UNIVERSITY OF BIRMINGHAM

SUSTAINABLE SUPPLY CHAIN MANAGEMENT (SSCM): AN EMPIRICAL ANALYSIS OF THE UK AUTOMOTIVE INDUSTRY

By

ALI ESFAHBODI

Thesis submitted to The University of Birmingham for the degree of DOCTOR OF PHILOSOPHY

College of Social Sciences
Business School
Department of Management
The University of Birmingham
March 2016

ABSTRACT

Sustainable supply chain management (SSCM) as a thriving sub-field of supply chain management (SCM) has garnered increasing attention from both academics and practitioners in the past two decades. Despite the fact that SSCM initiatives have been practised by manufacturing firms during this period, there is a concern as to whether these practices are being implemented because they are profitable or because of driving forces affecting them. In addition, a number of new debates have recently been opened up concerning the SSCM paradox, throwing doubt on whether the adoption of SSCM practices really pays, and thus the commercial benefits of 'going green' in the context of SCM remain open to question.

In the literature to date, the performance implications of SSCM are unclear, and therefore this thesis attempts to address this gap, questioning whether both environmental improvements and economic benefits can be incurred through undertaking an SSCM approach. Moreover, the consequences of SSCM adoption have not been investigated with respect to their associated exogenous and endogenous driving forces, constituting an additional knowledge gap. Therefore, this research was designed to achieve two main objectives: (i) determining the role of driving forces in the adoption of SSCM practices, and (ii) investigating whether SSCM practices can be both environmentally beneficial and commercially viable.

In light of these issues, this research develops a comprehensive SSCM drivers-practices-performance model with a focus on antecedent and outcome effects, relating theoretical linkages between driving forces, SSCM practices and commensurate performance outcomes. Sustainable Procurement, Sustainable Design, Sustainable Distribution and Investment Recovery are the focal constructs in the theoretical model, with Organisational Environment Management as an antecedent and Environmental and Cost Performance as consequences. Data was collected through online survey questionnaires from 186 UK automotive manufacturing firms to investigate these linkages in an effort to address the knowledge gap. The reliability, validity and goodness-of-fit of the research model were thoroughly assessed using widely accepted statistical tools. To test the posited hypotheses covering various SSCM drivers-practices-performance theoretical linkages, a Structural Equation Modelling (SEM) method was employed.

The complementary driving force of organisation environmental management (OEM), which encompasses both external environmental regulations and the internal commitment and support of top-level management, was identified as a necessary precursor giving rise to the successful adoption of SSCM practices. The empirical results further suggest that such SSCM implementation driven by a symbiotic combination of both external regulatory pressures and internal firm commitment drivers has a significant positive effect on environmental performance, delivering environmental improvements. However, the findings further suggest that SSCM implementation does not necessarily lead to improved cost performance, as only sustainable procurement was found to have a positive effect on cost performance.

This research contributes to the existing knowledge of SSCM by: (i) maintaining that regulations can only take SSCM adoption to a limited extent, and actually top-level management commitment and support is also required to fully and successfully drive the implementation of SSCM practices; (ii) asserting that the implementation of SSCM practices leads to improved environmental performance, while the economic performance is partially compromised, sustaining a negative trade-off in terms of cost performance. This second contribution clears the ambiguities within the contemporary SSCM knowledge concerning the consequences of SSCM implementation.

Lastly, this research provides useful insights for both managers seeking to adopt SSCM practices and policy-makers and regulators seeking to further promote an SSCM agenda. Business practitioners are furnished with a validated framework for evaluating the impacts of the implementation of SSCM practices on their organisational performance on both the environmental and cost levels. Furthermore, the major SSCM practices validated in this research enable manufacturers to identify those areas of SSCM where improvements are required and those areas which should be prioritised. While the short-term economic benefits of sustainable supply chains may not be evident, a proposition has been developed in this research so that long-term benefits can be accrued, providing 'win-win' opportunities for both environmental protection and economic benefit.

Keywords: Sustainable supply chain management (SSCM); Manufacturing firms; Environmental performance; Cost performance; Structural Equation Modelling (SEM).

ACKNOWLEDGEMENTS

I am indebted and grateful to both of my supervisors, Dr. Yufeng Zhang and Professor Glyn Watson for their invaluable guidance, enthusiastic encouragement and continuous support. I have been deeply privileged to work with such brilliant scholars, for whom I have the utmost respect, during the past few years of my endeavours here at the University of Birmingham. They have always been inspiring throughout my PhD journey, which has made me a pure and independent researcher. This thesis could hardly have been completed without their insightful guidance, delicate supervision, and sincere devotion.

I am also grateful to the Business School at the University of Birmingham for providing the bursary funding for my PhD. I would also like to add a note of thanks to Dr. Joe Sanderson for his constructive guidance during the annual review meetings.

My warmest thanks go to my lovely parents for their endless support and prayers throughout my entire life. Words fail me to express my appreciation and gratitude to the greatest parents, who were always there for me during both the good times and the difficult times. This thesis will be dedicated to them and to those to whom this means something.

TABLE OF CONTENTS

CHAPTER 5

CHAPTER 6

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

BOM: Bill of Materials

CFA: Confirmatory Factor Analysis

CFI: Comparative Fit Index

CMV: Common Methods Variance

CP: Cost Performance

CSR: Corporate Social Responsibility

e.g.: exempli gratia (*Latin*); for example

EFA: Exploratory Factor Analysis

ELV: End-of-Life Vehicle

EP: Environmental Performance

etc: et cetera (*Latin*); and the rest, and so forth

EU: European Union

EuP: Energy-Using Products

FAME: Financial Analysis Made Easy

GOF: Goodness-of-Fit

GSCF: Global Supply Chain Forum

GSCM: Green Supply Chain Management

i.e.: id est (*Latin*); that is

IFI: Incremental Fit Index

IR: Investment Recovery

IS: Information System

ISO: International Organization for Standardisation

KMO: Kaiser-Meyer-Olkin

LCA: Life Cycle Analysis

LISREL: Linear Structural Relations

NFI: Normed Fit Index

NNFI: Non-Normed Fit Index

OEM: Organisation Environmental Management

PCA: Principal Component Analysis

RMSEA: Root Mean Square Error of Approximation

RNG: Random Number Generator

RoHS: Restriction of Hazardous Substances

SCM: Supply Chain Management

SD: Sustainable Design

SDIST: Sustainable Distribution

SEM: Structural Equations Modelling

SP: Sustainable Procurement

SPSS: Statistical Package for the Social Sciences

SSCM: Sustainable Supply Chain Management

TBL: Triple Bottom Line

VIF: Variance Inflation Factor

WCED: World Commission on Environment and Development

WEEE: Waste Electrical and Electronic Equipment

CHAPTER 1

INTRODUCTION

1.1 Introduction

Following Figure 1.1, this chapter presents an overview of the research background, including the research gaps identified within existing knowledge (1.2), the scope of the study (1.3), the research questions (1.4), the research objectives (1.5), the research plan (1.6), the research delimitation including the sector and geographical area of analysis (1.7) and the significance of the study in terms of both academic and practical significance (1.8). In addition, the research methods used in this thesis, including the philosophical and methodological stances, are introduced (1.9), and finally, the overall structure of the research is presented (1.10), followed by the chapter summary (1.11).

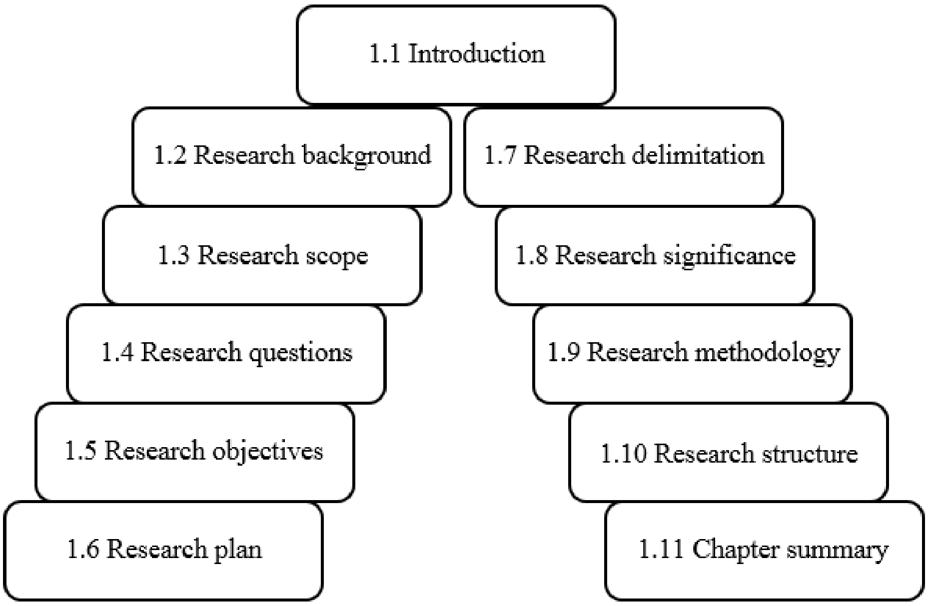


Figure 1.1 Structure of Chapter 1

1.2 Research background

Supply chains and how they are managed is considered to be one of the main sources of competitiveness in today's business environment, where most organisations are a part of at least one supply chain and competition is increasingly based on 'supply chain vs. supply chain' (Carter and Ellram, 2003; Bratic, 2011). The past couple of decades have witnessed tremendous developments in the field of supply chain management (SCM) due to its paramount importance in various areas. This rapid development, however, has been mirrored by increasing environmental concerns regarding waste, emissions generation and resource depletion associated with activities and functions involved within SCM (Giunipero et al., 2008). SCM is most closely linked with environmental outcomes, as it encompasses different business processes and operations that have direct environmental results, e.g. procurement, production, distribution, etc. (Handfield et al., 2005). Today, most firms are involved in and part of at least one supply chain, and the way in which supply chains are managed by these firms can minimise negative environmental impacts and enhance environmental protection (Seuring and Muller, 2008a; Ashby et al., 2012). Hence, SCM plays a pivotal role in environmental protection (Carter and Rogers, 2008).

Increasing environmental issues along with scarcity of resources and degradation of the living environment in general have led stakeholders, customers and government bodies to demand more environmentally protecting products and services (Linton et al., 2007). Such increasing stakeholder, customer and regulator expectations have caused firms to become fully responsible for their business processes and operations, demonstrating their environmental and ethical behaviour (Ashby et al., 2012).

Therefore, the expected line of (environmental and social) responsibility, along with increasing pressures exerted by stakeholders, customers, competitors and regulators at large, have pushed firms, and manufacturing firms in particular, to make their traditional supply chains more environmental friendly (Matos and Hall, 2007; Gimenez et al., 2012). In effect, in response to such external demands and community, competitive and regulatory pressures, the traditional supply chain has evolved to incorporate sustainable inputs and shifted to being a sustainable supply chain in order to provide more environmentally friendly products, services and product-service combinations (Sarkis et al., 2010). A concise theoretical background on supply chain management and how it has shifted its focus to sustainable supply chains is presented in Section 2.2, providing readers with a better understanding of the study background.

Environmental concerns and the inclusion of sustainable initiatives within the context of the supply chain have formed the cross-disciplinary field of sustainable supply chain management (SSCM) (Linton et al., 2007; Seuring and Muller, 2008a; Green et al., 2012a; Carter and Easton, 2011; Tritos et al., 2013; Brandenburg et al., 2014; Tseng et al., 2015). SSCM has gained increasing attention within both academia and industry and has become significantly topical in the academic literature of operations and supply chain management (Sarkis et al., 2011). This can be seen by the increasing number of published articles within top-tier journals in the past two decades, as well as the recent growing calls for papers for various special volumes on sustainable supply chain management (Jayaraman et al., 2007; Krause et al., 2009; Brandenburg et al., 2014; Yu and Ramanathan, 2015). The popularity of the SSCM topic is not limited to academia, and it has also gained growing interest from practitioners and manufacturing firms in particular, in the hope of mitigating negative environmental impacts while achieving performance gains (Sarkis et al., 2010; Zhu et al., 2012).

Today, the on-going environmental sustainability agenda urges manufacturing firms on a global scale to take environmental concerns into consideration and accept the necessity of environmental management, demonstrating a rational position on sustainability. With the increased attention paid to such environmental responsibilities in the past two decades, a growing number of manufacturing firms have recognised the concept of SSCM and have begun to undertake environmental initiatives across their supply chains. In effect, many manufacturing firms have started to implement proactive SSCM practices, providing environmentally friendly products and services that have the least negative environmental impacts (Green et al., 2012a; Taylor and Taylor, 2013). Accordingly, a number of proactive and boundary-spanning practices are being implemented today by manufacturers, such as sustainable procurement (Zsidisin and Siferd, 2001), sustainable production (Seuring and Gold, 2013), eco-design (Seuring and Muller, 2008b), sustainable distribution (Vachon and Klassen, 2006b) and investment recovery (Zhu et al., 2008a). All key partners of the supply chain, i.e. manufacturers, suppliers and customers, are required to work closely together to achieve the effective implementation of these SSCM practices (Carter and Easton, 2011).

Firms' responsiveness to the adoption of such environmental practices across the supply chain is largely associated with the efforts of government and regulatory bodies around the world to alleviate their negative impacts on the environment (Green et al., 2012a). Even though heightened customer demand for environmentally friendly products plays a part in SSCM implementation, manufacturing firms usually embark upon the adoption of SSCM practices in response to government environmental regulations (Boström et al., 2015). While the literature often identifies regulations as the main exogenous forces in the adoption of SSCM practices (Zailani et al., 2012), a number of studies have recently revealed that regulations are necessary but not sufficient in the implementation of SSCM practices (Zhu et al., 2013; Hsu et al., 2013). Recent studies have suggested that regulations can only take the adoption of SSCM practices so far, and that SSCM implementation also requires internal commitment and support within different levels of the firm (Sarkis et al., 2010; Zhu et al., 2013). In other words, the exogenous driving force behind regulations can only take the SSCM adoption to a limited extent, demanding the firm's endogenous support. In this study, a bundle of exogenous forces associated with regulations and endogenous factors associated with the firm's internal commitment are assumed to give rise to the adoption of an SSCM agenda. In the literature to date, the consequences of SSCM adoption have not been investigated with respect to their associated exogenous and endogenous driving forces, constituting a knowledge gap (Rao and Holt, 2005; Lee et al., 2012; De Giovannia and Vinzi, 2012; Zhu et al., 2012; Seuring and Gold, 2013). Accordingly, it is contended that there is a research gap within the SSCM literature concerning the driving forces associated with the adoption of SSCM practices.

As community and regulatory pressures push firms to adopt and maintain SSCM practices and develop environmentally friendly products and services, firms are being required to consider the impact of the adoption of such environmental initiatives not only on their environmental performance, but also on their economic performance (Pagell and Wu, 2009). The recognition of financial benefits gained from undertaking environmental initiatives, i.e. SSCM implementation, on a firm's bottom line is crucial for the dissemination of such environmental programmes, given the economic viability of the firm (Zhu and Sarkis, 2007). This contention is grounded in the fact that economic performance has traditionally been, and continues to be, the key priority for firms (Zhu et al., 2005; Schaltegger et al., 2014). Previous studies in favour of this argument have shown that the implementation of SSCM practices can provide 'win-win' opportunities with both environmental performance and economic benefits (Rao and Holt, 2005; Paulraj et al., 2008). While the 'win-win' argument of reaching both environmental protection and economic benefits has been used to promote SSCM implementation, this 'win-win' situation has not actually occurred in all studies (Zhu and Sarkis, 2007).

In this respect, previous research has asserted that the implementation of SSCM practices is expected to result in a higher level of environmental performance, as measured by reductions in wastes, emissions and the consumption of toxic materials, delivering environmental improvements (Seuring and Muller, 2008a; Green et al., 2012a). In terms of economic performance, previous studies have suggested that SSCM implementation can drive the improvement of a firm's financial bottom line through cost savings, stronger brand image and improved market share (Rao and Holt, 2005; Vachon and Klassen, 2008). The consensus within the existing knowledge has been centred on the idea that SSCM implementation can be both environmentally beneficial and commercially viable (Zhu and Sarkis, 2007; Lee et al., 2012), until new research emerged throwing doubt on this issue.

Although the relationships between the implementation of SSCM practices and organisational performance have been explored in previous studies (Paulraj et al., 2008; Green et al., 2008), a number of debates have recently opened up to question whether the implementation of SSCM practices will ultimately translate into profitability resulting in improved economic performance (Hollos et al., 2012; Green et al., 2012a). Recent studies, including some conceptual research and limited case studies (Shi et al., 2012; Walkers and Jones, 2012; Lakshmimeera and Palanisamy, 2013), have started to question the existing knowledge on whether the implementation of SSCM practices really pays. Thus, the topic of sustainable supply chains with respect to the impacts on firm performance remains under-researched and a subject of debate, which highlights a need to clarify this level of ambiguity within the literature. Such potential inconclusiveness within the existing knowledge has led to the identification of the study's research problems.

This study argues that while the body of literature on SSCM is elaborate, there is a lack of clarity in understanding the relationships between the implementation of SSCM practices and the commensurate performance outcomes. This thesis strives to bridge the ambiguity within the existing knowledge through a rigorous investigation of the newly opened debate on whether both environmental improvement and economic benefit can be incurred through undertaking SSCM practices (Green et al., 2012a; Hollos et al., 2012; Zhu et al., 2013).

Overall, we argue that despite recent developments in the SSCM literature, more empirical research is needed to establish the impact of SSCM practices on performance outcomes, particularly from a holistic and integrated perspective that takes into account the influential effects of SSCM's antecedents. Arguably, such comprehensive and integrated perspective allows this research investigation to obtain more credible results and report conclusive findings, bridging the mixed views within the existing knowledge.

1.3 Research scope

Having discussed the study's research background, this section goes on to address the study's research scope. Given the abovementioned research gaps, the aims of this thesis are twofold:

1) Determining the role of SSCM-related driving forces, encompassing external regulatory forces and internal firm commitment drivers, in the adoption of SSCM practices.
2) Investigating the consequences of the implementation of SSCM practices in terms of performance outcomes, specifically environmental and cost based ones.

In essence, this study aims to examine whether exogenous regulatory pressures and endogenous commitment factors exist in the adoption of SSCM practices and explore whether they are necessary and sufficient. Thereafter, it aims to investigate what such SSCM implementation, which is driven by a bundle of exogenous regulatory pressures and endogenous commitment factors, delivers in terms of environmental and economic performance. Figure 1.2 illustrates the research scope of this thesis. The intention is to explore and understand the theoretical linkages between Driving Forces→SSCM Practices→ Performance Outcomes.

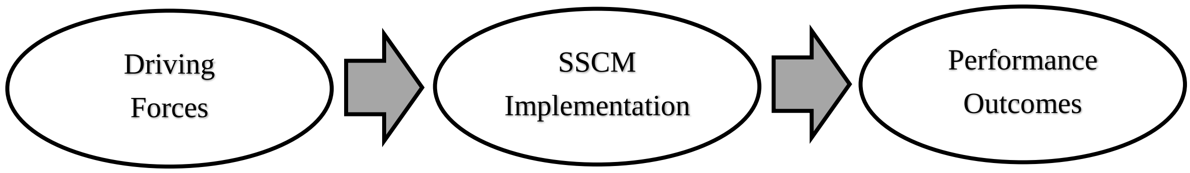


Figure 1.2 Research scope

1.4 Research questions

Despite recent developments in the SSCM literature, it is contended that there are considerable research gaps within the existing knowledge concerning the driving forces of SSCM implementation and also its associated consequences for firms' performance implications. The main research questions of this research project are formulated as follows:

> **RQ1:** Which factors both endogenous and exogenous to the firm need to be in place before SSCM practices are adopted?
>
> **RQ2:** What impact does the implementation of SSCM practices have on the environmental performance of the firm?
>
> **RQ3:** What impact does the implementation of SSCM practices have on the cost performance of the firm?

It is contended that there is a causal chain that brings the two sides of the research scope and the research questions together and further justifies the study choice. While the first side emphasises the idea that firms adopt SSCM practices for particular reasons, mainly external pressures and internal drivers, the second side further focuses on the consequences of the implementation of SSCM practices in terms of the environmental and cost performance of the firm. A holistic view surrounding firms' decision to continue the SSCM approach can be obtained by joining up these two strands, which delineates the future of the SSCM agenda. This will be further discussed in the next chapter.

1.5 Research objectives

The abovementioned research questions generate the study's overall aim of developing a conceptual SSCM drivers-practices-performance framework, focusing on the relationships between Driving Forces→SSCM Practices→ Performance Outcomes. In light of this overall aim and the study's research questions, the following objectives are central:

1. To identify the essential SSCM practices along with their associated driving forces.
2. To explore the relationships between SSCM driving forces, SSCM practices and environmental and economic performance.
3. To develop validated and reflective scales to measure the main research clusters of SSCM driving forces, SSCM implementation and performance outcomes.
4. To conceptualise and empirically assess a comprehensive SSCM drivers-practices-performance model.

This study seeks to answer the proposed research questions through the effective execution of the abovementioned research objectives.

1.6 Research plan

Having discussed the research background, the research gaps, the scope of this research and the research questions and objectives, this section goes on to outline the study's research plan, which enables the researcher to effectively conduct this research project to the desired end and completion point. Figure 1.3 depicts the research plan to achieve the study's main objectives.

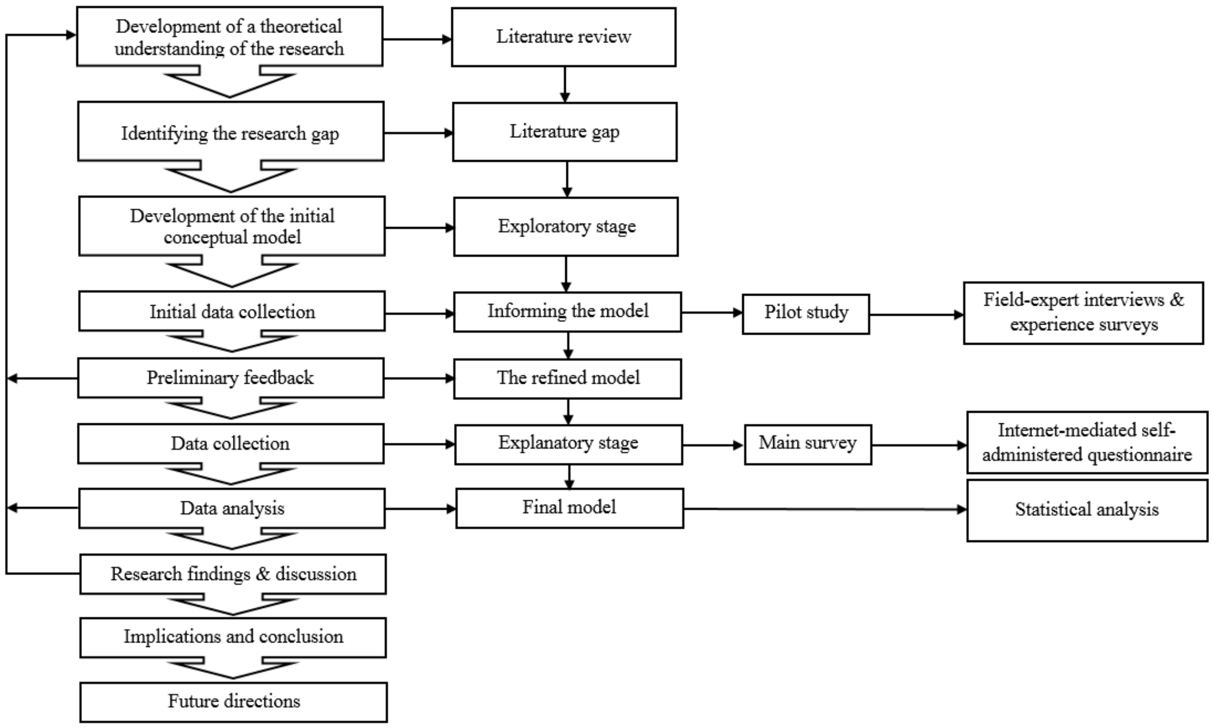


Figure 1.3 Research plan

1.7 Research delimitation

The boundaries of this study with respect to the sector and geographical area of analysis are presented in this section.

1.7.1 Sector of analysis

In this thesis, the sector of analysis is centred on sustainable supply chain management in a manufacturing context. The argument for choosing the manufacturing sector primarily lies in the fact that this is an area that has generated greater environmental challenges (Vachon and Klassen, 2008; Sarkis et al., 2010). The manufacturing sector has a significant role in sustainability performance, as it is largely associated with resource consumption and environmental damage on both the domestic and global scales (Kuik et al., 2011). In addition, manufacturers are broadly considered to be major polluters and resource consumers with a high capacity to provide negative environmental impacts (Inman et al., 2011). The manufacturing sector as a whole was adopted as the sector of analysis in this study to investigate whether the research phenomenon can mitigate environmental damages associated with this sector while achieving economic benefits. Generally, the manufacturing sector is more closely associated with environmental implications than sectors such as retail or services, due to its greater environmental damage (Preuss, 2001; Taylor and Taylor, 2013). Therefore, the manufacturing sector is seen as appropriate as an initial sector of analysis for this study.

However, the manufacturing sector is a broad area, and considering its diverse array of various industries, the SSCM approach may only be applied to a limited extent, given the complexity of this approach. In addition, the potential lack of green infrastructure in some manufacturing sectors may hinder essential SSCM initiatives being fully applied in all industries operating within the broad manufacturing sector (Zhu et al., 2010).

Therefore, in an attempt to further narrow the study's sector of analysis, the specific automotive industry was concentrated on, while not omitting the general focus on the broader manufacturing sector. The automotive industry was chosen for closer examination because it is both associated with greater environmental challenges and also fairly representative of the overall manufacturing sector, following its main principles (Nunes and Bennett, 2010; Bevis, 2011). According to Caniëlsa et al. (2013), Lin and Lan (2013), and Simpson et al. (2007), the automotive industry follows a set of characteristics, e.g. strong supplier, higher use of energy, high level of material usage, high level of waste, higher fixed costs, and highly cyclical, which forms key principles of the whole manufacturing industry. Thus, the automotive industry is deemed to be a fair representation of the manufacturing sector based on the contention that the characteristics of this industry are in line with the main principles of the average manufacturing sector. As regards newly emerging environmental concerns, automotive manufacturers are under more careful scrutiny in relation to their environmental impacts, such as emissions or waste generation, which further justifies the adoption of this sector for analysis (Lin and Lan, 2013; Luthra et al., 2014).

Furthermore, the choice of the automotive industry is also in line with the manufacturing focus of this study, as this sector is deemed to be one of the important sub-sets of the manufacturing industry, because its high-volume and heavy engineering features are consistent with the main characteristics and elements of manufacturing (Nunes and Bennett, 2010). Therefore, it can be a good representative of the broad manufacturing sector, as it encompasses the main manufacturing processes involved in the majority of the other manufacturing industries. It also comprises multiple other industries within itself, such as electronics, metal, plastics, rubber, etc. (Luthra et al., 2014). Collectively, the automotive industry is expected to be a fair representation of the average manufacturing sector as it relatively embraces other industries within itself. Moreover, from a practical perspective, sustainable initiatives are closely involved and also more tangible in the automotive industry, and thus SSCM implications can be thoroughly applied and assessed in this sector (SMMT, 2015). Hence, the automotive manufacturing sector is seen to be the appropriate sector of analysis for this study. A practical reason is also attached to the choice of automotive industry, which is mainly down to the high response rate of this industry compared to other manufacturing sectors within the pilot study. This will be discussed further in the pilot section in Chapter 4. Nevertheless, there are few other sectors such as chemical or food industry that can be studied in a SSCM context, opening up several future research avenues. This is acknowledged in the future research section within the last chapter.

In essence, the automotive industry comprises a product system that is directly and indirectly associated with economic wealth creation while effecting the natural and human environment along all stages of the product’s life cycle (Bevis, 2011). Automakers in general have a decisive influence on the aspects of product design and manufacturing, which are important in context of SSCM as each phase of a single car’s product life cycle carries with its related impacts on the human and natural environment (Koplin et al., 2007). Therefore, car manufacturers play a critical role for the environmental and societal development of our world within the SSCM context. There are various environmental standards and directives in this sector as car manufacturers and their associated suppliers are considered as the industry of high pollution and greater environmental challenges. These green standards include End-of-Life Vehicles (ELV), Restriction of Hazardous Substances (RoHS), Emissions Trading Scheme (ETS), Energy-Using Products (EuP), Waste Electrical and Electronic Equipment (WEEE), etc., which can alleviate negative environmental impacts of automakers' supply chains (Turner, 2007; Koh et al., 2012). These directives are developed for the purpose of reducing vehicle waste and enhancing the rate of vehicle recycling, targeting vehicle and its components, materials, fluids and repair materials (Lin and Lan, 2013).

Within a broader approach, Nunes and Bennett (2010) further highlights the relevance of the automotive industry in the context of traditional supply chain management. In support of this claim, they maintain that key SCM characteristics, i.e., cost, quality, flexibility, and delivery, are apparent in the automotive industry and can be empirically observed and effectively assessed, further justifying the study's sector of analysis. Moreover, the automotive industry is one of the few global industries that comprises numerous examples of customers requiring suppliers to meet minimum environmental standards (Simpson et al., 2007; Lin and Lan, 2013). The acquisition of inputs, i.e. purchased materials, components and other external input, in this sector accounts account for a high share of total expenditures, which is approximately 70 to 80 per cent of the total manufacturing cost (Nunes and Bennett, 2010; Caniëlsa et al., 2013). This renders the automotive sector one of the most supplier-dependent industries, further highlighting the relevance of this sector in the supply chain management context.

1.7.2 Geographical scope

The geographical area of analysis for this study is the UK. Sustainable supply chain management initiatives have been practised for more than a decade in the UK, receiving increasing attention among the UK manufacturing firms in recent years (Taylor and Taylor, 2013). The UK was chosen as the geographical setting for this study because of the regional importance of British manufacturers in terms of their share of Europe's total manufacturing outputs and resource requirements. In the resource-constrained environment of Europe, sustaining a reasonable level of resource consumption is crucial for British manufacturing to maintain limited resources for future generations. In addition, manufacturing in the UK, one of the highly influential regions inside Europe, the fourth largest manufacturing country within the EU (ONS, 2015), is crucial for the country's future prosperity, maximising environmental protection, performance gains and potential economic benefits. Moreover, following Sarkis et al.'s (2010) recommendation, the adoption of a single industry at a national level allows this research to isolate country-specific and sector-specific factors that may influence findings.

To further support the study's choice of geographical scope, it is contended that there is a reasonable level of the necessary knowledge surrounding SSCM agendas among UK manufacturers and the UK government. The ECO supply chain programme has been enacted by the UK government as a part of a larger programme on the UK's carbon footprint, promoting sustainability across the supply chain and also creating awareness of environmental protection among manufacturers (Bevis, 2011). During the past few years, the UK government, in order to promote sustainable supply chain initiatives such as sustainable distribution, has enacted stringent environmental regulations to limit the use of non-renewable resources such as diesel and petrol (Yu and Ramanathan, 2015). Apart from coercive actions, the UK government has also offered financial incentives such as grants and tax reductions to encourage manufacturers to further embark upon an SSCM agenda. For example, UK manufacturing firms using bio-fuels for their transportation systems can benefit from these types of financial incentive (SMMT, 2015). Hence, the geographical scope of the UK is applicable to this study, given the importance of environmental concerns and lack of resources as well as the sufficient understanding of the SSCM agenda within this region.

Furthermore, there are few industries within the UK as large, diverse and influential as the automotive industry. The UK automotive industry is the second largest single manufacturing sector in the UK, with product sales of £69.5 billion in 2014, representing approximately 14% of total UK manufacturing sales (SMMT, 2015). Another important aspect of the UK automotive industry that makes it influential is the fairly high number of jobs associated with this sector: there were 779,000 automotive jobs in 2014 (ONS, 2015). The British automotive market also represents 11% of overall UK exports (ONS, 2015). All these characteristics make this manufacturing industry even more environmentally and competitively sensitive from an SSCM perspective.

With respect to the SSCM context, this sector is rapidly improving its energy performance, and also improving its wider sustainability agenda. For example, compared to 2000, the amount of water used in the production process of each vehicle was down 49.1%, energy use per vehicle was down 48.1%, and most significantly the amount of waste sent to landfill was down 92.4% by 2014 (SMMT, 2015). Having made certain achievements, the UK automotive industry cannot afford to rest on its laurels, and the research aims to investigate the SSCM phenomenon within such a delimitation. Considering these characteristics that are relevant to the SSCM context and also the abovementioned arguments, the geographical scope of the UK is seen to be appropriate for this research.

1.8 Research significance

This study aims to advance the knowledge on sustainable supply chain management, specifically in terms of its impacts on firms' performance outcomes. The academic and practical significance of this study are respectively presented.

1.8.1 Academic significance

While prior research has explored the relationships between the adoption of SSCM practices and organisational performance (Geffen and Rothenberg, 2000; Zhu and Sarkis, 2004; Rao and Holt, 2005; Vachon and Klassen, 2008; Lee et al., 2012), recent emergent studies have started to throw doubt on this issue, questioning the previous findings concerning the positive impacts of SSCM practices on performance outcomes and instead offering mixed views (Walker and Jones, 2012; Shi et al., 2012). Therefore, it is argued that there is a lack of clarity within the existing knowledge concerning the impact of SSCM adoption on firms' performance. These uncertainties and ambiguities within the existing knowledge necessitate further empirical investigation. In addition, potential concern over the lack of consensus on the topic also calls for further research in this field.

On the other hand, current studies have neglected to include the effects of exogenous forces associated with regulations and endogenous factors associated with the firm's internal commitment when examining the relationship between the adoption of SSCM practices and performance outcomes. We argue that the existence of and response to such a bundle of driving forces will cause the relationships between SSCM practices and performance outcomes to vary. Hence, the notable absence of studies examining the relationships between adopting SSCM practices and performance outcomes that include the influential effects of antecedent driving forces encouraged this study to pursue further empirical investigation. This significantly distinguishes this study from existing research, as this is a first wave of empirical investigation taking into account the effects of driving forces associated with SSCM adoption when examining the impact of SSCM practices on performance outcomes.

This study makes a significant contribution to on-going research that relates sustainable practices along the supply chain to performance outcomes through the inclusion of driving forces associated with SSCM adoption, producing more credible findings and bridging the mixed views within the existing knowledge. This is also one of a few empirical studies that demonstrates an interrelation between performance outcomes, which has been overlooked in previous studies.

Another major significance of this study lies in its comprehensive and integrated perspective, which allows a thorough and rigorous empirical investigation of the impacts of SSCM adoption on performance outcomes. This research further contributes to the SSCM literature by integrating recently developed constructs into a framework using previous fragmented and disjointed studies to conceptualise a comprehensive SSCM drivers-practices-performance model. In effect, this investigation brings new insight into the SSCM field and clarifies existing knowledge on whether SSCM adoption can deliver both ecological and financial benefits. Hence, it is contended that the study is of academic significance.

1.8.2 Practical significance

Considering the complexities concerning the implementation of SSCM practices and the uncertainties about the benefits of such environmental initiatives, this thesis offers novel insights for practitioners on the SSCM agenda. In this respect, this study offers useful insights for both managers seeking to adopt SSCM practices and policy-makers and regulatory bodies seeking to further promote the SSCM agenda. Manufacturers are given managerial insights on how they can undertake environmental initiatives across their supply chain and successfully implement SSCM practices. In addition, policy-makers and legislators are given useful insights into how they can further motivate manufacturers to embark upon SSCM adoption.

Generally, the topic of SSCM with a focus on firms' performance outcomes is a relatively unexplored research area in the UK and has not been empirically studied, particularly within the UK automotive manufacturing industry, as existing studies primarily deal with anecdotal evidence and theoretical discussions (Shi et al., 2012; Yu and Ramanathan, 2015). Thus, this study is of practical significance, as it presents a first wave of empirical investigation concerning the impact of SSCM initiatives on British manufacturing firms' performance, offering managerial implications within this area.

Furthermore, practitioners are provided with a validated framework for assessing the synergistic impact of SSCM practices on their environmental and economic performance. The practical significance of this study can be further extended, as this thesis offers practical insights for manufacturing industries operating in a resource-constrained environment on how to convert their traditional supply chains into sustainable supply chains, mitigating environmental damage and achieving performance gains.

In addition, the SSCM initiatives validated in this work can help manufacturing firms operating in the UK to form a broader perspective within the EU to identify those areas of the supply chain that require improvement and the prioritisation of their green efforts. The key SSCM initiatives can serve as an audit tool and later on a benchmarking tool for managers to evaluate the perceptions of SSCM in their organisations, furthering the practical significance of this study. Therefore, it is contended that the study is of practical significance as well.

1.9 Research methodology

1.9.1 Research purpose and research philosophy

This study is considered to be an explanatory research project in regard to the core research constructs covering the main clusters of the research phenomenon which form the research model. Explanatory research is generally deemed to be a valuable means of finding out ‘what is happening?’ or ‘what is the impact?’, seeking to explain cause-and-effect relationships between certain research phenomena (Bryman and Bell, 2015). This study also includes an examination of the causal relationships of three main research clusters: driving forces associated with SSCM adoption, SSCM implementation and commensurate performance outcomes, using a sampling frame from one sector within a particular geographical scope. Hence, the explanatory approach, amongst other types of research, i.e. exploratory and descriptive, is found applicable to this study and considered an appropriate research purpose.

This study also adopts a positivist approach based on deductive logic, which has recently become a very popular perspective in social science and in operations and supply chain management studies in particular (Saunders et al., 2009; Soni and Kodali, 2012). The positivism paradigm is considered an appropriate philosophical stance for this study, as we believe the research phenomenon within the social world can be subjected to the same methods of investigation as the physical sciences and can be observed and examined empirically. This research project was therefore conducted under the positivist paradigm with a mono quantitative method.

1.9.2 Research method and research approach

Considering the main research objective of developing hypotheses and the research model, the quantitative method of the survey was employed and considered appropriate as it can facilitate the empirical examination of the hypotheses and research model. The qualitative method was excluded for use in this research because the research objective was not centred on exploring in-depth knowledge of particular phenomena (Bryman and Bell, 2015).

This study also employs the deductive reasoning approach, which develops hypotheses from existing knowledge and tests them through empirical observations (Saunders et al., 2009). Following this approach, the causal relationship model was conceptualised by a thorough review of contemporary literature surrounding the research phenomenon, working from the general to the specific. Thereafter, an Internet-mediated survey of SSCM drivers-practices-performance was conducted to obtain the required data and information to test the proposed research hypotheses. The research model was then empirically assessed using the Structural Equation Modelling (SEM) method, a sub-set of multivariate methodology (Hair et al., 2010). Furthermore, a SEM analysis was carried out to examine the individual hypotheses of relationships between the research constructs using LISREL software version 8.80.

1.10 Research structure

This section discusses the overall structure of this thesis in terms of the chapters and the main points presented within each chapter. This thesis is organised into seven chapters: introduction, literature review, conceptual development, methodology, analysis and results, discussions and conclusions. Figure 1.4 portrays the structure of the chapters in this thesis.

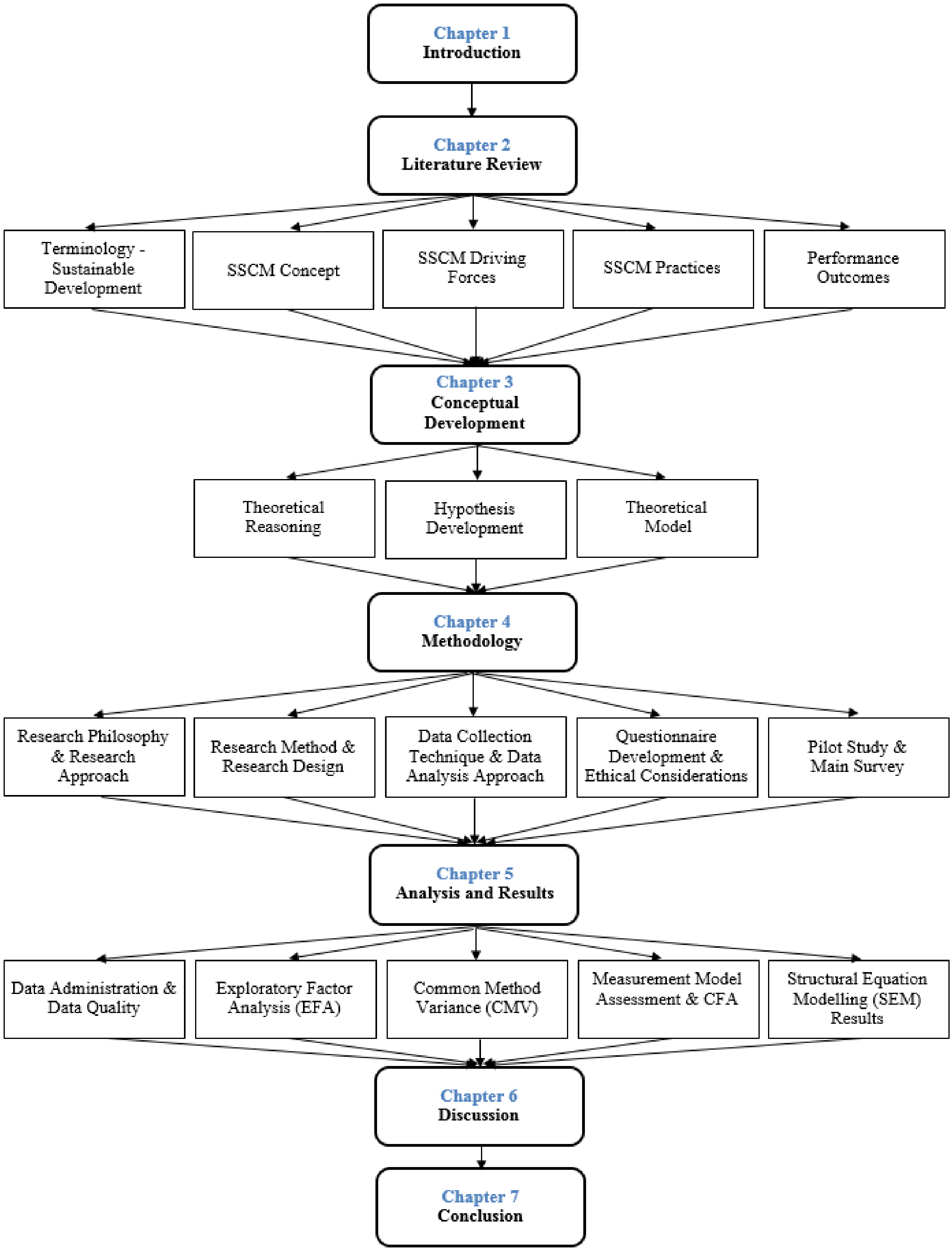


Figure 1.4 Research structure

Drawing on Figure 1.4, Chapter 1 (Introduction) presents the overview of the thesis. This chapter starts with the background of the research phenomenon and identifies the research gaps within the existing literature. Chapter 1 goes on to present the scope of the study, the research questions, the objectives of the study, the research plan, the research delimitation including the sector and geographical area of analysis, and the significance of the study. This chapter concludes with the research methods used in this thesis along with the overall structure of the thesis.

Chapter 2 (Literature Review) reviews the relevant literature surrounding the research topic and provides a theoretical background on the main research clusters covering the research phenomenon. This chapter begins with a brief theoretical background on the field of SCM and its key activities and processes, and also addresses how SCM has shifted its focus to sustainability. This is followed by an outline of the theoretical understanding of the SSCM concept along with its terminology and core components. The main research clusters relevant to the research phenomenon are emphasised: SSCM driving forces, implementation of SSCM practices and its commensurate performance outcomes. Thereafter, this chapter presents theoretical discussions on each of these research clusters, providing a theoretical foundation on various segments of the research phenomenon. Accordingly, this chapter builds the SSCM driving forces, SSCM practices and SSCM performance research clusters and develops their relevant dimensions. This synthesis of the main research clusters aids this study in achieving its primary objective of developing a robust conceptual SSCM drivers-practices-performance framework to effectively answer the research questions. Overall, this chapter attempts to provide the theoretical foundation for the integrated research phenomenon, and based on this foundation, the research framework is conceptualised.

In Chapter 3 (Conceptual Development), the integrated SSCM drivers-practices-performance model is presented. This chapter discusses the theoretical linkages between the three main research clusters of SSCM key driving forces, implementation of SSCM practices and performance outcomes. Furthermore, Chapter 3 discusses how the theoretical model was conceptualised with a focus on antecedents and outcome effects and how the research constructs were embedded into the model. The chapter then presents the hypothesis development concerned with the effects of Driving Forces→SSCM Practices→Performance Outcomes, and expounds on how each individual hypothesis was proposed. Chapter 3 finishes with the research model and the definition of the research constructs.

Chapter 4 (Methodology) describes and justifies the core methodology used in this thesis, including the research philosophy, the research approach, the research strategy, the research design and the research method, forming the 'research onion' of this thesis. This chapter goes on to present the questionnaire development in detail, including the choice of questionnaire and the design of the questionnaire structure. This is followed by the development of the measurement scale and the rationale for using primary data in this thesis. Chapter 4 also discusses the sampling strategy adopted in this study along with the ethical considerations. The chapter concludes with details of the pilot study and the main survey.

Chapter 5 (Analysis and Results) describes and justifies the proposed data analysis approach of Structural Equation Modelling (SEM) and contains the descriptive results of the research findings. This chapter presents the various analyses concerning the common method bias, scale assessment processes and measurement model assessment. Chapter 5 then concludes with the Structural Equation Modelling results and also reports whether the proposed hypotheses are supported or rejected.

