095	2.127	0.033	0.142
EEP	<---	PRES	0.115	0.063	1.837	0.066	0.109
IEP	<---	PRES	0.142	0.057	2.475	0.013	0.133
SM	<---	PRES	0.176	0.054	3.224	0.001	0.166
SS	<---	PRES	0.191	0.074	2.595	0.009	0.162
SSP	<---	PRES	1.000				0.909
CC	<---	REG	0.107	0.052	2.067	0.039	0.131
ED	<---	REG	0.303	0.085	3.567	***	0.234
EEP	<---	REG	0.680	0.069	9.915	***	0.711

IEP	<---	REG	0.742	0.066	11.227	***	0.766
SM	<---	REG	0.784	0.067	11.706	***	0.812
SS	<---	REG	0.416	0.070	5.958	***	0.388
SSP	<---	REG	0.281	0.047	6.006	***	0.281
ENVP	<---	SM	0.494	0.052	9.473	***	0.414
EP	<---	SM	-0.096	0.059	-1.628	0.104	-0.077
OP	<---	SM	-0.182	0.062	-2.953	0.003	-0.124
SP	<---	SM	0.026	0.089	0.290	0.771	0.018
ENVP	<---	SS	0.128	0.040	3.202	0.001	0.119
EP	<---	SS	0.061	0.046	1.321	0.187	0.055
OP	<---	SS	0.103	0.048	2.174	0.03	0.078
SP	<---	SS	0.018	0.071	0.250	0.802	0.014
ENVP	<---	SSP	-0.136	0.039	-3.466	***	-0.119
EP	<---	SSP	-0.176	0.049	-3.573	***	-0.147
OP	<---	SSP	-0.211	0.055	-3.831	***	-0.150
SP	<---	SSP	1.059	0.074	14.306	***	0.754