Chapter 6 (Discussion) discusses the findings of the study. This chapter draws on the findings for each proposed hypotheses in detail, informed by the results presented in Chapter 5. Chapter 6 provides critical discussions with respect to the research questions, expounding on the causal relationships between the driving forces of SSCM and adoption of SSCM practices, followed by discussing the theoretical relationships between SSCM implementation and performance outcomes. This chapter further discusses whether the findings of each of the hypothesised relationships are in line with existing studies and also explains the rationale where inconsistent results exist. An overview of theoretical views of SSCM driver-practice-performance elicited from this empirical investigation is then presented. The chapter finishes by addressing the noteworthy theoretical, methodological and empirical contributions of this thesis.

Finally, Chapter 7 (Conclusions) revisits the research objectives and summarises the answers to the research questions, concluding the findings of this study. This chapter also presents the study's main contributions along with the key managerial implications elicited from this research investigation. Chapter 7 finishes with the research limitations and recommends future directions offering further research opportunities.

1.11 Chapter summary

This chapter has provided an overview of the research context, covering the background of the research phenomenon, the research gaps found in the current literature, the scope of the study, primary research questions, main objectives of the study, and the research plan to effectively achieve these objectives. The research objective and research questions have been presented and their formulation discussed. Thereafter, the research delimitation has addressed and discussed why the UK automotive manufacturing sector is theoretically appropriate and practically significant in the research context. In addition, the research importance has been discussed in terms of academic and practical significance. We have presented why the chosen research phenomenon is worthy of empirical investigation at a PhD level and how it can theoretically and practically contribute to existing knowledge. Furthermore, the philosophical and methodological stances adopted in this thesis have been briefly explained and justified. Finally, this chapter has illustrated the overall structure of the thesis, covering the main points presented within each chapter.

Overall, Chapter 1 (Introduction) was intended to provide the foundation for this thesis, and based on this foundation, the next chapter will discuss the concept of sustainable supply chain management (SSCM) and its three relevant research clusters: SSCM driving forces, implementation of SSCM practices and SSCM performance outcomes. The position of this chapter in the thesis is depicted in Figure 1.5.

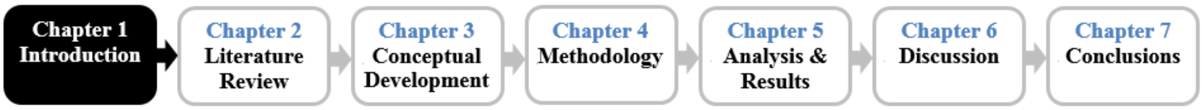


Figure 1.5. Position of Chapter 1 in this thesis

Before finishing this chapter it is worth mentioning that a certain level of iteration should exist in any PhD research project, demonstrating the consistency of the research process and its logical flow (Phillips and Pugh, 2005). With this in mind, this thesis attempts to narrate the study's progress from the starting point to the completion point with a reasonable level of iteration, presenting both the consistency of the research process and its logical flow.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter is broadly concerned with the overview of the literature surrounding the topic of sustainable supply chain management (SSCM). The primary aim of this chapter is to review the relevant literature to provide the theoretical background regarding the research phenomenon. Given the multi-disciplinary and integrated nature of the research phenomenon, this chapter seeks to explore and develop the main research clusters surrounding the research topic that are capable of addressing key issues related to the proposed research questions. As previously discussed, the primary objective of this research is to develop and empirically assess a conceptual framework of SSCM drivers-practices-performance, and to accomplish this, the relevant research clusters should be presented and synthesised.

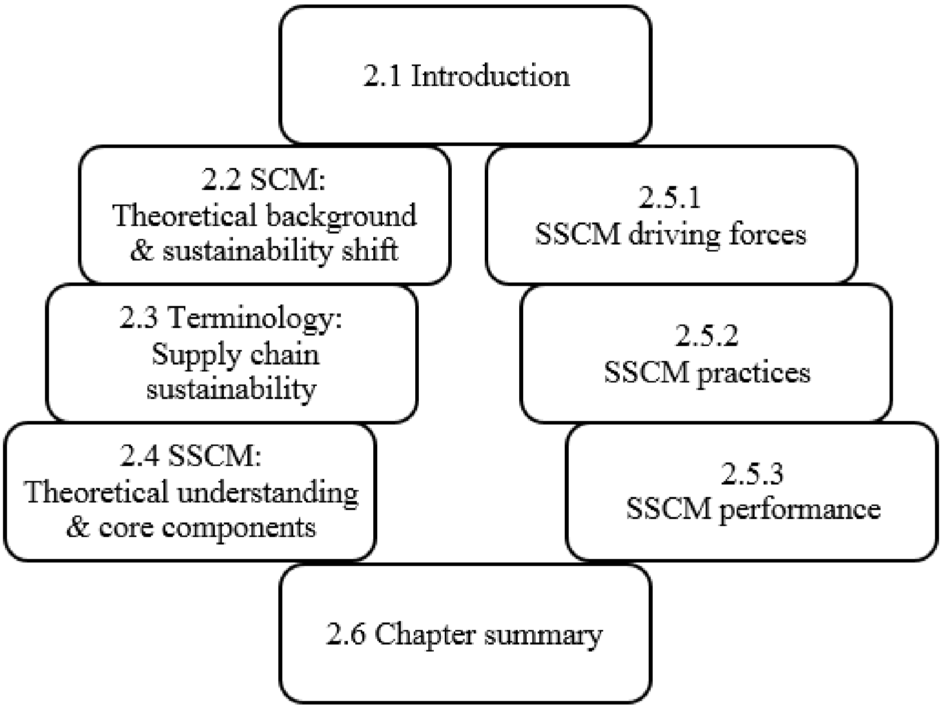


Figure 2.1 Structure of Chapter 2

As depicted in Figure 2.1, this chapter begins by providing a theoretical background for supply chain management (SCM), discussing its main activities and how it has shifted its focus to sustainability. In Section 2.3, the basic terminology concerning supply chain sustainability is presented, distinguishing the concepts of GSCM and SSCM. Section 2.4 provides a theoretical understanding of the SSCM concept and discusses its core components. In Section 2.5, the main research clusters relevant to the research topic are emphasised, covering the various integrated aspects of the research phenomenon. The main research clusters of SSCM driving forces, SSCM practices and SSCM performance are proposed with relation to the research questions. Thereafter, an overlapping literature approach is employed to synthesise these three main research clusters for the purpose of achieving the research objectives and answering the research questions. This approach also demonstrates where this research stands within the boundaries of SSCM knowledge.

This chapter then presents theoretical discussions for each of these research clusters, providing theoretical foundations for the research phenomenon. Section 2.5.1 addresses the major triggers for adopting SSCM and develops the research cluster of SSCM driving forces, describing exogenous forces and endogenous factors that give rise to SSCM adoption. Section 2.5.2 develops the research cluster of SSCM practices through a synthesis of pertinent SSCM literature concerning the essential sustainable practices required for effective SSCM implementation. In this regard, a systematic review approach of SSCM literature is employed to explore and identify essential SSCM practices. This approach not only provides a better understanding of SSCM initiatives and guides this study to more broadly view the boundaries of SSCM knowledge, but also allows it to develop relevant dimensions representing the SSCM practices and driving forces clusters. Section 2.5.3 provides theoretical discussions on performance outcomes associated with SSCM adoption to develop the third research cluster. Theoretical understanding concerning triple bottom line (TBL) principles is presented, and SSCM performance dimensions are then developed based on the TBL theoretical foundation. Finally, Section 2.6 summarises this chapter.

The synthesis of the main research clusters permits this study to achieve its primary objective in developing a robust conceptual framework of SSCM drivers-practices-performance and effectively answering the research questions. Overall, this chapter intends to provide the theoretical foundation for the integrated research phenomenon so that the conceptual framework can be built and developed. The position of this chapter in the thesis is illustrated in Figure 2.2.

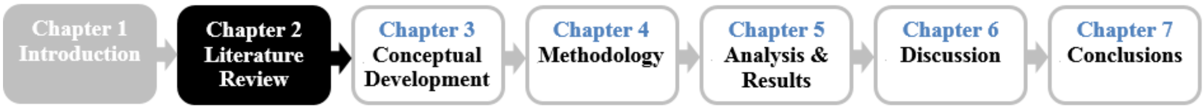


Figure 2.2 Position of Chapter 2 in this thesis

2.2 Supply chain management (SCM)

Before providing theoretical discussions on the research phenomenon, we will briefly present background on the concept of SCM, which is used in this study as the research foundation towards adopting the concept of SSCM. The field of SCM is an integrated and interdisciplinary topic that has continuously evolved to become a discipline in its own right rather than pure descriptive studies (Carter and Ellram, 2003; Storey et al., 2006). According to Slack et al. (2010), a supply chain is regarded as a logistic channel that provides the means of acquiring information, products and services through manufacturers or suppliers to end-customers in the most efficient way. It involves the operations within organisations that are either directly or indirectly linked in order to provide products and services to end-customers (Harrison, 2001). There are several definitions for SCM in the literature, but this thesis adopts the most widely used and most often quoted definition of SCM presented by Handfield and Nichols (1999, p. 2):

"Supply chain management is 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 systemwide costs while satisfying service level requirements."

In essence, SCM can be described as the parallel management and coordination of a complex network of processes involved in providing the end-user with products or services in the most efficient and cost-effective manner possible (Storey et al., 2006). The processes involved include the sourcing and inventory of raw materials and parts, work in process, manufacturing and product assembly, order entry and tracking, transportation and distribution, and finally delivery of finished goods to end-users (Handfield and Nichols, 1999; Lambert and Cooper, 2001). The abovementioned definition of SCM was adopted because it permits this study to effectively address key sustainable initiatives across the supply chain and discuss how they are developed and operationalised within the SCM context. The comprehensive terminology of SCM is used in this study as an umbrella term for the different set of approaches and principles of SSCM, which will be discussed in the following sections.

Generally, SCM seeks to manage relationships and business activities amongst three key members of the supply chain, i.e., the focal firm, supplier and customer, with the objective of being efficient and cost-effective across the entire supply chain (Croxton et al., 2001). According to the literature, there are four main activities involved in SCM: purchasing, production, distribution and financial affairs (see Figure 2.3). These main activities are either directly or indirectly linked to the key members of the supply chain, which necessitates establishing a good relationship between these parties that may ultimately lead to a win-win situation for all (Harrison, 2001; Bratic, 2011). The way in which these main activities are managed between the focal firm, suppliers and customers determines the efficiency and overall success of the supply chain (Storey et al., 2006). It should be noted that the main activities of

SCM depicted in Figure 2.3 were designed from the perspective of a manufacturing firm positioned in the middle of the supply chain (Croxton et al., 2001). Moreover, similar to the existing literature, the focal firm within the context of SCM is referred to as the manufacturer in this study (Zhu et al., 2010, Kuik et al., 2011; Taylor and Taylor, 2013).

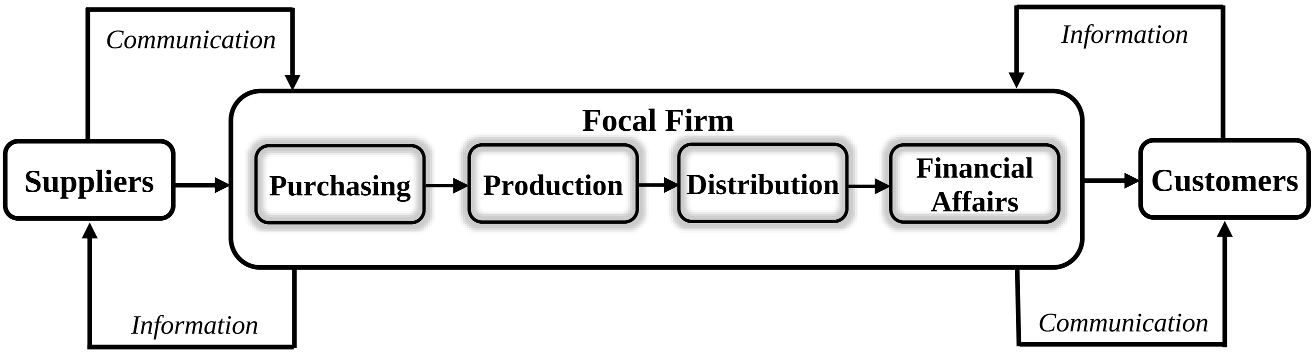


Figure 2.3 Main activities involved in SCM (Bratic, 2011; Anderson et al., 1997)

Drawing on Figure 2.3, purchasing activity refers to the task of acquiring goods or services to fulfil the goals of a firm (Lambert and Cooper, 2001). According to Storey et al. (2006), purchasing activities occur across the entire supply chain, and effective management of these activities can lead to cost reductions and help maximise efficiency. Production activity refers to the process of combining material inputs, i.e. raw materials or parts, and immaterial inputs, i.e. know-how or plans, to create outputs, i.e. goods or services, that have a value for the end-user (Harrison, 2001; Slack et al., 2010). Effective management of the processes involved in production can result in a higher level of efficiency across the supply chain (Lambert et al., 1998).

Furthermore, distribution activity refers to the process of making merchandise or a service available to the end-user using either direct or indirect means (Handfield and Nichols, 1999). This activity is also referred to as logistics and is broadly concerned with the transporting, warehousing and distribution of goods or services (Stock and Lambert, 2001). Optimisation of distribution and storage processes can enhance efficiency levels and help to achieve cost savings across the supply chain (Storey et al., 2006). Finally, financial affairs receives plenty of attention from most firms as it allows them to determine their true profitability by identifying the actual costs of activities involved in the chain, particularly from the customer's perspective (Bratic, 2011). It also deals with sales and marketing essentials, which are often the focus of business enterprises where all activities across the SCM can be turned into monetary value (Croxton et al., 2001).Although the body of knowledge on the SCM field is elaborate, its performance implications remain under-researched with respect to the industrial sustainability context (Handfield et al., 2005; Pagell and Wu, 2009; Zhu et al., 2012), the area to which this study seeks to contribute.

2.2.1 The sustainability shift in the supply chain

Having discussed the theoretical background of SCM necessary to establish the foundation of the research phenomenon, this section moves on to discuss how this concept has shifted its focus towards sustainability, setting up the SSCM topic. Traditional SCM has gradually evolved from being a concept that solely addresses economic and operational issues to being one that comprehensively embraces the broader social, economic and environmental matters associated with a firm's supply chain (Sarkis, 1999; Emmett and Sood, 2010; Carter and Easton, 2011). This is driven by a multitude of isomorphic drivers and pressures that push firms' traditional supply chains to be more responsible with respect to social and environmental issues (Diabat and Govindan, 2011). Figure 2.4 illustrates the evolution of SCM towards sustainability and the emergence of SSCM.

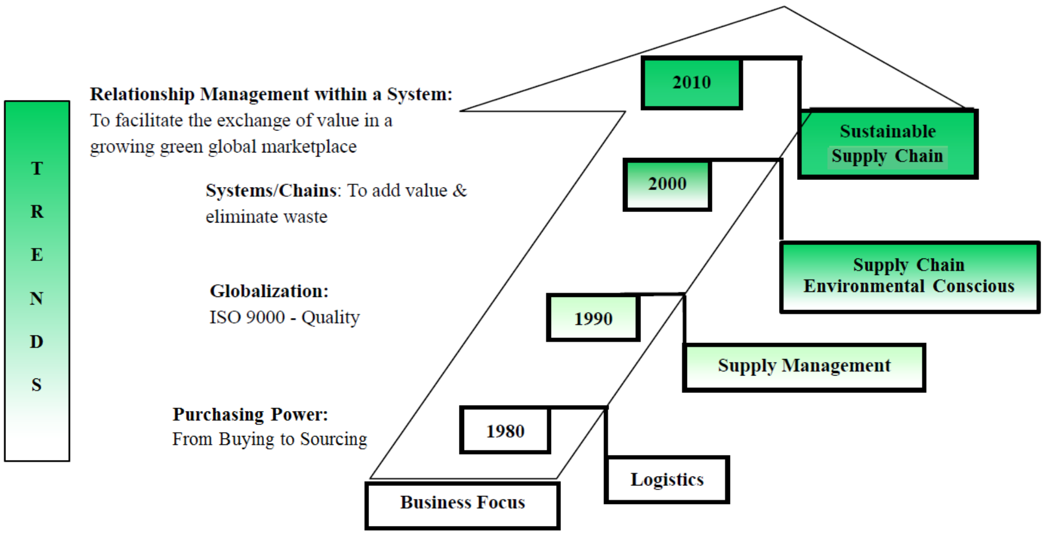


Figure 2.4 Supply chain sustainability revolution (Adapted from Gilbert, 2001)

According to Srivastava (2007), business enterprises gradually started to become more environmentally conscious from the late 1980s when the quality and supply chain revolutions occurred. During this era, high-volume production was established using command and control logic in machinery and assembly lines (Nahm and Vonderembse, 2002; Tu et al., 2001). However, such high-volume production resulted in a corresponding growth in serious environmental problems caused by the supply chain, such as pollution, solid or effluent waste, emissions and so forth (Vonderembse et al., 1997). These environmental problems driven from the traditional supply chain further led to broader negative environmental impacts, including acid rain and global warming in particular (Moffatt, 2004; Sarkis, 2006). These serious environmental concerns have forced policy-makers and business enterprises to move towards a post-industrial approach that balances economic performance with environmental issues (Doll and Vonderembse, 1991; Nahm and Vonderembse, 2002).

Furthermore, coming through the 1980s and into the 1990s, societies gradually became more modernised and affluent (Skinner, 1985), which led to heightened customer expectations of products, demanding better quality, greater variety, enhanced availability and, more recently, environmentally friendly products (Carter and Easton, 2011; Nelson et al., 2012). Such changing market conditions influenced by diverse stakeholder groups, including end-customers, regulators and competitors, caused a paradigm shift from industrial systems focusing only on mass-production and economic objectives to post-industrial systems focusing on developing environmentally friendly products and social and environmental objectives (Nahm and Vonderembse, 2002; Nelson et al., 2012). These consequential changes established the foundation for the transition of traditional SCM towards SSCM (Moore and Babu, 2008). Consequently, conventional SCM has shifted its focus from traditional economic objectives to a comprehensive approach that seeks to simultaneously take social, economic and environmental matters into consideration (Emmett and Sood, 2010; Sarkis, 2012).

Having discussed the important role of the post-industrial society in supply chain sustainability shifts, it is also worth mentioning the critical role of natural resources in this shift. Organisations, and manufacturing firms in particular, have come to realise that a substantial amount of environmental risks exist throughout their supply chains, especially with respect to natural resources (Seuring and Muller, 2008a; Zhou et al., 2008). Global growth in human population continues to put an appreciable pressure on the available natural resources around the globe, which are gradually diminishing (Srivastava, 2007; Lu et al., 2007). Therefore, appropriate use of natural resources is highly critical and may ensure the availability of natural resources for future generations (Moffatt, 2004). The scarcity of natural resources has pushed governments to impose environmental laws on manufacturing firms, particularly with respect to their activities associated with their supply chains (Sarkis et al., 2010). This focus on the supply chain context is due to the fact that processes involved in a supply chain are directly linked with environmental impacts and the use of natural resources (Sarkis, 2006; Emmett and Sood, 2010). Srivastava (2007) endorses this further and asserts that the main activities of SCM involve the exploitation and extraction of natural resources. Thus, the scarcity of natural resources is deemed to have played a key role in the supply chain sustainability shift.

Overall, in response to community pressures and heightened customer demand for products that are environmentally sustainable, alongside concern about the scarcity of natural resources, firms have incorporated sustainable inputs into their supply chains to provide more sustainable products or services (Lewis and Gretsakis, 2001; Seuring and Muller, 2008a; Sarkis et al., 2010). This has indeed led to a paradigm shift from the traditional supply chain to the sustainable supply chain approach that not only accounts for economic objectives but also for social and environmental matters (Sarkis, 2001; Carter and Rogers, 2008). Accordingly, SCM has evolved to include boundary-spanning activities such as sustainable procurement (Zsidisin and Siferd, 2001), sustainable manufacturing (Seuring and Muller, 2008b), product stewardship (Snir, 2001), sustainable distribution (Vachon and Klassen, 2006) and reverse logistics (Mollenkopf et al., 2007).

It is our belief that the emergent concept of sustainable supply chain management is an important topic that is worthy of research, considering the increasing attention and interest of academia and professionals that has been evidenced across published studies (Matos and Hall, 2007; Sarkis et al., 2010; Hsu et al., 2013; Tritos et al., 2013; Brandenburg et al., 2014; Zhu et al., 2012; Tseng et al., 2015; Green et al., 2015). However, despite all of the abovementioned drivers and incentives, there are still barriers to the successful implementation of SSCM, including the complexity of coordinating various proactive practices, potential costs and the lack of a sufficient understanding of sustainable initiatives along the supply chain. While appreciable efforts have been made by both practitioners and academics to tackle these barriers, further development of SSCM initiatives is required (Linton et al., 2007; Walker et al., 2008; Carter and Easton, 2011 Govindan et al., 2014).

2.3 Terminology concerning supply chain sustainability

2.3.1 SSCM vs. GSCM

Existing studies have extensively addressed the notion of sustainability within the SCM context and presented two widely used terminologies (Ashby et al., 2012): sustainable supply chain management (SSCM) and green supply chain management (GSCM). It should be noted that some other terms exist in the literature addressing sustainability issues in SCM that are not universally applied. Besides this, there are several overlapping concepts within these two terminologies, highlighting the need to distinguish between the terminologies and explain which is appropriate for this study.

GSCM is defined as the practice of monitoring and improving environmental performance within the supply chain context which only supports environmental sustainability across the supply chain (Zhu and Sarkis, 2004; Emmett and Sood, 2010; Wang and Gupta, 2011). The terminology for the GSCM concept along with its many elements has had many variations over time. However, most of these varied definitions of GSCM are specifically centred on environmental activities involved across the supply chain (Sarkis, 1999; Gilbert, 2001). According to Emmett and Sood (2010), the green supply chain aims to incorporate environmental criteria and considerations into activities associated with a firm’s supply chain. The ultimate goal of GSCM is to enhance the environmental performance of the supply chain by reducing negative environmental impacts (Srivastava, 2007; Esty and Winston, 2009).

On the other hand, sustainable supply chain management (SSCM), which is a more generic and comprehensive term, not only supports environmental sustainability but also supports economic and social sustainability throughout the entire supply chain (Carter and Rogers, 2008; Davis and Markley, 2007; Linton et al., 2007; Seuring and Muller, 2008a; Walker and Jones, 2012). Generally, SSCM is regarded as a synergistic conflation of corporate social responsibility, environmental management and SCM (Pagell and Wu, 2009; Carter and Easton, 2011). The notion of SSCM encompasses the inclusion of environmental considerations along with economic objectives and social matters within the SCM context (Yuang and Kielkiewicz-Yuang, 2001; Svensson, 2007; Kuik et al., 2011).

According to Carter and Rogers (2008), the sustainable supply chain management concept aims to take into consideration the core dimensions of sustainable development, i.e. environmental, social and economic, in managing activities within a firm's supply chain. The SSCM approach deals with social matters, economic objectives and ecological issues associated with firms' supply chain activities (Seuring and Muller, 2008a; Carter and Easton, 2011). Overall, SSCM seeks to establish social, economic and environmental sustainability towards operations and SCM with the purpose of enhancing firms' performance outcomes.

It should be noted that GSCM and SSCM are interchangeable in different contexts given the broad scope of sustainability where various concepts are addressed from different perspective (Ashby et al., 2012). However, the majority of existing studies assert that the GSCM concept mainly deals with environmental activities, while the SSCM concept accounts for environmental, social and economic objectives (Gilbert, 2001; Zhu and Sarkis, 2004; Linton et al., 2007; Pagell and Wu, 2009; Svensson, 2007; Seuring and Muller, 2008a Carter and Easton, 2011; Tseng et al., 2015).

This study adopts the terminology of SSCM owing to the comprehensive nature of this concept that simultaneously embraces the social, economic and environmental dimensions (Ashby et al., 2012). The SSCM approach, unlike GSCM, is capable of addressing social, environmental and economic implications throughout the whole supply chain at the same time (Carter and Easton, 2011). In addition, the adoption of SSCM terminology enables this study to meet the core research objective in exploring the relationships between sustainable supply chain management practices and their commensurate performance outcomes at both the environmental and cost levels. From a holistic perspective, SSCM has its roots in the sustainable development dimensions in which the foundation of this study is rooted, encompassing the social, economic and environmental domains (Blewitt, 2014). The notion of sustainable development and how its dimensions relate to this study is presented in the following section.

2.3.2 Sustainable development

This section describes the notion of sustainability and provides a brief introduction to the core dimensions of sustainable development. The term sustainability used in this study is of a broad nature and has been widely addressed from different perspectives and purposes, and is deemed as a non-monolithic research agenda that includes multi-disciplinary approaches (Rogers et al., 2007). The notion of sustainability has become pivotal in operations and SCM, as it is closely associated with the main activities involved in this area and is also highly tangible in this context (Seuring and Muller, 2008a; Carter and Easton, 2011). Furthermore, the SSCM approach has its roots in the concept of sustainable development and follows its core dimensions, integrating environmental, economic and social issues throughout the supply chain. Thus, it is necessary to provide a clear definition of this concept, which is widely used in this study. The World Commission on Environment and Development (WCED) (1987, p.8) has presented the most often quoted and most adopted definition of sustainability:

"Development that meets the needs of the present without compromising the ability of future generations to meet their needs."

It is widely recognised that the WCED's broad concept of sustainable development integrates social, environmental and economic objectives, constituting environmental sustainability, social sustainability and economic sustainability (Rogers et al., 2007). Environmental sustainability includes the approach of making decisions and taking actions such that they have the least negative environmental impacts possible (Blewitt, 2014). It urges the conservation and protection of the natural and non-renewable resources, which our society and economy depend upon (Carter and Rogers, 2008). This ensures that natural systems continue to generate and maintain natural resources for future generations. In the SCM context, environmental sustainability is closely associated with the consumption of energy and other resources within manufacturing firms, as well as the footprint that is left behind as the result of their operations (Emmett and Sood, 2010).

Social sustainability is generally about enhancing social and ethical values associated with a firm's activities (Carter, 2004). It leads enterprises to be responsible for their operations and business activities demonstrating their ethical behaviours (Zhu et al., 2013). It also requires firms to provide equally opportunities, promote social connectedness within society and take actions in the interests of the labour force and community (Rogers et al., 2007). Social sustainability encompasses external communities, i.e. people in society, and internal communities, i.e. personnel (Gimenez et al., 2012). Furthermore, social sustainability often involves society-related activities such as labour rights, social equity, corporate social responsibility (CSR), human rights, health equity, social support, quality of life and community development (Rogers et al., 2007; Blewitt, 2014; Elkington, 1998). Engaging in such social activities can improve firms' social reputation and corporate image and ultimately enhance their social performance (Fombrun, 2005).

The concept of economic sustainability is well understood and straightforward and is about making sure that the business is functioning profitability while its operation is not creating negative social and environmental impacts (Rogers et al., 2007). In essence, economic sustainability endeavours to undertake traditional economic objectives while taking into account their social and ecological implications (Carter and Rogers, 2008). It also involves a process of using the available resources at a firm's disposal to their best advantage (Blewitt, 2014). In addition, it urges optimal use of the available resources in a responsible and efficient way which may eventually provide long-term benefit. Thus, economic sustainability calls for establishing profitability over the long term (Barbier, 1987).

In summary, this section has provided a clear definition of sustainability, which is widely used in this study, discussing the key dimensions of sustainable development, social economic, and environmental in which the SSCM concept has its roots.

2.4 Sustainable supply chain management (SSCM)

The concept of SSCM has increasingly become a popular topic among both practitioners and academics, due to various factors supporting its acceptance and favouring its adoption such as stockholder requests, heightened customer expectations, governmental legislation, social pressures on corporate image and reputation, competitor pressures, environmental concerns about pollution and the scarcity of natural resources, and so forth (Sarkis et al., 2010; Zailani et al., 2012; Hsu, et al., 2013). During the past few decades, firms have been trying to come to an approach that simultaneously deals with the economic, social and environmental challenges associated with their supply chains (Carter and Easton, 2011). The SSCM approach can furnish firms of all sizes and segments with the successful integration of social, economic and environmental considerations, which is today deemed to be a key strategic issue for competing in the growing international marketplace (Seuring and Muller, 2008a; Carter and Rogers, 2008).

In essence, SSCM incorporates the principles of environmental management, corporate social responsibility and SCM with the purpose of mitigating environmental damage while achieving performance gains (Linton et al., 2007; Tseng et al., 2015). Carter and Roger (2008, p. 368) use the complementary definition of SCM and an extensive review of the sustainability literature to introduce their definition of SSCM:

"The strategic integration and achievement of an organisation's environmental, social and economic goals in the systematic coordination of key inter-organisational business processes for improving the long-term performance implications of the focal firm and its supply chains."

SSCM, which is based on the sustainable development dimensions, is conceptualised and depicted in Figure 2.5.

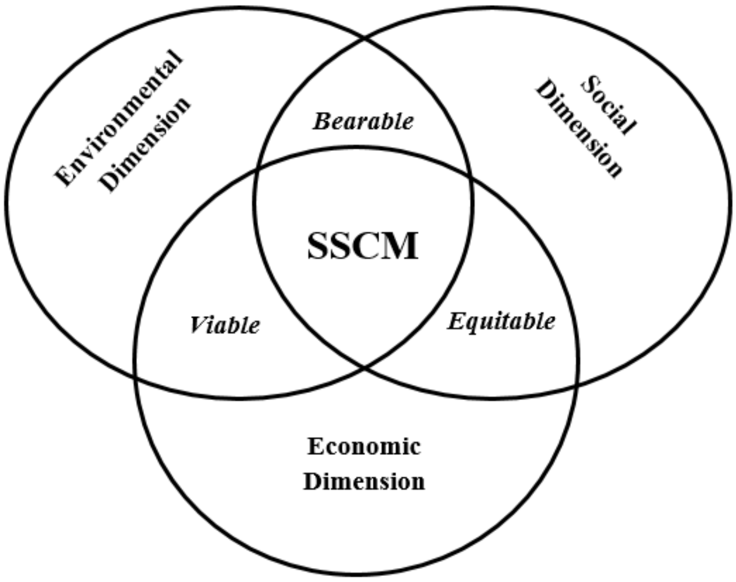


Figure 2.5 Conceptualisation of SSCM (Carter and Rogers, 2008)

We adopted this conceptualisation of SSCM, which from a holistic perspective, establishes the foundation of the sustainability notion within the supply chain context in this research. The intersection of the social, environmental and economic dimensions of this conceptualisation represents a potentially powerful means of conveying what sustainability, at a broader level in general and within a supply chain setting in particular, means for an organisation (Carter and Rogers, 2008). SSCM endeavours to undertake social and environmental activities associated with the supply chain, with a broader consideration of the firm's overall economic objectives (Matos and Hall, 2007). It directs firms to identify and engage in environmental and social activities falling inside the aforementioned intersection, which will improve or at least not harm the economic performance (Carter and Easton, 2011).

Drawing on Figure 2.5, the intersection of the environmental and social domains is labelled ‘bearable’, which omits the economic component. Colby et al. (1995) argue that it is very easy for manufacturing firms to save energy if they just turn off all the lights and shut down their production line, but that is not exactly bearable. Firms are encouraged to undertake environmental and social initiatives with the broader consideration of the overall economic objectives of the firm (Rogers et al., 2007). Walley and Whitehead (1994) state that it has always been claimed that responding to environmental and social-environmental challenges can be costly and complicated. For instance, in terms of using natural resources, it is not equitable to reduce energy costs by spending a substantial amount of money on energy efficiency or renewable energy resources which may risk a firm’s overall financial status. Therefore, it is important that firms undertake environmental initiatives in an equitable sense that will hopefully help, or at least not harm, the economic goals of the firm. Furthermore, Porter and van der Linde (1995) advocate that undertaking environmental and social initiatives can result in long-term improvement in the economic performance if such an undertaking remains viable for the firm.

Overall, the environmental, social, and economic dimensions form various sub-intersections, ‘bearable’, ‘equitable’ and ‘viable’, and it is contended that SSCM falls into the core intersection at the centre. We argue that, from a holistic perspective, the SSCM concept simultaneously addresses environmental, social and economic objectives within the supply chain context. It represents the core intersection of the conceptualisation shown in Figure 2.5, and causes the firm to endeavour to undertake economic, social, and environmental initiatives associated with the supply chain in a bearable, equitable and viable way (Carters and Rogers, 2008). Hypothetically, such bearable, equitable and viable undertakings may provide a ‘win-

win' opportunity with environmental protection and economic benefit (Zhu et al., 2013). This promises to allow firms to not only survive but to thrive when undertaking environmentally and socially related supply chain initiatives, as long as these undertakings follow the bearable, equitable and viable approach (Carters and Easton, 2011).

However, very often the literature struggles to operationalise the social dimension of the SSCM concept, given the complexity of its related initiatives within the SCM context (Pagell and Wu, 2009; Schaltegger et al., 2014). In light of this, the research mainly focuses on the environmental and economic dimensions, following a similar approach employed by many scholars when operationalising the SSCM concept (Vachon and Klassen, 2008; Rao and Holt, 2005; Green et al., 2012a; Hollos et al., 2012; Zhu et al., 2013). Nevertheless, the social dimension is indirectly attained to some extent in operationalising the environmental and economic dimensions of the SSCM concept, as undertaking activities that fall within these two dimensions also contributes to the social dimension (Carter and Easton, 2011; Blewitt, 2014). This can be further explained by taking a perspective that those organisations that are attempting to undertake SSCM initiatives that fall within the environmental and economic dimensions are generally viewed as socially responsible firms contributing to the social dimension of the SSCM concept (Lee et al., 2012). The following section operationalises the SSCM concept, mainly focusing on its environmental and economic dimensions.

2.4.1 Core components of SSCM

Having discussed the concept of SSCM from a holistic perspective, it is important to provide a detailed theoretical understanding of the main activities involved in this approach, so that the SSCM concept can be operationalised. This furnishes a better and more comprehensive understating of SSCM and its main components and also enables this study to develop the three main research strands: SSCM driving forces, SSCM practices implementation and SSCM performance outcomes.

Different studies have defined the SSCM approach from different perspectives for particular purposes and industries (Svensson, 2007; Pagell and Wu, 2009). In this research, SSCM is described as the management of raw materials and processes from suppliers to manufacturer to final-customer, along with product take-back for the purpose of minimising environmental impacts (Hu and Hsu, 2010). In light of such a definition, the sustainable supply chain concept endeavours to cover all phases of the product life cycle, ranging from the point of origin, including raw material extraction, through the design, manufacturing and distribution phase, to the point of consumption by customers and the product's disposal at the end of its life cycle, attempting to close the loop (Vachon and Klassen, 2006; Diabat and Govindan, 2011). Unlike the traditional supply chain, the sustainable supply chain takes into consideration the environmental impact of production processes as products flow along it (Simpson et al., 2007). Hence, the sustainable supply chain extends the conventional supply chain to encompass activities that endeavour to minimise life cycle environmental impacts, such as green purchasing, materials consumption reduction, eco-design, reduction of hazardous materials, resource saving, energy usage reduction and product recycling and disposal (Svensson, 2007; Seuring and Muller, 2008a).

Accordingly, this means the SSCM approach is comprised of various boundary-spanning components including sustainable procurement, which requires purchased inputs to have low environmental impacts; sustainable manufacturing, which facilitates internally driven environmental activities such as remanufacturing and reuse; sustainable distribution, which minimises the logistical impact of material flows; and reverse logistics, which attempts to close the loop with a focus on disposal and recycling initiatives (Vachon, 2007; Zhu et al., 2008d). Basically, four core components are involved in a simplified SSCM approach: sustainable procurement, sustainable manufacturing, sustainable distribution and reverse logistics (Zhu et al., 2005; Seuring and Muller, 2008b; Linton et al., 2007; Pagell and Wu, 2009). Figure 2.6 provides a representation of these core components.

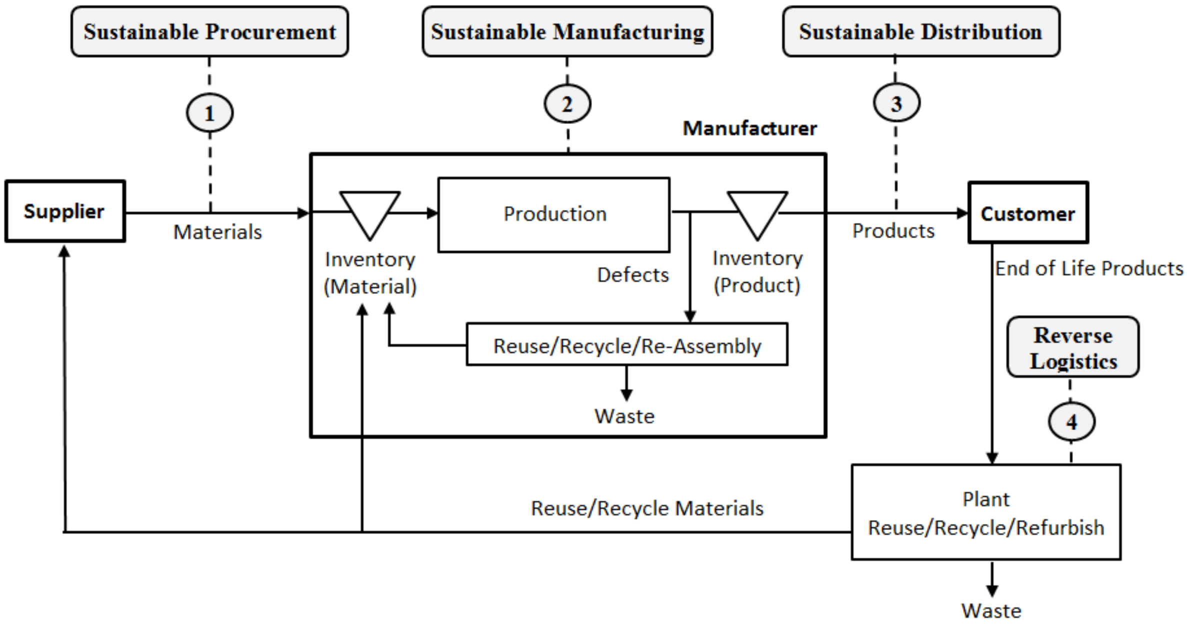


Figure 2.6 Core components involved in simplified SSCM (adapted from Diabat and Govindan, 2011)

Drawing on Figure 2.6, sustainable procurement focuses on cooperating with suppliers to provide manufacturers with raw materials or services that are environmentally sustainable (Carter, 2005). The manufacturer then uses these environmentally friendly inputs to develop products in an energy-efficient way that requires lower levels of material consumption and energy usage through sustainable manufacturing (Vachon and Klassen, 2008). Sustainable manufacturing involves the reuse, recycling and reassembly of defects and by-products[1] produced in manufacturing processes which will be used again as material inputs (Chunga and Wee, 2011). Sustainable distribution involves the transportation of final products through sustainable distribution in a way that has the lowest possible negative environmental impact

[1] Refers to a secondary product derived from the manufacturing process of a primary product (Wouters et al., 2012).

(Vachon and Klassen, 2006). Finally, reverse logistics attempts to close the supply chain loop, by taking back used or end-of-life products from their final destination with an aim of reusing, recycling and disposal initiatives, minimising life cycle environmental impacts (Jayaraman and Luo, 2007; Zhu et al., 2008d).

Notably, these core components involved in SSCM have their roots in the main activities of SCM (see Figures 2.3), and are derived from them in this research. In view of this, the core components of SSCM are in line with the main activities involved in SCM in the sense that sustainable procurement, sustainable manufacturing, sustainable distribution and reverse logistics fall within the boundaries of the main SCM activities of purchasing, production, distribution and financial affairs respectively. While the SSCM components follow the principles of the key activities involved in SCM, they further extend the scope of the traditional supply chain practices to more broadly address and undertake sustainability-related supply chain initiatives (Seuring and Muller, 2008b). Each of the main SSCM components is briefly introduced in the following sub-sections.

2.4.1.1 Sustainable procurement

Sustainable procurement is defined as an environmental purchasing approach that focuses on collaborating with suppliers for the purpose of developing products, services and product-services combinations that are environment-friendly (Zsidisin and Siferd, 2001). It involves a set of environmental purchasing activities that facilitate materials consumption reduction and the reuse of materials (Carter et al., 2000). It primarily deals with supplier evaluation and selection in order to purchase materials that are in line with environmental requirements and criteria (Min and Galle, 2001; Carter, 2005) and minimise environmental impacts (Carter and Narasimhan, 2000). This approach helps firms to tackle ecological concerns by undertaking environmental initiatives within the process of purchasing when responding to environmental challenges.

As can be seen in Figure 2.6, sustainable procurement activity is positioned between the suppliers and manufacturer, acquiring sustainable inputs, i.e. environmentally friendly services and raw materials (Carter and Carter, 1998). This highlights a need to establish good relationships with suppliers to effectively undertake environmental initiatives in order to develop more environmentally friendly products and services (Paulraj et al., 2008). It should be noted that sustainable procurement activity normally requires firms to work with various suppliers and sub-tier suppliers in order to fulfil their goals in minimising environmental impacts (Carter et al., 1998). Sustainable procurement includes a number of proactive practices such as establishing environmental requirements for purchasing items, suppliers' ISO 14000 certification, environmental audit for suppliers' internal management and so forth (Vachon and Klassen, 2008; Hu and Hsu, 2010). Sustainable procurement-related practices are presented in the SSCM practices section.

2.4.1.2 Sustainable manufacturing

Sustainable manufacturing is generally referred to as efficient production processes using inputs with low environmental impacts, which in effect generates lower levels of pollution and waste (Lakshmimeera and Palanisamy, 2013). It requires manufacturers to develop their products in an energy-efficient way that minimises energy consumption and avoids the use of harmful substances within their manufacturing processes (Kuik et al., 2011). Sustainable manufacturing is considered a well-researched area in the literature (Gungor and Gupta, 1999; Sarkis, 2001; Esty and Winston, 2009; Walke et al., 2010). This concept is also known as green manufacturing or clean production, and was first presented by Crainic et al. (1993) and further developed by various authors to also include the pivotal practice of sustainable design (Handfield et al., 2005; Vachon, 2007).

In most cases, the literature asserts that sustainable design activity is considered to be the most significant sub-attribute of sustainable manufacturing (Zhu et al., 2005; Hu and Hsu, 2010; Seuring and Muller, 2008b). The practice of sustainable design represents the sustainable manufacturing approach, as it covers the environmentally related supply chain activities involved in the manufacturing processes and more importantly can be measured in an academic context (Schaltegger et al., 2014). With this in mind, this thesis uses sustainable design practice, which represents the sustainable production approach. Sustainable design, which is commonly referred to as eco-design, primarily deals with the consideration of environmental concerns in all phases of the product's life cycle (Lewis and Gretsakis, 2001). This is sometimes referred to as life cycle assessment (LCA), which is considered a helpful tool for evaluating and analysing the environmental impact associated with all stages of a product's life cycle from cradle to grave, ranging from design to consumption and product disposal (Grote et al., 2007; Finnveden et al., 2009).

The sustainable design approach requires manufacturing firms to design their products and services in a way that minimises the usage of energy and materials consumption and facilitates the recovery, reuse and recycling processes (Grote et al., 2007). The success of sustainable design requires cooperation with customers and can be obtained through a number of practices such as cooperation with customers towards cleaner production and eco-design (Green et al., 2012a). Hence, the success of sustainable manufacturing activity and its main sub-attribute of sustainable design depends on cooperation with customers and suppliers.

Furthermore, sustainable manufacturing activity with the help of sustainable design practice can facilitate closing the supply chain loop through the reuse and remanufacturing of by-products, minimising life cycle environmental impacts (Preuss, 2001). Sustainable manufacturing plays a critical role in enhancing firms' environmental performance, as it is most closely associated with the entire life cycle of products (Vachon and Klassen, 2006). Hence, sustainable manufacturing is of paramount importance in the SSCM context and is deemed to be the most important activity involved in SSCM. Drawing on Figure 2.6, sustainable manufacturing activity is positioned near the middle of SSCM, between suppliers and customers, attempting to develop products or services that are environmentally sustainable. It involves a number of sustainable practices such as the design of products to decrease the use of hazardous substances in their manufacturing process, design of products for reduced consumption of materials and energy usage, and so forth, which will be further presented in Section 2.5.3 (Zhu et al., 2008a).

2.4.1.3 Sustainable distribution

Sustainable distribution generally refers to the process of the transportation of products or services throughout the supply chain from suppliers to manufacturer to final-customer with the purpose of having the lowest possible negative environmental impact (Wu and Dunn, 1995; Svensson, 2007). It focuses on storing and moving products or services in a way that minimises associated environmental damage, alleviating degradation of the living environment (Vachon, 2007). It generally encompasses the whole distribution process, including order processing, storage and warehousing, packaging and labelling, delivery to the customers and taking back packaging (Seuring and Muller, 2008b). Basically, sustainable distribution integrates environmental initiatives into the traditional distribution concept to mitigate the logistical impact of material flows and product transportation (Sarkis, 2006).

Sustainable distribution activity mainly deals with packaging and logistics characteristics. Packaging characteristics, including shape, size and materials used, have an appreciable impact on the whole distribution process due to their direct effects on product transportation, e.g. the footprint that is left behind during product transportation (Emmett and Sood, 2010). Appropriate packaging capability including rearranged loading patterns can lead to lower levels of material use, reducing the amount of handling required and increasing space utilisation in the warehouse (Lakshmimeera and Palanisamy, 2013). Arguably, this can ultimately result in the improved environmental performance of the firm.

Logistics characteristics, including the design and planning of a logistics network, involve making various logistical decisions. Lakshmimeera and Palanisamy (2013, p. 47) address a number of important logistical decisions that firms encounter: central warehouse or distributed network, direct shipping or hub-and-spoke[2], private fleet or third party services, and intermodal or single mode. Logistics characteristics involved in sustainable distribution that aim to mitigate environmental impacts include more direct routes, minimising empty miles, better space utilisation, fewer shipments, full truck loads, shorter movements and less handling (McKinnon, 2005; Lakshmimeera and Palanisamy, 2013). Arguably, each of these issues influences economic, operational and environmental performance outcomes because of their causal effects on cost, quality, delivery time, responsiveness, and wastes and emissions.

Sustainable distribution sits between the customers and manufacturer, dealing with product transportation with the purpose of having the least negative environmental impacts possible (see Figure 2.6). The success of sustainable distribution requires cooperation with customers throughout the whole distribution process and can be obtained through a number of proactive practices such as cooperation with customers for green packaging or using less energy during

[2] A system of distribution where the items being distributed are routed into and out of a central location (Lumsden et al., 1999).

product transportation (Green et al., 2012a). The sustainable distribution-related practices that facilitate the mitigation of logistical impacts are presented in Section 2.5.3.

2.4.1.4 Reverse logistics

Reverse logistics is the opposite of traditional or forward logistics, and is referred to as a process where unused or end-of-life products are retrieved from the point of consumption for possible refurbishing and recycling purposes and eventually appropriate disposal (Van-Hock, 2000; Dowlatshahi, 2005). Theoretically, this approach requires manufacturers to systematically take back previously shipped products from the point of consumption for remanufacturing, recycling and disposal (Rogers and Tibben-Lembke, 2001). In other words, reverse logistics comprises the management of goods flowing from their point of consumption back to the point of origin with the objectives of reuse and recapturing value (Mollenkopf et al., 2007).

The reverse logistics approach can potentially extend the initial life of materials and products through possible recycling and reuse, mitigating life cycle environmental impacts (Jayaraman and Luo, 2007). This implies that the reverse logistics approach plays a crucial role in the SSCM context, as it attempts to effectively close the supply chain loop, which can minimise life cycle environmental impacts and deliver environmental performance improvements (Zhu et al., 2008d). Therefore, manufacturers that adopt reverse logistics initiatives can become more environmentally efficient and are expected to have better performance outcomes. The automotive industry as a sub-segment of the manufacturing sector is a good example of this approach, where reverse logistics are widely employed in which car collection services are offered by car manufacturers (Simpson et al., 2007). Arguably, this further endorses our research position on conducting SSCM research with a manufacturing focus.

Reverse logistics has recently extended its scope to not only include the process of recapturing the value of unused or end-of-life products but also to embrace surplus sales of by-products and excess assets (Lai et al., 2013). Effective surplus sales can be accomplished through the investment recovery initiative, which is deemed in the literature to be the main sub-attribute of the reverse logistics approach within the SSCM context (Prahinski and Kocabasoglu, 2006; Zhu et al., 2008d). In essence, investment recovery involves the task of recapturing the value of end-of-life products and unproductive or unused assets through effective reuse and surplus sales or divestment (Green et al., 2012a). It requires the sale of by-products, used materials, excess inventories and capital equipment (Zhu et al., 2010). Investment recovery endeavours to maximise the value of end-of-life products and unproductive assets, minimising life cycle environmental impacts while achieving financial benefits. Therefore, this study uses the investment recovery practice, which represents the reverse logistics approach and attempts to close the supply chain loop in the most efficient and cost-effective manner possible. Drawing on Figure 2.6, reverse logistics activity, including its main sub-attribute of investment recovery, is positioned near the end of SSCM, attempting to effectively close the supply chain loop through surplus sales of unproductive assets and reusing and recycling end-of-life products or materials in order to take them back to the point of origin to be used again as material inputs (Jayaraman and Luo, 2007).

In summary, a comprehensive theoretical background concerning the concept of SSCM and its core components has been provided. In addition, a critical argument has been made to demonstrate the linkage between SSCM and traditional SCM, contending that the SSCM concept was derived from traditional SCM to undertake sustainability-related initiatives. Each of the abovementioned SSCM components is of paramount importance in the manufacturing context, as they endeavour to facilitate mitigating environmental damage while achieving performance outcomes. Having discussed the concept, we now move on to address the main research clusters surrounding the research phenomenon, which enable this study to answer the research questions.

2.5 Research clusters

Given the multi-disciplinary nature and integrated perspective of the research phenomenon, this study endeavours to develop the main research clusters that cover different aspects of the SSCM phenomenon being studied in this thesis. This section therefore intends to give an overview of the different research clusters relevant to the research phenomenon and presents theoretical discussions surrounding them which can aid this thesis in answering the research questions. To do this, an overlapping literature approach is conducted to bring all three main research clusters together, which assists this study in achieving its key research objective of conceptualising the SSCM drivers-practices-performance framework.

The initial step in answering the first research question, *'Which factors both endogenous and exogenous to the firm need to be in place before SSCM practices are adopted?'* is to explore and address the drivers for the adoption of SSCM initiatives. We need to study the role of driving forces in the adoption of SSCM practices, which further leads to affecting firms' performance implications. The rationale behind this idea can be explained by the fact that SSCM initiatives must be adopted in the first place to have impacts on performance outcomes. Collectively, we develop the first research cluster of SSCM driving forces that address the drivers, pressures and triggers for SSCM adoption. In doing this, the pertinent literature addressing various drivers and pressures, triggering the SSCM approach is reviewed (Section 2.5.2). This is also deemed to be a stepping stone approach to other research questions as it looks into the driving forces for SSCM adoption, which further results in impacts on performance outcomes.

The next step in answering the other research questions, *'What impact does the implementation of SSCM practices have on the environmental and cost performance of the firm?'* is to identify the essential SSCM practices required for effective implementation. We need to explore and ascertain the critical practices of SSCM in order to investigate their impacts on firms' performance outcomes. Accordingly, we develop the second research cluster of SSCM practices that covers the essential practices required for effective SSCM implementation. To do so, this study employs a systematic review approach to extensively explore sustainable practices across the supply chain in order to identify the essential SSCM practices (Section 2.5.3). This enables this study to meet a major part of its key research objective, i.e. conceptualising the SSCM drivers-practices-performance framework, as it enables us to develop the core constructs of SSCM practices.

The final step in answering our research questions requires the study and review of the performance outcomes associated with the implementation of SSCM practices. In order to investigate the consequences of SSCM implementation in terms of performance outcomes, we need to explore and ascertain the relevant performance dimensions within the SSCM context. Thus, we develop the third research cluster of SSCM performance, covering the performance outcomes associated with the implementation of SSCM practices. To do this, the pertinent literature surrounding SSCM performance implications is reviewed (Section 2.5.4). This enables us to deal with the part of the research question which focuses on SSCM performance outcomes and also assists us to achieve another part of our research objective in developing the boundaries of the performance dimensions.

Overall, in order to achieve the research objective and effectively answer the proposed research questions we need to explore and develop the three integrated research clusters of SSCM driving forces, SSCM practices and SSCM performance. In doing this, we need to synthesise these main research clusters, which can be accomplished by conducting an overlapping literature approach, which we will discuss next.

2.5.1 Overlapping literature approach

Having introduced the research clusters required for achieving the key research objective, this section discusses the overlapping literature approach to synthesise the main research clusters in order to answer the research questions. The following main clusters surrounding the research phenomenon are central in this study: SSCM driving forces, SSCM practices and SSCM performance implications. Although other research streams on SSCM exist within the literature, they were excluded from this research as they were not in line with the research questions and objectives. For instance, the research streams on risk management and change management addressed in the SSCM literature were excluded from the literature review as they fall beyond the scope of this research.

Hence, the abovementioned SSCM clusters were adopted due to their relevance to the research questions, which permits this study to achieve its core objective and effectively answer the research questions. Pagell and Wu, (2009), Lee et al. (2012), Tritos et al., (2013), Hsu et al. (2013) and Ashby et al. (2012) also report that these research streams are primarily involved in SSCM-related studies concerning implementation and performance implications, further endorsing our research position in adopting these research clusters. Having presented the main research clusters, we go on to suggest an overlapping literature approach to synthesise the three main research clusters.

The overlapping literature approach is employed in this thesis for the purpose of developing an SSCM drivers-practices-performance framework, through adopting and synthesising the research clusters: SSCM driving forces, SSCM practices and SSCM performance. These research clusters encompass key issues related to the primary research question in the sense that the driver-oriented SSCM stream addresses the antecedents of sustainable supply chain adoption, while SSCM practices and the performance-oriented SSCM stream deal with practice implementation and its commensurate performance outcomes. Figure 2.7 presents the overlapping literature on the adopted SSCM research clusters.

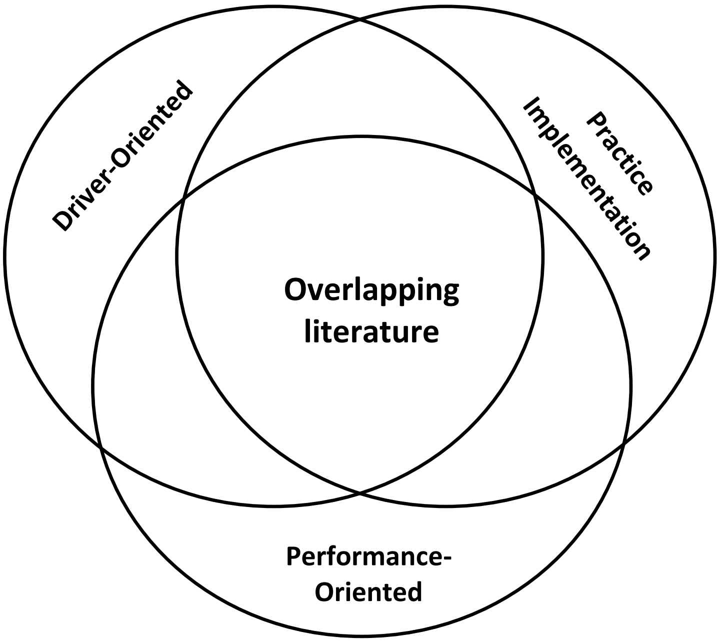


Figure 2.7 The overlapping literature on the main SSCM clusters

This study links and synthesises these three integrated SSCM research clusters in effort to answer the proposed research questions. This thesis benefits from the overlapping literature approach because bringing various integrated SSCM clusters together can help it to achieve the main research objective of developing an SSCM drivers-practices-performance framework, which can ultimately provide answers to our research questions. With this in mind, the three main SSCM research clusters are developed in the following sections and will be synthesised in the next chapter, contributing to the development of the research model.

Having said that, we would further argue that there is a causal chain that brings these three research clusters together, further justifying the study's choice in examining such an integrated research phenomenon. Basically, it is contended that firms adopt SSCM practices for particular reasons, mainly external pressures and internal drivers. Consequently, the implementation of SSCM practices driven by SSCM-related driving forces impacts organisational performance in terms of both environmental and cost levels. By joining up these two strands, a holistic view can be captured concerning firms' decision to continue undertaking SSCM initiatives, delineating the future of the SSCM approach. Figure 2.8 presents a tentative holistic view of SSCM.

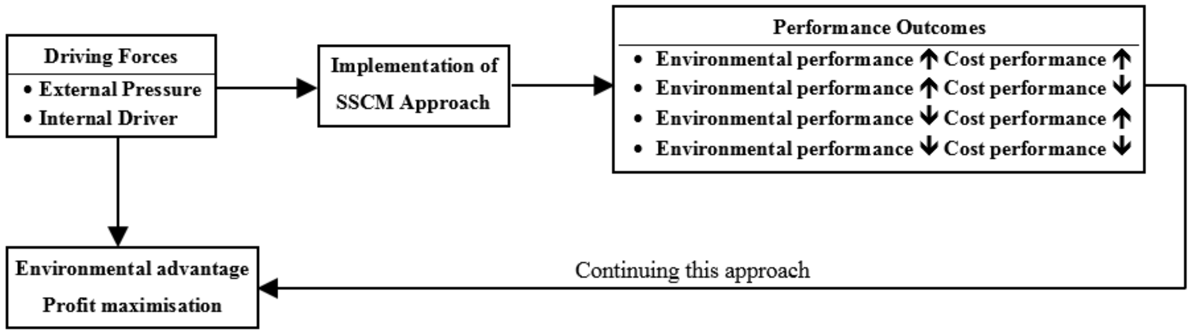


Figure 2.8 A tentative holistic view of SSCM

Drawing on Figure 2.8, in an attempt to bring the research questions together, this study seeks to provide a bigger picture of the SSCM agenda from firms' perspective when they are continuing to undertake such environmental initiatives. Basically, we would argue that if firms implement SSCM practices to achieve certain intended gains, i.e. improved environmental and cost performance, they will not continue to do this if those gains do not materialise. It would be irrational to do so unless there is a strong regulatory pressure behind it which pressurises firms to continue undertaking such approaches. In light of this, we propose four prospective options concerning a firm's decision to continue undertaking the SSCM approach, constituting the future the of the SSCM agenda, as follows.

(a) Environmental performance↑ / Cost performance↑: if the implementation of SSCM practices leads to improved environmental and cost performance, firms will definitely continue to undertake this approach, because it pays to be good. It also satisfies regulatory bodies and key stakeholders, including customers and shareholders.

(b) Environmental performance↑ / Cost performance↓: if SSCM implementation improves environmental performance but deteriorates cost performance, it will be difficult for firms to continue undertaking SSCM initiatives unless regulatory bodies provide a strong imperative to do so, shareholders as ethical investors motivate the firm to do so by taking a perspective that they are doing the right thing, or customers show an appetite to support the initiatives, notwithstanding the increase in prices.

(c) Environmental performance↓ / Cost performance↑: if SSCM implementation reduces environmental performance but improves cost performance, firms will continue to undertake this approach but may adapt. The reason for such a decision lies in the fact that it is profitable and thus attractive for firms from a commercial perspective. However, it does not deliver environmental improvements, and environmental regulations may require some fine tuning.

(d) Environmental performance↓ / Cost performance↓: lastly, if the implementation of SSCM practices does not lead to improved environmental performance and also deteriorates the cost performance, firms will definitely abandon continuing this approach.

We will determine which of these prospective options is more relevant in the final chapter when the outcomes of this research are attained. This may delineate the future of the SSCM agenda. We now move on to discuss each of the main SSCM research clusters, providing theoretical foundations to develop a conceptual framework which is capable of assessing the impact of the implementation of SSCM practices on performance outcomes while considering the influential effects of SSCM driving forces.

2.5.2 SSCM driving forces

This section aims to address the research cluster of SSCM driving forces, which focuses on pressures and drivers for the acceptance and adoption of the SSCM approach. It then presents theoretical discussions of the role of various driving forces in the adoption of SSCM practices, which further affect firms' performance outcomes. In addition, the rationale behind the idea that SSCM driving forces are of significance in assessing performance implications is provided. Finally, the main triggers for the SSCM approach are presented, summarising the main SSCM driving forces.

As previously discussed in Section 2.2.1 on the supply chain sustainability shift, the degradation of the living environment and the scarcity of resources have led various groups of stakeholders, customers, competitors and regulatory bodies to demand more environmentally friendly products and services (Hsu et al., 2013; Zhu et al., 2013). Such increasing expectations have caused firms to become fully responsible for their business operations, also accounting for their ethical and environmental aspects, broadening firms' traditional scope to take social, environmental and economic objectives into account (Carter and Rogers, 2008). In the SCM context, this has led firms to pursue sustainable practices along their supply chains and adopt SSCM practices. This is of significance because in today's global market most manufacturing firms are a part of at least one supply chain in which main life cycle environmental impacts lie (Matos and Hall, 2007).

In essence, a bundle of diverse pressures exerted by stockholders, customers, competitors and governmental bodies drives firms to realign their strategic imperatives to include responsiveness, customer focus and most recently the environmental sustainability of their supply chain (Sarkis et al., 2010; Green et al., 2012a). The intense scrutiny exerted by the aforementioned groups has made firms realise that the responsibilities of their business operations do not end at the boundaries of their organisations, and they are ultimately responsible for the environmental impacts of their supply chains (Seuring and Gold, 2013). Such increasing driving forces have caused firms to consider environmental concerns and incorporate sustainable inputs when managing their supply chains. In effect, manufacturing firms have accepted the necessity of environmental management principles across their supply chains and started to embark upon the adoption of SSCM practices in response to stockholder and customer demands as well as competitor and regulatory pressures (Hsu et al., 2013). Therefore, it is contended that the bundle of pressures exerted by diverse groups of stockholders, customers, competitors and regulatory bodies, which forms the driving forces cluster, triggers the adoption of SSCM. Each of these groups that push firms to embark upon adopting SSCM are discussed individually in the following sections.

2.5.2.1 Government

Firms involved in today's sophisticated supply chains face increasing pressures from various groups, especially governments, to accept responsibility for the social and environmental implications of their business operations beyond their immediate organisational boundaries (Zailani et al., 2012). Scarcity of resources and environmental degradation have prompted governmental bodies at both the national and international level to exert pressures on manufacturers, as the main resource consumers and polluters, through enacting environmental regulations (Zhu et al., 2013). Governments play a critical role in the transition to a more sustainable society by exerting coercive pressures on manufacturing firms through stringent environmental legislation (Boström et al., 2015).

From a practical perspective, government agencies as powerful groups can influence the actions of manufacturing firms by enacting environmental regulations with respect to their supply chain. Such governmental coercive pressures are associated with the conformity occurring through influence exerted by those in power and, because of their authoritative capacity, are considered the most powerful driving forces towards the adoption of environmental initiatives (Sarkis et al., 2010). For instance, during the past few years, the UK government, in order to support the adoption of SSCM initiatives, has enacted stringent regional and national environmental regulations to limit the use of non-renewable resources such as diesel and petrol in the distribution process (Taylor and Taylor, 2013; SMMT, 2015). Environmental regulations can control manufacturers' over-consumption and over-exploitation of natural resources.

According to the literature, export and sales to foreign customers including both industrial and end-customers are deemed one of the major drivers for the adoption of environmental initiatives and SSCM practices in particular (Zhu et al., 2013; Govindan et al., 2014). Firms, manufacturing firms in particular, must be in compliance with regulations and environmental laws enacted by national or multi-national governments, in order to sell and export their products or services to their foreign customers. Such compliance requirements push firms to adopt environmental initiatives and obtain various environmental certificates which permit them to export their products (Curkovic and Sroufe, 2011). In this regard, the EU has enacted various Environmental Directives such as End-of-Life Vehicles (ELV), Restriction of Hazardous Substances (RoHS), Energy-Using Products (EuP), Waste Electrical and Electronic Equipment (WEEE), etc., which can mitigate the environmental impacts of manufacturers' supply chains (Gerrard and Kandlikar, 2007; Turner, 2007; Koh et al., 2012).

Such international regulatory policies not only push EU manufacturers to undertake environmental initiatives across their supply chains, but also force overseas manufacturers which intend to export and sell to foreign customers to embark upon the adoption of SSCM practices. For example, during 1997 to 1999, commodities of Chinese manufacturers with an estimated value of approximately 20 billion US dollars were rejected because they were not in compliance with international environmental regulations and failed the environmental requirements (Zhu et al., 2005, p. 452). Therefore, it is contended that firms' success and financial bottom lines can be diminished if they fail to comply with the relevant international environmental requirements and regulations. This indicates the significance of the government driving forces in the adoption of environmental initiatives, and SSCM practices in particular.

Governments, apart from their coercive role, also apply motivating forces by offering financial incentives in the form of subsidies or tax reductions to encourage the adoption of environmental initiatives (Diabat and Govindan, 2011). In this respect, many governments have instituted different incentives to motivate manufacturers to play a more voluntary role in environmental protection (Boström et al., 2015). For example, the UK government has offered financial incentives such as grants and tax reductions to encourage manufacturers that adopt SSCM initiatives such as using bio-fuels for their transportation systems (Taylor and Taylor, 2013; SMMT, 2015). Potentially, this can mitigate environmental damage and bring ecological benefits to society and economic benefits to manufacturers.

Overall, regional or international environmental regulations and their associated compliance issues have led most manufacturers to pursue SSCM-related practices and embark upon SSCM adoption, which in turn allows the initiation of the development of environmentally friendly products or services. Therefore, governmental coercive pressure is deemed to be the major trigger for SSCM adoption, given its authoritative capacity in driving environmental initiatives (Sarkis et al., 2010).

2.5.2.2 Stockholders

Stockholders are another group within the driving forces cluster that exert pressures on firms to adopt environmental initiatives and embark upon SSCM adoption. In essence, stockholders refers to internal groups who have a vested interest in the firm (Karra and Affes, 2014).

According to the literature, generally the adoption of environmental initiatives and sustainable practices across the supply chain relies on internal commitment and support within various different levels of the firm (Seuring and Muller, 2008a; Diabat and Govindan, 2011).

Stockholders have the capacity to dictate their agenda, such as environmental sustainability, to the senior management of firms (Paloviita and Luomaaho, 2010). Once such an environmental sustainability vision receives internal support and commitment from the firm's top-level management, the firm can proceed to undertake new environmental initiatives such as SSCM practices (Green et al., 2012a). In other words, stockholders can facilitate the adoption of SSCM practices by exerting internal pressures on the firm to adopt environmental sustainability agenda as a key part of the organisation's mission statement, yielding the internal commitment and support of the firm (Sarkis et al., 2010; Green et al., 2012a). Collectively, stockholders play a critical role in the adoption of SSCM practices and the dissemination of such environmental undertakings. Therefore, stockholders' pressures are deemed to be one of the major triggers for the adoption of SSCM (Karra and Affes, 2014).

Stockholders are not only interested in the economic performance of the firm, but also in its social and environmental performance (Walker et al., 2008). Stockholders' pressures are broadly concerned with firms' environmental image and social acceptance, seeking to enhance the social and environmental performance of the firm (Paloviita and Luomaaho, 2010). According to Hsu et al. (2013), the existence of social and environmental problems in a firm's supply chain can tarnish their environmental image and social acceptance, which can further lead to a critical loss of both reputation and profit. This further highlights the role of stockholders' pressures in internally motivating firms to demonstrate an environmentally responsible corporate vision through adopting proactive environmental initiatives. Therefore, stockholders' pressures which yield internal commitment and support within the firm are deemed to be a major driving force that facilitates the adoption of SSCM practices.

2.5.2.3 Customers

Generally, the chief aim of all processes and activities involved in SCM is to satisfy the final customer (Handfield and Nichols, 1999). This can be explained by the fact that managing supply chain operations is only justified when its commensurate products are ultimately accepted by customers. The customer therefore is of importance in the SCM setting, as they can influence firms to adopt new supply chain initiatives (Handfield et al., 2005). The growing environmental concerns within today's society have led to increasing environmental awareness and have gradually led to a paradigm shift among customers to demand more environmentally friendly products and services (Seuring and Muller, 2008a). Diabat and Govindan (2011) and Luthra et al. (2014) also maintain this, and state that customers are becoming more and more environmentally conscious and demanding products or services that are developed under high environmental and social standards. Considering the importance of customers in the SCM context and their emergent environmental consciousness, customers are deemed to be another trigger for SSCM adoption (Hsu et al., 2013).

With such increasing environmental awareness in today's community and the heightened environmental expectations of customers, firms might fear that their customers will boycott their products if they are not environmentally sustainable, which could lead to reputation loss and eventually financial loss (Sarkis et al., 2010). Hsu et al. (2013) endorse this and suggest that customers would be reluctant to engage with firms with social or environmental problems reported in their supply chains. It is worth mentioning that in the manufacturing context, industrial customers also demand environmental protection initiatives for the purpose of satisfying their own end-customers (Taylor and Taylor, 2013).

Therefore, another driving force that contributes to the SSCM adoption is customer pressures, demanding products that are created through environmentally sustainable processes. It should be noted that this research treats customer pressure as a sub-attribute of governmental pressures incurred in the form of environmental regulations, given the fact that customer pressures are largely accrued within the coercive pressure of government agencies (Boström et al., 2015). Porter (2008) also maintains this and asserts that regulation is a force that can act with other forces such as customer pressures, serving as comprehensive forces that embrace customers' pressures in a sense. In other words, the customer pressures feed into the regulatory pressures. Thus, following a similar approach to that employed by many scholars when examining customer pressures in the SSCM context (Sarkis et al., 2010; Zhu et al., 2010; Green et al., 2012a; Luthra et al., 2014), we do not directly incorporate customer pressure within the driving forces, as these are normally accrued in the form of the coercive pressures of governmental legislations.

2.5.2.4 Competitors

Competitors is the last group within the driving forces cluster that motivate firms to embark upon SSCM adoption. In today's global market where competition is growingly based on 'supply chain vs. supply chain' and also in view of emergent environmental considerations, firms' chances for success and competitiveness lie mainly within their management of their supply chains (Giunipero et al., 2008). It can be contended that relying solely on a traditional supply chain may not be sufficient for firms to compete with their competitors, because the competition among firms is now largely positioned at the supply chain level (Ashby et al., 2012).

Generally, the competitor driving forces occur when firms follow and mimic the policies and actions of successful competitors in the market (Rivera, 2004). Thus, firms attempt to imitate competitors' actions for the purpose of replicating the path of their success, which is also referred to as 'competitive benchmarking' in the manufacturing context (Vachon and Klassen, 2008). In this respect, leading manufacturing firms undertake proactive environmental initiatives and adopt SSCM-related practices in order to lead among their competitors in the industry, seeking a higher competitive advantage (Zhu et al., 2010).

With the existing fierce competition in today's competitive market, firms face pressures from their successful competitors as they continuously attempt to steal market share by providing environmentally conscious customers with sustainable products or services (Hsu et al., 2013). Therefore, those firms which may not be keen to undertake environmental initiatives across their supply chain are pushed to adopt SSCM practices in order to compete with their leading competitors that already possess SSCM capability. In other words, leading manufacturers that undertake environmental initiatives along their supply chain motivate other firms to follow a similar action in adopting SSCM practices. The rationale is simply to mimic and follow the actions of successful competitors in the market in an attempt to replicate their success path (Sarkis et al., 2011).

However, it should be noted that, from a practical perspective, competitors are not considered as the major trigger for SSCM adoption, but are still deemed to be a motivating force (Hsu et al., 2013). In this regard, despite Zhu et al. (2012) hypothetically suggesting that competitor pressure exists in the SSCM context, they found that competitive pressures do not significantly influence manufacturing firms in undertaking SSCM-related initiatives. Thus, we do not fully incorporate competitor pressure within the driving forces in accordance with the corresponding literature that suggests that competitive pressures do not play a major role in giving rise to SSCM adoption in practice (Zhu et al., 2012; Hsu et al., 2013).

2.5.2.5 Triggers for SSCM

This section summarises the abovementioned driving forces under the umbrella term of triggers for SSCM, encompassing the pressures exerted from government, stockholders, customers and competitors. This diverse bundle of driving forces pushes manufacturing firms to adopt proactive sustainable practices across their supply chain, demonstrating a rational position on environmental sustainability. Figure 2.9 represents the major triggers for the adoption of SSCM.

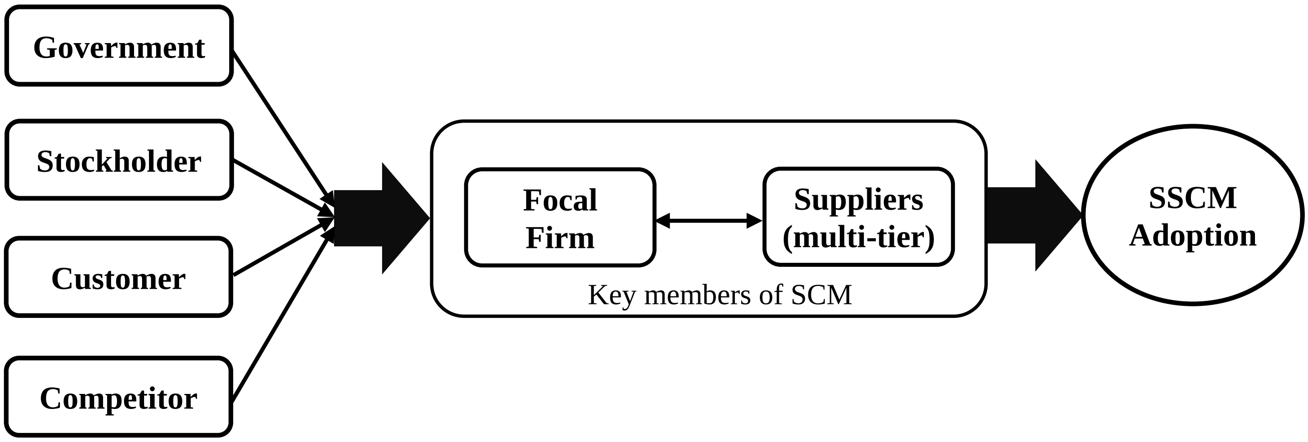


Figure 2.9 Triggers for sustainable supply chain management

Drawing on Figure 2.9, the diverse bundle of driving forces consists of government, stockholder, customer and competitor groups which lead the focal firm to pursue SSCM-related practices. It should be noted that the focal firm normally passes these pressures on to its suppliers when it is pressured (Seuring and Muller, 2008a). This indicates that the success of the adoption of SSCM is dependent upon collaboration with suppliers, highlighting the important role of suppliers in SSCM adoption.

In summary, Section 2.5.2 addressed the cluster of SSCM driving forces and provided theoretical discussions surrounding the major triggers for the adoption of SSCM. The diverse bundle of driving forces of government, stockholders, customers and competitors were presented and asserted to push firms to undertake proactive environmental initiatives and adopt sustainable practices across their supply chains. In particular, it was contended that firms embark upon SSCM adoption in response to varied reasons such as governmental environmental regulations and their associated compliance issues; stockholders' concerns for a greater environmental image and public perception and their commensurate requests for firms' internal commitment; increasing environmental awareness in today's community and the heightened environmental expectations of customers, demanding environmentally friendly products; and competitive pressures from competitors. This section has assisted the development of the research framework in conceptualising the SSCM driving forces, contributing to the research objective.

2.5.3 SSCM practices

Having discussed the major driving forces that lead firms to embark upon the adoption of SSCM practices, this section aims to develop the research cluster of SSCM practices that encompasses the essential sustainable practices required for the effective implementation of SSCM. With this aim, this section explores and identifies the critical practices of SSCM to ultimately investigate the impacts of their implementation on firms' performance outcomes.

In order to identify the critical SSCM practices, this study adopts a systematic review approach to extensively explore sustainable practices across the supply chain to ascertain those required for effective SSCM implementation. The systematic review approach also guides this study to view the boundaries of the SSCM dimensions and more broadly understand the proactive practices required for SSCM implementation. Details on the systematic review approach employed in this thesis are provided in Appendix A. Providing details of conducting the systematic review approach maximises the replicability and reliability of this research investigation, demonstrating the rigour of the research process.

Identifying the essential or critical SSCM practices permits this study to develop the core SSCM dimensions that can further represent the implementation of SSCM practices. This also facilitates the conceptualisation of the SSCM drivers-practices-performance framework, as the primary research objective, by contributing to the part of the framework associated with SSCM practices. This thesis can further benefit from this approach because identifying the essential SSCM practices will enable it to confirm whether the existing constructs of SSCM practices cover the identified SSCM practices. This can ascertain the appropriateness of SSCM practice constructs developed in the existing literature, ensuring the rigour of the research process. Therefore, it is contended that exploring and identifying essential SSCM practices is of the essence for this thesis, as it facilitates the development of the study's conceptual framework.

To achieve this aim, a systematic review approach was conducted across top-tier operations and supply chain management journals over a 23-year time frame (1990 to 2013), with the goal of identifying essential SSCM practices. The time period was selected in accordance with the corresponding literature, which suggests that the majority of high-quality research on SSCM-related studies has been conducted after 1990 (Giunipero et al., 2008; Seuring and Muller, 2008a; Ashby et al., 2012). Consequently, the analysis of our systematic review resulted in the identification of 35 SSCM practices, which are summarised along with their representative references in Table 2.1. According to the pertinent SSCM literature, these identified practices are essential for the effective and successful implementation of SSCM (Zhu et al., 2005; Vachon, 2007; Svensson, 2007; Pagell and Wu, 2009; Linton et al., 2007; Seuring and Muller, 2008a; Carter and Rogers, 2008; Zhu et al., 2008a; Hsu and Hu, 2010; Green et al., 2012a).

Table 2.1. Essential practices for SSCM implementation emphasised by selected authors

Essential SSCM Practices	Representative reference
1. Establish environmental requirements for purchasing items	Murray (2000); Green et al. (1998); Min and Galle (2001); Carter (2005); Seuring and Gold (2013)
2. Suppliers' ISO14001 certification	Chen (2005); Rao (2005); Zhu et al. (2007); Svensson (2007)
3. Establish an environmental risk management system for SSCM	Cousins et al. (2004); Lu et al. (2007); Seuring and Muller (2008a)
4. Effective communication platform within companies and with suppliers	Geffen and Rothenberg (2000); Paulraj et al. (2008); Zhu et al. (2007); Hollos et al. (2012)
5. Environmental auditing for suppliers	Jayaraman et al. (1999); Rao and Holt (2005)
6. Cross-functional integration	Zhu et al. (2005); Linton et al. (2007); Sarkis (2012)
7. Environmental policy for SSCM	Zhu and Sarkis (2004); Zailani et al. (2012); Green et al. (1998)
8. Environmental education and training	De Burgos Jimenez and Cespedes Lorente (2001); Sarkis (2001)
9. Manpower involvement	Cantor et al. (2012); Linton et al. (2007); Jayaraman et al. (2007)
10. Information system	Grabis et al. (2007); Vachon (2007); Hollos et al. (2012)
11. Total quality environmental management	Zhu and Sarkis (2004); Seuring and Muller (2008a)
12. Top management support & commitment	Pagell and Wu (2009); Shi et al. (2012); Seuring and Gold (2013)
13. Establish an environmental database of products	Geffen and Rothenberg (2000); Lu et al. (2007); De Giovannia, and Vinzi (2012)
14. Environmental compliance statement	McIntyre et al. (1998); Sarkis et al. (2010);
15. Green purchasing	Min and Galle (2001); Carter (2004); Seuring and Muller (2008a)
16. Bill of material (BOM)	Tan et al. (2002); Zhu et al. (2005)
17. Supplier selection and evaluation	Enarsson (1998); Lu et al. (2007); Koplin et al. (2007)
18. ISO 14001 certification	Babakri et al. (2003); Seuring and Muller (2008a)
19. Cooperation with customers for using less energy during product transportation	Wu and Dunn (1995); Dowlatshahi (2005); Vachon and Klassen (2006); Green et al. (2008)
20. Use of renewable energy in product packaging	Svensson (2007); Vachon and Klassen (2006b); Vachon (2007); Hollos et al. (2012)
21. Use of renewable energy in product transportation	Wu and Dunn (1995); Rao (2002); Dowlatshahi (2005);Vachon (2007); Green et al. (2008)
22. Cooperation with customers for green packaging	Zhu and Sarkis (2007); De Giovannia and Vinzi (2012); Gimenez et al. (2012)
23. Tracking the development of directives	Grote et al. (2007); Koh et al. (2012); Gerrard and Kandlikar (2007)
24. Design of products for reduced consumption of materials or energy	Simpson et al. (2007); Vachon and Klassen (2006); Zhu et al. (2008a); Hsu et al. (2013)
25. Design of products to avoid or reduce use of hazardous materials	Zhu and Sarkis (2007); Vachon and Klassen (2007); Hsu and Hu (2009); Green et al. (2012a)
26. Design of products for reuse, recycle, recovery of materials or parts.	Sarkis (2001); Tan et al. (2002); Grote et al. (2007); Mollenkopf et al. (2007); Hsu et al. (2013)
27. Applying LCA to carry out eco-reporting	Matos and Hall (2007); Chunga and Wee (2011)
28. Collaboration on product recycling with the same industry sector	Vachon and Klassen (2008); Zhu and Sarkis (2007); Grote et al. (2007); Lozano (2008)
29. Cooperation with customers for eco-design and cleaner production	Zhu et al. (2005); Zhu and Sarkis (2007), Green et al. (2012a); Walker and Jones (2012)
30. Produce disassembly manual	Koufteros (1999); de Bakker et al. (2002)
31. Join local recycling organisation	Tsoulfas and Pappis (2006); Pullman et al. (2009)
32. Product testing report	Tu et al (2001); Zhu et al. (2007)
33. Sale of excess materials or inventories	Zhu and Sarkis (2006); Zhu et al. (2008a); Green et al. (2012a)
34. Sale of scrap and used materials or by-products	Mollenkopf et al. (2007); Zhu et al. (2007); Zhu and Sarkis (2007)
35. Sale of excess capital equipment	Zhu et al (2008a); Svensson (2007); Green et al. (2012a)

Each of these SSCM practices is concisely outlined in Appendix A.4, furthering understanding of these initiatives. It is important to mention that the rigorous process of exploring and identifying SSCM practices (see Appendix A), which involved assessing pertinent SSCM literature, not only provides a better and more comprehensive understanding of SSCM initiatives but also guides this study to more broadly view the boundaries of SSCM knowledge. More importantly, this thesis uses these practices to develop the core SSCM dimensions to be representative of the implementation of SSCM practices, which will be discussed in the next section. This assists the thesis in conceptualising the SSCM drivers-practices-performance framework, contributing to the section of the framework that covers SSCM practices, ensuring that the primary research objective will be achieved.

2.5.3.1 Core SSCM dimensions

Having presented the essential SSCM practices, this study moves on to develop core SSCM dimensions to contribute to conceptualising an SSCM drivers-practices-performance framework representing the implementation of SSCM practices. In light of this, we studied the 35 identified practices with the aim of discerning the boundaries of SSCM practices, which in turn helped us to develop core SSCM dimensions. In doing this, this study attempted to categorise the essential SSCM practices into major groupings that cover the main activities and processes involved within SSCM and serve as a representative of SSCM practices.

Accordingly, the identified SSCM practices were categorised into four major pre-established dimensions representing core SSCM constructs: sustainable procurement, sustainable distribution, sustainable design and investment recovery (see Table 2.2). Furthermore, each of the practices was placed into relevant dimensions based on their subjects and related research areas. It is important to note that these categories were previously established and validated by various authors, as displayed in Table 2.2, and this study grouped the essential SSCM practices into the four major groupings in line with existing studies.

It should be noted that a number of identified SSCM practices fall merely within the boundary of organisation and thus are directly associated with the focal firm's involvement. These practices are of a precursory nature, facilitating the adoption of other SSCM practices. They are deemed to be internal driving forces that complement the external pressures which form SSCM driving forces for SSCM adoption. Considering their potential contribution in conceptualising the research framework, we grouped them into a separate dimension of organisation environmental management, which facilitates and supports the adoption of SSCM practices. Grouping these particular practices into the organisation environmental management dimension is also consistent with existing studies, suggesting this dimension broadly encompass both external pressures and internal drivers in the SSCM context (Zhu and Sarkis, 2007; Zhu et al., 2007; Hu and Hsu, 2010; Green et al., 2012a).

Organisation environmental management is most closely associated with the focal firm's involvement in internally driving SSCM adoption, which is sometimes referred to in the literature as organisation involvement (Hu and Hsu, 2010). Arguably, this dimension is considered as an antecedent or stepping stone to the adoption of core SSCM dimensions. Organisation environmental management is generally referred to as a dimension that describes a cluster of SSCM pressures and driving forces that give rise to the adoption of SSCM practices (Zhu et al., 2008a; Seuring and Muller, 2008a). Table 2.2 displays the identified SSCM practices and their representative dimensions.

Table 2.2. Essential SSCM practices and driving forces along with their associated dimensions

Dimension	SSCM Practices
Sustainable Procurement (Min and Galle, 2001; Carter, 2005)	Establish environmental requirements for purchasing items Establish an environmental database of products Environmental compliance statement Green purchasing Bill of material (BOM) Supplier selection and evaluation Suppliers' ISO14001 certification Environmental auditing for suppliers
Sustainable Distribution (Wu and Dunn, 1995; Green et al., 2008)	Use of renewable energy in product transportation Cooperation with customers for green Packaging Cooperation with customers for using less energy during product transportation Use of renewable energy in the process of product packaging Information System
Sustainable Design (Grote et al., 2007; Zhu et al., 2008a)	Design of products for reduced consumption of materials and energy Design of products to avoid or reduce use of hazardous materials Design of products for reuse, recycle, recovery of materials or parts Applying LCA to carry out eco-reporting (Life cycle management) Tracking the development of directives Establish an environmental risk management system for SSCM Produce disassembly manual Product testing report Manpower involvement Cooperation with customers for eco-design & cleaner production
Investment Recovery (Zhu et al., 2008a; Emmett and Sood, 2010)	Sale of excess materials or inventories Sale of scrap and used materials or by-products Sale of excess capital equipment Collaboration on product recycling with the same industry sector Join local recycling organisation
Dimension	**SSCM Practices Driving Forces**
Organisation Environmental Management (Hu and Hsu, 2010; Green et al., 2012a; Hsu et al., 2013)	Top management support and commitment ISO 14001 certification Environmental education and training Total quality environmental management Cross-functional integration Environmental policy for SSCM Effective communication platform within companies and with suppliers

As can be seen from Table 2.2, a set of essential SSCM practices was categorised into the sustainable procurement dimension, because these practices primarily deal with the activities involved in the acquisition of environmentally sustainable inputs. In addition, considering the sustainable procurement focus that is centred on collaboration with suppliers (Carter, 2005), we grouped this set of practices into the sustainable procurement dimension, as they are largely associated with suppliers. Another set of SSCM practices was grouped under sustainable distribution, due to the nature of these practices being centred on logistics and distribution implications.

Furthermore, those SSCM practices that are largely associated with product development and manufacturing processes and also closely involved in eco-design related activities, were placed into the sustainable design dimension. Moreover, the set of SSCM practices that mainly deal with the divestment of excess assets and recapturing the value of unused or end-of-life products were categorised into the investment recovery dimension. Finally, those practices that fall merely within the boundary of organisation and are directly associated with the focal firm's involvement were grouped into the organisation environmental management dimension. This dimension encompasses practices that facilitate and support the adoption of other SSCM practices, constituting the SSCM-related driving forces presented in Section 2.5.2.

From a holistic perspective, the four core dimensions of SSCM practices were developed following key principles and activities involved in SCM, including purchasing, production, distribution and financial affairs (see Section 2.2.1), and also consistent with the core components of SSCM, namely sustainable procurement, sustainable manufacturing, sustainable distribution and reverse logistics (see Section 2.4.1). It is then contended that the developed SSCM dimensions are derived from the chief principles of SCM in line with the core components of SSCM, indicating their comprehensive nature. This shows the consistency of the research process throughout this chapter and demonstrates the rigour of the development of the comprehensive SSCM drivers-practices-performance framework.

As summarised in Figure 2.10, the core SSCM dimensions of sustainable procurement, sustainable distribution, sustainable design and investment recovery represent the implementation of SSCM practices. This research recognises that the SSCM concept is of an integrated and multi-disciplinary nature and thus is open to integrating new sustainable practices; however it is somewhat unrealistic and impractical to include all SSCM initiatives when developing SSCM dimensions. Furthermore, it may be argued that these four SSCM dimensions may not represent all SSCM practices, however we found sufficient evidence that existing studies have used the combination of these dimensions when representing the implementation of SSCM practices (Zhu et al., 2008a; Green et al., 2012a; Luthra et al., 2014; Lee et al., 2012; Hsu et al., 2013; Zhu et al., 2013). Thus, it is contended that the four dimensions displayed in Figure 2.10 are appropriately representative of SSCM practice implementation.

Figure 2.10 Core SSCM dimensions representing SSCM practice implementation

Overall, this study has categorised the identified SSCM practices into the relevant groupings and developed the core SSCM dimensions representing the implementation of SSCM practices. This thesis benefits from this approach in the conceptualisation of the research framework, as these developed dimensions contribute to the section of the framework that covers SSCM practice implementation, ensuring that the primary research objective will be achieved. The reasoning for grouping SSCM practices is because it is relatively unrealistic to include all of the identified practices in the research framework. Various authors also maintain this and employ similar grouping approaches as a verified applicable technique concerning the development of conceptual frameworks and generating dimensions for SSCM practices (Sarkis et al., 2012; Lee et al., 2012; Zhu et al., 2013). The conceptualisation of the research framework will be discussed in detail in Chapter 3.

In summary, Section 2.5.3 has provided a brief synthesis of the literature concerning the essential practices required for the effective implementation of the SSCM approach. In doing this, this study employed a systematic review approach examining top-tier operations and SCM journals in order to explore and identify essential SSCM practices. This enabled this study to more broadly view and understand critical SSCM practices, discerning the boundaries of the SSCM dimensions. Finally, the identified SSCM practices were grouped into four major dimensions representing the implementation of SSCM practices. This thesis benefits from this section as it assists the development of the research framework in conceptualising SSCM practice implementation, contributing to a major part of the research objective.

2.5.4 SSCM performance

Thus far, we have provided theoretical discussions on triggers for SSCM adoption and essential SSCM practices, which in turn have assisted us in developing their representative dimensions, contributing to the conceptualisation of the research framework. Having addressed the research clusters of SSCM driving forces and SSCM practices, we move on to present the SSCM performance research cluster. This section aims to address and develop the SSCM performance research cluster that focuses on performance implications concerning the SSCM context. This is essential, as it deals with the final step in answering the research question covering the performance outcomes associated with SSCM implementation. This highlights the need to address SSCM performance implications and develop the SSCM performance dimensions, contributing to the development of the research framework in terms of the section covering SSCM performance. Before presenting the SSCM performance research cluster, we introduce the triple bottom line (TBL) concept and discusses how this study builds the theoretical foundation of the performance outcomes associated with SSCM, on TBL principles.

2.5.4.1 Triple bottom line (TBL)

This section briefly introduces the triple bottom line concept and demonstrates its linkage to both the sustainable development concept and the SSCM approach. This section then attempts to use TBL principles to establish the theoretical foundation concerning the performance outcomes associated with SSCM to develop the SSCM performance dimensions. The TBL concept, which is also referred to as the three Ps, i.e. people, plant and profit, was introduced and developed by Elkington (1998). Elkington (1998) argues that firms' organisational performance, at a broader level, falls within three key pillars: social, environmental and financial. The TBL concept has been operationalised through a framework that seeks to simultaneously take into account social, economic and environmental issues from a microeconomic point of view and balance their associated performances (Elkington, 2004; Carter and Rogers, 2008).

In essence, the core dimensions of sustainable development have been operationalised in the TBL framework, addressing environmental, social and economic objectives within a business context (Elkington, 1989; Blewitt, 2014). The rationale behind the TBL framework involves the idea that an organisation's ultimate health or success should be assessed not only by its traditional financial value, but also by its environmental behaviours and social or ethical values

(Gimenez et al., 2012). In other words, organisations cannot be successful in the long run if they fail to take into account social, economic and environmental issues (Elkington, 2004).

The TBL basically captures the intersection of economic, social and environmental performance, where there are activities that firms can engage in which can positively impact society and the natural environment and also lead to long-term economic benefits (Carter and Easton, 2011). This study builds the foundation of the performance outcomes associated with SSCM on the TBL performance pillars. Figure 2.11 shows the TBL framework along with its key performance pillars.

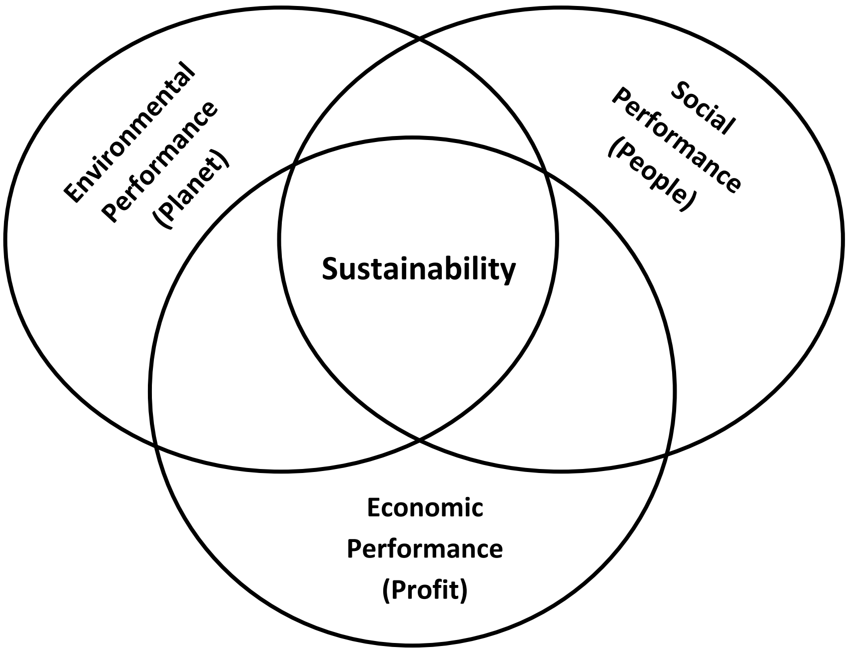


Figure 2.11 Triple bottom line (TBL) framework (Carter and Rogers, 2008)

Many manufacturing firms have adopted the TBL framework to assess their performance at a broader level for the purpose of creating higher business value and sustaining long-term success (Hollos et al., 2012; Govindan et al., 2014). The environmental pillar of TBL endeavours to enhance the status of the living environment and takes into account environmental considerations and criteria within a firm’s business activities (Gimenez et al., 2012). It deals with environmental initiatives that can help organisations to minimise their negative environmental impacts (Lai et al., 2013). The social pillar of TBL deals with social and ethical values associated with an organisation's activities. It urges organisations to conduct their activities to be both fair and beneficial towards the labour force and the community (Carter and Easton, 2011). The economic pillar of TBL endeavours to undertake traditional economic objectives while working harmoniously within the social and environmental settings to embrace social and ecological implications (Elkington, 1998). It basically pertains to the financial value created by the firm after deducting the cost of all inputs including environmental considerations and social criteria. In other words, TBL's economic pillar accounts for traditional profit plus other entities within the social and environmental domains that are included in profit calculations such as the costs of pollution and worker displacement (Lai et al., 2013). Thus, it differs from the conventional accounting definition of profit, which solely centres on economic objectives.

Overall, the TBL framework simultaneously considers social, environmental and economic objectives and endeavours to work harmoniously within these three performance domains to balance them in order to create greater business value and sustain long-term success. Indeed, this is in line with the SSCM approach, which incorporates environmental considerations along with economic issues and social criteria within activities associated with the firm's supply chain (Carter and Easton, 2011). Therefore, it is contended that the adopted SSCM approach is consistent with the TBL framework principles, establishing the foundation of SSCM performance outcomes on the TBL performance pillars. Following this line of theoretical reasoning, this study adopted the TBL performance pillars of environmental and economic performance to develop SSCM performance dimensions. Accordingly, we developed SSCM performance dimensions that represent the environmental and financial consequences of SSCM adoption. It is also worth mentioning that there is a reasonable level of consistency within the research foundation, given the fact that the sustainable development concept, SSCM approach and TBL framework are closely linked with one another, all endeavouring to address economic, social and environmental issues from their own perspectives.

2.5.4.2 SSCM performance measures

This section provides a theoretical foundation on traditional performance measurement as well as sustainability-based performance evaluation, assisting this study to develop the SSCM performance measurement. In order to remain competitive and secure long-term success, firms should be able to assess their performance measurement as a prerequisite for their improvement (Kaplan and Norton, 2001). This highlights a need for an effective approach to evaluate performance measurement. In view of this, Slack et al. (2010, p. 606) define performance measurement as:

"The process of quantifying action, where management means the process of quantification and the performance of the operation is assumed to derive from actions taken by its management."

Traditional performance measurement may not be appropriate in the SSCM setting, as it is purely associated with financial-based performance evaluation (Kaplan and Norton, 2001). By contrast, performance measurement in the context of SSCM is relatively new (Shi et al., 2012), which provides a potential opportunity for firms to evaluate their performance implications after adopting SSCM practices. In conjunction with the TBL framework, the assessment of SSCM performance cannot solely be based upon its financial aspect, and requires the integration of other business intangibles such as social and environmental aspects (Elkington, 2004).

In this regard, Hervani et al. (2005) argue that to assess the impacts of the implementation of SSCM practices on firms' performance, there is a clear need to effectively measure environmental performance alongside economic performance. In light of this, they assert that the effective measurement of SSCM performance requires an extension of existing measurements to embrace the key dimensions of sustainable development, i.e. economic, social, and environmental, accounting for their intersections as well, i.e. bearable, equitable, and vital (see Figure 2.5). This highlights a need for a set of sustainability indicators that are credible, comparable and complete (Shi et al., 2012). Hence, it is contended that SSCM performance measurement can be developed by the inclusion of a set of sustainability indicators in the existing traditional performance measurement within the SCM context.

Generally, firms encounter a wide range of possible practical approaches in developing indicators that are capable of measuring social, economic, and environmental performance. However, the wide range of possible approaches that firms may take to develop such indicators depends upon a number of factors, such as the firm’s overall financial bottom line, and the amount of resources it is willing to dedicate (Schaltegger et al., 2014). In this respect, the United Nations provides a number of metrics, benchmarks and indices that are credible, comparable and complete, which can be used to measure sustainability (Bell and Morse, 2008). The purpose of this set of sustainability indicators is generally to enhance the atmosphere, production and consumption patterns, land, economic development, freshwater, seas and coasts, oceans, etc. (Bell and Morse, 2008).

Furthermore, Kaplan and Norton (2001) assert that traditional performance measurement solely based on financial aspects is not capable of measuring all of the critical elements influencing business success. A number of early studies maintained this when developing sustainability-based performance measurements, and stated that measuring all the critical factors influencing business success requires the incorporation of environmental aspects with traditional financial-based performance measurement (Sarkis, 2001; Figge et al., 2002). They employed the United Nations sustainability indicators to extend traditional performance measurement and developed sustainability-based performance measurements. Over the course of time a number of emergent studies (Green and Inman, 2005; Zhu et al., 2008a; Esty and Winston, 2009) have proposed and empirically validated a set of SSCM performance measurements using the United Nations sustainability metrics and indices, which not only include financial aspects but also encompass other business intangibles including environmental aspects. Following a similar approach, this thesis intends to employ both financial and environmental measures in examining the consequences of SSCM practices in terms of performance outcomes.

2.5.4.3 SSCM performance dimensions

Very often in the literature, performance outcomes within the context of sustainable supply chains are referred to as SSCM performance (Lee et al., 2012; Schaltegger et al., 2014). This research cluster is closely associated with the consequences of implementing SSCM practices in terms of performance outcomes. As previously discussed, this study employs the TBL performance pillars in the SCM context and develops SSCM performance dimensions including SSCM-related environmental and economic performance. These two SSCM performance dimensions are presented in the following sub-sections. In addition, the position of the literature concerning SSCM-related environmental and economic performance is addressed below.

2.5.4.3.1 Environmental performance

The existing literature has explored SSCM performance and examined relationships between the implementation of SSCM practices and the commensurate performance outcomes, including environmental and economic performance (Zhu and Sarkis, 2004; Rao and Holt, 2005; Zhu et al., 2007; Hollos et al., 2012; Lee et al., 2012; De Giovannia and Vinzi, 2012; Schaltegger et al., 2014). The literature has offered rich insights into the potential patterns of sustainability-based supply chain relations for enhancing environmental performance (Rao and Holt, 2005; Zhu and Sarkis, 2007; Zhu et al., 2013; Yu and Ramanathan, 2015). In this regard, the literature's position in supporting positive associations between SSCM adoption and environmental performance is quite reasonably strong.

The current literature states that the adoption of environmental management programmes along the supply chain, and the implementation of SSCM practices in particular, can improve firms' environmental performance (Rao, 2005; Zhu and Sarkis, 2007). For example, Vachon and Klassen (2008) have found a significant positive linkage between implementation of SSCM initiatives and improvement in environmental performance. They argue that in the manufacturing setting, close collaboration with suppliers aids the adoption and development of innovative environmental technologies, delivering ecological benefits.

Zhu and Sarkis (2007) also assert that the adoption of eco-design initiatives within the SCM context could lead to improvements in environmental performance due to their ability to minimise products' life cycle environmental impacts. It should be noted that although in most cases the literature demonstrates that SSCM practices can improve environmental performance, a few early studies found little relationship between the adoption of environmental initiatives and environmental performance in the SCM setting (e.g. Levy, 1995). This implies the potential existence of different possible outcomes concerning environmental performance when implementing SSCM practices (see Table 2.3). However, recent studies tend to agree on a positive relationship between adopting SSCM practices and environmental performance (Zhu and Sarkis, 2007; Hollos et al., 2012; Zhu et al., 2012).

In essence, the environmental performance in this study refers to the environmental impact reduction incurred through implementing SSCM practices. This environmental performance dimension is largely associated with the reduction of emissions, hazardous material, waste discharge and waste disposal (Zhu et al., 2008a; Schaltegger et al., 2014). Environmental issues in SCM have become a major concern for manufacturing firms for various reasons, ranging from governmental regulations and their associated compliance issues, stockholder requests, heightened environmental expectations of customers and public perception, to competitive pressures from competitors (see Section 2.5.2). Thus, environmental performance is deemed a crucial issue for manufacturing firms.

According to the literature, the environmental performance dimension in the SSCM context is comprised of two key performance measurements: environmental impact reduction and related social issues (Shi et al., 2012; Schaltegger et al., 2014). The existing literature argues that social issues are very complex in the SSCM context, and suggests treating related social issues as a sub-component within the environmental performance dimension that complements environmental impact reduction (Zhu et al., 2007; Schaltegger et al., 2014). Following a similar approach, this study omits the direct use of social issues due to their complexities, and adopts environmental impact reduction, which complements related social issues, as the main measure of the environmental performance dimension.

A number of studies have operationalised environmental impact reduction through a set of validated indicators such as reduction of materials usage, reduction of energy consumption, decrease or avoidance of the use of hazardous and harmful materials, elimination or reduction of waste generation and waste disposal, decrease in pollution or emissions, and decrease in frequency of environmental accidents (Hervani et al., 2005; Zhu et al., 2008a; Esty and Winston, 2009). We also employ this set of indicators to operationalise the environmental performance dimension to assess firms' environmental performance when adopting SSCM practices (see Chapter 4 for more details). It should be noted that these measures have been developed based on international environmental regulations as the most influential trigger for undertaking environmental initiatives.

2.5.4.3.2 Economic performance

The SSCM performance literature has been somewhat mixed on the relationships between economic performance and the adoption of SSCM practices, with inconclusive findings (Geffen and Rothenberg, 2000; Rao and Holt, 2005; Zhu et al., 2005) of positive or negative associations, largely in favour of positive linkages. Hence, the position of the literature on SSCM adoption and economic performance is relatively less clear-cut than that on environmental performance.

According to the current literature, undertaking environmental initiatives across the supply chain, and the adoption of SSCM practices in particular, can improve firms' economic performance (Zhu and Sarkis, 2004). For example, Rao and Holt (2005) have found significant positive relationships between adopting SSCM practices and economic performance and point out that the implementation of SSCM practices could lead to improved economic performance. They argue that adopting such environmental practices improves customer satisfaction and corporate reputation, which can in turn bring economic benefits. Vachon and Klassen (2008) and Paulraj et al. (2008) also assert that in the SSCM context, inter-firm relations yield informal and formal mechanisms that promote trust and reduce risk, which in turn increase commitment, cooperation and ultimately profitability.

In contrast, a few early studies suggested that economic performance is clearly not reaped in short-term profitability when adopting SSCM-related practices (Bowen et al., 2001). Moreover, recent studies, including some conceptual research and limited case studies (Shi et al., 2012; Walker and Jones, 2012), have begun to question the previous SSCM performance literature, raising concerns as to whether implementing SSCM practices eventually translates into profitability. This also implies the potential existence of different possible outcomes concerning economic performance when implementing SSCM practices. However, most literature remains in favour of a positive association between SSCM practices and economic performance (Wagner and Schaltegger, 2004; Seuring and Muller, 2008a; Lee et al., 2012).

In view of the above discussions, Table 2.3 presents an overview of the SSCM performance literature, displaying different possible outcomes concerning environmental and economic performance when implementing SSCM practices. These potential uncertainties within the SSCM performance cluster highlight a need for further empirical investigation. Therefore, it is contended that despite recent developments in the SSCM performance literature, more empirical research is needed to establish the impacts of SSCM practices on performance outcomes.

Table 2.3. Possible SSCM-related performance outcomes

	Performance outcomes	
Implementation of SSCM practices	Environmental ↑ Economic ↑	Environmental ↓ Economic ↑
	Environmental ↑ Economic ↓	Environmental ↓ Economic ↓

In essence, economic performance in this study represents the financial consequences of SSCM adoption and basically refers to cost reductions incurred through implementing SSCM practices. The developed economic performance dimension is mainly related to reducing costs associated with energy consumption, purchased materials, waste discharge, waste treatment and disposal (Green et al., 2012a). Economic performance can be measured from different perspectives with various indicators, given its broad use and varied applications. Generally, the major financial indicators used within academia to measure economic performance include sales, profit, reduced cost, growth and brand image (Hervani et al., 2005; Schaltegger et al., 2014).

However, in most cases the literature suggests measuring economic performance through cost reduction, as the most effective approach to examining the financial consequences of SSCM adoption, serving as an appropriate proxy for exploring the effects of implementing SSCM practices on financial outcomes (Zhu et al., 2008a; Lee et al., 2012; Green et al., 2012a). Adopting a similar approach, this thesis employs a measuring approach to economic performance focused on cost reduction. Given this cost reduction focus, we classify economic performance as cost performance in this study. Thus, cost performance is developed to represent the financial consequences of SSCM adoption.

In summary, Section 2.5.4 has provided theoretical discussions surrounding performance outcomes associated with SSCM adoption. Accordingly, two SSCM-related performance dimensions of environmental and cost performance were developed using the theoretical foundation of the TBL framework, representing the environmental and financial consequences of SSCM adoption. The relevant measures associated with these two performance dimensions have also been presented. Finally, the positon of the existing literature on SSCM performance dimensions has been addressed, covering different possible outcomes concerning environmental and economic performance arising from implementing SSCM practices. This thesis benefits from this section because it assists the development of the research framework in conceptualising SSCM performance, contributing to the research objective.

2.6 Chapter summary

This chapter has broadly focused on three key research clusters which are indispensable in establishing an appropriate foundation for this study. It began with a theoretical background for SCM, presenting its main activities, and discussing how it has shifted its focus to sustainability. The basic terminology concerning supply chain sustainability was then presented, distinguishing the GSCM and SSCM concepts. Subsequently, the adopted SSCM concept has been extensively addressed along with its core components. Furthermore, in view of the integrated nature of the research phenomenon, the main research clusters of SSCM driving forces, SSCM practices and SSCM performance have been identified due to their relevance to the proposed research questions. In light of this, an overlapping literature approach has been proposed and employed to synthesise these three research clusters to eventually answer the research questions. In doing this, this chapter has provided theoretical foundations for each cluster in the research phenomenon.

In this regard, the major triggers for adopting SSCM have been addressed. Accordingly, the first research cluster of SSCM driving forces was developed, describing exogenous forces and endogenous factors that give rise to SSCM adoption. The second research cluster of SSCM practices was then developed through a synthesis of pertinent SSCM literature concerning the essential sustainable practices required for the effective implementation of SSCM. In light of this, a systematic review approach of SSCM literature was employed across a 23-year time frame, to explore and ascertain essential SSCM practices. Consequently, 35 essential SSCM practices were identified and further categorised into major relevant groupings, representing the SSCM practices and driving forces dimensions.

Finally, theoretical discussions on performance outcomes associated with SSCM adoption have been provided to develop the third research cluster. Relevant SSCM performance measures have been presented and SSCM performance dimensions developed using the theoretical foundation of the TBL framework. The synthesis of these developed research clusters permits this thesis to achieve its primary objective in developing a robust conceptual SSCM drivers-practices-performance framework and effectively answer the research questions. The developed research clusters of SSCM driving forces, SSCM practice implementation and SSCM performance will be operationalised in the next chapter, contributing to the development of the research framework. Overall, Chapter 2 (Literature Review) was intended to provide the theoretical foundation for the integrated research phenomenon, and based on this foundation, the next chapter will develop the conceptual SSCM drivers-practices-performance framework.

CHAPTER 3

CONCEPTUAL DEVELOPMENT

3.1 Introduction

The core of this chapter is the development of the research framework in relation to the research phenomenon. This chapter, then, aims to conceptualise a theoretical model of SSCM drivers-practices-performance and its relationship with the three integrated clusters of the research phenomenon, with a focus on antecedents and outcomes and indications of cause and effect. As depicted in Figure 3.1, this chapter begins with the theoretical reasoning for developing the conceptual framework and subsequently the initial research model using the theoretical foundations presented in Chapter 2. Chapter 2 was mainly focused on providing a theoretical understanding of the three main research clusters surrounding the integrated research phenomenon. This chapter uses the theoretical foundation of these research clusters, i.e. SSCM driving forces, SSCM practices and SSCM performance, to develop a comprehensive SSCM drivers-practices-performance research framework. This will make a contribution to SSCM knowledge through conceptualising a comprehensive framework which is capable of assessing the impacts of the implementation of SSCM practices on performance outcomes while considering the influential effects of SSCM driving forces. This allows the study to achieve its primary objective and ultimately answer the research questions.

This chapter goes on to theoretically develop the research hypotheses pertaining to the effects of SSCM driving forces on SSCM adoption which in turn impact performance outcomes. These theoretical linkages are discussed in the hypothesis development section. The hypothesis development concludes Section 3.3 with 13 proposed hypotheses for further empirical investigation. As final points, Section 3.4 presents the theoretical model along with a summary of the research hypotheses. In addition, this chapter operationalises the developed dimensions through seven underlying constructs, encompassing the three main research clusters. The theoretical linkage between the research model and the Triple Bottom Line (TBL) framework is also presented, demonstrating the rigour of the research process. Finally, Section 3.5 concludes this chapter with a summary.

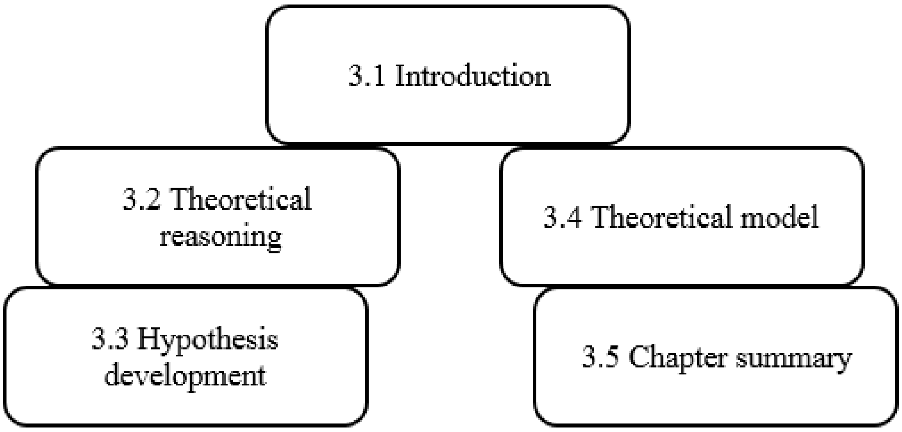


Figure 3.1 Structure of Chapter 3

Overall, Chapter 3 attempts to develop a robust conceptual SSCM drivers-practices-performance framework, based on the theoretical foundation presented for the main research clusters. The position of this chapter in the thesis is presented in Figure 3.2.

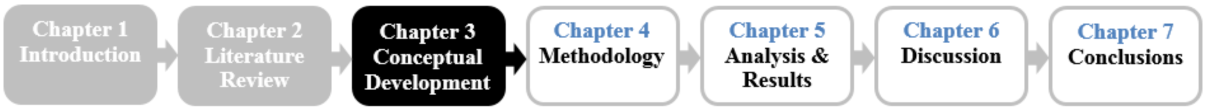


Figure 3.2 Position of Chapter 3 in this thesis

3.2 Theoretical reasoning

This section forms the core of the study's theoretical underpinnings and presents the theoretical reasoning for conceptualising the research framework. In light of this, first this section attempts to provide the generic reasoning concerning the development of the conceptual framework from a holistic perspective. As previously discussed, the adoption of sustainable supply chain management (SSCM) is largely influenced by various driving forces. It has been contended that the exogenous driving force represented by regulations can only take SSCM adoption to a limited extent, and that it actually requires internal commitment and support from various different levels of the firm. Collectively, a set of exogenous forces associated with environmental regulations, and endogenous factors associated with firms' internal support, which form a bundle of SSCM driving forces, is deemed to give rise to the adoption of SSCM practices. In this study, such a bundle of SSCM driving forces describes a set of external pressures and internal drivers that lead manufacturing firms to embark upon SSCM adoption, which may lead to a set of consequences in terms of performance outcomes. In addition, this is of academic significance, as the adoption of SSCM practices has not to date been articulated with respect to such a comprehensive cluster of driving forces that covers both external pressures and internal drivers (Seuring and Muller, 2008a; Seuring and Gold, 2013). Following this line of reasoning, the theoretical linkage between the SSCM driving forces and the implementation of SSCM practices clusters is established, contributing to the development of the first phase of the conceptual framework (see Figure 3.3).

Moreover, we argue that the implementation of SSCM practices influences performance outcomes within the SSCM context, as they are measured by environmental impact reduction and its associated cost reduction (see Sections 2.5.4.3.1 and 2.5.4.3.2). Therefore, it is contended that the adoption of SSCM practices delivers performance outcomes in the form of environmental and economic consequences. From a holistic perspective, the implementation of organisational practices such as SSCM adoption is deemed to have causal impacts on organisational performance both at the environmental and cost levels, given the rational causation, exercising a certain degree of influence on performance outcomes (Paulraj et al., 2008; Slack et al., 2010). Following this reasoning concerning performance measurement and the causation rationale, the implementation of SSCM practices is postulated to have impacts on performance outcomes. Therefore, the theoretical linkage between the implementation of

SSCM practices and SSCM performance outcomes clusters is established, contributing to the development of the second phase of the conceptual framework (see Figure 3.3). Accordingly, we develop the theoretical linkages between the three main research clusters and conceptualise the research framework with a focus on antecedent and outcome effects, as depicted in Figure 3.3. This focus was adopted in line with our research questions, looking into the driving forces that need to be in place before SSCM practices are adopted and the potential outcomes of such SSCM implementation.

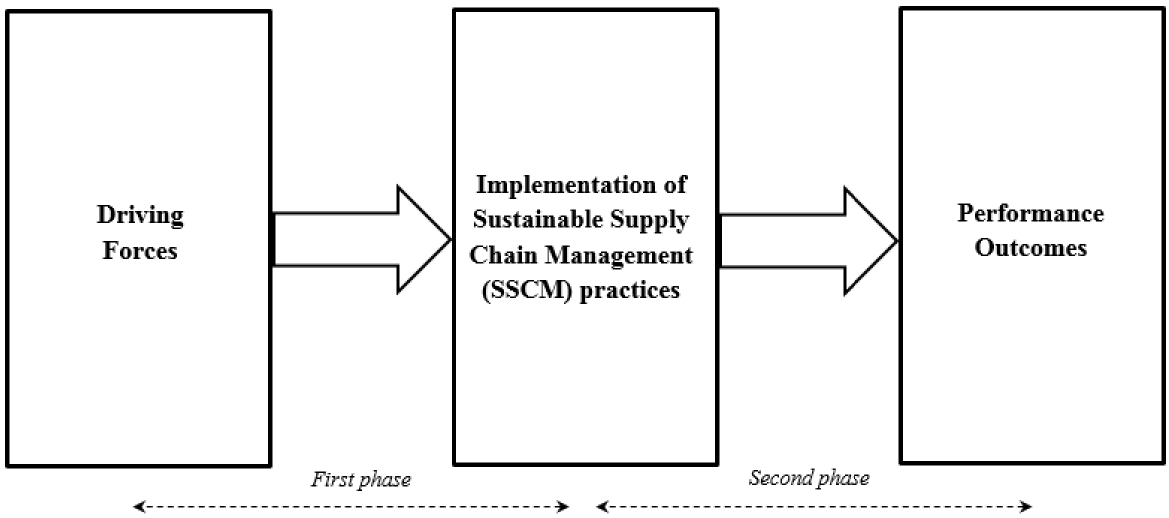


Figure 3.3 Conceptual framework of SSCM driving forces-practices-performance

On the other hand, we argue that the existence of and response to a driving forces cluster that encompasses both exogenous forces and endogenous factors will cause the relationship between the implementation of SSCM practices and performance outcomes clusters to vary. Arguably, the effect of the driving forces antecedent on SSCM adoption can further influence the relationship between SSCM practices and performance outcomes. This is also of academic significance, as this is the first wave of research investigation which takes into account the influential effects of the driving forces associated with SSCM adoption when examining the impacts of SSCM implementation on performance outcomes (Rao and Holt, 2005; Lee et al., 2012; Zhu et al., 2012).

Having developed the conceptual framework, this section moves on to provide more detailed theoretical reasoning concerning the development of the research model from an integrated perspective. Therefore, this section attempts to operationalise the main clusters of the conceptual framework in order to develop the initial research model. As previously presented in Section 2.5.3.1, we developed the organisation environmental management (OEM) dimension that serves as a proxy in representing the research cluster of SSCM driving forces. We define OEM in this study as a construct which describes a bundle of external pressures and internal drivers that give rise to the adoption of SSCM practices. The OEM construct, encompassing both endogenous factors associated with firms' internal support and exogenous forces behind environmental regulations, leads manufacturing firms to embark upon SSCM adoption. Therefore, the OEM construct is postulated to have a direct relationship with the adoption of SSCM practices. We rely on the OEM construct to explore whether exogenous regulatory pressures and endogenous commitment factors exist in the adoption of SSCM practices and investigate whether they are necessary and sufficient in embarking upon SSCM implementation. In this regard, the OEM construct is deemed to be an antecedent to the adoption of SSCM practices. With this set of arguments, we develop the first phase of our initial model by incorporating the OEM construct as an antecedent of SSCM adoption, establishing a theoretical linkage between the OEM construct and SSCM implementation (see Figure 3.4).

Having operationalised the SSCM driving forces cluster through the organisation environmental management (OEM) construct, this section moves on to operationalise the cluster of SSCM implementation. As previously presented in Section 2.5.3.1, we developed four major dimensions of sustainable procurement (SP), sustainable design (SD), sustainable distribution (SDIST) and investment recovery (IR), which cover the main activities and processes involved within sustainable supply chain management, serving as a representative of SSCM practices. We define SP, SD, SDIST and IR in this study as focal constructs which describe the implementation of SSCM practices that may lead to a set of consequences in terms of performance outcomes. Collectively, these four core constructs are focal to the research model, in line with the focus of the conceptual framework on antecedent and outcome effects.

Furthermore, we argue that the implementation of sustainable procurement, sustainable distribution, sustainable design and investment recovery practices is expected to influence performance outcomes in the form of environmental performance, as measured by reductions in energy usage, solid waste, air emissions, effluent wastes, waste emissions and the consumption of toxic substances and harmful materials (Green et al., 2012a; Zhu et al., 2008a; Schaltegger et al., 2014). It is also contended that implementation of these focal SSCM practices is expected to influence performance outcomes in the form of cost performance, as measured by cost reductions associated with energy cost savings, material recovery savings, waste discharge savings, green purchasing cost savings and waste treatment, environmental risk or penalty cost savings (Zhu et al., 2008a; Schaltegger et al., 2014).

In essence, the focal SSCM practices (i.e. sustainable procurement, sustainable distribution, sustainable design and investment recovery) are initiatives that are environmentally friendly by nature and designed to minimise a product's environmental impact without creating a trade-off with other performance dimensions, such as costs and functionality (Grote et al., 2007; Seuring and Muller, 2008a). Collectively, the implementation of these focal SSCM practices reduces material consumptions, generated wastes, emissions, energy usage, and excessive inventory and is deemed to have an impact on environmental performance because of these direct environmental results. It also impacts the cost performance, as each of the SSCM practices has a direct causal effect on costs and profits, i.e. the quantifiable measurement criteria of economic performance (Wagner and Schaltegger, 2004; Hervani et al., 2005). Thus, following this line of theoretical reasoning concerning the organisational performance and the causation rationale, the implementation of SSCM practices is postulated to have an impact on both environmental performance and cost performance.

As final points, this section attempts to operationalise the cluster of performance outcomes. As previously presented in Section 2.5.4, we developed two main dimensions of environmental performance and cost performance that represent the performance outcomes of SSCM implementation. We define environmental performance (EP) and cost performance (CP) in this study as performance constructs which describe the ecological and economic consequences of the implementation of SSCM practices. Collectively, these two performance constructs are placed as consequences in the research model in line with the focus of the conceptual framework on antecedent and outcome effects. We further argue that environmental performance is influenced by the implementation of the focal SSCM constructs, given their direct environmental results. From an economic standpoint, it is further contended that the cost performance of the firm is affected when implementing the focal SSCM constructs, given the cost reductions incurred through commensurate environmental impact reduction (e.g. decrease in expenses in energy consumption, waste disposal, etc.).

With the above arguments, we develop the second phase of our initial model by incorporating SP, SD, SDIST and IR practices as the focal constructs of the model, and also embedding EP and CP performance constructs as the outcomes, establishing theoretical linkages between the focal constructs of SSCM practices and performance constructs (see Figure 3.4). Therefore, in accordance with our conceptual framework, we develop the comprehensive SSCM drivers-practices-performance model as depicted in Figure 3.4. The model's claim to comprehensiveness stems from the fact that the embedded focal SSCM dimensions were developed following key principles of SCM that encompass all of the main activities involved in SCM, and also in line with the core components of the SSCM concept. The comprehensive nature of the research model is also consistent with our objective in developing it from the holistic and integrated perspective required for the inclusion of the influential effects of the SSCM driving forces when examining the impacts of SSCM implementation on performance outcomes.

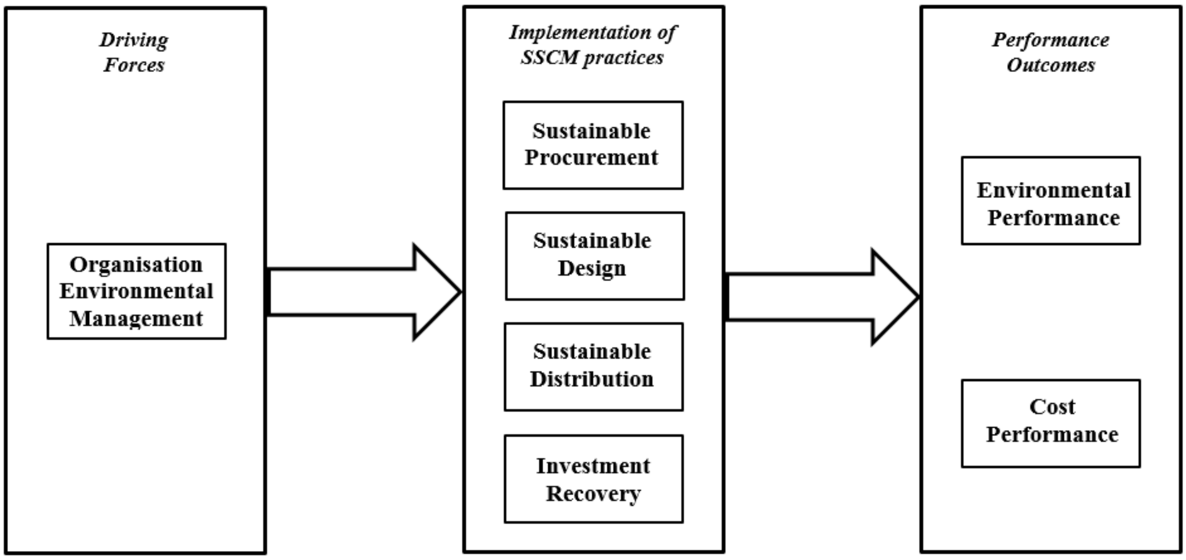


Figure 3.4 Initial SSCM drivers-practices-performance model

Overall, our initial model was developed using the theoretical anchors of SCM theory and also theoretical reasoning concerning organisational performance and the causation rationale. Furthermore, the holistic and integrated perspective of the research model allows this study to effectively assess the impact of the implementation of SSCM practices on performance outcomes with the inclusion of the effects of SSCM driving forces, discovering more credible findings.

3.3 Hypothesis development

The aim of this section is to develop theoretical relationships between the embedded constructs in order to theorise the final model. In the previous section, the conceptual framework and consequently the initial research model were developed following theoretical reasoning concerning organisational performance and the causation rationale as well as the theoretical underpinnings of SCM theory. This takes one step closer to achieving the study's primary objective of developing a comprehensive SSCM drivers-practices-performance model. In light of this, this section attempts to formulate a number of hypotheses about the relationships between the embedded constructs, using the theoretical foundation presented for the SSCM driving forces, SSCM practices and SSCM performance clusters and also the empirical evidence within the corresponding literature.

In developing the study's research hypotheses, the contingency perspective is considered, following a similar approach employed by many scholars when proposing hypotheses or structuring causal relationships (Layder, 1988; Carter and Jennings, 2004; Green et al., 2012b; Hollos et al., 2012). The contingency perspective implies that our proposed hypotheses might be neither true nor false under every possible valuation, enabling us to either reject or confirm the study's research hypotheses (Layder, 1988). This section concludes with a number of hypotheses for further empirical investigation.

3.3.1 Organisation environmental management and SSCM practices

As previously discussed, a diverse bundle of various groups of stakeholder, customer, competitor and regulatory bodies trigger the adoption of SSCM practices (see Section 2.5.2.5). It has been widely accepted that the pressures exerted from these various groups have the capacity to influence a firm's responsiveness to adopting SSCM initiatives such as sustainable procurement, sustainable design, sustainable distribution and investment recovery (Zhu and Sarkis, 2007; Seuring and Muller, 2008a). In this regard, it was contended that firms embark upon undertaking environmental initiatives along their supply chain for various reasons, ranging from governmental regulations and their associated compliance issues, stakeholder requests, heightened environmental expectations of customers and public perception, to competitive pressures from competitors.

Very often, the literature identifies the exogenous driving forces associated with environmental regulations as the prime trigger for undertaking environmental initiatives and adopting an SSCM agenda in particular, given their authoritative capacity (Zailani et al., 2012; Boström et al., 2015). However, such regulatory driving forces are here considered purely as a stringent pressure which can only take SSCM adoption so far. Arguably, from a practical perspective, governmental coercive pressures to push firms to pursue SSCM-related practices are necessary but not sufficient (Sarkis et al., 2010). We argue that it also requires internal commitment and support from various different levels of the firm. Collectively, a set of endogenous factors associated with firms' internal support and exogenous forces behind environmental regulations is postulated to give rise to the adoption of SSCM practices. In light of this, the construct attached to this agenda that encompasses both external pressures exerted by regulatory bodies and internal drivers associated with the firm's commitment is referred to as organisation environmental management (OEM). The OEM construct serves as an appropriate proxy that describes both the exogenous pressures and endogenous drivers which may yield the adoption of SSCM practices. In this respect, the OEM construct was posited as an antecedent to the implementation of SSCM practices.

In this study, OEM is defined as the practice of accepting and developing sustainable supply chain management in response to regulatory pressures and the commitment and support of top-level management. In essence, the OEM construct encompasses a number of observable practices such as commitment from senior and mid-level managers, support from senior and mid-level managers, total quality environmental management, ISO 14001 certification, environmental compliance and auditing programmes, environmental education and organisational learning (Zhu et al., 2008a; Seuring and Muller, 2008a; Green et al., 2012a).

Each of these practices is associated with the implementation of the SP, SD, SDIST and IR constructs, as they drive the adoption of these main SSCM initiatives. This driving role attached to external pressures exerted by regulators and the firm's internal drivers, arguably gives rise to the adoption of the SP, SD, SDIST and IR constructs. Thus, these observable practices that form the OEM construct are postulated to have a direct relationship with the adoption of SP, SD, SDIST and IR. Therefore, it is contended that the OEM construct serves as an appropriate proxy in representing the SSCM driving forces cluster, encompassing both external pressures, i.e. ISO 14001 certification, environmental compliance and auditing programmes, and internal drivers, i.e. commitment from top-level management, support from senior and mid-level managers, environmental education and organisational learning, and total quality environmental management (Hu and Hsu, 2010; Sarkis et al., 2010; Hsu et al., 2013).

In addition to the above reasoning, we use the empirical evidence within the corresponding literature to further support the proposed relationship between the OEM and the adoption of the SP, SD, SDIST and IR constructs as follows. According to Hamel and Prahalad (1989), senior management support is a key driver for the successful adoption and implementation of new organisational practices, including new innovative technologies and environmental programmes and activities. The studies of de Bakker et al. (2002) and Rice (2003) maintain this and argue that in order to ensure environmental excellence and the dissemination of innovative environmental technologies, senior management should be totally committed.

In essence, management commitment to an environmental protection agenda is imperative to ensure that an environmentally friendly life cycle approach is adopted (Finnveden et al., 2009). Consistent with these studies' stances, Green et al. (2012a) assert that once commitment to and support for the SSCM agenda has been received from top and mid-level management, the firm can proceed with the implementation of SSCM-related practices. Hence, we contend that firms with a high level of internal commitment and support concerning environmental management are more likely to strengthen their operations and processes to implement the SSCM practices of SP, SD, SDIST and IR. Without such internal commitment and support, it is difficult for firms to adopt SSCM-related practices.

Furthermore, environmental compliance issues are considered to be external pressures that push firms to conform to environmental laws, standards and requirements, playing a crucial role in adopting SP, SD, SDIST and IR practices (Wee and Quazi, 2005). In light of this, ISO 14001 certification, the other observable practice of the OEM construct, is associated with firms' environmental compliance and is gained in response to the external pressures exerted through environmental regulations. The ISO 14001 certification practice within the OEM construct represents external coercive pressures to adopt SSCM practices that firms face. This environmental certification establishes an effective environmental management system within the firm, promoting the undertaking of SSCM initiatives, which arguably affects the adoption of SSCM practices.

In addition, Cantor et al. (2012) maintain that environmental education and organisational learning significantly impact the implementation of SSCM practices, because a better perception of environmental sustainability promotes an environmental protection agenda amongst staff who are closely involved in managing the implementation of SSCM practices. In this regard, Walker et al. (2008) proffer that environmental education and training programmes provided by focal firms greatly improve staff environmental awareness of the SSCM agenda, which in turn can facilitate SSCM implementation. They argue that the successful implementation of SSCM practices depends upon the staff within various departments of the firm who are responsible for managing different SSCM initiatives, and cannot be achieved without environmental education and training. This further highlights the critical role of the firm's internal drivers in the adoption of SSCM practices. In this regard, Bevis (2011) argues that car manufacturing firms that have a low level of awareness concerning environmental issues tend to have higher energy usage within their production processes, and in turn higher operational costs. This also highlights the importance of the internal driving role of the firm concerning environmental education and organisational learning.

Moreover, Zhu and Sarkis' (2007) empirical study suggests that the incorporation of total quality environmental management as a key part of the firm's mission statement is deemed a necessary precursor to successful implementation of SSCM practices. They argue that applying total quality management approaches to the firm's overall environmental strategy facilitates and supports the undertaking of environmental initiatives along the supply chain. Thus, it is argued that total quality environmental management affects the adoption of SSCM practices.

Therefore, considering the above theoretical arguments and empirical evidence, the OEM construct is postulated as an antecedent to the implementation of SSCM practices, affecting focal SSCM practices including sustainable procurement, sustainable design, sustainable distribution and investment recovery. With this set of arguments, we propose the following hypotheses:

H1a. Organisation environmental management is directly and positively associated with sustainable procurement.

H1b. Organisation environmental management is directly and positively associated with sustainable design.

H1c. Organisation environmental management is directly and positively associated with sustainable distribution.

H1d. Organisation environmental management is directly and positively associated with investment recovery.

3.3.2 Link between SSCM practices and environmental and cost performance

We argue that SSCM practices of sustainable procurement (SP), sustainable design (SD), sustainable distribution (SDIST) and investment recovery (IR) are adopted in response to external regulatory pressures and due to the firm's internal drivers, and collectively the implementation of these practices is expected to influence its environmental and cost performance, as measured by the environmental impact reduction and its commensurate cost reduction (Green et al., 2012a). In essence, in this study, the focal SSCM practices of SP, SD, SDIST and IR are by their nature environmentally friendly initiatives, designed to minimise a product's environmental impact without creating a negative trade-off with other performance dimensions such as cost (Grote et al., 2007; Seuring and Muller, 2008a). In this regard, given that the implementation of these SSCM practices reduces materials consumption, generated wastes, emissions, energy usage and excessive inventory, each of these practices is deemed to have an impact on environmental performance, considering their direct environmental results. Therefore, it is contended that SSCM practices can have a positive effect on a firm's environmental performance.

Furthermore, the SSCM practices of SP, SD, SDIST and IR can potentially cut the costs of energy consumption and purchased materials, decrease the costs of waste treatment and discharge, reduce the cost of excessive inventory maintenance and avoid fines or penalties due to environmental accidents. Thus, it is contended that the implementation of SSCM practices impacts on cost performance, given their direct causal effect on costs and profits, through the cost reduction associated with energy cost savings, material recovery savings, waste discharge savings, green purchasing cost savings and environmental risk or penalty cost savings. Therefore, we argue that SSCM practices can have a positive effect on a firm's cost performance.

In addition to the above reasoning, we use the empirical evidence within the corresponding literature to further develop the hypotheses on the relationships between each of the focal SSCM constructs and the environmental and cost performance. As discussed in Chapter 2, previous empirical studies have investigated the relationships between the implementation of SSCM practices and performance outcomes, including environmental and cost performance. Although the existing literature sometime offers mixed views on this matter, the overall literature remains largely in favour of a positive association between SSCM practices and environmental performance, and relatively in favour of a positive association for cost performance (Geffen and Rothenberg, 2000; Rao and Holt, 2005; Seuring and Muller, 2008a; Vachon and Klassen, 2008; Hollos et al., 20120; Zhu et al., 2012). We then propose the individual research hypotheses on the relationships between the focal SSCM constructs and environmental and cost performance in the following sub-sections, using the empirical evidence within the corresponding literature and the above theoretical arguments.

3.3.2.1 Linkage between sustainable procurement and environmental and cost performance

Generally, the core SSCM practices of sustainable procurement, sustainable design, sustainable distribution and investment recovery are developed specifically to improve the environmental performance of the firm (Zhu and Sarkis, 2007). Sustainable procurement practice ensures that purchased items are in line with desirable ecological attributes, which requires close collaboration with suppliers to acquire environmentally friendly inputs (Carter and Carter, 1998). Suppliers play a crucial in improving firms' environmental performance, as they are involved in ensuring that purchased materials are environmentally sustainable and have been produced using environmentally friendly processes (Hsu et al., 2013). In this respect, manufacturing firms and car manufacturers in particular commonly tend to make collaborative efforts with certain suppliers that possess green resources essential for the acquisition of environmental friendly inputs (Bevis, 2011). Arguably, the acquisition of such environmentally friendly inputs assists the manufacturing firm to develop products and services that are environmentally sustainable, mitigating environmental impacts.

Geffen and Rothenberg (2000) and Vachon and Klassen (2008) endorse this and assert that, in the manufacturing setting, close collaboration and strong relationships with suppliers aids the adoption of sustainable procurement, leading to improved environmental performance. They argue that close collaboration and strong relationships with suppliers assists in the development of innovative environmental technologies in the acquisition of the environmentally friendly inputs required for developing environmentally sustainable products, which deliver improvements in environmental performance. In addition to this, Zhu and Sarkis (2007) and Hollos et al. (2012) find a positive relationship between the implementation of the SSCM practice of sustainable procurement and improvements in environmental performance, as it provides environmentally friendly inputs that generate less wastes and emissions. Therefore, the sustainable procurement construct is postulated to have a positive impact on environmental performance.

On the other hand, we argue that sustainable procurement also affects the cost performance of the firm, because employing environmentally friendly suppliers with green resources appreciably influences the firm’s financial performance. The reasoning for this is down to the fact that environmentally friendly suppliers tend to give different price quotations to those that are not comparatively environmentally friendly, which in turn affects the firm’s cost performance (Carter, 2005). Thus, a certain degree of direct association between sustainable procurement and cost performance is posited. Furthermore, the practice of sustainable procurement facilitates the elimination of wastes and emissions by providing environmentally friendly inputs (Green et al., 2012a). Arguably, such waste minimisation can lead to reduced costs associated with waste treatment, waste disposal and waste discharge, potentially resulting in better cost performance. Rao and Holt (2005) and De Giovannia and Vinzi (2012) support this and demonstrate a significant positive linkage between green purchasing and economic performance. They find that the SSCM practice of sustainable procurement leads to improved economic performance. Thus, the sustainable procurement construct is posited to have a positive impact on cost performance.

Accordingly, with this set of theoretical arguments and empirical evidence, we propose the following hypotheses:

H2a. Sustainable procurement is directly and positively associated with environmental performance.

H3a. Sustainable procurement is directly and positively associated with cost performance.

3.3.2.2 Linkage between sustainable design and environmental and cost performance

As previously discussed, the core SSCM practices such as sustainable design are broadly developed to improve the environmental performance of the firm (Zhu and Sarkis, 2007). Sustainable design practice is generally concerned with designing products or services with environmental considerations for the purpose of minimising life cycle environmental impacts (Emmett and Sood, 2010). Sustainable design requires that manufacturers design products in a way that minimises consumption of materials and energy usage and decreases the use of hazardous materials within the manufacturing process (Zhu et al., 2007). This practice involves the development of the firm’s eco-design activities, including designing for reduced consumption of materials and energy and to decrease the use of hazardous substances (Kuik et al., 2011).

Undertaking such eco-design activities minimises the consumption of materials and energy, and reduces the use of hazardous materials, in turn decreasing the hazardous waste generated, leading to improved environmental performance. In this regard, Zhu and Sarkis (2007) and Green et al. (2012a) find a positive relationship between the implementation of sustainable design and improvements in environmental performance, and maintain the capability of eco-design practices to mitigate products' life cycle environmental impacts through materials and energy usage reduction. Furthermore, Diabat and Govindan (2011) proffer that sustainable design will directly and positively affect the firm's environmental performance, as the impetus of the designers will be towards reducing the negative environmental impacts of the design. Hence, the sustainable design construct is posited to have a positive effect on environmental performance.

On the other hand, we argue that sustainable design also affects the cost performance of the firm, given its capability for energy cost savings, material purchasing cost savings and hazardous waste disposal cost savings. The practice of sustainable design is broadly focused on the elimination of energy usage and materials consumption associated with production and also the reduction of the use of hazardous materials. In view of this, the implementation of sustainable design practices is expected to minimise the consumption of material and energy within production processes, and also reduce the use of hazardous substances. Collectively, this can cut the cost of purchased materials and energy consumption and avoid fines due to environmental accidents, and thus reduce costs associated with hazardous waste disposal, ultimately resulting in better cost performance.

Thus, the sustainable design construct is postulated to have a positive effect on cost performance. Supporting this, Rao and Holt (2005) demonstrate a direct positive linkage between sustainable design and economic performance, and find that the implementation of sustainable design leads to competitiveness and improved economic performance. Their discussion also centres on the capability of eco-design activities to minimise material and energy usage, leading to reduced costs associated with material and energy consumption. Furthermore, Zhu et al. (2012) argue that eco-design's focus on minimising the consumption of materials and energy facilitates the reuse and recycling of component materials and parts, which in turn yields less waste. They proffer that such waste minimisation incurred through the reuse and recycling of component materials and parts should lead to reduced costs associated with waste disposal, potentially resulting in improved cost performance.

Therefore, with this set of arguments, we hypothesise the following:

H2b. Sustainable design is directly and positively associated with environmental performance.

H3b. Sustainable design is directly and positively associated with cost performance.

3.3.2.3 Linkage between sustainable distribution and environmental and cost performance

Generally, the SSCM practice of sustainable distribution is fundamentally developed to improve the environmental performance of the firm, and seeks to mitigate the logistical impact of material flows and product transportation (Seuring and Muller, 2008b). As discussed in Chapter 2, sustainable distribution encompasses a set of proactive environmental practices (e.g. minimising empty miles, more direct routes, better space utilisation, shorter movements, etc.) that enhance the transportation system so as to leave the lowest possible negative environmental impact. From a practical perspective, manufacturing firms and car manufacturers in particular often employ third-party logistics providers with green expertise to effectively carry out sustainable distribution initiatives (Svensson, 2007; Bevis, 2011). Such third-party logistics providers who possess green expertise furnish firms with green packaging and green logistics characteristics that have the capacity to mitigate logistical impacts (Emmett and Sood, 2010).

These green packaging and green logistics activities decrease the material usage involved in packaging along with its commensurate wastes and also reduce the emissions generated and energy usage throughout the distribution process, which arguably leads to improved environmental performance. In this regard, Vachon and Klassen (2006) and Lakshmimeera and Palanisamy (2013) find a direct positive relationship between the implementation of sustainable distribution and improvements in environmental performance. They argue that green packaging and green logistics activities involved in sustainable distribution mitigate the logistical impacts of product transportation, through reducing emissions generated across the distribution process and materials used in product packaging, resulting in better environmental performance. Therefore, the sustainable distribution construct is posited to have a positive impact on environmental performance.

In addition, we argue that sustainable distribution also impacts the cost performance of the firm. The practice of sustainable distribution is broadly focused on the elimination of energy usage throughout the whole distribution process and also the reduction of materials used in product packaging. Arguably, such minimisation of energy usage and material consumption should lead to reduced costs associated with the energy usage involved in product transportation and materials used in product packaging, potentially resulting in improved cost performance. For example, green logistics initiatives of minimising empty miles, more direct routes and better space utilisation decrease the consumption of fuel within the transportation process, which leads to reduced costs associated with fuel consumption, resulting in better cost performance.

Hence, the sustainable distribution construct is postulated to have a positive impact on cost performance. The studies of Rao and Holt (2005) and Hollos et al. (2012) support this and demonstrate a direct positive linkage between sustainable distribution and the economic performance of manufacturing firms. They find that the implementation of sustainable distribution practice leads to improved economic performance, given its energy cost-saving ability concerning reductions in fuel consumption in product transportation. They further suggest that sustainable distribution activities aid the reduction of carbon emissions and waste levels throughout the distribution process, minimising the footprint left behind during product transportation, which can be reaped in long-term profitability through growth in brand image.

Accordingly, considering the above theoretical arguments and empirical evidence, we propose the following hypotheses:

H2c. Sustainable distribution is directly and positively associated with environmental performance.

H3c. Sustainable distribution is directly and positively associated with cost performance.

3.3.2.4 Linkage between investment recovery and environmental and cost performance

In essence, the practice of investment recovery, similar to other core SSCM practices, is developed specifically to enhance environmental sustainability and improve the environmental performance of manufacturing firms (Green et al., 2012). As discussed in Chapter 2, investment recovery practice is broadly concerned with the task of recapturing the value of end-of-life products or unproductive assets through effective reuse or surplus sales and divestment (Zhu et al., 2008a). This practice deals directly with the reuse and recycling of end-of-life products and involves taking back discarded products as well as preparing them for recycling procedures. Collectively, the reuse and recycling of end-of-life products can decrease wastes and emissions associated with scrap and used materials, leading to improved environmental performance.

In addition, investment recovery practice focuses on surplus sales and divestment of unproductive assets of the firm. The surplus sales of unused or unproductive assets can enhance the environmental performance of the firm, because once firms dispense with these unproductive assets, the wastes and emissions associated with these assets will be eliminated along with the energy usage involved in their maintenance. Green et al. (2012a) maintain this and demonstrate a positive direct linkage between the implementation of investment recovery practice and environmental performance. They further argue that investment recovery practice also reduces excessive inventory as part of the aim of divesting unproductive assets, which eliminates emissions of excess inventories and energy usage concerning their maintenance. Hence, the investment recovery construct is posited to have a positive effect on environmental performance.

On the other hand, we argue that investment recovery also affects the cost performance of the firm, given its capability of material recovery cost savings, direct monetary benefits and cost reductions incurred through low inventory maintenance. The practice of investment recovery is mainly focused on surplus sales of excess inventories, scrap and used materials and excess capital equipment for the purpose of maximising the value of end-of-life products and unproductive assets (Zhu et al., 2008a). In view of this, the implementation of investment recovery practice minimises the energy usage required for the maintenance of inventories, and also reduces the wastes associated with material recovery. Collectively, this can reduce the energy costs for excessive inventory maintenance, and also cut the costs associated with waste disposal, as less wastes are incurred through material recovery.

In addition, the approach of surplus sales of unproductive assets directly affects the economic performance of the firm, as it brings monetary benefits. Thus, the investment recovery construct is postulated to have a positive effect on cost performance. In favour of this, Zhu and Sarkis (2007) find a direct positive relationship between investment recovery and economic performance. They report that the implementation of investment recovery practice leads to improved economic performance, given its capability in material recovery cost savings and surplus sales of scrap and used materials. Furthermore, Prahinski and Kocabasoglu (2006) argue that the major proportion of the excess sales generated through the investment recovery practice becomes part of manufacturing firms' profit, regardless of their industry sector. In light of this, they proffer that investment recovery can be legitimately viewed as both an environmentally and an economically beneficial practice. In this regard, Lin and Lan (2013) find similar results for car manufacturing firms as a sub-set of the broad manufacturing sector that possess all the main manufacturing characteristics together with the basic foundation for sustainable practices.

Therefore, with this set of theoretical arguments and empirical evidence, we propose the following hypotheses:

H2d. Investment recovery is directly and positively associated with environmental performance.

H3d. Investment recovery is directly and positively associated with cost performance.

3.3.3 Linkage of environmental performance and cost performance

Although previous empirical studies have investigated the relationships between the implementation of SSCM practices and performance outcomes, the interrelation between environmental and cost performance has been neglected (Rao and Holt, 2005; Zhu and Sarkis, 2007; Vachon and Klassen, 2008; Hollos et al., 2012). Considering the definitions of the environmental and cost performance dimensions, we attempt to demonstrate a potential direct linkage between these performance outcomes. In this study, environmental performance relates to the ability of manufacturing firms to decrease energy and materials consumption and also reduce solid wastes, effluent wastes, air emissions and the use of hazardous substances, whereas cost performance refers to manufacturing firms' ability to reduce costs associated with energy consumption, purchased materials, waste treatment, waste disposal, waste discharge and fines or penalties for environmental accidents. Such definitions imply a certain degree of association between environmental performance and cost performance in a sense that reduction of waste, energy consumption, and material usage is expected to cut costs, leading to improved cost performance

While environmental performance represents the environmental impact reductions when implementing SSCM practices, cost performance represents the cost savings incurred through those environmental impact reductions. In other words, the main features of environmental performance, i.e. reduction of solid or effluent wastes, reduction of air emissions and decrease in consumption of materials or energy, are directly linked to reduced costs associated with waste discharge, waste treatment, energy usage and materials consumption. This indicates a causal linkage from environmental performance (environmental impact reductions) to cost performance (cost savings associated with environmental impact reductions).

Furthermore, the contention of positive relationship between environmental and cost performance is grounded on the fact that environmental performance represents innovative environmental technologies, environmental friendly initiatives and to a broader extent an operational efficiency (Vachon, 2007; Inman et al., 2001; Green et al., 2015), which improves firm competitive advantage (Davis and Markley, 2007; Esty and Winston, 2009), increases company environmental reputation and in turn its brand image (Sarkis et al., 2010; Walkers and Jones, 2012), enhances firm legitimacy (Hsu et al., 2013), and reflects strong organisational and management capabilities (Linton et al., 2007; Lee et al., 2012). Collectively, these certain characteristics are likely to be translated into profitability resulting in improved cost performance, by driving the improvement of a firm's financial bottom line through cost savings, stronger brand image and improved market share.

Within a measurement approach, there is a direct linkage between SSCM performance outcomes, i.e. environmental performance → cost performance. This can be explained by the fact that in the SSCM context environmental performance is being measured by reductions in waste, emissions, energy usage, and the consumption of toxic substances and harmful materials, while cost performance is measured by cost reductions associated with environmental performance initiatives such as energy cost savings, material recovery savings, waste discharge savings, environmental risk and penalty cost savings (Seuring and Muller, 2008a; Zhu et al., 2008a; Green et al., 2012a). Therefore, it is contended that changes in environmental performance directly influence change in the cost performance, as its related initiatives cause cost performance practices to be incurred, indicating a direct relationship between environmental and cost performance.

From an economic standpoint, it is further argued that the cost performance of the firm is positively affected when undertaking the environmental performance related initiatives, given the cost reductions incurred through commensurate environmental impact reduction (e.g. decrease in expenses in energy consumption, waste disposal, material usage, etc.). In other words, environmental performance related initiatives can potentially cut the costs of energy consumption and purchased materials, decrease the costs of waste treatment and waste discharge, reduce the cost of excessive inventory maintenance and avoid fines or penalties due to environmental accidents (Sarkis, 2012; Green et al., 2015). Arguably, these cost saving features direct causal effect on costs and profits, indicating a certain degree of direct and positive association between environmental performance and cost performance. For instance, environmental performance focus on minimisation of energy usage and material consumption should lead to reduced costs associated with the energy usage involved in product transportation and materials used in product packaging, potentially resulting in improved cost performance (Emmett and Sood, 2010).

Therefore, a direct linkage between environmental performance and cost performance is posited. Moreover, the conceptual study of Shi et al. (2012) maintains this and suggests that the cost-saving nature of environmental performance initiatives can yield improved economic performance. Proposing such a potential linkage can further extend the significance of this study, as this is one of few empirical research studies that demonstrates an interrelation between performance outcomes that has been overlooked in previous studies.

Accordingly, we hypothesise:

H4. Environmental performance is directly and positively associated with cost performance.

Overall, 13 individual research hypotheses have been developed for further empirical tests, based on the theoretical arguments concerning the main research clusters of SSCM driving forces, SSCM practices and SSCM performance and also the empirical evidence within the corresponding literature. These proposed hypotheses cover the broad scope of our research questions and are capable of guiding this study towards the desired end.

3.4 Theoretical model

In previous sections, we have developed the conceptual framework and consequently the initial research model and have theorised 13 research hypotheses. This takes the final step towards achieving the study's primary objective of developing a comprehensive SSCM drivers-practices-performance model. In this regard, this section goes on to present the final research model which is capable of assessing the impacts of the implementation of SSCM practices on the firm's performance outcomes with the inclusion of the effects of the SSCM driving forces.

To do so, this study attempts to incorporate the theorised hypotheses into the initial model, and to develop individual theoretical linkages between the embedded constructs in order to theorise the final model. Accordingly, the final SSCM drivers-practices-performance model is developed, linking driving forces, SSCM practices and their relationships with performance outcomes. Figure 3.5 depicts the theoretical model that guides this research.

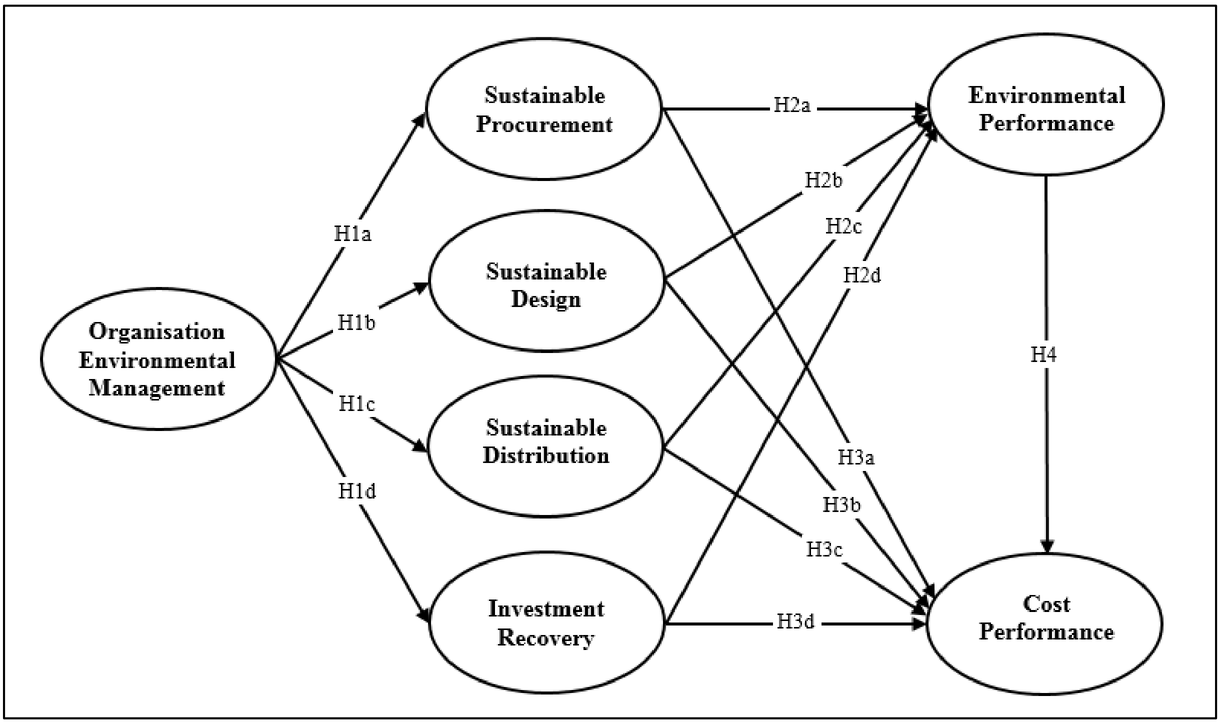


Figure 3.5 Comprehensive SSCM drivers-practices-performance model with hypotheses

Our theoretical model is a path analytical model with six latent[3] variables (see Figure 3.5): organisation environmental management (OEM), sustainable procurement (SP), sustainable design (SD), sustainable distribution (SDIST), investment recovery (IR), environmental performance (EP) and cost performance (CP). Each of the hypothesised relationships depicted in the research model is theorised as being direct and positive. Generally, the SSCM practices of sustainable procurement, sustainable design, sustainable distribution and investment recovery are the focal constructs in the theoretical model, with organisation environmental management as an antecedent and environmental and cost performance as consequences.

[3] Latent variables represent theoretical constructs that are not directly observed. Generally, measurements of latent variables are inferred indirectly by linking them to a number of observed variables that can be measured through multiple indicators (Hair et al., 2010).

In essence, it is posited that the organisation environmental management construct drives the adoption of SSCM practices, and in turn the implementation of SSCM practices delivers performance outcomes in the form of improved environmental and cost performance. With this in mind, it is argued that the organisation environmental management construct has causal relationships with the focal SSCM constructs of sustainable procurement, sustainable design, sustainable distribution and investment recovery, whereby these focal SSCM constructs also attain causal relationships with the constructs of performance outcomes. Collectively, changes made as a result of organisation environmental management affect the ability to implement SSCM practices, which will impact both environmental and cost performance.

The relationships between the organisation environmental management construct, the focal SSCM practices and environmental and economic performance are theorised in order to first investigate whether the exogenous regulatory pressures and the firm's endogenous drivers exist in the adoption of SSCM practices and explore if they are necessary and sufficient; and second to assess the impacts of SSCM implementation on performance outcomes with the inclusion of the effects of the SSCM driving forces.

As depicted in Figure 3.5, the four focal SSCM constructs of sustainable procurement, sustainable design, sustainable distribution and investment recovery represent the implementation of SSCM practices, as they cover the main activities and functions involved within SSCM (Zhu et al., 2005; Seuring and Muller, 2008b). In addition, the organisation environmental management construct represents SSCM driving forces, as it encompasses a set of external regulatory pressures and internal drivers associated with the firm's involvement that drive the adoption of an SSCM agenda. Moreover, the environmental and cost performance constructs represent the performance outcomes of SSCM implementation, describing the ecological and economic consequences of the implementation of SSCM practices. This is in line with our literature review on the three main SSCM clusters presented in Chapter 2, and in particular consistent with the core dimensions developed in Sections 2.5.3.1 and 2.5.4.3. Definitions of the constructs incorporated in the theoretical model are presented in Table 3.1.

Table 3.1. Construct definitions.

Construct	Definition
Organisation Environmental Management	Organisation environmental management is the practice of accepting and developing sustainable supply chain management in response to regulatory pressures and commitment and support from top- to mid-level management (Seuring and Muller, 2008a; Zhu et al., 2008a).
Sustainable Procurement	Sustainable procurement focuses on cooperating with suppliers for the purpose of developing products that are environmentally sustainable (Carter and Carter, 1998; Zhu et al., 2008a).
Sustainable Distribution	Sustainable distribution refers to environmentally conscious transportation of products or services from suppliers to manufacturers to final customers with the purpose of having the least possible negative environmental impact (Esty and Winston, 2009; Green et al., 2012b).
Sustainable Design	Sustainable design requires that manufacturers design products that minimise the consumption of materials and energy, facilitate the reuse, recycling and recovery of component materials and parts, and avoid or reduce the use of hazardous products within the manufacturing process (Grote et al., 2007; Zhu et al., 2008a).
Investment Recovery	Investment recovery refers to the process of recovering and recapturing the value of end-of-life products and unproductive assets through effective reuse and surplus sales. It requires the sale of excess inventories, scrap and used materials and excess equipment (Zhu et al., 2008a; Emmett and Sood, 2010).
Environmental Performance	Environmental performance relates to the manufacturing plant's ability to reduce energy usage, materials consumption, air emissions, effluent wastes and solid wastes and to decrease consumption of hazardous substances and toxic materials (Zhu et al., 2008a; Schaltegger et al., 2014).
Cost Performance	Cost performance relates to the manufacturing plant's ability to reduce costs associated with energy consumption, purchased materials, waste treatment, waste disposal, waste discharge, and fines or penalties for environmental accidents (Zhu et al., 2008a; Schaltegger et al., 2014).

Overall, this study has developed a comprehensive SSCM drivers-practices-performance model, linking driving forces, SSCM practices and their relationships with performance outcomes. This study contributes to the SSCM literature by developing a comprehensive model that is capable of assessing the impacts of the implementation of SSCM practices on performance outcomes while considering the influential effects of SSCM driving forces. Our proposed SSCM drivers-practices-performance model is the first in this area that looks at the research phenomenon from a holistic and integrated perspective, integrating three main SSCM research clusters into one comprehensive model.

In addition, this study develops an understanding of how a combination of the driving forces of external regulatory pressure and the internal drivers of the firm gives rise to the adoption of an SSCM agenda, serving as a stepping stone approach for the effective implementation of SSCM practices. Lastly, an empirical examination of the proposed hypotheses should enable this study to effectively answer the research questions: '*Which factors both* endogenous*and* exogenous *to the firm need to be in place before SSCM practices are adopted?' 'What impact does the implementation of SSCM practices have on the environmental and cost performance of the firm?'* The empirical examination of the study's research model and its hypotheses is provided in Chapter 5.

3.4.1 Linking the theoretical model to the Triple Bottom Line (TBL) framework

In line with our literature review surrounding the Triple Bottom Line (TBL) framework presented in Section 2.5.4.1, we argue that from a holistic perspective, the foundation of our proposed SSCM drivers-practices-performance model is also consistent with the main principles of the TBL framework. This can be explained by the fact that our research model follows the principles of the TBL framework in which the environmental performance construct falls within the ecological pillar of TBL and the cost performance construct falls within the economic pillar of TBL. The other constructs of the research model, including the OEM and focal SSCM constructs, not only pertain to the ecological and economic pillars but also fall within the social pillar of TBL, because firms which are adopting environmental initiatives such as SSCM practices are viewed as socially responsible (Lee et al., 2012). In light of this, we argue that our proposed model is in line with the TBL framework and follows its main principles, seeking to assess performance implications at a broader level, and consider traditional financial value along with environmental behaviours and social or ethical values. Therefore, from a holistic perspective, a linkage between the theoretical model and the TBL framework is central, which further demonstrates the rigour of the research model development.

3.5 Chapter summary

The focus of this chapter was to develop the research model that guides this thesis to answer the research questions. In light of this, this chapter has provided the theoretical reasoning for developing the conceptual framework and subsequently the initial model, and the hypothesis development to present the theoretical model. This chapter began with theoretical reasoning concerning the conceptual development using the theoretical foundations presented in Chapter 2. At this stage, the theoretical linkages between the three main clusters of the research phenomenon were established using the theoretical foundations of these integrated clusters, and consequently the study's conceptual framework was developed with a focus on antecedent and outcome effects. Thereafter, in accordance with our conceptual framework, the initial research model was developed, with indications of cause and effect following theoretical reasoning concerning the organisational performance and the causation rationale as well as the theoretical underpinnings of SCM theory.

Furthermore, 13 individual research hypotheses have been developed for further empirical tests among the embedded constructs, based on the theoretical arguments concerning the main research clusters of SSCM driving forces, SSCM practices and SSCM performance and also the empirical evidence within the corresponding literature,. Finally, a comprehensive SSCM drivers-practices-performance model has been developed, which is capable of assessing the impacts of the implementation of SSCM practices on performance outcomes while considering the influential effects of SSCM driving forces. This will allow this thesis to achieve its primary objective in developing a robust conceptual model that covers driving forces, SSCM practices and their performance outcomes, guiding this thesis to effectively answer the research questions.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 Introduction

Since the first three chapters have laid the essential foundation concerning the research phenomenon, the research methodology applicable to this study can now be presented. This chapter is broadly concerned with the transition process from a purely theoretical research study to a suitable practical research investigation, yielding answers to the research questions. In this regard, this chapter presents the development of the philosophical and methodological implications of this study and addresses the justification of choices applicable to these implications. The chapter comprises two main sections: the first entails various philosophical and methodological considerations of this study, including the research philosophy, research approach, research strategy, research method, research design, data collection technique and data analysis approach along with the justification for the choices made; while the latter part deals with other practical sub-attributes of the study's methodological issues such as questionnaire development, data type, ethical considerations, pilot study, sampling strategy and data collection procedures.

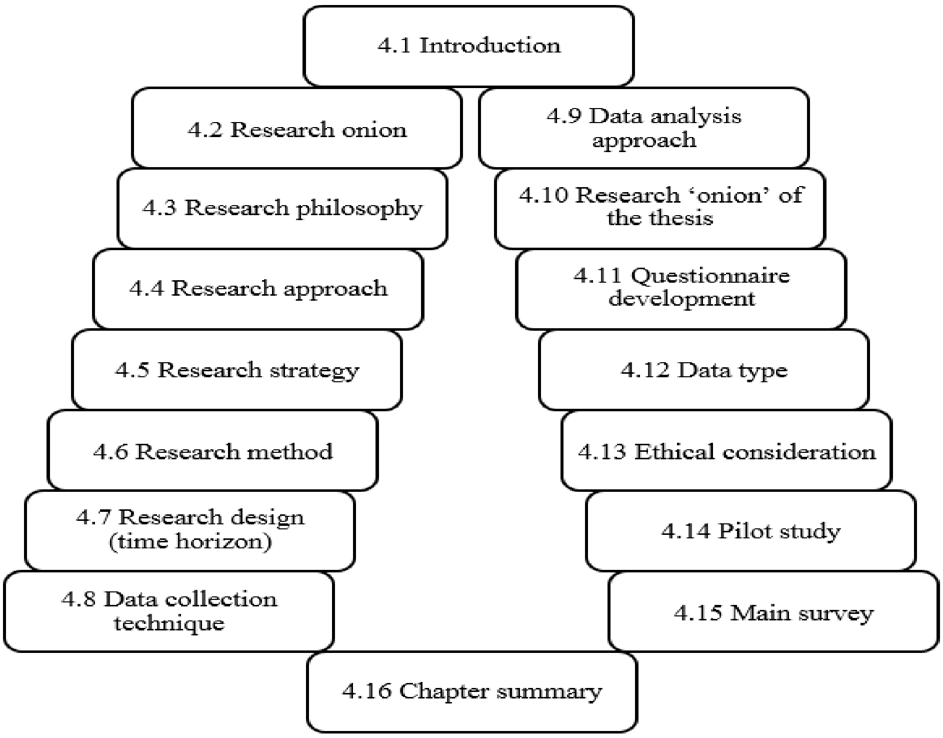


Figure 4.1 Structure of Chapter 4

As depicted in Figure 4.1, this chapter begins by discussing the research onion suggested by Saunders et al. (2009) which this study adopted, following its implications to address the applicable philosophical and methodological issues. In Section 4.3, the philosophical stance of this study is addressed as the starting point at which the core of the research methodology was formed. Thereafter, Sections 4.4 and 4.5 present the study's research approach and research strategy. The research method and research design are then introduced in Sections 4.6 and 4.7 along with the justification for the choices made. In addition, the data collection technique (4.8) and the data analysis approach (4.9) are introduced, leading to finalising the research 'onion' of this thesis in Section 4.10. Important sub-attributes of the methodological procedures are further discussed, including questionnaire development (4.11), applicable data type (4.12), ethical issues (4.13), pilot study (4.14) and the main survey implications (4.15). Lastly, Section 4.16 completes this chapter with a summary.

In essence, this chapter seeks to provide detailed information concerning the various procedures involved in conducting the practical considerations of this research for the purpose of providing a high level of transparency and maximising replicability, demonstrating the rigour of the research process. The position of this chapter in the thesis is illustrated in Figure 4.2.

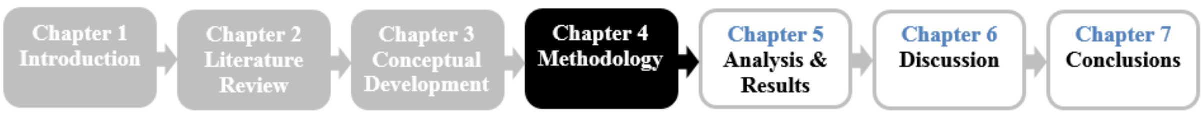


Figure 4.2 Position of Chapter 4 in this thesis

4.2 The research onion

Saunders et al. (2009) have developed a research onion (Figure 4.3) that is concerned with the main philosophical and methodological considerations which researchers need to address in order to effectively answer their research questions. The proposed research onion encompasses all of the main elements of a rigorous social research project, particularly in the context of business and management. As depicted in Figure 4.3, the outer layers of the research onion cover the philosophical considerations of the research, while the inner layers address the practical considerations. We adopted Saunders et al.'s (2009) research onion in this study to develop and justify the philosophical and methodological issues of this thesis. Employing such a comprehensive research onion is a widely used approach in business management studies, particularly at PhD level, to help yield answers to the research questions (Saunders et al., 2009). Each layer of the research onion is discussed along with its relevance to this thesis in the following sections.

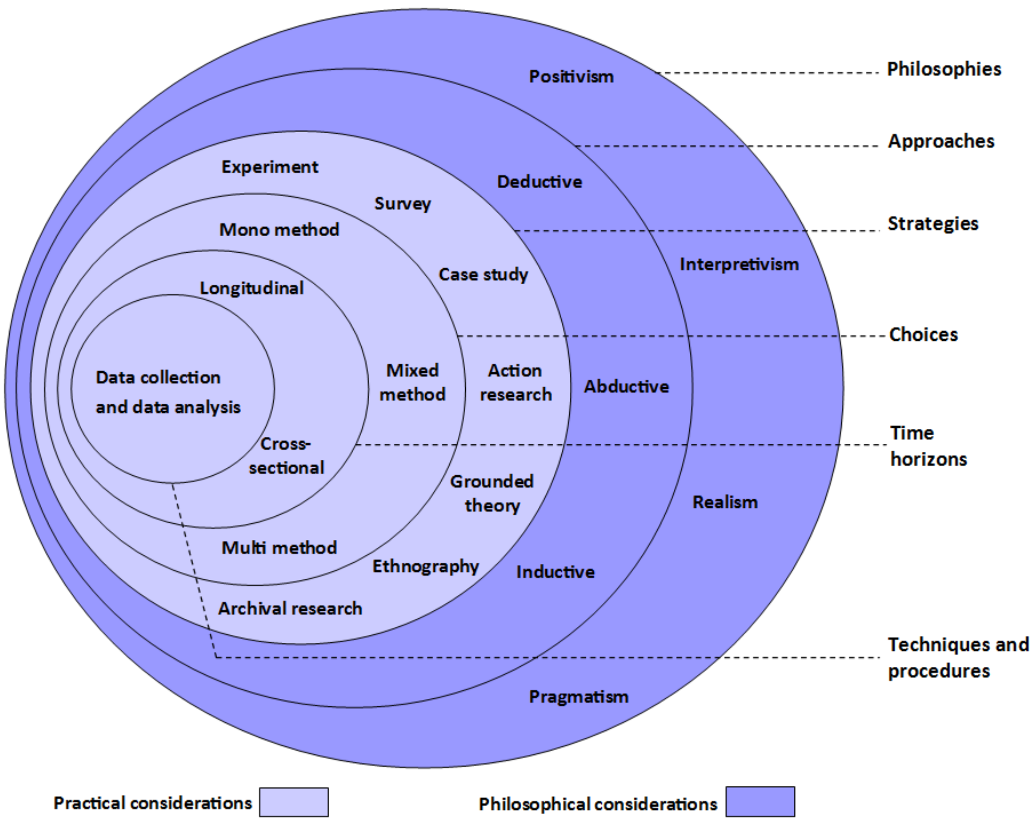


Figure 4.3 The research 'onion' (Saunders et al., 2009, p.108)

4.3 Research philosophy

Research philosophy is commonly referred to as an overarching term relating to the development of research knowledge and the nature of that knowledge (Saunders et al., 2009). The research philosophy comprises critical assumptions about the way in which a researcher views the world. According to Saunders et al. (2009), these assumptions will underpin the main elements of a study's research strategy and the methods. Generally, a research philosophy covers the way in which data about the research knowledge should be collected, analysed and used (Burrell and Morgan, 2000).

Many scholars suggest that there are three major ways of thinking about the research philosophy in social science: epistemology, ontology and axiology (Bryman, 2001; Saunders et al., 2009). They assert that the research philosophy can be defined with the help of these three research paradigms. Bryman and Bell (2015) further endorse that different research philosophies are developed under the umbrella of these research paradigms, i.e. from epistemology, ontology and axiology stances. In essence, the research paradigm is central to the research methodology for all research in social science and is concerned with "the world view" (Mangan et al., 2004). The research paradigm was defined by Kuhn (1970) as:

"People's value judgements, norms, perspectives, theories, ideologies, standards, myths, and approved procedures that govern their thinking and action." (cited in Gummesson, 1999, p. 18)

Based on the concept of the research paradigm developed by Kuhn (1970), and the fact that people view the world differently (Mangan et al., 2004), many scholars (Saunders et al., 2009; Bryman and Bell, 2015) argue that researchers may design their research differently and thus may adopt different research philosophies. Moreover, Johnson and Clark (2006) highlight that it is important for researchers to show their philosophical positions and defend their philosophical choices in relation to the alternatives they could have adopted.

In this regard, many distinguished scholars (e.g. Creswell, 2003; Saunders et al., 2009; Bryman and Bell, 2015) have concluded four major philosophical positions that are most commonly adopted in management research: positivism, realism, interpretivism and pragmatism. These research philosophies fall within the first layer of the research onion (Figure 4.3), indicating that the research philosophy is considered as the first stage of the research methodology. Hence, these various philosophical considerations are deemed as a starting point at which the design of the study is decided. This will be the basis for selecting an appropriate research philosophy to be conducted in our research prior to adopting suitable research methods.

These major research philosophies are developed through the concept of the research paradigms of epistemology, ontology and axiology (Saunders et al., 2009). Each of these research paradigms have appreciable differences which affect the way in which a researcher thinks about the research process (Bryman and Bell, 2015). Therefore, the research philosophies are usually addressed and compared in terms of epistemological, ontological and axiological stances (Saunders et al., 2009). A summary of comparisons of the four major research philosophies in terms of their epistemology, ontology, axiology and methodology standpoints is provided in Table 4.1.

Table 4.1. Comparison of the four major research philosophies in management research

	Positivism	Interpretivism	Realism	Pragmatism
Epistemology: the researcher's view regarding what constitutes acceptable knowledge	Only observable phenomena can provide credible data, facts. Focus on causality and law like generalisations, reducing phenomena to simplest elements	Subjective meanings and social phenomena. Focus upon the details of situation, a reality behind these details, subjective meanings motivating actions	Observable phenomena provide credible data, facts. Insufficient data means inaccuracies in sensations (direct realism). Alternatively, phenomena create sensations which are open to misinterpretation (critical realism). Focus on explaining within a context or contexts	Either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question. Focus on practical applied research, integrating different perspectives to help interpret the data
Ontology: the researcher's view of the nature of reality or being	External, objective and independent of social actors	Socially constructed, subjective, may change, multiple	Is objective. Exists independently of human thoughts and beliefs or knowledge of their existence (realist), but is interpreted through social conditioning (critical realist)	External, multiple, view chosen to best enable answering of research question
Axiology: the researcher's view of the role of values in research	Research is undertaken in a value-free way, the researcher is independent of the data and maintains an objective stance	Research is value bound, the researcher is part of what is being researched, cannot be separated and so will be subjective	Research is value laden; the researcher is biased by world views, cultural experiences and upbringing. These will impact on the research	Values play a large role in interpreting results, the researcher adopting both objective and subjective points of view
Data collection techniques most often used	Highly structured, large samples, measurement, quantitative, but can use qualitative	Small samples, in-depth investigations, qualitative	Methods chosen must fit the subject matter, quantitative or qualitative	Mixed or multiple method designs, quantitative and qualitative

(Source: Saunders et al., 2009)

According to Saunders et al. (2009), each of these research philosophies is better at doing different things. It is not logical to state that one particular research philosophy is stronger or better than another. Each has its own advantages and disadvantages and it is merely down to the researcher to adopt the most appropriate one that enables them to extract the facts for their research. In this regard, Saunders et al. (2009) further assert that choosing a research philosophy is dependent upon the research question(s) that a researcher seeks to answer.

Drawing on Table 4.1, the interrelationship between the epistemological stance (what constitutes acceptable knowledge), ontological stance (what is the nature of reality) and axiological stance (what is the role of values in research) determines the research philosophy (Doyal, 1993; Saunders et al., 2009). The comprehensive summary of the four major research philosophies in management research (Table 4.1) guides this study to adopt the appropriate research philosophy to effectively answer the research questions. The next section presents the most well-adopted research philosophies in the field of supply chain management (SCM) and addresses the philosophical stance of this thesis along with its justification.

4.3.1 Research philosophy in SCM research

Positivism and interpretivism are the two major research philosophies which have been widely adopted in supply chain and operations management research (Mangan et al., 2004; Golicic and Davis, 2012). The positivist and interpretivist stances have both played a fundamental role in SCM research due to the multi-disciplinary nature of this field of study (Mangan et al., 2004).

4.3.1.1 Positivism

The doctrine of positivism is addressed in a number of different ways by various authors and thus is difficult to pin down in a precise manner (Bryman and Bell, 2015). Despite this, positivism is commonly referred to as a research paradigm or philosophical stance that argues that information and positive facts (verified data) are derived from sensory experience and interpreted through rational and mathematical treatments (Saunders et al., 2009). In positivism, the social realm is considered as like the natural world, indicating that social science is subject to investigation in a similar way to physical science (Bryman, 2001). Chalmers (1999) states that from a positivism perspective, science is derived from facts and on this basis, a research study is considered scientific when it is derived from the facts of experience.

In the SCM context, positivism has been a dominant perspective, given the fact that the majority of SCM literature is derived from the facts of experience (Carter and Ellram, 2003). One of the philosophical considerations of positivism is that reality is 'out there' and the researcher should be concerned to find the most objective and effective way to gather information or positive facts about such a reality (Bryman and Bell, 2015).

Positivism is often characterised by quantitative techniques and based on the establishment of the measurement of facts (Saunders et al., 2009). Furthermore, SCM research largely involves the development of knowledge and generalised theory according to its scientific background (Chicksand et al., 2012). This is consistent with the positivism paradigm, which is generally concerned with the development of research models and research hypotheses to be tested with empirical data (Bryman, 2001). Mangan et al. (2004) assert that the positivism approach has contributed significantly to SCM research, especially in terms of theoretical implications and managerial insights, owing to the focus of the positivist approach on theory testing.

4.3.1.2 Interpretivism

On the other hand, the interpretivism paradigm has also been used in SCM research as a philosophical stance. The interpretivism (anti-positivism) paradigm asserts that the social world cannot be considered as similar to physical science, because social science is far too complex to be studied only through theories and scientific explanations (Saunders et al., 2009). Interpretivism as an opposing perspective of positivism posits that the social world can only be understood and interpreted from the standpoint of the people being studied by the researcher (Bryman and Bell, 2015). In interpretivism, the central belief is that reality can only be fully understood through interpretation of and intervention in reality (Bryman, 2001). In this case, one of the key philosophical considerations of interpretivism is that reality is evolving and dynamic, and this involves a wide array of subjective interpretations of social acts or realities (Bryman and Bell, 2015). Furthermore, the interpretivism paradigm contends that these various interpretations of reality are themselves part of the scientific knowledge that scientists seek to investigate (Mangan et al., 2004).

In contrast to positivism, the interpretivism paradigm is often characterised by qualitative research and does not rely on the establishment of the measurement of facts (Burrell and Morgan, 2000). The interpretivism paradigm contributes to the SCM field by providing in-depth and information-rich research, owing to the concentration of the interpretivist approach on the context of empirical findings (Mangan et al., 2004). In addition, the interpretivist approach, as opposed to the positivist approach, maintains that the researcher cannot avoid influencing the phenomena they study (Saunders et al., 2009).

4.3.2 Philosophical stance of this thesis

We start this sub-section by referring to a quotation by Dobson (2002) about the importance of the research philosophical position.

"The confidence provided by understanding different philosophical positions provides the researcher and the practitioner with the power to argue for different research approaches and allows one confidently to choose one's own sphere of activity." (Dobson, 2002, p. 4)

Since this thesis shows awareness of different philosophical positions relevant to the SCM research, we can now confidently choose the appropriate research philosophy for this study. The philosophical stance of this thesis falls within the positivist approach, which perceives that the research knowledge is 'out there' and can be observed in the natural world. In light of this, a researcher who considers data as required resources from which to derive facts follows the position of the natural scientist. Arguably, this can be the position of the supply chain and operations management specialist who is dealing with the collection and analysis of 'facts' (Saunders et al., 2009). Following a similar perspective, reality in our study is represented by objects that are considered to be 'real', such as distribution initiatives or procurement practices. Furthermore, the chief objective of this thesis is to conduct an empirical study using real data, which is in line with a positivist stance. Therefore, the positivism paradigm is adopted as the philosophical stance of this thesis, as we believe that the social world can be subjected to the same methods of investigation as physical science, and research knowledge can be observed and examined empirically (Bryman and Bell, 2015).

As discussed, the positivism paradigm not only seeks theory development through establishing causalities but also theory testing through empirical examinations (Saunders et al., 2009). This is consistent with what was presented in Chapter 3, as the theoretical foundations – linking the research model and research hypotheses to theories – follow the principles of the positivist approach. Since the positivist approach involves the development of the research model based on relevant theories, this facilitates this study generating hypotheses to be empirically examined in order to derive facts about the impact of SSCM implementation on performance outcomes.

Furthermore, one of the major advantages of positivism over interpretivism is that a positivist researcher must set aside their own personal values in studying a particular phenomenon, which minimises any potential bias in the research (Saunders et al., 2009). Arguably, in the context of a relatively unbiased study which can potentially generate valid results, it is expected that the results can be generalised to other cases as well. This is not possible in the interpretivism stance, in which the researcher is viewed as part of what is being researched and unable to avoid influencing the phenomena they study. The positivism stance is further justified since it is associated with the desired explanatory research purposes to understand causal relations rather than to obtain the more in-depth and information-rich understanding of a particular phenomenon possible through an interpretivism stance (Saunders et al., 2009). Hence, with this set of arguments, we believe a positivism stance is justified and appropriate in our study, as it philosophically facilitates the development of the research model and its linkage to relevant theories required for theory testing, which is germane to the core objectives of this research.

4.4 Research approach

The main research approaches widely used in the social world of business and management can be classified as deductive, inductive or abductive. They form the second layer of Saunders et al.'s (2009) research 'onion' depicted in Figure 4.3. A summary of the key features of these research approaches is presented in Table 4.2.

Table 4.2. Main features of the research approaches

Research approach	Starting point	Objective	Findings
Deductive	Begins with a theory that can be in the form of theoretical framework	Testing theory	Deductively drawn through confirming or falsifying prior hypotheses constitute findings; - Statistical generalisability
Inductive	Empirical observations	Developing theory	Inductively drawn based on empirical observation constituting findings; - Analytical generalisability
Abductive	May start with real-life observation and/or with pre-perceptions and theoretical knowledge	Developing theory through developing an understanding of a new phenomenon	Abductively drawn through suggesting hypotheses and the application of these hypotheses to the empirical research constitutes findings; - Relatively generalisable

(Source: adapted from Kovacs and Spens, 2005)

As can be seen from the table above, a deductive approach usually begins with the theory to generate hypotheses being empirically tested (theory testing), whilst an inductive approach usually starts with empirical observations leading to emerging hypotheses to develop a theoretical framework or theory (theory building) (Bryman, 2001). The emphasis in deductive research is generally on causality, following the positivism paradigm, whilst for inductive research the aim is centred on exploring new phenomena through an in-depth investigation, following the interpretivism paradigm (Saunders et al., 2009). Abductive research is simply a conflation of the deductive and inductive approaches which begins with real-life observation and/or theoretical knowledge.

Having discussed the main features of the different research approaches within social science, we can now confidently choose the appropriate research approach for this study. The research approach of this thesis falls within the deductive approach, which derives a logical understanding of a certain issue from the theory, consistent with what was presented in Chapter 3. The deductive approach will assist this research in theory-testing concerning existing knowledge – one of the study's chief aims – as it entails the development of a theoretical or conceptual structure based on a review of the extant literature prior to its empirical testing (Bryman, 2001). Most studies in supply chain and operations management which use a quantitative technique adopt deduction as a research approach for theory-testing purposes (Chicksand et al., 2012). The processes of deduction are depicted in Figure 4.4.

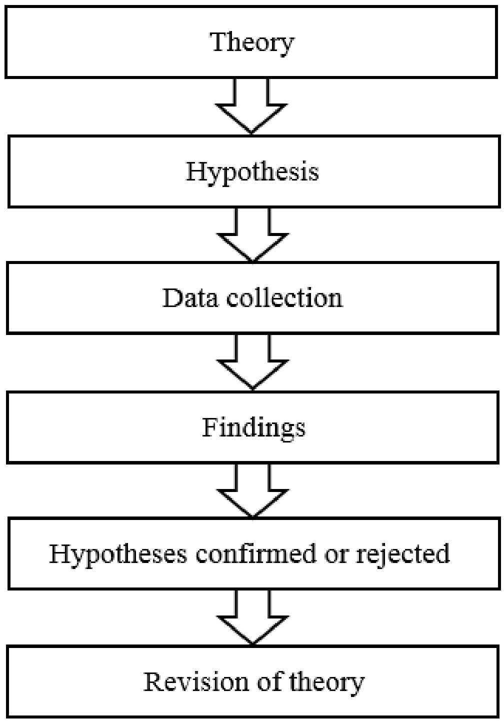


Figure 4.4 The process of deduction (source: Bryman and Bell, 2015, p. 23)

What was presented in Chapter 2 and Chapter 3 – the literature review and conceptual development – precisely followed the process of deduction (shown in Figure 4.4). In line with the deductive approach, we started with a literature review on SCM to derive a logical understanding of SSCM drivers, practices and performance from the theory. More specific hypotheses were then proposed based on a review of the pertinent theoretical setting set out in the extant literature, using the deductive approach. Consequently, the theoretical framework with causal relationships was developed from the relevant theoretical understanding, to be tested in an empirical setting. As suggested by Chalmers (1990), such a deductive approach will end with a logical conclusion based on confirmation or falsification of the proposed hypotheses. Chalmers (1999, p. 69) expounds the process of testing hypotheses in deductive research as follows:

"... hypotheses are proposed by scientists as solutions to a problem. The conjectured hypotheses are then criticised and tested. Some will be quickly eliminated. Others might prove more successful. When an hypothesis that has successfully withstood a wide range of rigorous tests is eventually falsified, a new problem ... has emerged. This new problem calls for the invention of new hypotheses, followed by renewed criticism and testing."

Therefore, when a hypothesis is rejected, a new research direction can be presented which can potentially lead to a revision of the theory. In light of this, the proposed theoretical model of SSCM performance presented in Chapter 3 will be empirically tested and the results of this work will be used to refine existing thinking in the area of SSCM, providing new opportunities for future research.

Furthermore, from a philosophical perspective, the deductive approach uses 'logic' in extracting the facts, which is also consistent with the positivism paradigm (Saunders et al., 2009). This indicates an appropriate consistency between the adopted research philosophy and research approach, reflecting the rigorous philosophical considerations of this thesis. Hence, following the process of deduction (theory→ hypotheses→ data collection→ findings→ hypotheses confirmed or rejected→ revision of theory and future directions), the deductive approach is adopted as the research approach of this thesis, and thus up to this stage this study has employed the positivism paradigm and followed the deductive approach.

4.5 Research strategy

In this section, we address research strategies, which form the inner layers of our research 'onion' covering the practical considerations of this study (Figure 4.3). The research strategy plays a fundamental role in any social research, as it facilitates a study being able to turn its research question into a research project (Saunders et al., 2009). Creswell (2003) distinguishes a research strategy from a research methodology by explaining that a research strategy operates at a more applied level of methodology with the purpose of providing more specific directions. However, in this study we treat the research strategy and research methodology as an umbrella concept that embraces the practical considerations of both research strategy and methodology, following an approach employed by many researchers in management studies (Saunders et al., 2009). Many leading scholars in social science (e.g. Gummesson, 1999; Bryman, 2001; Burrell and Morgan, 2000; Saunders et al., 2009; Bryman and Bell, 2015) agree that seven major research strategies are widely used within business and management research: experiment, survey, case study, action research, grounded theory, ethnography and archival research. These strategies can be used according to the purpose of the research, i.e. exploratory, descriptive or explanatory (Yin, 2003).

4.5.1 Research strategies in SCM

The wide array of different research strategies used in SCM research is clearly associated with the multi-disciplinary nature of SCM as a topic (Mentzer and Kahn, 1995). Chicksand et al.

(2012), Mentzer and Kahn (1995), Giunipero et al. (2008) and Sachan and Subhash (2005) review different types of research strategies used over the years in SCM research. We compare the results of these review papers in Table 4.3 to provide a better understanding of the positions of these strategies in SCM research. Arguably, this will facilitate the adoption of a certain strategy for this study and provide a justification for choosing an appropriate method.

Table 4.3. Types of research methodology used in SCM research

Type of research strategies	Mentzer and Kahn (1995)[a]	Sachan and Datta (2005)[b]	Giunipero et al. (2008)[c]	Chicksand et al. (2012)[d]
Survey	47.3 %	34.6 %	56 %	40.3 %
Case study	15.8 %	21.1 %	19 %	31.6 %
Simulation	12.4 %	5.0 %	9.0 %	4.3 %
Interviews	10.6 %	6.8 %	4.0 %	4.8 %
Archival studies	9.6 %	15.8 %	NA	NA
Mathematical modelling	4.3 %	10.4 %	NA	3.8 %
Conceptual model	NA	6.3 %	9.0 %	12.8 %
Literature review	NA	NA	3.0 %	2.4 %

Note: NA: Not available
[a] JBL during 1978-1993.
[b] JBL, SCMIJ, IJPDLM during 1999-2003.
[c] JSCM, IJPDLM, JOM, IJLM, JBL, IJOPM, IMM, MS, DS during 1997-2006.
[d] SCMIJ, JPSM, JSCM during 1994-2010.

Journal abbreviations:
JSCM Journal of Supply Chain Management
IJPDLM International Journal of Physical Distribution and Logistics Management
JOM Journal of Operations Management
IJLM International Journal of Logistics Management
JBL Journal of Business Logistics
IJOPM International Journal of Operations and Production Management
IMM Industrial Marketing Management
MS Management Science
DS Decision Science
SCMIJ Supply Chain Management: an International Journal
JPSM Journal of Purchasing and Supply Management

Drawing on the reviews presented in Table 4.3, surveys have generally been the most widely used research strategy in SCM research, followed by case studies (Sachan and Subhash, 2005; Mentzer and Kahn, 1995; Giunipero et al., 2008; Chicksand et al., 2012). These reviews also suggest that the use of conceptual model has increased, whereas action research and ethnography strategies are no longer so popular in SCM studies (Giunipero et al., 2008; Chicksand et al., 2012). Overall, based on these reviews, surveys and case studies are deemed the two most dominant research strategies in SCM research, which can be used as a milestone approach in selecting appropriate research strategies for this study. The next section will discuss the research strategy of this thesis.

4.5.2 Research strategy of this thesis

In social science, the choice of a research strategy is influenced by the type of research questions(s), thus the research strategy should be adopted according to the research questions (Bryman, 2001). According to Saunders et al. (2009), the key factors in choosing the research strategy are as follows:

- the ability to answer the research questions
- the ability to meet the research objectives
- the consistency with the philosophical considerations (i.e. the research philosophy and research approach)
- the availability of research resources (e.g. money, time)
- the boundary of existing knowledge

Considering the above criteria, a survey approach was adopted to be conducted as the research strategy in this thesis, as it enables the study to meet its core objectives and answer the proposed research questions. The survey strategy is intertwined with the deductive logic of the research approach, as it often involves an empirical examination of a theoretical framework following an approach of testing existing knowledge (Bryman and Bell, 2015). It is also intertwined with the purpose of the research, which is explanatory. Explanatory research entails studies that establish causal relationships among certain constructs (Saunders et al., 2009), which is precisely what was presented in Chapter 3. Explanatory research is generally deemed a valuable means of finding out 'what is happening' or 'what is the impact' and also seeks to explain cause-and-effect relationships between certain research phenomena, i.e. constructs

(Saunders et al., 2009). According to Bryman (2001), explanatory research is usually conducted through surveys or experiments.

The primary research questions of this study are '*Which factors need to be in place before SSCM practices are adopted?*' and '*What impact does the implementation of SSCM practices have on the environmental and cost performance of the firm?*' In addition, the core objective of this study is to develop a theoretical SSCM drivers-practices-performance model. This entails empirical examinations of causal relationships (proposed hypotheses) between research variables, which will be presented in Chapter 5. Hence, explanatory research is seen as appropriate to both achieve the core research objective and answer the primary research question. This clearly indicates that the study purpose (explanatory) is intertwined with the selected strategy (survey). From a philosophical perspective, the survey strategy follows the positivist approach as it can target what the researcher aims to study within a particular theory (theoretical setting) or conceptual structure (Saunders et al., 2009).

Furthermore, the adopted survey strategy follows the framework of the selection of the research strategy developed by Bryman and Bell (2015), which further justifies the selection of the research strategy. Bryman and Bell (2015) propose a framework that presents criteria for adopting an appropriate research strategy based on the type of research questions asked (see Figure 4.5). Figure 4.5 illustrates how the research strategy is adopted in this study.

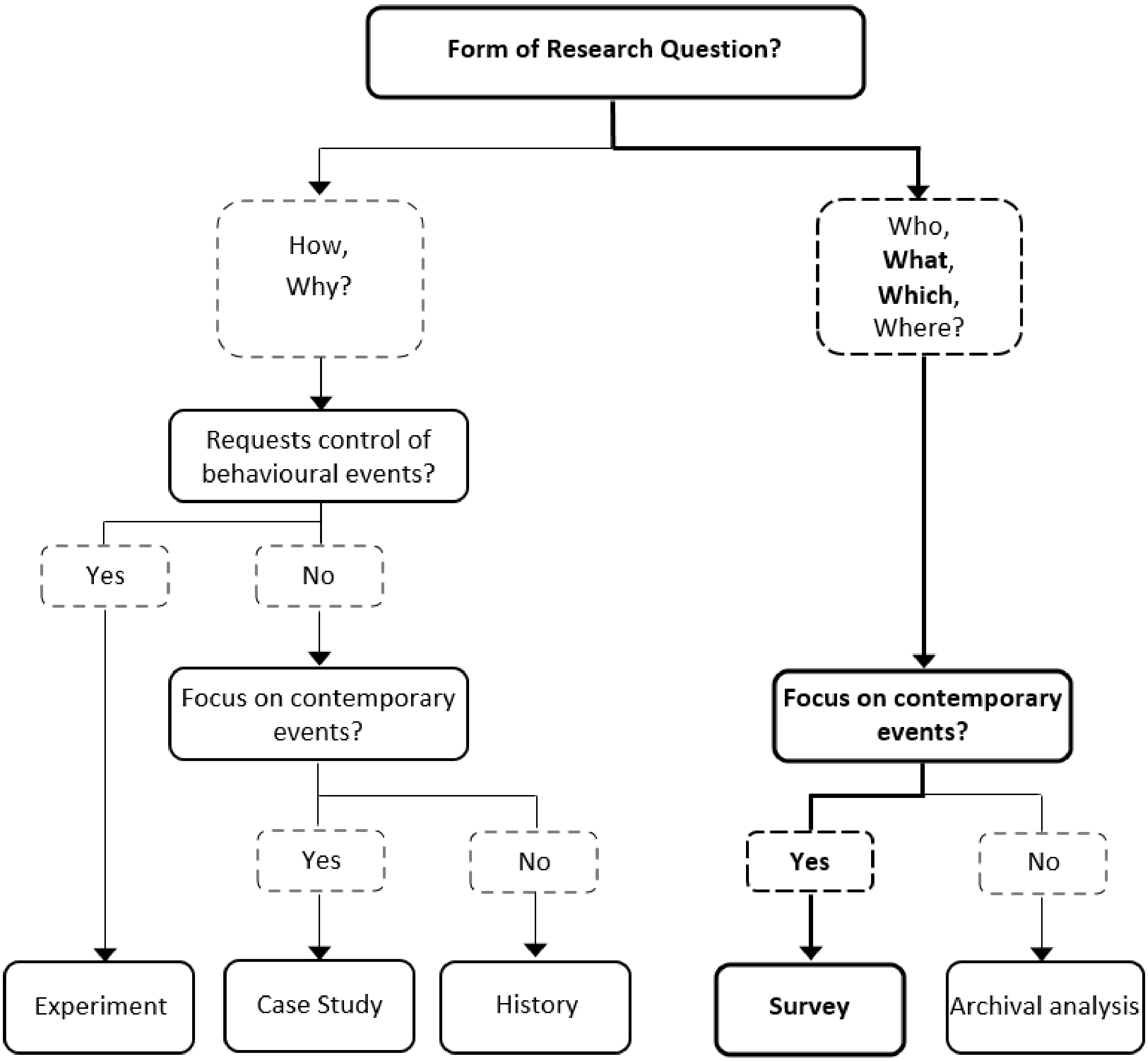


Figure 4.5 Selection of research strategy (source: Yin, 2003; Bryman and Bell, 2015)

Drawing on Figure 4.5, the bold boxes and arrows represent the selected choice of the research strategy for this thesis. Given the fact that the appropriate strategy must be selected according to the type of research question asked (Saunders et al., 2009), the survey strategy was adopted following the type of our primary research question, 'Which' and 'What'. Based on Bryman and Bell's (2015) framework, this type of question could fit perfectly with a survey strategy in which the focus is on contemporary events. This research also focuses on the phenomenon of sustainable supply chain management practices in the manufacturing settings, which are deemed contemporary events.

Even though the case study approach is the second most popular research strategy in SCM (Soni and Kodali, 2012; Chicksand et al., 2012), we did not adopt this strategy, because it was not in line with our primary research question. A case study is usually associated with the 'Why' type of research question and deemed an appropriate strategy for studies with the purpose of theory building (Saunders et al., 2009), rather than theory testing, which is what we intend to do in this research (testing existing knowledge). A case study is often employed to study 'why is this happening?' which requires a deeper understanding of a certain phenomenon and calls for information-rich research and a more in-depth understanding of the case (Yin, 2003). Arguably, such a strategy can be relatively cost- and time-intensive for this research setting.

Therefore, with the above set of arguments, it is apparent that the survey approach is the most appropriate strategy for data collection in order to attain the core objective of this study and answer the research questions. In the next sub-section we briefly discuss the nature of the survey strategy.

4.5.2.1 Surveys

The survey strategy is the most common approach in business and management research, particularly in the SCM context, and is widely employed to answer 'what, which and where' types of questions (Saunders et al., 2009; Chicksand et al., 2012). In favour of our selected research strategy, Soni and Kodali (2012, p. 762) endorse that more than half of empirical research in the SCM field used survey-based methodologies in their study (316 papers out of 619, 55.54%). The chief aim of employing the survey strategy is to test the research inquiries through empirical observation, which is in line with deductive reasoning (Bryman, 2001). The survey strategy is built on the logic of deductive inquiry, which in this respect is consistent with the study's research approach of deductivism. In addition, the survey strategy is in line with explanatory studies (the purpose of this research project), where it is widely employed to examine causal relationships among variables (Bryman and Bell, 2015).

According to Saunders et al. (2009), the survey strategy is associated with three main data collection techniques: questionnaires, structured observations and structured interviews. Amongst these data collection techniques, the survey questionnaire is the most common approach in operations and SCM research (Forza, 2002; Soni and Kodali, 2012). The questionnaire strategy is easy to administer and relatively inexpensive, and thus deemed to be a non-invasive approach for measuring different aspects of supply chain and operations management (Forza, 2002). Considering these advantages, the adopted survey strategy fits perfectly with the research resources (e.g. time, money) available to the author and also the extent of existing knowledge on the SSCM topic. In addition, employing the questionnaire survey as the study's research strategy enables this study to sample sufficient respondents to measure the posited variables and test the research hypotheses. Hence, the questionnaire survey is employed in this study as it can assist us in examining the effects of SSCM driving forces and practices on performance outcomes by providing an efficient and suitable tool for obtaining the required information.

Even though the survey approach is the most dominant research strategy in SCM research (Sachan and Subhash, 2005; Soni and Kodali, 2012), it has some limitations, such as low response rate, non-response bias and potential respondent interpretation bias due to a lack of required knowledge (Saunders et al., 2009). However, following Hair et al. (2010), these sorts of limitations can be mitigated by employing appropriate statistical techniques, which will be addressed at the end of this chapter. It should be noted that none of the research strategies outlined in Figure 4.5, i.e. experiment, survey, case study, action research, grounded theory, ethnography, archival research, is inherently inferior or superior to any other, and each has some limitations (Saunders et al., 2009).

4.6 Research method

Having discussed the appropriate selected research strategy, this section goes on to briefly address another layer of our research 'onion' (Figure 4.3), covering the choice of research method. There are two main data collection techniques in business and management research: the quantitative method, which is focused on numeric (numbers) data; and the qualitative method, which is focused on non-numeric (words) data (Saunders et al., 2009). The quantitative method is predominantly associated with questionnaires, whilst the qualitative method is mainly associated with interviews (Creswell, 2003). The researcher has a choice of research method in using either a single data collection technique (mono method) or more than one data collection technique (multiple methods) (Saunders et al., 2009). The mono method is concerned with either quantitative or qualitative techniques, whilst multiple methods embraces multi-methods and mixed methods, which both entail further sub-methods (see Figure 4.6). Multi-methods uses either more than one quantitative or qualitative technique, whereas mixed methods employs quantitative and qualitative techniques either at the same time or one after the other (Saunders et al., 2009).

Researchers generally choose their research method based on the research question, which enables them to attain their research objective and ultimately answer the research questions (Creswell, 2003). Figure 4.6 gives a visual representation of the choices of research methods in business and management research and illustrates the position of this thesis on the selected research method.

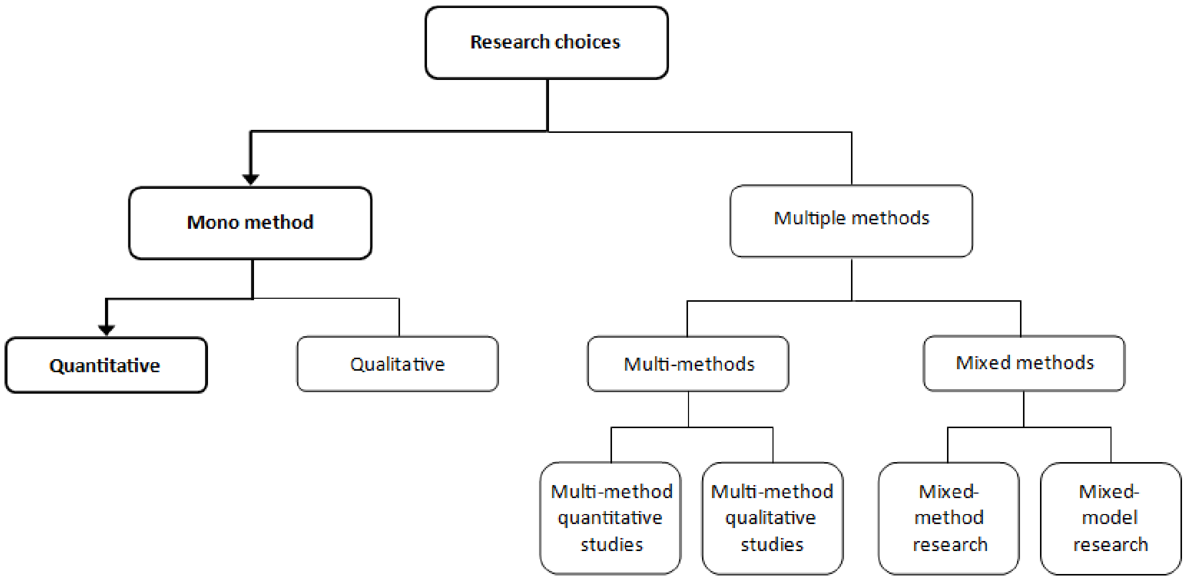


Figure 4.6 Choices of research methods (source: Saunders et al., 2009)

Drawing on Figure 4.6, the bold arrows and boxes represent the choice of the research method for this thesis. We adopted a mono quantitative method in line with our selected research philosophy, i.e. the positivist paradigm, and research approach, i.e. deductive logic concerning testing existing knowledge (see Table 4.4). Thus, a mono quantitative method is appropriate for this thesis and deemed adequate due to its ability to carry out the empirical examination required to answer the research questions. Bryman and Bell (2015) outline the fundamental criteria of quantitative and qualitative methods in terms of the research philosophy, research approach and role of theory (see Table 4.4). We used these criteria to select the quantitative method in this thesis.

Table 4.4. Fundamental criteria in quantitative and qualitative methods

	Quantitative	**Qualitative**
Philosophical position	Natural science model, in particular positivism	Interpretivism
Research approach (logic of the research)	Deductive	Inductive
Role of theory in relation to research	Testing of theory	Generation of theory

(Source: Bryman and Bell, 2015)

The disadvantage of using mixed methods as an alternative approach is mainly concerned with the justification of the selected choice. Mixed methods can often be subject to criticism as to why a particular single method is not adequate to empirically investigate a particular phenomenon (Golicic and Davis, 2012). Employing mixed methods in this thesis could have complicated the study's research methodology, since the mono method was deemed adequate for this research. Furthermore, mixed methods often entail threats to the reliability, as different data collection techniques could yield inconsistent findings (Mangan et al., 2004). Considering this set of arguments, and given the fact that mixed methods were beyond the research resources, we did not choose mixed methods in our study. In addition, the qualitative approach was excluded as it is not in line with our philosophical stance and research approach (see Table 4.4).

Therefore, this thesis applies a mono quantitative survey-based method to examine the outcome of SSCM implementation on firms' performance outcomes. In this approach, the mono quantitative method is the choice of research method and the survey is deemed the appropriate research strategy, both falling within the inner layers of our research 'onion'.

4.7 Research design (time horizon)

In this section we address another inner layer of our research 'onion' that covers the practical consideration of the time horizon of this study. According to Saunders et al. (2009), time horizons of research designs are independent of the choice of research methods and strategy. This gives a need to clearly address the time horizon of this research which can further demonstrate the rigour of the research process. Research design is predominantly associated with the time horizon and deals with the time dimension of the research to be conducted (De Vaus, 2009). Many scholars within business and management research (e.g. Saunders et al., 2009; Bryman and Bell, 2015) use the more specific term time horizon when referring to the generic term of the research design. Following a similar approach, we consider the generic term research design as the time horizon in this study.

Most research studies in social science, particularly within management research, are necessarily time-constrained (Saunders et al., 2009). In light of this, and also based on the time dimension, research within business and management can be classified as cross-sectional or longitudinal. The cross-sectional approach studies a particular phenomenon (or phenomena) at a particular point of time (snapshot approach), whilst longitudinal research aims to study the same concept at multiple points of time (Saunders et al., 2009). Business and management research has greatly benefited from the cross-sectional approach due to its advantages of being financially feasible and relatively cheap, time-efficient and simple (Bryman and Bell, 2015).

Although the cross-sectional approach is predominately associated with the quantitative method, it may also employ qualitative methods, as some case studies are based on interviews conducted at a single point of time over a short period (Yin, 2003). Furthermore, cross-sectional research is in line with the positivism paradigm, since in this type of time horizon (at a single point of time) a researcher is not able to exercise a measure of control over the phenomena being studied (Bryman, 2001). The cross-sectional approach may be conducted in studies with all types of research purpose, i.e. exploratory, descriptive and explanatory (Saunders et al., 2009).

On the other hand, management research has also benefited from the longitudinal approach due to its capacity to study change and development (Saunders et al., 2009). Longitudinal research allows sufficient time for observing a phenomenon (or phenomena) being studied, and thus is often used to map change (Bryman and Bell, 2015). Longitudinal research generally investigates a phenomenon (or phenomena) at more than one point of time, thus it can offer an in-depth and information-rich understanding of the concept being studied, which is often associated with case studies (Yin, 2003). In longitudinal studies, researchers are able to exercise a measure of control over the phenomena being studied, reflecting the idea that they cannot avoid influencing the phenomena they are studying (Saunders et al., 2009). Thus, longitudinal studies are deemed to follow the philosophical stance of interpretivism. Overall, a longitudinal time horizon is a powerful approach for information-rich research, but it is associated with being more complicated, time-consuming and costly (De Vaus, 2009).

4.7.1 Rationale for using the cross-sectional approach in this thesis

Researchers may employ different time horizons based on different types of research questions and circumstances because they are associated with use of time and can incorporate time in different settings (Saunders et al., 2009; De Vaus, 2009). Based on the research questions, the cross-sectional approach was adopted in this thesis, as we are interested in a snapshot of current SSCM initiatives that might affect the performance of the firm in terms of environmental and cost performance. This study seeks to empirically assess the theorised model through empirical observations (data collection) at a particular point of time. Moreover, this study does not intend to map any changes or development of SSCM practices or examine their impact over time, thus the longitudinal approach was excluded for this study.

Furthermore, following Phillips and Pugh (2005), a research study at the level of a PhD project should stay within certain limits and is necessarily time-constrained, which does not permit the use of the longitudinal approach in our thesis. In addition, the survey strategy is widely employed in cross-sectional research, as it can facilitate studying a particular phenomenon (or phenomena) at a given point in time (Saunders et al., 2009). This indicates a rational consistency between our selected research strategy and time horizon. Moreover, the selected cross-sectional approach follows the positivism philosophical stance and fits perfectly with the quantitative data collection technique (Bryman and Bell, 2015). Therefore, with this set of arguments, the cross-sectional approach is seen as the most appropriate time horizon for this thesis.

4.8 Data collection technique

Having discussed the study's research philosophy, research approach, research strategy, research method and research design, this section moves on to address the data collection technique appropriate for this study, forming the last layer of the study's research onion. As previously discussed, questionnaires are the most commonly used data collection technique within the survey strategy in supply chain and operations management research (Forza, 2002; Soni and Kodali, 2012). Generally, a questionnaire is referred to as a data collection instrument in which each respondent is asked to answer the same set of questions in a pre-determined order (Saunders et al., 2009, p. 360). Questionnaires work best with explanatory studies and analytical research as they enable researchers to examine and explain cause-and-effect relationships between variables (Saunders et al., 2009). Thus, it is in line with the research aims seeking to understand the causal relationships between driving forces, SSCM implementation and commensurate performance outcomes, guiding this study to answer the research questions.

According to Bryman and Bell (2015), the choice of data collection technique is broadly dependent upon the resources available for collecting data, chiefly time and money, the expertise of the researcher and the degree of precision required. In light of this, the survey questionnaire is seen as appropriate, as it can provide an inexpensive, quick, precise and efficient tool for obtaining the required information in relation to the research inquiries (Forza, 2002). It should be noted that other possible data collection techniques that are associated with the survey strategy, such as structured observation and semi-structured or unstructured interviews, were evaluated for this thesis. However, the questionnaire technique was adopted because it is deemed the most appropriate research instrument for assessing the proposed research hypotheses and research questions. This is because the questionnaire technique can provide this research with an instrument to obtain the required SSCM-related information from a set of individuals with knowledge of SSCM initiatives and their organisational performance in an inexpensive and efficient manner. More detail about the adopted data collection technique is provided in the questionnaire development section.

4.9 Data analysis approach

Having discussed the choice of data collection technique for this study, this section goes on to address the data analysis approach, concluding the last layer of the study's research onion. According to Hair et al. (2010), the choice of data analysis technique broadly relies on the purpose of the study. As previously discussed, the purpose of this study is explanatory, seeking to investigate cause-and-effects relationships to understand the impacts of SSCM driving forces on SSCM adoption and thereafter on performance outcomes.

Referring to the proposed research model in Figure 3.5, multiple relationships exist among variables that need to be tested. In light of this and the explanatory purpose of the study, the applicable data analysis techniques for this study, based on Hair et al. (2010), are multiple regressions and structural equation modelling (SEM), which are the main methods of analysis in multivariate analysis. The multivariate analysis techniques of multiple regressions and SEM are broadly used when a study is dealing with more than one variable, analysing more than one statistical outcome variable at a time (Field, 2009; Schumacker and Lomax, 2010; Kline, 2011).

The next step is to choose between these two techniques, determining the appropriate data analysis approach to achieve the rest of the research objectives. Drawing on the research model (Figure 3.5), multiple relationships of dependent and independent variables exist in our proposed model. This indicates that if we use multiple regressions analysis, we need to run four separate sets of analyses; first between the OEM construct and the focal SSCM constructs; second between the focal SSCM constructs and the environmental performance construct; third between the focal SSCM constructs and the cost performance construct; and fourth between environmental performance and cost performance. The reasoning for this is that the multiple regressions analysis is only able to examine a single relationship between independent and dependent variables, and in social science research, one independent variable can be the dependent variable in another dependence relationship (Hair et al. 2010).

As for this study, the multiple regression technique first needs to treat OEM as the independent variable and the focal SSCM practices of SP, SD, SDIST and IR as dependent variables, and then attempt to treat the focal SSCM practices as independent and environmental and cost performance as dependent, and finally treat environmental performance as the independent variable and cost performance as the dependent variable. Schumacker and Lomax (2010) and Kline (2011) suggest that such a technique is not recommended for analysing structural models with independent and dependent variables, as it involves multi-stage analysis which may generate bias in the results.

In addition, employing a multiple regressions technique is not line with the holistic and integrated perspective of the proposed model required for the inclusion of the influential effects of the SSCM driving forces when examining the impacts of SSCM implementation on performance outcomes. Multiple regressions analysis is not able to take interaction effects among the posited variables into account (Hair et al., 2010), which is opposed to our objective of assessing the impacts of the focal SSCM variables on performance outcomes while considering the influential effects of OEM. Considering these arguments, using multiple regressions is excluded in analysing the research model.

On the other hand, the SEM technique is able to examine multiple relationships of dependent and independent variables while considering interaction effects among the posited variables (Kaplan, 2000). It depicts all of the relationships amongst independent and dependent variables and expresses them in a series of equations (Kline, 2011). Furthermore, SEM attempts to analyse all the relationships between variables in one sitting, producing less biased results (Kaplan, 2000). The structural equation modelling (SEM) technique is a widely used data analysis approach in analysing structural models that encompass independent and dependent variables (Bagozzi and Yi, 2012).

Many operations and SCM scholars employ the SEM technique when examining causal links among various aspects of the SSCM research area, for example, Green et al. (2008) examining the impacts of logistics performance on organisational performance; Sarkis et al. (2010) examining causal relationships between stakeholder pressures and the adoption of environmental practices; Inman et al. (2011) examining causal links between sustainable manufacturing and firm performance; Carter and Jennings, (2004) analysing the structural relationships amongst top management leadership, government regulation and sustainable purchasing; Green et al. (2015) analysing the causal links between green supply chain practices and environmental performance.

Generally, the SEM method has many advantages compared with other multivariate techniques such as multiple regressions, factor analysis and path analysis. While other multivariate techniques are restricted to examining a single relationship at a time, the SEM method allows the estimation of a series of separate causal relationships simultaneously, which helps to effectively examine all the relationships of a structural model in one sitting (Kaplan, 2000; Bagozzi and Yi, 2012). This capability is highly relevant to this research as it allows a simultaneous estimation of all the posited hypotheses between driving forces and SSCM practices (*H1a* through *H1d*) and among SSCM practices and performance outcomes (*H2a* through *H2d*, *H3a* through *H3d* and *H4*) in one sitting, producing more accurate and credible results. In this regard, Bagozzi and Yi (2012) maintain that the use of SEM provides an integrative function as a single umbrella of methods that covers testing measurements and causal hypotheses, which is parsimonious compared to the separate regressions models required in multiple regressions.

In addition, SEM is capable of identifying new relationships in the model and suggesting any potential relationships that can statistically exist based on modification indices (Kaplan, 2000; Schumacker and Lomax, 2010). In other words, SEM estimates all of the possible relationships between the embedded variables of the model, which assists the researcher to ensure that all potential relationships are theorised. Such a distinctive capability of suggesting new hypotheses that were not originally considered in the model can open up new avenues for research. The SEM method also provides a model diagnosis concerning the overall stability and fitness of the structural model for the purpose of achieving the best model fit (Byrne, 1998; Kline, 2011). Such advantages permit the SEM technique to perform better than multiple regressions in terms of model improvement and also minimise multi-collinearity problems. Furthermore, the SEM technique can be applied to models with latent variables, which are not observed directly (Kaplan, 2000). As all variables in this study are latent (theoretical constructs that are inferred indirectly by linking them to a number of observable items), the SEM method seems to be an appropriate analysis approach.

Having said that, as with any data analysis technique, the SEM method also some limitations. According to Hair et al. (2010), the main limitation associated with this technique is the fact that it is computationally intensive, requiring an understanding of the language of the SEM concept (in terms of its philosophical foundation) and also of operationalising SEM software programs (in terms of their proper execution). They maintain that the SEM technique is complex and employing it as a data analysis method, demands a certain level of SEM-related quantitative expertise from the researcher. The second limitation of this technique is the sample size requirements (Kaplan, 2000). Although the recommended range of sample sizes suitable for SEM analysis is 150-400, this may vary based on the complexity of the research model in terms of the number of posited variables (Hair et al., 2010; Kline, 2011). Moreover, the SEM method generally works better with larger samples (Kaplan, 2000).

Considering the advantages of the SEM method over other multivariate techniques, and also our objective to assess the theorised model as a whole, the SEM technique is selected as the data analysis approach for this study. This method enables us to assess the impacts of the implementation of SSCM practices on the performance outcomes while considering the influential effects of the OEM driving forces, generating more credible results. As for the potential limitations associated with this method, the author has the necessary knowledge to fully perform the SEM technique. In terms of the sample size requirement, this study seeks to reach the minimum threshold in an attempt to stretch the limits of the sample. The philosophical foundation of SEM will be discussed in the next chapter to provide a better understanding of this data analysis technique.

In essence, structural equation modelling (SEM) technique is being executed by two widely used approaches: Covariance based SEM (CB-SEM) and Partial Least Square SEM (PLS-SEM). The major distinction between CB SEM and PLS SEM is straightforward and down to the research objective. According to Hair et al. (2014), if the research objective is theory testing and confirmation the appropriate method is Covariance based SEM (CB-SEM). In contrast, if the research objective is theory building and development, then the appropriate method is Partial Least Square SEM (PLS-SEM) (Hair et al., 2014). In support of this, Bagozzi and Yi (2012) also highlight that PLS-SEM method is recommended for exploratory research where researchers intend to build a theory and develop their own model, while CB-SEM is recommended for explanatory or descriptive research where researchers attempt to test a theory and confirm an established model with minor changes. Conceptually and practically, the PLS-SEM method is similar to performing multiple regression analysis (Hair et al., 2011). According to Hair et al. (2011), in PLS-SEM method *"the primary objective is to maximize explained variance in the dependent constructs but additionally to evaluate the data quality on the basis of measurement model characteristics"* (p. 140).

Furthermore, the CB-SEM method benefits from the important feature of universal goodness-of-fit (GOF), which confirms whether the data fits the structural model (Hair et al., 2014). In contrast, PLS-SEM has no adequate goodness-of-model fit measure and is unable to explain how well the collected data fit the model (Schumacker and Lomax, 2010). In view of the above arguments, the Covariance based SEM (CB-SEM) method is deemed more appropriate for this research than Partial Least Square SEM (PLS-SEM), considering our research objective, i.e. theory testing, CB-SEM strong explanatory capability in explaining cause-and-effect relationships, and its distinctive feature of comprehensive model fit information.

4.10 The research 'onion' of this thesis

Research methodology is deemed to be a critical part of research, implying that the selected methodological choices should be clearly addressed and justified (Saunders et al., 2009). In light of this, we have provided a step-by-step approach to selecting the main elements of the research methodology, ranging from philosophical to practical considerations. This indeed maintains the replicability of the research. The research 'onion' of this thesis is illustrated in Figure 4.7, representing a holistic view of our research methodology. The selected choices in this thesis are depicted in bold.

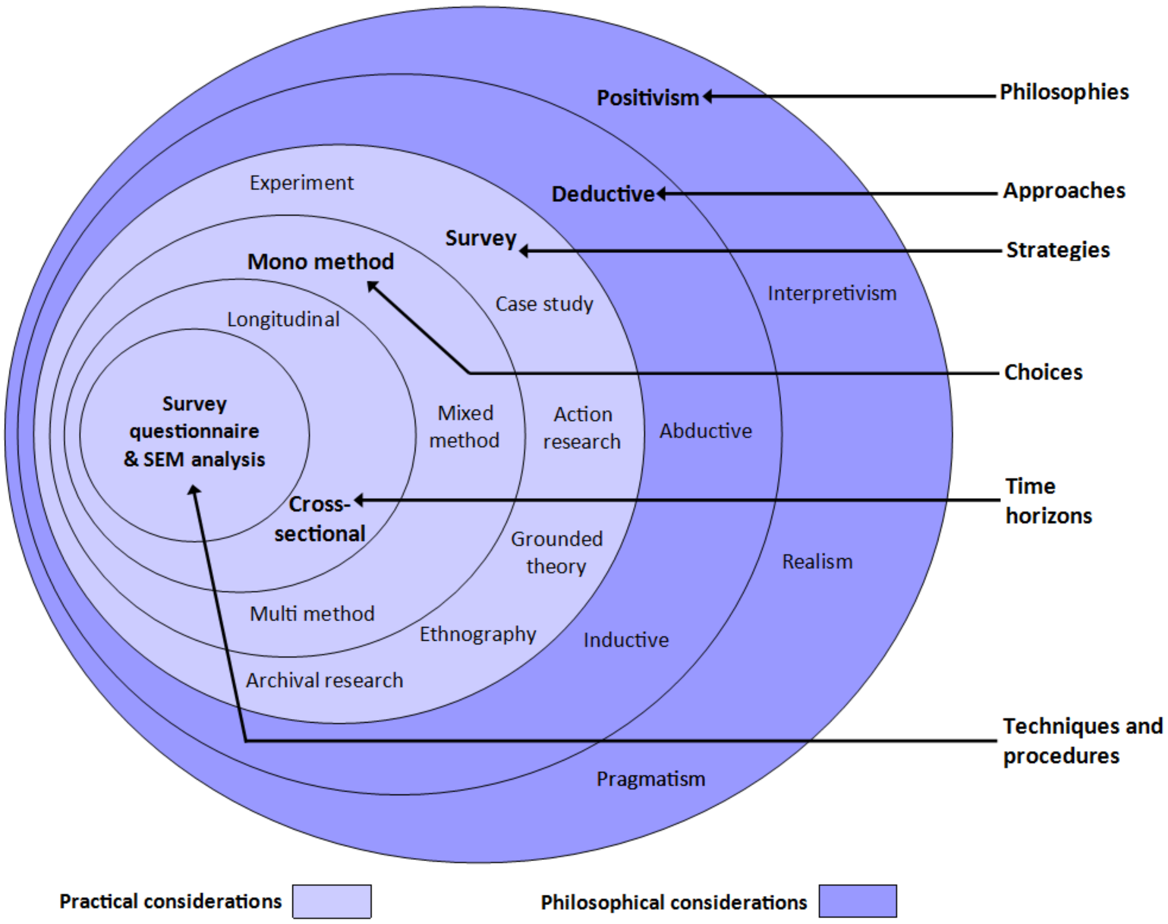


Figure 4.7 Research onion of this thesis (adapted from Saunders et al., 2009)

Drawing on Figure 4.7, the positivism philosophical stance was chosen based on the research questions that are followed by adopting the deductivism research approach according to the research objective, covering the philosophical considerations of the research. The inner layers of the research ‘onion’ are concerned with the practical considerations of the thesis associated with the appropriate research strategy, choices on research methods and time horizons that are adopted. Based on the research questions and corresponding to the adopted philosophical stance, the survey strategy was chosen to be conducted by a mono quantitative method with a cross-sectional time horizon. Lastly, the survey questionnaire and SEM technique were proposed to be employed in this study as the relevant data collection technique and data analysis approach.

Having discussed the core of the research methodology, ranging from philosophical to practical considerations, this study goes on to address other practical sub-attributes of the study's methodological procedures such as questionnaire development, data type, ethical considerations, pilot study, sampling strategy and data collection procedures. The following sections discuss these key methodological issues in detail.

4.11 Questionnaire development

4.11.1 The choice of questionnaire

There are two main types of questionnaire in business and management research (see Figure 4.8): self-administered questionnaires, including Internet-mediated, postal and delivery-collection questionnaires, in which the presence of the researcher is not required; and interviewer-administered questionnaires, including structured interviews and telephone questionnaires, where the researcher is present (Saunders et al., 2009). The following figure displays the different types of questionnaire used in business and management research. The bold texts indicate the choices selected in this thesis.

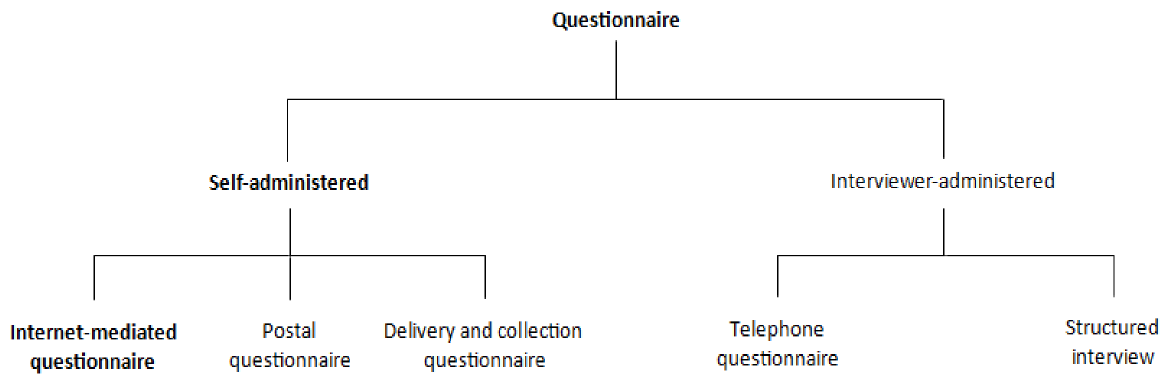


Figure 4.8 Types of questionnaire (source: Saunders et al., 2009, p. 357)

The choice of questionnaire is generally influenced by the research questions and objectives (Saunders et al., 2009), and in particular by the following factors:

- Appropriate sample size required for data analysis
- Types and number of questions required to collect data
- Importance of reaching a specific group of people as participants
- Researcher's time window for completing data collection
- Feasibility of automating data entry
- Researcher's financial implications regarding fieldwork

Considering these factors and in accordance with our primary research question, an Internet-mediated self-administered questionnaire was employed as the data collection technique for this thesis. The interviewer-administered questionnaire was excluded as it mainly focuses on the in-depth understanding of a concept and is particularly good for 'why' type questions (Saunders et al., 2009). In addition, this type of questionnaire is usually unable to target a large sample size (Robson, 2002).

A self-administered questionnaire is deemed appropriate in line with our primary research questions as it can assist us to examine and explain causal relations between SSCM-related driving forces, SSCM practices and commensurate performance outcomes. Furthermore, self-administered questionnaires have other advantages over interviewer-administered questionnaires such as being more convenient for respondents, shorter in length, having no interviewer variability, being easy to follow and answer, cheaper to administer, faster to administer, able to reach a wider geographical areas, having a low number of open questions, etc. (Klassen and Jacobs, 2001; Robson, 2002; Bryman and Bell, 2015).

From the three main types of self-administered questionnaire, the Internet-mediated questionnaire was employed because of the resources available to the author. An Internet-mediated questionnaire fit the time available to the author to complete the data collection. It also benefits from the ease of automating data entry and financial implications regarding the fieldwork. More importantly, with an Internet-mediated questionnaire we can reach a specific group of people (i.e. manufacturing managers) who are capable of providing us with the information required to answer our research questions. The delivery-collection questionnaire is not widely used in PhD studies due to the prolonged period of time required for the delivery and collection of questionnaires (Saunders et al., 2009). Also, it is not recommended where the samples are geographically dispersed due to its inability to cover all participants. Table 4.5 summarises the main attributes of the two most widely used types of self-administered questionnaire.

Table 4.5. Main attributes of self-administered questionnaires

Attribute	***Internet-mediated***	***Postal***
Main features	Computer literacy is a must, allows flexible design	Anonymity is high
Confidence that right person has responded	High in case of email survey	Low unless collecting answers in person
Likelihood of distortion of responses	Low	May be contaminated by consultation with others
Characteristics of respondents	Computer-literate, people who can be contacted by email, Internet, intranet	Literate people who can be contacted by mail; selected by name, household, organisation
Sample size	Very large and may be locally or internationally dispersed	Large, tends to be locally dispersed due to associated cost
Response rate	Variable, 12% or lower, 30% if using intranet	Variable yet 30% is reasonable
Response time	Ranges from minutes to hours to days to weeks	Ranges from days to weeks to months
Financial resources	Designing a web page using online expert systems or software providers, data entry in the form of an email	Outward and return postage, photocopying, clerical support, Data entry
Time taken to complete collection	Varies according to sample size; the average is 2–6 weeks from distribution (dependent on number of follow-ups)	Varies according to sample size; the average is 4–8 weeks from posting (dependent on number of follow-ups)
Data input	Usually automated	Closed questions can be designed so that responses may be entered using optical mark readers after questionnaire has been returned

(Source: Saunders et al., 2009, p. 364)

4.11.2 Rationale for using Internet-mediated questionnaire in this thesis

Drawing on Table 4.5, the main advantages of conducting an Internet-mediated survey are the fact that it is both time- and cost-effective. While the possibility of distortion of respondents' answers is reasonably low in this approach, the confidence that the response is from the correct person is also high when using email (Saunders et al., 2009). It is also convenient for respondents because they can complete the survey based on their availability. More importantly, an Internet-mediated survey enables the author to approach large qualified samples of manufacturing managers who are capable of providing the required information regarding our research questions. Furthermore, the potential risk of missing data can be mitigated through certain techniques of the web page design of the survey (Sue and Ritter, 2007), which will be discussed in the following section. Therefore, with set of above attributes, the Internet-mediated questionnaire is deemed appropriate to be adopted in this thesis.

4.11.3 Design of questionnaire structure

Having determined the type of questionnaire needed and its method of administration, we now move on to questionnaire design issues. Churchill and Iacobucci (2002) offer a nine-step procedure for questionnaire development (see Figure 4.9), which can maximise the quality of the questionnaire. Accordingly, our questionnaire was carefully designed based on their steps, because the suggested steps are highly constructive for designing an appropriate questionnaire.

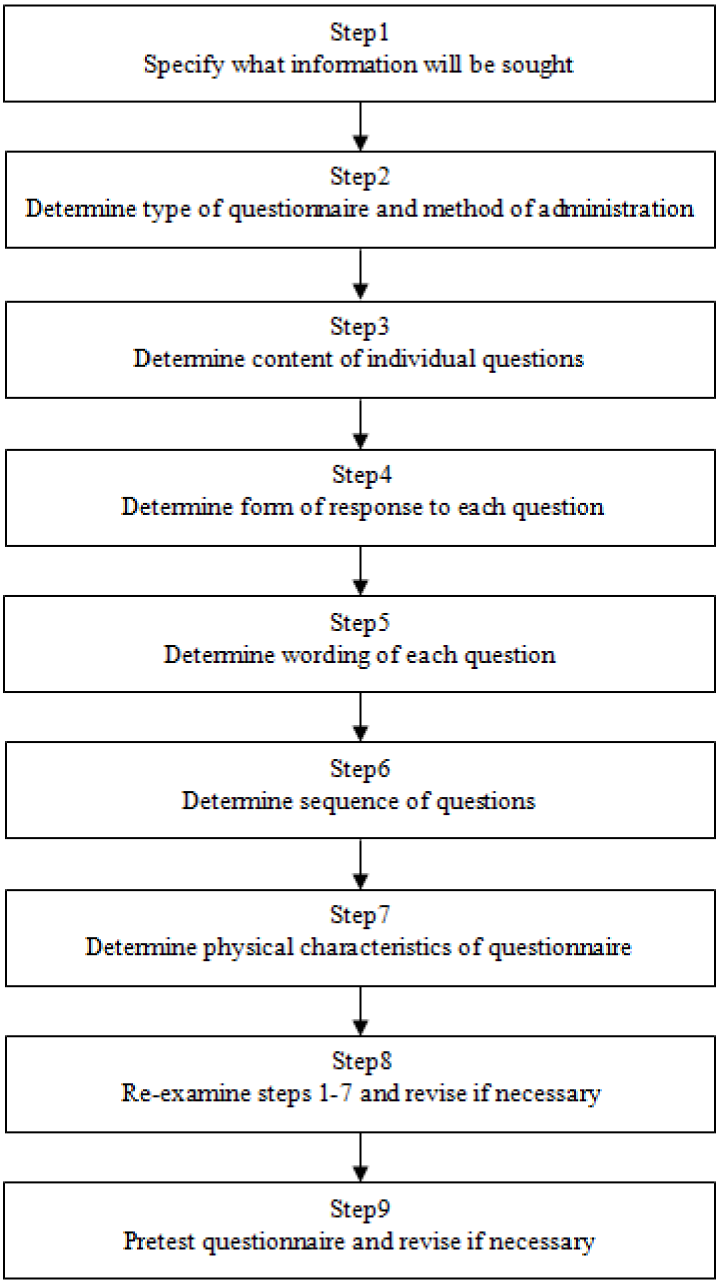


Figure 4.9 Procedure for developing a questionnaire (source: Churchill and Iacobucci, 2002)

As can be seen from Figure 4.9, the required information concerning our research questions was specified in the first step and then the type of questionnaire was determined along with its method of administration (Step 2), as presented in the previous section. In addition, in Step 1, the information was sought based on the research constructs and their definitions, which were presented in Section 3.4. Furthermore, the following steps were determined for our questionnaire development:

Step 3: Question generation and content

The contents of individual questions were determined to ensure the content validity. According to Bryman and Bell (2015), an extensive review of the literature enables researchers to find an appropriate set of questions relevant to their research scope. Following a similar approach, the extensive literature review conducted in Chapter 2 enabled us to find an appropriate set of questions within existing studies. These are consisted of 42 questions that fully cover the seven posited research constructs in the theoretical model, presented in Section 4.11.4. Furthermore, Hair et al. (2010) suggest that where there is no appropriate set of questions within existing studies, researchers need to either develop a new set of questions or modify an existing one. However, for this research we identified an appropriate set of questions (measurement items) from existing studies that have been used by various authors (see Section 4.11.4), indicating that there was no need to develop a new set of questions.

Step 4: Form of response

The form of response to each question was determined in this step. A five-point Likert (1932) type method of summated ratings was used in our questionnaire. This Likert-type scale was adopted in this study because it is capable of providing interval- or ratio-based data. Participants were asked to record their opinion using a scale where 1 corresponded to “Not at all” and 5 to “To a great extent” for performance constructs and another relevant scale where 1 corresponded to “Not considering it” and 5 to “Implementing successfully” for SSCM constructs. The five-point Likert scale is the most powerful scale for statistical analysis and widely used in quantitative research (Field, 2009; Hair et al., 2010).

Step 5: Question wording

The wording of each question was also determined. Another critical procedure for designing a questionnaire is to avoid ambiguity in the questionnaire (Churchill and Iacobucci, 2002). In view of this, each question was presented in the most simple manner possible in order to avoid any potential ambiguity. In addition, concise descriptions of each research construct were included at the beginning of each set of questions associated with each construct to improve the clarity of the questions (see questionnaire in Appendix B).

Step 6: Question sequence

Having determined the form of response and appropriate question wording in the previous steps, the sequence of questions was also determined in the next step to make the questionnaire flow freely. The sequence of the questionnaire and its questions is a very important factor that ensures a logical flow. An appropriate logical flow is necessary for any questionnaire as it minimises ambiguity for respondents that may distort their answers and eventually violate the validity of the data (Hair et al., 2010). Thus, the appropriate arrangement of the questionnaire and its questions was considered in designing the questionnaire to ensure a logical flow. In this regard, each set of questions was arranged in a particular order to follow their relevant research construct (see Appendix B). In addition, the arrangement of the research questions was determined following the sequence of the SSCM drivers-practices-performance model, such that the questions related to the driving forces were presented first, followed by the questions covering SSCM practices constructs and the questions related to performance outcomes.

Step 7: Physical characteristics of the questionnaire

Once the sequence of questions had been determined, the physical characteristics of the questionnaire were determined in the next step. Good physical characteristics are important for a questionnaire as they incentivise the respondent to participate. This also ensures the completion of the questionnaire by the respondent (Hair et al., 2010). Our questionnaire (hard copy version) consisted of five A4 size pages including the cover sheet and the introductory package explaining the purpose of the research (see Appendix B). This provided respondents with a better understanding of our research scope and background. Furthermore, we used a clear font type, Times New Roman, with a size of 12 points in a well-organised format. This enables the respondent to comfortably answer the questions and complete the questionnaire (Saunders et al., 2009).

Step 8: Re-examination and revision of questionnaire

Another critical procedure for developing a good quality questionnaire is re-examination and revision of the questionnaire (Churchill and Iacobucci, 2002). Once the contents and questions of the questionnaire had been initially designed, a detailed re-examination of the whole questionnaire was undertaken. This allowed us to check for any potential errors in the questionnaire. Accordingly, all of the previous steps were re-examined and revised where necessary. In view of this, a number of errors in questions were minimised and the sequence of a few questions was revised to enhance the logical flow of the questionnaire and further minimise any possible ambiguity. This ensured that our questionnaire is capable of obtaining the SSCM-related information required to answer the research questions.

Step 9: Questionnaire pre-testing

The final step outlined by Churchill and Iacobucci (2002) for developing a questionnaire is pre-testing. Questionnaire pre-testing is an essential factor of questionnaire development (Hair et al., 2010). This allows the researcher to check for and tackle any potential errors after the questionnaire has been finalised. Details of the questionnaire pre-testing (pilot) are provided in Section 4.14.

4.11.4 Measurement scale development

As previously discussed, we did not need to develop new measurement scales from scratch, since prior research had already developed a set of validated measurement scales useful for this study. In essence, in this study, the measures of driving forces, SSCM practices and performance components are developed on the basis of previous studies (e.g. Zhu et al., 2008a; Esty and Winston 2009; Green et al., 2012b). Zhu and Sarkis (2004) developed the initial measurement scales for SSCM practices which were further developed and assessed by Zhu et al. (2008a) to not only cover SSCM practices but also encompass measures associated with performance outcomes. Zhu et al. (2008a) verified their developed measures and maintained four underlying constructs which show the key dimensions of SSCM practice: sustainable procurement (SP), sustainable design (SD), sustainable distribution (SDIST) and investment recovery (IR). Furthermore, they validated the measuring variable of organisation environmental management (OEM) and also maintained performance measures of economic and environmental performance.

We directly adopted the measurement scales of Zhu et al. (2008a) in this study. For ‘sustainable distribution’ and ‘sustainable design’, we utilised additional items found in Esty and Winston (2009) and Green et al. (2012b). We incorporated these measurement items into our questionnaire to examine and explain the relationships between SSCM driving forces, practices and performance outcomes. The measurement scales used in this study are displayed in Table 4.6. It is worth mentioning that these measures were originally developed for the manufacturing sector, specifically focusing on the automotive, electronic, chemical/petrochemical and mechanical industries (Zhu and Sarkis, 2004; Zhu et al., 2008a; Zhu et al., 2013). This further justifies the adoption of these measures as they are in line with the manufacturing focus of the study and its sector of analysis.

It should be noted that the adopted measurement scales that were validated by Zhu et al. (2008a) have been used by various authors and published across top-tier operations and supply chain management journals in studies such as Vachon and Klassen (2008); Hsu et al. (2013); Green et al. (2012a); De Giovannia and Vinzi (2012); Lee et al. (2012); Hollos et al. (2012); Gimenez et al. (2012); Zailani et al. (2012); Zhu et al. (2010); Zhu et al. (2013); Green et al. (2015).

Arguably, the fact that they have been widely used and assessed within pertinent SSCM literature indicates the sufficient validity of Zhu et al.'s (2008a) measures. Hence, the measurement scales of Zhu et al. (2008a) were employed in this study as validated indicators to evaluate SSCM driving forces, the implementation of SSCM practices and its commensurate performance outcomes.

Table 4.6. Measurement scales

Organisation Environmental Management (Zhu et al., 2008a)	
Please indicate the extent to which you perceive that your company is implementing each of the following.	
(five-point scale: 1 = Not at all; 2 = To a small extent; 3 = To a moderate extent; 4 = To a relatively great extent; 5 = To a great extent)	
OEM1	Commitment to SSCM from senior managers.
OEM2	Support for SSCM from mid-level managers.
OEM3	Cross-functional collaboration for environmental improvements.
OEM4	Total quality environmental management.
OEM5	Environmental compliance and auditing programmes.
OEM6	ISO 14001 certification.
OEM7	Environmental Management Systems.
Sustainable Procurement (Zhu et al., 2008a)	
Please indicate the extent to which you perceive that your company is implementing each of the following.	
(five-point scale: 1 = Not at all; 2 = To a small extent; 3 = To a moderate extent; 4 = To a relatively great extent; 5 = To a great extent)	
SP1	Eco labelling of products.
SP2	Cooperation with suppliers for environmental objectives.
SP3	Environmental audit for suppliers' internal management.
SP4	Suppliers' ISO 14000 certification.
SP5	Second-tier supplier environmentally friendly practice evaluation.
SP6	Providing design specification to suppliers that includes environmental requirements for purchased item.
Sustainable Design (Zhu et al., 2008a; Esty and Winston, 2009)	
Please indicate the extent to which you perceive that your company is implementing each of the following.	
(five-point scale: 1 = Not at all; 2 = To a small extent; 3 = To a moderate extent; 4 = To a relatively great extent; 5 = To a great extent)	
SD1	Design of products for reduced consumption of materials.
SD2	Design of products for reduced consumption of energy.
SD3	Design of products for reuse, recycle, recovery of material, component parts and by-products.
SD4	Design of products to avoid or reduce use of hazardous materials in their manufacturing process.
SD5	Cooperation with customers for eco-design.
SD6	Cooperation with customers for cleaner production.
Sustainable Distribution (Zhu et al., 2008a; Green et al., 2012b)	
Please indicate the extent to which you perceive that your company is implementing each of the following.	
(five-point scale: 1 = Not at all; 2 = To a small extent; 3 = To a moderate extent; 4 = To a relatively great extent; 5 = To a great extent)	
SDIST1	Cooperation with customers for using less energy during product transportation.
SDIST2	Cooperation with customers for green packaging.
SDIST3	Use of renewable energy in any mode of product transportation.
SDIST4	Use of renewable energy in the process of product packaging.
SDIST5	Upgrade freight logistics and transportation systems (either software or hardware such as minimising empty miles, reducing container weight, improving refrigeration, etc.).
SDIST6	Tracking and monitoring emissions caused in product distributions (e.g., carbon footprint).
Investment Recovery (Zhu et al., 2008a)	
Please indicate the extent to which you perceive that your company is implementing each of the following.	
(five-point scale: 1 = Not at all; 2 = To a small extent; 3 = To a moderate extent; 4 = To a relatively great extent;	

5 = To a great extent)	
IR1	Sale of excess inventories or materials.
IR2	Sale of scrap and used materials or by-products.
IR3	Sale of excess capital equipment.
Environmental Performance (Zhu et al., 2008a) Please indicate the extent to which you perceive that your company has achieved each of the following during the past year. (five-point scale: 1 = not at all; 2 = a little bit; 3 = to some degree; 4 = relatively significant; 5 = significant)	
EP1	Reduction of air emissions.
EP2	Reduction of waste emissions.
EP3	Reduction of solid wastes.
EP4	Reduction of effluent wastes.
EP5	Decrease of consumption for hazardous/harmful/toxic materials.
EP6	Decrease of frequency for environmental accidents.
EP7	Improvement of enterprise's environmental situation.
Cost Performance (Zhu et al., 2008a) Please indicate the extent to which you perceive that your company has achieved each of the following during the past year. (five-point scale: 1 = not at all; 2 = a little bit; 3 = to some degree; 4 = relatively significant; 5 = significant)	
CP1	Decrease of costs for purchased materials.
CP2	Decrease of costs for energy consumption.
CP3	Decrease of fees for waste treatment.
CP4	Decrease of fees for waste discharge.
CP5	Decrease of fines for environmental accidents.

It is worth mentioning that the systematic review approach employed in Chapter 2, which led to the identification of essential SSCM practices, enabled us to discern whether these underlying measures actually show the key dimensions of SSCM practices. This is due to the fact that reviewing 68 pertinent SSCM articles as the output of the systematic review approach (see Appendix A) enabled us to more broadly view and understand the boundaries of the SSCM initiatives, furnishing us with the capability to confirm whether the measuring items of a developed scale practically represent that construct. Thus, in line with our literature review, we rely on what was presented in Section 2.5.3.1 on the SSCM core dimensions to check whether the measurement items of Zhu et al.'s (2008a) constructs are consistent with what we found in the literature, so that its appropriateness can be verified. A comparison between the 35 identified SSCM practices and Zhu et al.'s (2008a) measuring items revealed that the measurement items of Zhu et al.'s (2008a) constructs reasonably cover the essential SSCM practices, and their underlying constructs relatively fall within the core SSCM dimensions presented in Table 2.4. Therefore, we support the claim of appropriate measurement scales for Zhu et al.'s (2008a) measures.

4.12 Data type

4.12.1 Primary data

The data required to validate the proposed hypotheses and carry out empirical examination for this study are specifically concerned with SSCM practices and SSCM performance. However, there is little existing information and data on SSCM research, as this emerging topic is still in the early stages of development (Seuring and Muller, 2008a,b; Green et al., 2012a). Furthermore, in empirical studies, data are often obtained directly by the researcher for a particular research project (Saunders et al., 2009). This is commonly referred to as primary data collection, where original primary data are obtained directly by the researcher through various methods such as questionnaires, interviews and direct observation (Bryman, 2001).

Generally, the use of primary data is suggested when the required data is not available to the researcher from published sources (Bryman and Bell, 2015). In this research investigation, we need information that is only available from certain types of manufacturing managers with knowledge of SSCM. Published sources containing the required data on SSCM practices and performance were not available to the author. Most of the available secondary data comprised general information on environmental sustainability initiatives, irrespective of SCM focus and performance implications, which were considered not applicable for this thesis. This necessitated a need to collect primary data for this study which furnish us with the appropriate and up-to-date information required to answer the research questions.

Therefore, based on the discussion above, this study suggests the use of primary data as there are no secondary data available. Primary data collection is always associated with selecting appropriate sampling techniques, as it is not possible to collect the required original data from an entire population (Saunders et al., 2009). Section 4.15.1 will discuss the study's sampling technique for data collection once ethical considerations and pilot-testing have been described.

4.13 Ethical considerations

Research ethics is deemed a crucial element in conducting a research project within social science research. It is broadly referred to as the appropriateness of researchers' behaviour in connection with the rights of those who are the subjects of the research project (Saunders et al., 2009). The ethical issues of voluntary participation, informed consent, risk of harm, confidentiality and anonymity are central and should be considered by researchers when conducting any research project within the social science context (Bryman and Bell, 2015). Generally, at PhD level, the conduct of research is guided by the researcher's university's ethical guidelines that address the main ethical issues (Phillips and Pugh, 2005).

The author followed the University of Birmingham's ethical guidelines and considered the main ethical issues of the principles of voluntary participation, the requirements of informed consent, ethical standards concerning risk of harm for participants, confidentiality of the information provided by respondents and principles of anonymity that ensure that participants will remain anonymous throughout the study. For example, an informed consent statement was provided at the beginning of the questionnaire, informing participants that their consent will be assumed by their completion of the survey. In addition, a password-protected flash drive was allocated for the data storage so that the data could be preserved and accessible for ten years, following the data storage and retention requirements of the University of Birmingham Code of Practice for Research.

Furthermore, to ensure the study's research ethics, an ethical review application was completed and submitted to the research ethics committees along with a sample of the questionnaire. The study's ethical application was reviewed by the Humanities & Social Sciences Ethical Review Committee of the University of Birmingham, and granted full ethical approval with reference number ERN_13-0730 prior to the pre-survey fieldwork and the main survey.

4.14 Pilot study

Prior to conducting the main survey questionnaire, we pre-tested the developed questionnaire to determine whether the questionnaire items could be fully understood and check if more items need to be added to ensure that the questionnaire was capable of obtaining answers to the research inquiries. Generally, pre-testing a questionnaire, as an integral part of the survey design process (see Section 4.11.3), highlights any potential problems before launching the main survey and provides preliminary feedback that enables the researcher to ensure clarity and ease of completion (Malhotra and Grover, 1998). To pilot-test our developed questionnaire, we followed the pilot-testing procedures presented by Forza (2002), which suggest that in order to effectively pre-test survey questionnaires in operations management, the proposed survey should be checked by the following groups: academics, industry experts, and potential informants or respondents. In light of this, we pre-tested our questionnaire with these groups in three stages.

In the first stage, four academics from the University of Cambridge, Northwestern University and University of Birmingham were invited to pilot-test the survey through a number of informal interviews during the "9th International Symposium on Global Manufacturing" in September 2013. These academics had been previously contacted and informed about the pilot test. A copy of our survey questionnaire along with the conceptual model and the research hypotheses was emailed to each of these academics one week before conducting the interview, providing them with an overview of the research purpose and objective. The chosen academics were reasonably knowledgeable and experienced in the SCM field and industrial sustainability.

The four academics were individually interviewed for an average length of approximately half an hour. These interviews allowed the observation of the interviewees' body language, indicating their agreement, disagreement or confusion about the questionnaire items, which was considered and noted down by the researcher. During the interview, wording and layout issues were examined as well as the measurement scales employed, to determine whether the indicators really measured the constructs (face validity). Based on these interviews, we marginally modified the questionnaire, mainly on the five-point scales for the SSCM variables and how to present Standard Industrial Classification (SIC).

In this regard, we made the Likert scales for the SSCM variables more consistent with the Likert scales for environmental and cost performance to avoid confusing respondents with two different Likert scales. Accordingly, when asking respondents "please indicate the extent to which you perceive that your company is implementing each of the SSCM practices" the five-point scale for the SSCM variables was modified from "1 = not considering it; 2 = planning to consider it; 3 = considering it currently; 4 = initiating implementation; 5 = implementing successfully" to "1 = not at all; 2 = to a small extent; 3 = to a moderate extent; 4 = to a relatively great extent; 5 = to a great extent". In addition, the firm category classification was changed from the North American Industry Classification System (NAICS) to the UK Standard Industrial Classification (UK SIC). The second draft of the survey was created by applying these revisions. Furthermore, these interviews allowed us to examine the content validity of the employed measurement scales, i.e. the extent to which the full content of the definition is represented on a scale, ensuring that they measure the construct they are supposed to measure (Hair et al., 2010). Although the content validity was already assumed in this study as we directly employed well-established and validated reliable scales from prior studies, the pilot study also verified the content validity of the employed measures.

In the second stage, additional industry expert interviews were conducted to determine whether the questionnaire items were appropriate for the automotive industry. Two site visits to Vauxhall Motors were made by the researcher in early November 2013 and three experts in the area of SSCM were informally interviewed. The purpose of this set of interviews was to remove any impractical questions irrelevant to the car manufacturing sector and ensure that our survey could be fully understood by manufacturing managers involved in the automotive industry, as our potential respondents in the main survey.

Similarly to Stage 1, a copy of the survey questionnaire along with the conceptual model and the research hypotheses was emailed to each of these industry professionals beforehand, providing them with an overview of the research purpose and objective. They were also provided with a copy of the questionnaire during the interview. We managed to pilot-test all the questionnaire items and the screening and demographic questions with three different managers: a supply chain manager, a purchasing manager and an operations manager. Each interview lasted approximately 40 minutes. Consequently, two questions within the sustainable design measures were deleted as one was found to overlap with another question and the other was suggested to fall outside the eco-design scope. This stage also resulted in us replacing variables jargon with their full terms, and adding a brief description of each construct at the beginning of each section to further enhance the clarity of the survey.

Accordingly, the third draft of the questionnaire was developed. In addition, drawing on these industry experts' experience, we confirmed that the information collected by our questionnaire relatively represented the main SSCM activities within the automotive industry, ensuring the completeness of the questionnaire items. This stage broadly ascertained that all measurement items were consistent with the average knowledge of manufacturing managers involved in the automotive sector. It should be noted that the number of interviews was deemed sufficient in the first and second stage, as we reached a certain level of saturation in improving our survey, where no more changes were required.

In the third stage, a copy of the updated survey was emailed to potential respondents from the UK automotive industry for the final pilot-testing of the questionnaire. The key purpose of distributing the pilot questionnaire was to check *"how well conceptualisations of the problem match the actual experience of the practitioner"* (Malhotra and Grover, 1998, p. 408). The pilot survey was conducted in association with the UK Financial Analysis Made Easy (FAME) database, to which the researcher had access as a doctoral researcher at the University of Birmingham. In the pilot stage, we used sampling but we did not apply rigorous standards, as recommended by Saunders et al. (2009), who assert that detailed and thorough sampling standards are not commonly used at the pilot stage. However, we employed rigorous sampling standards for our main survey, as presented in Section 4.15.1.

A total of 50 British car manufacturing firms were randomly selected using the FAME database, and contacted via email. The respondents consisted of various senior to mid-level manufacturing managers ranging through operations managers, plant managers, supply chain managers, logistics managers, purchasing managers and engineering managers. We asked these respondents to complete the updated questionnaire and informed them that our survey was in the final process of development, and required their feedback for further improvements. A section was added at the end of our updated questionnaire, asking respondents to provide feedback regarding any potential problems they might have encountered in answering the questionnaire items regarding instructions, ambiguity, wording and layout, and overall survey content. Eight responses were received at this pilot stage. Comments were mainly focused on the survey length and in particular the long cover sheet and detailed introductory package explaining the purpose of the research and confidentiality statement. We considered their feedback and accordingly shortened the cover sheet and confidentiality statement, and also made the description of each construct more concise. Thus, the final version of the questionnaire was developed (see Appendix B).

This rigorous pilot test, checking the survey with three groups of academics, industry experts and potential respondents, which entailed employing their knowledge and experience of the SSCM concept and also the automotive industry sector, confirmed the legitimacy and rigour of the survey. This also ensured the reliability of the data and the completeness of the survey in obtaining answers required for the research inquiries. The sole purpose of conducting the pilot test was to examine and improve the quality of the survey questionnaire.

4.15 Main survey

Subsequent to the pilot study, we proceeded to conduct the main survey. This section addresses the key issues involved in conducting a rigorous survey, such as sampling implications and data collection procedures.

4.15.1 Sampling

Sampling is an important part of any empirical research and is associated with the selection of the correct individuals, events or objects from which the required information is collected (Bryman and Bell, 2015). Irrespective of the research questions and objectives, a researcher should consider the appropriate use of sampling in their research, as it is relatively impracticable and unrealistic to collect and analyse data from every possible case due to restrictions of time, access and money (Saunders et al., 2009). In light of this, researchers often employ a range of sampling techniques to reduce the amount of data they must collect, by considering a manageable size of data from a sub-group within the population of all possible cases (Saunders et al., 2009). This allows them to generalise the findings for the studied sample to the entire population to a reasonable extent, if the sampling process is properly carried out (Bryman, 2001).

According to Saunders et al. (2009) and Bryman and Bell (2015), the sampling process comprises five key steps:

- selecting the most appropriate sampling technique
- identifying the target population
- determining the sample size
- determining the sampling frame
- executing the sampling process and validating the sample

These five steps were carried out for this study's sampling and are discussed in the following.

4.15.1.1 Sampling technique

The main sampling techniques in social research are broadly divided into two types (Saunders et al., 2009): probability sampling (representative sampling) and non-probability sampling (judgemental sampling). In probability sampling, each sampling case is selected from the population with an equal chance or probability (i.e. selected samples can be representative of the population). In other words, individuals or objects of the population have equal probability or opportunity to be selected as research samples by the researcher. This enables the researcher to answer the research inquiries by estimating statistically the characteristics of the population from the sample (Saunders et al., 2009). The probability sampling technique is commonly associated with survey-based strategies and explanatory studies and also is widely employed in quantitative research, where the key purpose of sampling is to achieve a representative sample that can explain certain research phenomenon (Saunders et al., 2009; Bryman and Bell, 2015).

Unlike probability sampling, in non-probability sampling there is no fixed probabilistic chance that objects can be selected as a sample from the population (i.e. the selected sample is not representative of the population). In other words, the probability of objects being selected from the population is not known and thus it is not possible for the researcher to make statistical inferences about the population's characteristics (Saunders et al., 2009). Non-probability sampling is commonly related to qualitative research where the main objective of sampling is to collect specific objects or cases that can provide an in-depth understanding of a certain phenomenon (Creswell, 2003). The ability to generalise the findings is the main issue that distinguishes these two sampling techniques: whereas research findings can be generalised through probability sampling, they may not with non-probability sampling, at least not on statistical grounds (Saunders et al., 2009).

Considering the above arguments, probability sampling is deemed appropriate for this study given its capacity to provide a representative sample essential for validating and generalising the findings. In addition, probability sampling is in line with the study's research method and research purpose and also consistent with the selected survey research strategy where we make inferences from the collected samples to answer the research inquiries.

There are four main types of probability sampling: simple random sampling, systematic sampling, stratified sampling and cluster sampling (Bryman and Bell, 2015). The choice of technique is dependent upon various factors such as research questions, sampling frame, sample size, geographical area, relative cost and the ease of explaining the technique to support workers (Saunders et al., 2009). Table 4.7 summarises the main characteristics, advantages and drawbacks of each probability sampling technique, determining the choice of sampling technique for this study.

Table 4.7. Factors in choice of probability sampling techniques

Sample type	Procedures	Characteristics	Evaluation	Implication
Simple random sample: All elements in the population are considered and each of them has the same chance of being selected as a subject	Creating a sampling frame for all the population's elements, then selecting subjects using a purely random process such as random generator computer program or random number table.	Accurate and easy accessible sampling frame required; Sample size is better with over a few hundred; Wide coverage of many geographical areas, unless face-to-face contact is required.	***Advantages:*** Generalisability of findings is high; Frequently used in practice; - Easy to use. ***Drawbacks:*** Lack of efficiency compared to stratified sample; High cost with large sample size.	Highly relevant to this study; Ability to make generalisations i.e., statistical inferences; Consistent with research questions and available resources (the study budget and time)
***Systematic random sample*:** A systematic selection process selects the first element randomly from the sampling frame and then every nth number on the list is selected.	Creating a sampling frame; Calculating sampling intervals; Choosing a random starting point and then drawing subjects at every interval.	Requires accurate and easy accessible sampling frame with no periodic patterns; Suitable for all sample sizes; Wide coverage of many geographical areas, unless face-to-face contact is required.	***Advantages:*** Easy to use with availability of sample frame; Relatively moderate cost; Moderately used. ***Drawback:*** Possibility of systematic biases; Any resulting statistics could not be fully trusted due to the risk of data manipulation; The exact size of the population should be available; Risk of a hidden periodic trait within the population.	May be applicable to the study subject to mitigating systematic biases that may occur. It is also open to criticism concerning the ability to construct sampling systems to increase the likelihood of achieving a targeted outcome.
***Stratified sample*:** A probability sampling procedure in which sub-samples are drawn from samples within different sub-groups or strata that have some equal characteristics.	Creating a sampling frame for each of several categories of elements, drawing a random sample from each category, and then combining all samples' categories.	Clear logic for adopting it; Requires accurate, easily accessible sampling frame that can be divided in relevant strata; Concentrated if face-to-face contact required, otherwise has wide geographical area coverage.	***Advantages:*** Most efficient compared to all probability samples; Low cost if the sampling frames are available; Moderately used; Allows deeper view in data analysis. ***Drawbacks:*** Time-consuming; Requires sampling frame for each stratum.	Beyond the scope of the study due to the lack of need for different strata within the population (data collection targets one particular sector within the sampling frame).
Cluster sample: A sampling technique in which the population is divided into discrete groups or clusters prior to sampling that can be based on any naturally occurring grouping, e.g. geographical areas.	Creating a sampling frame for larger cluster units; Drawing a random sample of the cluster units; Creating a sampling frame for cases within each selected cluster.	Geographically based clusters; Requires accurate, easily accessible sampling frame that relates to relevant clusters; Sample size is as large as practicable.	***Advantages:*** Low cost of data collection if sampling frames are available; Frequently used for large sample size. ***Drawbacks:*** Least efficient and reliable sampling technique; Time-consuming; Requires allocated resources, e.g. money.	Not applicable to the study as it is largely associated with a sampling frame with different geographically based clusters.

(Source: adapted from Saunders et al., 2009; Bryman and Bell, 2015)

Drawing on Table 4.7, and considering the advantages and relevance to this study, the most appropriate sampling technique for this study is simple random sampling, as this study does not require face-to-face contact, the sampling frame does not contain clusters or strata, it is relatively cost-efficient and the required sample is of a manageable size. In addition, simple random sampling is in line with the study's choice of data analysis (i.e. structural equation modelling). According to Kaplan (2000), use of simple random sampling is recommended when employing the SEM data analysis technique, as *"... the main estimation methods involved in SEM such as maximum likelihood assume that data are generated according to simple random sampling"* (p. 70). Therefore, simple random sampling is selected as the sampling technique in this study.

4.15.1.2 Population

The next step in the sampling process involves identifying the target population. Generally, the target population is concerned with the universe of units from which the qualified samples are selected (Bryman and Bell, 2015). This research seeks to investigate the impacts of SSCM practices on the performance of UK car manufacturing firms, so in order to acquire the information required for answering the research inquiry it is wise to target UK firms that are involved in the automotive industry. Hence, the target population in this study is UK car manufacturing firms (i.e. in England, Scotland, Wales and Northern Ireland). This population is deemed appropriate for the study (see Section 1.7) and is expected to provide us with data that is consistent with the manufacturing focus of the theoretical model.

We used the Financial Analysis Made Easy (FAME) database to identify the population of this research. The FAME database contains detailed information on 2.6 million major public and private companies in the UK and Ireland with up to 10 years of history. Access to this data service was made available to the author as a doctoral researcher at the University of

Birmingham. FAME provides both a 'quick' and 'advanced' search through which we ran an advanced search and excluded Irish companies. Furthermore, during the search process we used the UK standard industry classification (UK SIC) available on FAME to narrow the search to manufacturers of motor vehicles, trailers and semi-trailers.

Accordingly, 6,016 UK car manufacturing firms were identified and exported to a Microsoft Office Excel 2010 workbook. This database of 6,016 UK car manufacturing firms is considered the population for this research. The large number of academic papers published in top-tier operations and supply chain management journals that have used the FAME database is a good indicator of the appropriateness of this database at the academic level (e.g. Taylor and Taylor, 2013; Yu and Ramanathan, 2015). This facilitates ensuring the accurate representation of the population and minimising the possibility of sampling frame error.

4.15.1.3 Sample size

The choice of sample size mainly depends on the following (Saunders et al., 2009):

1) the type of data analysis technique the researcher intends to carry out (often statistical analyses have a minimum threshold for the required data cases)
2) the margin of acceptable levels of statistical error (this is associated with the accuracy that a researcher requires for any estimates made from the sample to the population)
3) the size of the population from which the sample is selected
4) a sufficient level of certainty that ensures the characteristics of collected samples will represent target population
5) the number of questions (if many questions are asked, a larger sample size is required)

However, in reality in many cases the choice of sample size apart from the type of data analysis is made in accordance with practical considerations of available resources, time, budget and other limitations (Saunders et al., 2009; Bryman and Bell, 2015). Therefore, the choice of sample size is largely associated with the data analysis technique and the resources available to the researcher. In view of this, we attempted to determine the sample size based on the study's data analysis approach (SEM) while not compromising the other abovementioned factors.

According to Hair et al. (2010) and Kline (2011), the recommended range of sample sizes suitable for SEM analysis is 150-400, varying according to the complexity of the research model in terms of the number of posited variables. They suggest using a minimum of five samples per observed variable for SEM analysis, as this makes factor analysis feasible. Our proposed research model consists of seven theoretical constructs, each of which have five observed variables on average (see Figure 3.5 and Table 4.6). This indicates that we need a minimum of 175 samples to run the SEM analysis (7 (number of constructs) * 5 (number of observed variables) * 5 (number of required samples per observed variables) = 175). With this in mind, we set the threshold of the sample size to 200 so we could safely reach the minimum threshold of 175 samples. This sample size is appropriate for the proposed statistical technique of SEM based on Hair et al.'s (2010) recommendation. In addition, the proposed sample size is in line with the study's choice of sampling technique, as it meets the sample size requirement for the simple random sampling technique, which works better over a few hundred (see Table 4.7).

4.15.1.4 Sampling frame

Having determined the sample size, this section moves on to address the sampling frame of this research and discuss how it is selected. The sampling frame consists of the listing of all units within the population who have been selected as samples (Bryman and Bell, 2015). Generally, the sampling frame is related to the list of the members of the target population from whom the sample is drawn (Saunders et al., 2009). It represents the list of all potential respondents to whom the participation requests will be sent. Generally, determining the size of the sampling frame relies on the chosen sample size and the expected response rate that will yield the required sample size (Bryman and Bell, 2015).

Although response rates vary, Klassen and Jacobs (2001) assert that the best expected response rate for online surveys conducted in operations and SCM is approximately 11% (ranging from 5-11%). Thus, in order to acquire 200 samples (the required sample size) we need a sampling frame of 1,825 (1825*(11/100) = 200). With this in mind, we set the threshold for the size of the sampling frame to 1,825, so it could potentially provide us with the required 200 samples, which falls within the recommended range of 150 to 400 considered acceptable for this research.

The sampling frame of this research is represented by 1,825 car manufacturing firms in UK that were randomly selected using a simple random sampling technique. We used Random Number Generator (RNG) software Version 1.30 to randomly select the sampling frame from the population. First we coded each firm in the population with numbers from 1 to 6,016. Then, we imported the 6,016 coded firms into the RNG software, which randomly generated 1,825 numbers. We then matched these 1,825 numbers with the population database to find which number represented which company. This ultimately led to creating the sampling frame of this research, which is consisted of a list of 1,825 car manufacturing firms in the UK randomly selected from the entire population to be contacted for data collection. According to Saunders et al. (2009), random number generator software is a widely used approach in the simple random sampling technique, and ensures the sampling frame is representative of the target population as each case has an equal probability of being selected.

The final step of the sampling process is concerned with the validation of the sample. Given that the sample was obtained through the simple random sampling technique, it is statistically representative of the population. The reasoning for this lies in the fact that a simple random sample has all the desired characteristics on statistical grounds (such as mean and variance of statistics) of a representative sample of the target population (Field, 2009). The sampling frame of this research, comprising 1,825 car manufacturing firms randomly selected using a computer program, is statistically representative of the entire population of 6,016 firms. In addition, the ratio of the sample frame to the population is approximately one third, which in practice provides a sufficient level of certainty that ensures that the characteristics of the collected samples will represent the target population.

4.15.2 Survey unit of analysis and key respondents

The unit of analysis in operations and supply chain management research is mainly concerned with individuals, firms, plants, groups, systems and projects (Flynn et al., 1999; Slack et al., 2010). In essence, the unit of analysis is determined in accordance with the research question (Bryman and Bell, 2015). In this research, the unit of analysis is the car manufacturing firm, with manufacturing managers as the key respondents. This was determined based on the proposed research questions that seek to investigate the impacts of SSCM practices on the performance of car manufacturing firms.

Malhotra and Grover (1998) assert that the individuals surveyed can be representatives of their own selves, their expertise, their project and most importantly their companies. They maintain that the use of the firm as the unit of analysis is often represented by individuals in survey-based research conducted in operations and SCM. For this research, the key respondents who represent their firms are various senior to mid-level manufacturing managers ranging through plant managers, supply chain managers, logistics managers, purchasing managers, operations managers, engineering managers, sales managers and industrial waste managers. This range of managers is seen as appropriate, as these roles are either directly or indirectly involved in managing SSCM-related practices, and thus the respondents are capable of providing valid responses to the proposed research questions and their associated hypotheses. In other words, these sorts of managers are likely to have the necessary knowledge concerning SSCM initiatives and should also have a comprehensive view of their firms in relation to the SSCM agenda. Other published studies have used this range of managers when examining SSCM initiatives and their performance implications, e.g., Sarkis et al. (2010), Green et al. (2012a,b), De Giovannia and Vinzi (2012); Hollos et al. (2012); Zhu et al. (2013), Green et al. (2015).

4.15.3 Online survey

After conducting the abovementioned steps of the sampling process, this section goes on to discuss how data were collected. In this research, the data collection was conducted in association with the FAME data service, which the researcher accessed to acquire contact information for the 1,825 car manufacturing firms in the sampling frame. To the best of our knowledge, there is no available database in the UK that provides more information about UK car manufacturing firms than FAME. In addition, it is impracticable for the researcher to prepare this sort of list of UK car manufacturing firms by himself owing to restrictions of access, money and time. Therefore, the FAME database is deemed to be an appropriate source of data collection for this study.

For the main survey, we distributed the final version of the questionnaire, which had been modified during the pilot study, to the selected 1,825 firms via an online survey. We created the online survey using the Web-based survey service of Bristol Online Surveys (BOS). In line with the pilot study revisions (see Section 4.14), in developing the online survey instrument, we avoided abbreviations, jargon, vagueness, confusion, double negatives, questions that are beyond respondent’s capabilities, leading and double-barrelled questions and questionnaire items with more than 20 words. This ensures unbiased responses and leads to a better response rate (Sue and Ritter, 2007). Furthermore, we included a number of demographic questions concerning job title and the number of years the respondent has held their position, in order to eliminate respondent bias and evaluate their competency for this research (Klassen and Jacobs, 2001). Forza (2002) advocates this and suggests that answers obtained from respondents who are knowledgeable are considered trusted and credible, and minimise bias or random error.

One possible problem sometimes associated with online surveys is social desirability bias. This type of bias occurs when a respondent gives a socially acceptable response or answers in a manner that will be viewed favourably by their organisation, rather than an honest or actual response (Creswell, 2003). We tackled the effect of social desirability bias in our online survey by confirming the anonymity of respondents and confidentiality of answers. This makes the respondents aware that their identity and affiliation will be totally hidden during the entire research process. This approach is widely used in survey-based research to mitigate social desirability bias (Forza, 2002; Sue and Ritter, 2007). Considering the features promoting anonymity and confidentiality, and also the fact that the questionnaire items are not concerned with sensitive information or personal behaviour, we can claim that there is no concern regarding social desirability bias in this research.

Furthermore, clear instructions were included in the online survey concerning completing each of the survey questions, ensuring that the survey flowed smoothly without confusion. We also limited the number of choices the respondents could select in answering each question to one, which not only minimises response bias but also facilitates statistical analysis. Response options were presented using checkboxes for screening and demographic questions and radio buttons for Likert-type scale questions. According to Field (2009), the use of Likert-type scale questions reduces the likelihood of common method variance. Moreover, we employed a multi-page format (comprising eight pages) in our online survey in order to avoid respondent fatigue that often results from excessive scrolling in a one-page survey (Sue and Ritter, 2007). In this regard, we included a progress bar on each survey page to show the percentage of the survey completed, allowing respondents to estimate the time required to finish the whole survey. This can increase the number of completed surveys, in particular for surveys that are not long (Forza, 2002).

More importantly, in creating the online survey, we used an option offered by the Web-based survey service that does not allow respondents to submit the survey if any question remains unanswered. This eliminates the risk of missing data, which plays a crucial role in data analysis (Sue and Ritter, 2007; Field, 2009). In addition to this option, we included an option to allow respondents to move back to a previous page and update their answers throughout the survey prior to submission, ensuring more valid answers and credibility (Sue and Ritter, 2007). Finally, we included a concise thank you note at the end of the survey, along with an optional section asking participants to provide their contact information if they wished to receive a copy of the research summary report.

4.15.4 Survey administration

We distributed the online survey to the targeted car manufacturing firms using the FAME database via an email invitation process. We embedded the link to the online survey in our email invitation, ensuring the anonymity of participants and also providing convenience for respondents when accessing the survey. The link to the online survey was generated by the Web-based survey tool of Bristol Online Surveys (BOS) that provided us with the functionality for developing and administering the survey.

We carefully designed the survey invitation email, as we realised that firms and respondents may potentially be reluctant to collaborate on surveys. The invitation email for survey collaboration is of paramount importance, as it is the starting point of contact with potential respondents that influences their decision whether to participate to the survey (Forza, 2002). In view of this, we included a statement in our email invitation indicating that the survey was being conducted in collaboration with the University of Birmingham, to confirm the purpose of this research as academic, not commercial, which can establish trust with participants.

We also addressed the research purpose in the invitation letter, along with the confidentiality of respondents' answers, which can increase the response rate and eliminate response bias (Klassen and Jacobs, 2001). To further convince and motivate respondents to participate in the survey, a summary report of the research findings was offered as an incentive to be sent to those who were interested in receiving the outcomes of this research. Overall, we designed the invitation letter to be short and concise in appreciation of respondents' time restraints. We also informed participants that completing the survey only required 10-15 minutes, as this might have a positive effect on the response rate (Sue and Ritter, 2007). Lastly, we finished the invitation message with a verbal appreciation of respondents' time and effort for participating in our research project.

The data collection was conducted within a period of approximately nine weeks from January to April 2014. We officially launched the survey on Tuesday 21 January 2014 by sending the email invitation survey to the 1,825 members of the sampling frame. In order to increase the response rate, we sent a follow-up email to all the members of the sampling frame two weeks later on Tuesday 4 February 2014. As it was not possible for the researcher to know for certain which respondents had already completed the survey, the follow-up request was sent to all 1,825 members of the sampling frame. However, we added a note to the follow-up email stating, "if you have already participated in the survey, please disregard this email". We chose Tuesday as the date for both launching the survey and sending the follow-up email, because distributing surveys at the beginning or end of the week is not generally recommended (Sue and Ritter, 2007). We received the last response on 6 April 2014. The completed surveys were automatically sent to the BOS online portal, to which the researcher had access through the University of Birmingham subscription.

We received almost all of the responses within three weeks of launching the survey. A total of 1,825 firms were contacted via the survey invitation email and 238 responses were received. It is important to note that each response was from an individual firm. In addition, 91 firms stated that they were unable to participate in this research because of the large number of such enquiries or due to changes in their operations (or they gave no reason). A breakdown of the survey responses is presented in Figure 4.10. Of the 238 responses received, 14 were screened out as non-managers and 224 managers completed the survey. Furthermore, of the 224 respondents, 38 selected the 'other manager' position. We excluded the data from these 38 respondents in the dataset analysed, due to concerns related to their possible lack of knowledge of SSCM. This further ensured valid responses and the credibility of the data. Finally, the data from 186 manufacturing managers who have the necessary knowledge to fully complete the survey was included in the dataset to be subsequently analysed. Therefore, the raw response rate and effective response rate are 13% (238/1825) and 10.2% (186/(1825-14)) respectively. As such, the response rates are acceptable within operations and SCM studies, where the observed average response rate is approximately 11% (Klassen and Jacobs, 2001).

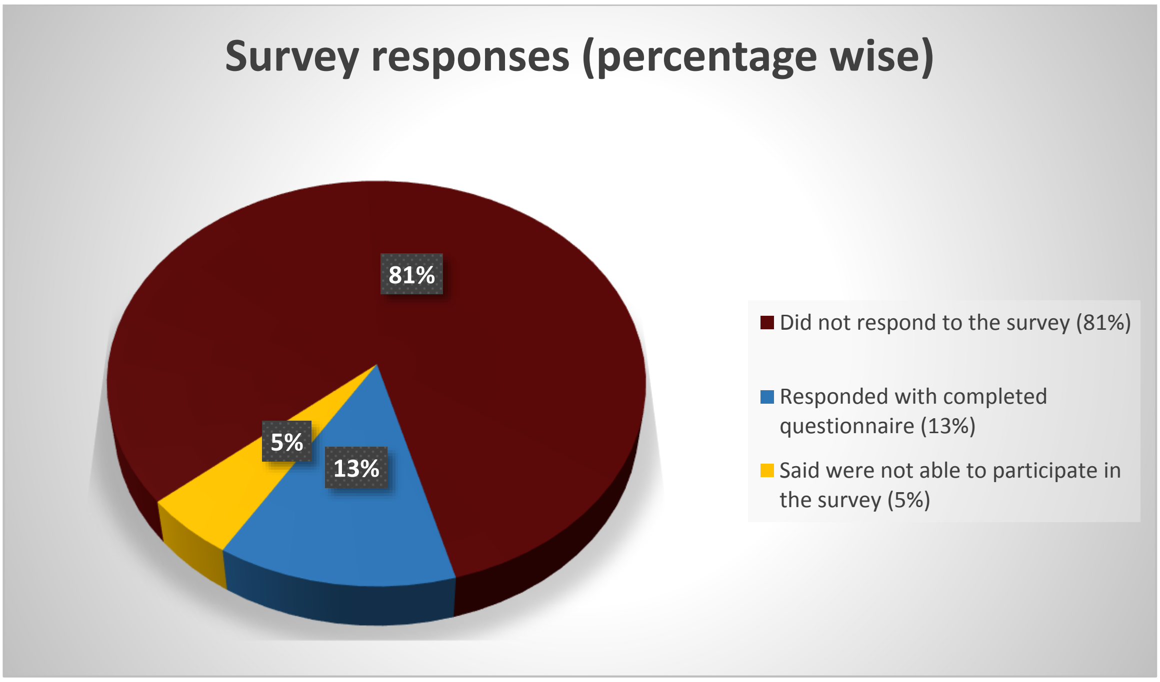


Figure 4.10 Breakdown of the survey responses

4.15.5 Non-response bias

As we used two waves of requests in distributing the survey, non-respondent bias can endanger the credibility of the collected responses, referring to the difference between a group of respondents, i.e. early-wave respondents, and a group of non-respondents, i.e. late-wave respondents (Armstrong and Overton, 1977). This is generally related to concerns about any significant difference between the characteristics of these two groups (Lambert and Harrington, 1990). In view of this, we assessed non-response bias to examine whether any significant difference existed between early and late respondents.

To do this, we categorised respondents into two groups: early-wave group, representing the responses received during the first two weeks (128 responses) and late-wave group, representing the responses received after the follow-up email (58 responses). A comparison of the means of each construct between the two groups was then conducted using the two tailed t-test, a widely adopted method for testing non-respondents bias (Kaplan, 2004; Field, 2009). The comparisons resulted in statistically non-significant differences between early-wave and late-wave respondents at the 0.01 level ($P<0.01$), suggesting that non-response bias was not a problem in this research. In essence, the general equality found between the characteristics of the early-wave and late-wave groups indicates that non-response bias has not negatively impacted the assembled data set, confirming the absence of non-response bias (Lambert and Harrington, 1990; Inman et al., 2011).

4.15.6 Sample characteristics

This section provides an overview of the characteristics of the firms which participated in the survey. This is important, as the study’s conclusions will be drawn based on these characteristics. Industry type, firm size and respondent type generally present the main characteristics of the sample in operations and SCM research (Forza, 2002). In this research, in terms of industry type characteristics, the collected samples are represented through a number of car manufacturing firms. As all of the research samples were collected from one sector (the automotive industry), sector-specific variance is isolated and thus the reliability of the statistical inferences about characteristics is maintained (Kaplan, 2004; Sarkis et al., 2010).

Furthermore, in terms of firm size characteristics, we measured the firm size based on the number of employees, obtained through one of the demographic questions. According to the EU criteria for firm size classification, firms are broadly classified as large if they have 250 or more employees and as small/medium if they have fewer than 250 employees (Gimenez et al., 2012). With this in mind, of the 186 firms, 47 were classified as large firms (26%) and 139 were classified as small and medium size firms (74%).

While not the primary focus of this research, it is useful to check whether the firm size affects the assembled data set. To do this, the data for the 47 large firms were placed into a separate dataset (L), while the data for the 139 small and medium size firms were placed into another dataset (S/M). A comparison of the means of each construct between the two datasets was then conducted using a one-way ANOVA. Analysis of variance (ANOVA) is a commonly employed statistical technique to examine the various types of difference between groups of samples, such as variation caused by the effect of a certain characteristic of groups such as firm size (Field, 2009). The comparisons resulted in statistically non-significant differences at the 0.05 level ($P<0.05$) between these two databases (S/M) and (L).

This suggests that firm size is not affecting the assembled dataset, given the general equality found between the characteristics of the large and small/medium firms' datasets. Consequently, this indicates that the characteristics of the samples are similar irrespective of firm size, confirming that the effect of the firm size (on the relationships between the posited constructs) was not a problem in this research. Therefore, the 186 firms in the assembled dataset are treated as similar in this research, irrespective of the firm size. This is consistent with Walker and Jones' (2012) study, where they conclude that the SSCM agenda has been received well in practice by UK manufacturers ranging from small/medium size to large, as SSCM initiatives have been in practice for more than a decade in the UK. We employed the ANOVA test over other statistical analysis such as the t-test because it is of higher statistical significance (a more accurate statistical technique), can test more than two groups of samples (Field, 2009), and more importantly is commonly used to check the variation caused by the effect of characteristics of sample groups such as firm size (Gimenez et al., 2012; Kaplan, 2004; Luthra et al., 2014).

In terms of respondent type, all of the respondents hold manufacturing management positions in their firms. Drawing on Table 4.8, the majority of respondents are supply chain, plant and operations managers, representing 23%, 21% and 19% of the total respondents respectively. The rest of the respondents are logistics managers, purchasing managers, engineering managers, industrial waste managers and sales managers. Therefore the collected sample is made up of individuals with knowledge of their firm's SSCM-related initiatives. This diverse array of manufacturing managers ensured the credibility of responses and in turn the robustness of the findings (Inman et al., 2010; Green et al., 2012a). The average years that the respondents have held their position is 7.12 years with a range of 2-18 years. They work for firms with an average of 304.52 employees. Table 4.8 provides the sample's demographics.

Table 4.8. Sample demographics summary

Job Title	Number
Plant Manager	39
Logistics Manager	21
Operations Manager	35
Purchasing Manager	17
Supply Chain Manager	42
Sales Manager	10
Engineering Manager	8
Industrial Waste Manager	14
Total	*186*
Industry classification (UK SIC – Standard Industrial Classification)	
Manufacture of Motor Vehicles, Trailers and Semi-Trailers	186
Mean years in current position	7.12
Mean number of employees	304.52

In essence in this research, job role along with the number of years holding that position are considered as the main criteria to determine how knowledgeable and experienced the respondent is. These types of criteria are widely used in business management studies, and in particular within operations and SCM research (Forza, 2002; Bryman and Bell, 2015). The relevant job role and the average period spent in that position reflect the respondent's sufficient knowledge and experience, allowing them to answer the survey questionnaire as the appropriate individual. Consequently, the respondents were deemed to be representative of the sampling frame, as they are in line with the key respondent criteria (see Section 4.15.2), reflecting the characteristics of members of the sampling frame. As can be seen from Table 4.8, the collected responses are fairly close to the pre-determined respondent criteria, indicating that the research samples are representative of the target population. The respondents consisted of various manufacturing managers who have identical characteristics to those of the target population. Therefore, the collected samples are validated, as the research samples have all the desired characteristics of a representative sample of the target population, ensuring a sufficient level of certainty that the samples represent the population on statistical grounds.

4.16 Chapter summary

This chapter has presented a step-by-step approach to conducting an investigation of the philosophical and practical considerations applicable to this study. In terms of the philosophical considerations, the positivist paradigm was adopted as the philosophical stance of this thesis, which then informed the research logic of deductivism as the study's research approach. For the practical considerations, the survey research strategy and the mono quantitative research method were adopted, which gave rise to decisions about the research time horizon and data collection technique. In addition, the SEM technique was proposed as the study's data analysis approach, based on the research model. Subsequently, a holistic view of the core methodology of this research was then provided, presenting the philosophical and methodological stances of this thesis (see Figure 4.7). Furthermore, other practical sub-attributes of the methodological issues were discussed, such as questionnaire development, data type and ethical considerations. A pre-test of the developed questionnaire was conducted in three stages, resulting in several modifications. As final points in this chapter, the study's sampling strategy was addressed and accordingly the simple random sampling technique was employed. Data collection was then conducted through an online survey questionnaire, which yielded 186 responses. Lastly, potential limitations of the risk of missing data and non-response bias were mitigated, and sample characteristics were presented.

In essence, detailed discussions have been provided concerning the various procedures involved in conducting the practical considerations of this research for the purpose of providing a high level of transparency and thus maximising replicability, demonstrating the rigour of the research process. The next chapter presents the analyses of the collected data using the proposed data analysis technique (SEM), reporting the key findings of this study.

CHAPTER 5

ANALYSIS AND RESULTS

5.1 Introduction

This chapter is broadly focused on the results of the data analysis using appropriate quantitative techniques. As the research model was previously developed based on the research questions (Chapter 3) and the main philosophical and methodological implications applicable to this study have been addressed (Chapter 4), the next step is to examine the collected data to report the results of this research. The data analysis is divided into two parts: first, examining the appropriateness of the collected data in terms of validity and reliability to make sure the construct validation is satisfactory; second, testing the posited hypotheses on the causal relationships between the research constructs.

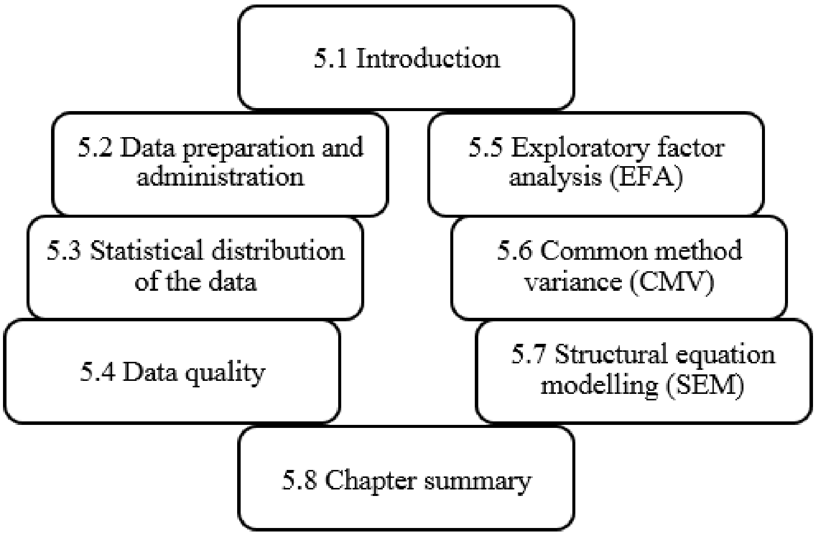


Figure 5.1 Structure of Chapter 5

As depicted in Figure 5.1, this chapter begins with the data entry process and administration in Section 5.2 and then presents statistics concerning the distribution of the data in Section 5.3 to examine the appropriateness of the data in terms of it having a normal distribution prior to launching the data analysis. Thereafter, in Section 5.4 the data quality issues are addressed including reliability, face validity, content validity, construct validity, convergent validity and discriminant validity, for the purpose of establishing the truthfulness and credibility of the results. In Section 5.5, exploratory factor analysis (EFA) is conducted to confirm that the measurement items account for one underlying variable, determining whether they are actually representing their respective measures. Moreover, in this section the convergent validity of the employed constructs is confirmed as part of the prior regression analysis. As the final step prior to performing the SEM analysis, the common method variance (CMV) is assessed in Section 5.6 to determine the presence of common method bias in the survey data. Thereafter, the structural equation modelling (SEM) method is thoroughly discussed in Section 5.7, covering its philosophical foundation and analysis results. Furthermore, the proposed SEM technique is employed to perform the confirmatory factor analysis (CFA) necessary to evaluate the measurement model and the discriminant validity of the research constructs; and the structural analysis necessary to assess the research hypotheses constituting the theorised model, reporting the hypotheses testing results. Lastly, a summary of this chapter is presented in Section 5.8.

In essence, the quality of the data collected and measures employed are first evaluated to ensure their sufficient reliability and validity, and then the causal relationships in the theoretical model are tested generating the results of this investigation. This chapter seeks to provide detailed information concerning the various statistical procedures involved in conducting appropriate quantitative analysis, establishing the credibility of the results and maintaining the robustness of the research findings. The position of this chapter in the thesis is illustrated in Figure 5.2.

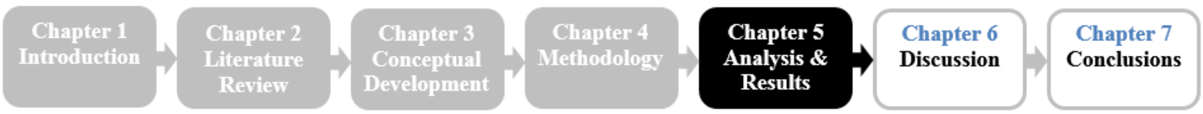


Figure 5.2 Position of Chapter 5 in this thesis

5.2 Data preparation and administration

The Internet-mediated survey not only assisted this research in obtaining the required responses but also offered the advantage of better accuracy of data entry through employing the BOS online data service. As previously discussed, we used the Web-based survey service of Bristol Online Surveys (BOS) to develop and administer the online survey. Once the data collection was finished, we accessed the BOS online portal to retrieve the survey data. The data was uploaded from the BOS online portal into an Excel file. We then refined the extracted dataset by excluding data related to 'non-managers' and 'other-managers'. Once the dataset of 186 firms had been formed, we coded each variable in the Excel file, i.e. organisation environmental management → OEM, sustainable procurement → SP, sustainable design → SD, sustainable distribution → SDIST, investment recovery → IR, cost performance → CP, environmental performance → EP.

According to Field (2009), before conducting any statistical analysis, two main issues concerning the appropriateness of the collected data are central and must be checked using suitable techniques. These two issues are missing data and normal distribution of data. As previously discussed, the risk of missing data was mitigated in this research through employing a feature in the online survey preventing survey submission if any question remained unanswered. This technique has recently become popular within quantitative research to mitigate the risk of missing data (Sue and Ritter, 2007). However, it requires employing an advanced survey data service that offers this feature. The appropriateness of the collected data in terms of its normal distribution is presented in the next section.

5.3 Statistical distribution of the data

The following step examined the appropriateness of the collected data to check whether the data is normally distributed. To do this, we first transferred the 186 data sets from Excel into an SPSS file, using the IBM SPSS statistical package version 22.00. Summary values for the research constructs were then computed by averaging the measurement items in the variables for all samples, e.g., (OEM1+OEM2+OEM3+OEM4+OEM5+OEM6+OEM7)/7 → OEM, or (SD1+SD2+SD3+SD4+SD5+SD6)/6 → SD, or (CP1+CP2+CP3+CP4+CP5)/5 → CP.

The averaged variables were then selected in SPSS for descriptive statistics analysis to summarise the distribution of the data. In addition, the functions of skewness and the kurtosis test were enabled in the descriptive statistics analysis, because the skewness and kurtosis coefficients are used as valid statistical indicators for the appropriateness of data in terms of its normal distribution (Field, 2009). Table 5.1 presents the descriptive statistics specified in the SPSS output.

Table 5.1. Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
OEM	186	2.29	4.57	3.4823	.35612	-.026	1.100
SP	186	2.00	4.67	3.1201	.42650	.592	1.521
SD	186	2.17	5.00	3.4588	.57247	.414	-.594
SDIST	186	2.00	4.83	3.1057	.43481	.579	1.901
IR	186	1.33	4.00	2.4516	.56237	.261	.088
EP	186	2.00	4.86	3.3118	.42867	.353	1.568
CP	186	2.00	4.80	3.1355	.53477	.534	.677
Valid No.	186						

According to Field (2009), the recommended value for skewness and kurtosis coefficients that determine data normality is within the -2.00 to +2.00 range. Drawing on Table 5.1, the collected data for all of the variables is normally distributed, with the skewness and kurtosis coefficients falling within the recommended range. This confirms that we have a normal data distribution relatively for each variable, and thus data normality is assumed. Histograms for each variable were then generated by SPSS (see Figure 5.3), showing the normal distribution of the data.

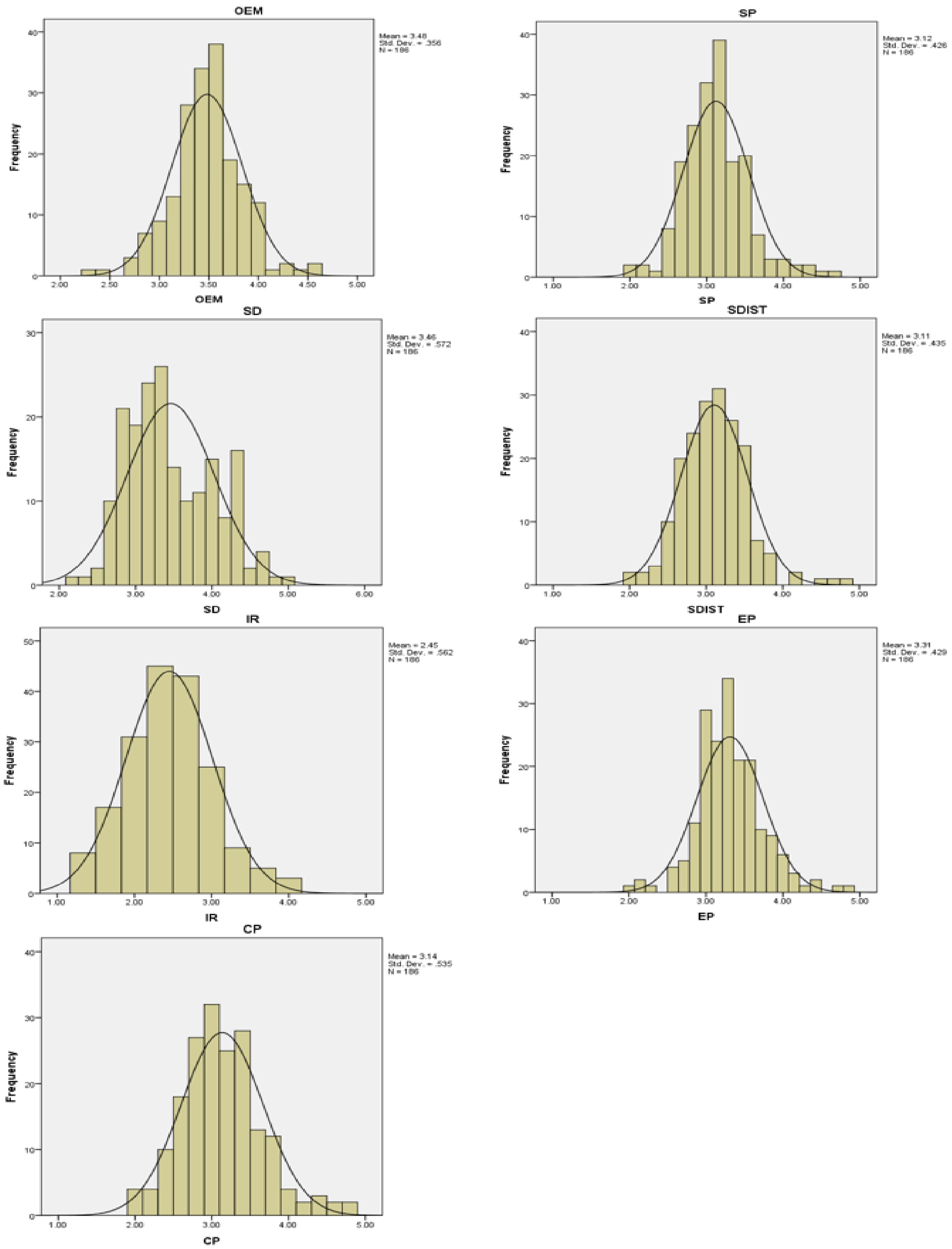


Figure 5.3 Histograms of OEM, SP, SDIST, SD, IR, EP and CP variables for data distribution

5.4 Data quality

Having discussed the appropriateness of the collected data in terms of both the risk of missing data and the normal distribution of the data, it is beneficial to address data quality implications before conducting the statistical analyses. Data quality is a crucial issue in both quantitative and qualitative social research, as it is one the most important indicators for establishing the truthfulness and credibility of results, maintaining the robustness of research findings (Kaplan, 2004). Data quality is commonly determined by the two main complementary concepts of validity and reliability (Saunders et al., 2009).

In essence, validity refers to truthfulness and is concerned with the degree to which a concept being measured corresponds accurately to the real world, i.e. social reality (Bryman and Bell, 2015). It is basically associated with evaluating the precision and relevance of research results, determining the integrity of research findings (Saunders et al., 2009). Thus, validity is deemed to be the most important criterion of research quality, determining the extent to which the research findings can be generalised. There are three main aspects of research validity in quantitative studies: face validity, content validity and construct validity (see Table 5.2).

Table 5.2. Validity types

Validity type	Concept	Implication to this research
Face validity	The basic type of validity measures that implies that judgement by the scientific community determines whether the indicators really measure the construct.	It is assured through pre-testing the measures in the pilot study.
Content validity	Assesses the degree to which the full content of the definition is represented in a measure.	It is assumed, since the measurement scales were adopted directly from existing published research. It is further confirmed in line with the extensive literature review conducted in Chapter 2 and the pilot study (Section 4.14).
Construct validity	Used for measures with multiple indicators (measuring instruments), asking the question: if the measure is valid, do the various indicators operate in a consistent manner?	It is attained through confirming convergent validity and discriminant validity (see Section 5.5 and 5.7.2.2).

Convergent validity (subtype of construct validity)	Is established when the results obtained from two different instruments measuring the same concept are highly correlated.	It is largely tested using exploratory factor analysis (EFA) in Section 5.5.
Discriminant validity (subtype of construct validity)	Is established when the results obtained from two different instruments measuring different concepts are uncorrelated and should already be predicted as an assumption based on theory.	It is tested using confirmatory factor analysis (CFA) in Section 5.7.2.2.

(Source: adapted from Field, 2009; Hair et al., 2010; Bryman and Bell, 2015).

These types of validity are broadly concerned with evaluating the ability of an indicator (measuring item) to measure the theoretical concept that it is devised to measure, i.e. the extent to which the indicator measures what it claims to measure (Hair et al., 2010). Each of these types of validity and their relevance to this research is addressed below, ensuring the integrity of the study's findings.

In essence, in this research, validity was subjectively assessed in the form of face and content validity and also empirically tested in the form of construct validity, covering both convergent and discriminant validity. The face validity in this research was assured in line with our comprehensive pilot test where a pre-test of the measures employed was conducted with a number of academics specialising in the operations and SCM area. Since qualified academics and professionals involved in operations and SCM verified the correspondence between the indicators and their associated construct (i.e. that the indicators really measure the construct), the face validity of the measurement scales was confirmed.

In terms of content validity, since all the measurement scales were adopted directly from prior research (Zhu et al., 2008a; Esty and Winston, 2009; Green et al., 2012b) that had already been validated and used in other published research (Green et al., 2012a; Hollos et al., 2012; Hsu et al., 2013; De Giovannia and Vinzi, 2012; Green et al., 2015), content validity was assured. In addition, the content validity of the measurement scales was further confirmed by the systematic review of pertinent SSCM literature along with the conducted pilot study that involved the judgement of academics and professionals expert in operations and SCM. As such, in this research both the face validity and content validity of the adopted measurement scales were confirmed. Furthermore, construct validity is commonly empirically tested through factor analysis and can be attained through confirming convergent validity using exploratory factor analysis (EFA) and discriminant validity using confirmatory factor analysis (CFA). The construct validity of the theoretical constructs is assessed in the following sections.

The other important concept that determines data quality is reliability. In essence, reliability is concerned with the consistency of a set of indicators being measured, in the sense that the same outcome is yielded under similar procedures (Bryman and Bell, 2015). Reliability is also referred to as the overall consistency or dependability of research measures, whereby high reliability is attained if the research measure yields the same results under consistent conditions (Saunders et al., 2009). Hence, satisfactory reliability requires that the numerical results generated by the indicators of a measure should not vary on account of the characteristics of the measurement procedure or measurement scale itself (Hair et al., 2010). It also requires research measures to remain fairly stable irrespective of the respondents' state or uncontrollable testing conditions (Field, 2009). Therefore, reliability mainly deals with the quality of research measures in terms of their consistency or repeatability.

Kaplan (2004) and Field (2009) maintain that reliability is primarily determined by Cronbach's α value in quantitative studies. Cronbach's α (alpha) is widely employed as an estimate of the reliability which is concerned with how closely a set of indicators are related as a group within a research measure, indicating the consistency of the measure (Hair et al., 2010). According to Field (2009) and Hair et al. (2010), the acceptable value for Cronbach's α (Alpha) is 0.60 or ideally 0.70, indicating high construct reliability. It is sometimes necessary to refine research measures and reduce the number of measurement items to achieve the recommended Cronbach's alpha value, ensuring sufficient construct reliability. We used the SPSS software package to empirically analyse the reliability of each of the research measures. To do this, we selected all measurement items for each measure (e.g. OEM1, OEM2, OEM3, OEM4, OEM5, OEM6 and OEM7) and carried out the reliability analysis individually for each research measure (seven times). The results of the reliability analysis are presented in Table 5.3.

Table 5.3. Reliability statistics

Variable	Cronbach's Alpha
OEM	0.670
SP	0.685
SD	0.726
SDIST	0.733
IR	0.633
EP	0.740
CP	0.754

As can be seen from Table 5.3, the reliability coefficients (Cronbach's alpha values) for the variables of SD, SDIST, EP and CP exceed the ideal recommended 0.70 level, indicating high construct reliability. The Cronbach's alpha values for the variables of OEM, SP, and IR also exceed the 0.60 minimum level, indicating sufficient construct reliability (Field, 2009; Hair et al., 2010). Therefore, the overall reliability for all of the study variables was considered satisfactory, with an average value of 0.707. The satisfactory reliability suggests that internal consistency exists among the research variables, confirming that the measurement items for each construct consistently represent the same latent variable (Kaplan, 2004; Hair et al., 2010).

5.5 Exploratory Factor analysis (EFA)

Having determined the research construct reliability, this section seeks to assess the construct validity of the research measures (latent variables) using exploratory factor analysis (EFA). EFA is a statistical technique within the family of multivariate statistics that seek to uncover the structure of measured variables, and is generally considered as one of the preliminary steps in conducting a rigorous quantitative analysis (Kaplan, 2004). By employing the EFA method, we can identify the number of factors associated with each research measure, in which the term 'factor' refers to the fundamental dimensions that account for the original set of observed variables (Hair et al., 2010). Thus, EFA enables researchers to check whether all observed variables (measuring items) represent one underlying factor and contribute to the underlying dimensions (factors) of that measure (Field, 2009), as the indication of evidence for construct validity. Hence, the EFA method provides evidence of the construct validity of self-reporting scales and determines the construct validity if all of the observed variables of a measure account for one underlying factor.

Hair et al. (2010) assert that with EFA, each research measure is related to one underlying factor (in most cases) through a factor loading estimate, providing a tool for analysing the pattern of loadings among observed variables. Generally, factor loading refers to the correlation of each observed variable (measurement item) and its corresponding factor, which is used as the main statistical criterion in factor analysis to determine the significance of the factor (Kaplan, 2004). In most cases, when the observed variable has low factor loading, it is removed from the measure, as it does not significantly contribute to the measure for the purpose of enhancing construct validity (Hair et al., 2010; Kline, 2011).

The distinctive feature of EFA is that it can provide researchers with information regarding how many factors are required to best represent the research measure, in case one underlying factor is not sufficient to account for all observed variables (Hair et al., 2010). Hence, the EFA technique can be conducted regardless of the knowledge of how many factors exist in each measure (Field, 2009). Very often, the EFA process involves reducing the number of observed variables of a measure to ensure that the other remaining observed variables represent one underlying factor, indicating that all observed variables are contributing to that research measure which determines the construct validity (Kaplan, 2004). In this regard, EFA can provide information for refining the research measures and their associated observed variables to achieve one underlying factor, ensuring the construct validity (Hair et al., 2010).

Having provided the necessary background on the EFA method, we now present how EFA was conducted in this study. We performed the factor analysis for each research measure, i.e. OEM, SP, SD, SDIST, IR, EP and CP, using the SPSS software package. Factor analysis is commonly used for metric measures (Kaplan, 2004), and since all the research measures were treated as metric, performing factor analysis on these measures was appropriate. The SPSS software uses principal component analysis (PCA) as the statistical technique of factor extraction for all measures (Field, 2009). According to Field (2009), PCA is statistically represented thorough eigenvalues, generated in the SPSS output. In this regard, Hair et al. (2010) proffer that only factors with eigenvalues of more than 1 are acceptable. They describe the 'eigenvalue' as "the amount of variance accounted for by a factor" (Hair et al., 2010, p. 102).

Lastly, in terms of the factor analysis rotation method, we used the Varimax rotation technique to extract factors for all the research measures. Field (2009, p. 664) describes the Varimax rotation method as "maximising the dispersion of loading with factors and loads a smaller number of variables highly onto each factor resulting in more interpretable clusters of factors" and states that this is a widely used technique in extracting factors, particularly for a sample size of more than 100. The results of the factor analysis for each research measure are presented below as specified in the SPSS output.

5.5.1 Organisation environmental management (OEM) measure

The OEM measure comprises seven measurement items. The Kaiser-Meyer-Olkin (KMO)[4] measure confirmed the sampling adequacy required for principal component analysis (PCA),

[4] Kaiser-Meyer-Olkin (KMO) is a measure of sampling adequacy that is employed to test the appropriateness of the data for factor analysis (Field, 2009; Luthra et al., 2014).

with KMO=0.707 exceeding the suggested minimum standard of 0.60 required for conducting factor analysis (Field, 2009; Luthra et al., 2014). In addition, the eigenvalue for the OEM measure was 2.484, higher than the acceptable value of 1. However, factor analysis provided two factor solutions for the OEM measure, indicating that all of the measurement items are not fully representing the OEM measure, as they do not account for one underlying factor. As previously discussed, these concerns can be mitigated through refining the research measure by reducing the number of measuring items to ensure the construct validity (Hair et al., 2010). One of the distinctive feature of using SPSS software is that it provides the researcher with a loading plot for the extracting factor that can be used as a rotation solution guide by identifying which items can be removed to ensure that all remaining items account for one underlying factor (Field, 2009). Figure 5.4 displays the factor analysis loading plot with Varimax rotation for the OEM measure as specified in the SPSS output.

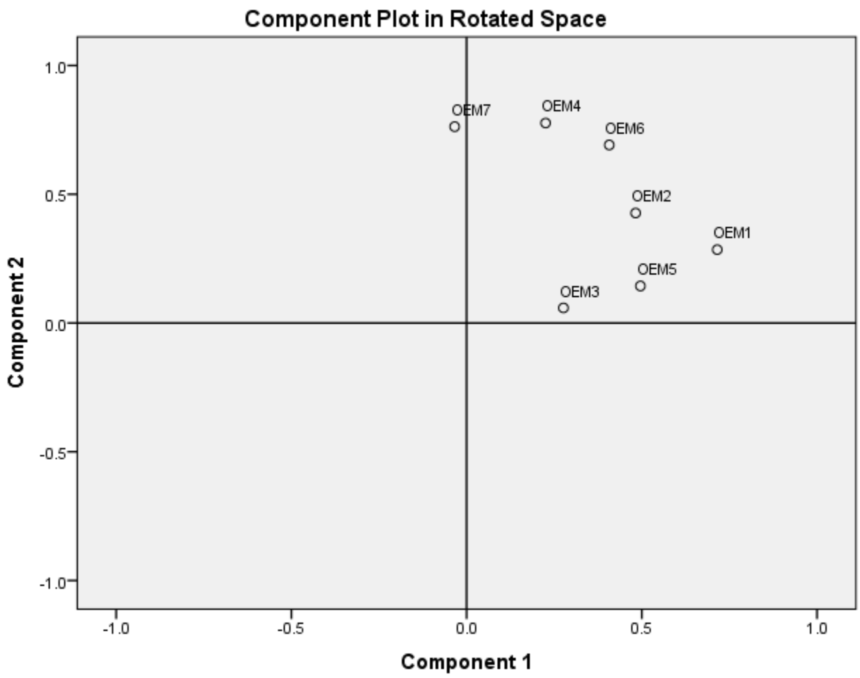


Figure 5.4 OEM factor analysis: rotation and loading plot

As can be seen in Figure 5.4, OEM 7 is not consistent with the other measurement items, as it is distant from them, preventing them from converging as one factor. Based on the recommendation by Field (2009), we excluded OEM 7 from the OEM measure in the hope of achieving a one factor solution. We performed the factor analysis again for the OEM measure this time without OEM 7. This time, the factor analysis resulted in a one factor solution, indicating that all of the measuring items truly represent the OEM measure, accounting for one underlying factor (Field, 2009). It is worth mentioning that when one factor is extracted from the measuring items of a measure, SPSS does not produce a loading plot concerning a rotation solution. If removing one item will not yield a one factor solution, it is recommended to continue removing other items that are not converging until a one factor solution is reached (Hair et al., 2010). However, if it is not possible to achieve one factor by removing measuring items, it is recommended to convert the measure into separate measures.

Furthermore, in terms of factor loadings, Hair et al. (2010) assert that for larger sample sizes in general, lower loadings can be considered significant, and recommends factor loadings of 0.50 or higher, and ideally 0.70 to indicate adequate convergent validity. Factor loading for measures is primarily associated with variance extracted (VE), which is defined as the average percentage of variation explained among measurement items (Hair et al., 2010; Field 2009). The factor loading for the OEM measure produced in the SPSS output was 0.59, exceeding the recommended level of 0.50 (Hair et al., 2010), specifying the practical significance of the derived factor. This indicates that the one factor solution accounted for 59% of variance in the OEM measure, providing evidence of adequate convergent validity. Therefore, after removing OEM 7, the convergent validity of the OEM measure was confirmed. This is a widely used approach in determining that all measurement items within a measure are consistent with each other and assuring they actually represent that measure (Sarkis et al., 2010; Inman et al., 2011; Luthra et al., 2014).

OEM 7 in the survey questionnaire is concerned with the question “please indicate the extent to which you perceive that your company is implementing each of the following:

Environmental Management Systems (OEM 7)”. After conducting an EFA, it was decided that OEM 7 was not consistent with the other OEM measuring items. Therefore, in order to ensure the analysis was rigorous, it was deemed suitable to exclude this measuring item entirely when measuring the OEM variable. The reasoning behind this may be down to Environmental Management Systems (OEM 7) being too broad in nature, as respondents may not have a clear understanding of this concept compared to other OEM items, and thus it was not consistent with other respective items. With regards to the EFA method, many studies (Sarkis et al., 2010; Inman et al., 2011; Luthra et al., 2014) have also disregarded certain measuring items as they were not consistent with other measuring items under investigation. Generally in the quantitative research, it is common to have anomalies within certain measuring items, as the real data collected from the survey may not always fit the measures, given the different behaviour and nature of the collected data (Kaplan, 2004; Field, 2009).

5.5.2 Sustainable procurement (SP) measure

The SP measure comprises six measurement items. The Kaiser-Meyer-Olkin (KMO) measure confirmed the sampling adequacy for principal component analysis, with KMO=0.691, exceeding the recommended 0.60 level (Field, 2009). In addition, the eigenvalue for the SP measure was 2.374, higher than the acceptable value of 1. Similarly to the OEM measure, factor analysis provided two factor solutions for the SP measure, meaning that all of the measuring items are not truly representing the SP measure. Using the SPSS factor analysis rotation and loadings plot feature (see Figure 5.5), we managed to identify the measuring item that was not converging with the other SP items.

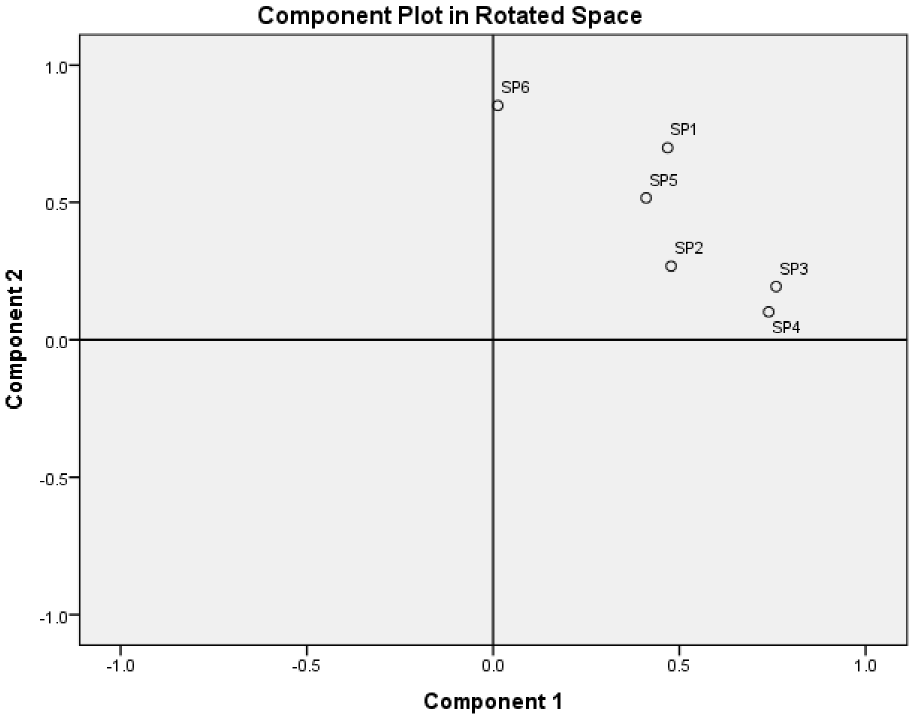


Figure 5.5 SP factor analysis: rotation and loadings plot

Drawing on Figure 5.5, SP 6 was excluded from the SP measure as it appeared to be distant from the other items, preventing them from converging as one factor. The factor analysis was performed again for the SP measure without SP 6, this time resulting in a one factor solution, indicating that all measuring items truly represent the SP measure, accounting for one underlying factor. The factor loading for the SP measure was 0.55, exceeding the recommended 0.50 level (Hair et al., 2010), specifying the practical significance of the derived factor. This also indicated that the one factor solution accounted for 55% of variance in the SP measure, providing evidence of sufficient convergent validity. Thus, after removing SP 6, the construct validity of the SP measure was also assured in terms of convergent validity.

5.5.3 Sustainable design (SD) measure

The SD measure consists of six measurement items. The Kaiser-Meyer-Olkin (KMO) measure confirmed the sampling adequacy for principal component analysis, with KMO=0.783, which exceeded the suggested minimum standard of 0.60 required for conducting factor analysis (Field, 2009). Factor analysis provided a one factor solution with an eigenvalue of 2.557, exceeding the recommended value of 1. Since one factor was extracted among the SD measuring items, a loadings plot was not produced in the SPSS output. The factor loading for the SD measure was 0.52, which was higher than the recommended level of 0.50 (Hair et al., 2010), indicating the practical significance of the derived factor. Consequently, the total variance explained by the SD measure was 52%, providing sufficient evidence for adequate convergent validity. Therefore, the construct validity of the SD measure in terms of convergent validity was confirmed.

5.5.4 Sustainable distribution (SDIST) measure

The SDIST scale comprises six measurement items. The sampling adequacy for principal component analysis was verified with a Kaiser-Meyer-Olkin (KMO) value of 0.745, exceeding the recommended 0.60 level (Field, 2009). In addition, the eigenvalue for the SDIST measure was 2.624, higher than the acceptable value of 1. Similarly to the OEM and SP measures, factor analysis provided two factor solutions for the SDIST measure, suggesting that all measuring items are not fully representing the SDIST measure. Using the SPSS factor analysis rotation and loadings plot feature (see Figure 5.6), the measuring item that was not converging with the other SDIST items was identified.

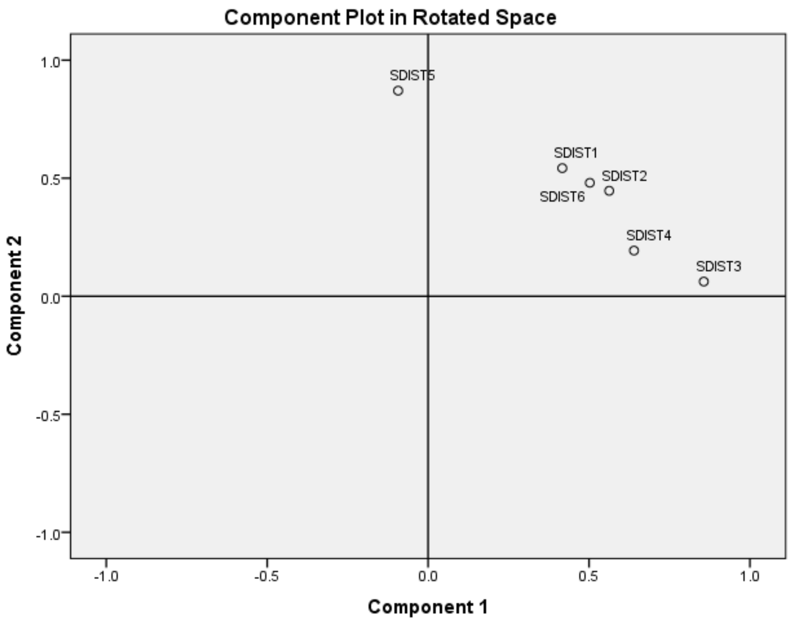


Figure 5.6 SDIST factor analysis: rotation and loadings plot

As can be seen in Figure 5.6, SDIST 5 was excluded from the SDIST measure as it was distant from the other items, preventing them from converging as one factor. The factor analysis was then performed again for the SDIST measure, this time without SDIST 5, resulting in a one factor solution, suggesting that all the measuring items truly represent the SDIST measure accounting for one underlying factor (Field, 2009). The factor loading for the SDIST measure was 0.60, exceeding the minimum suggested standard level of 0.50 (Hair et al., 2010) and specifying the practical significance of the derived factor. This also indicated that the one factor solution accounted for 60% of variance in the SDIST measure, providing sufficient evidence of convergent validity. Therefore, after removing SDIST 5, the construct validity of the SDIST measure in terms of its convergent validity was also verified.

SDIST 5 in the survey questionnaire is concerned with the question “please indicate the extent to which you perceive that your company is implementing each of the following: Upgrade freight logistics and transportation systems (either software or hardware such as minimising empty miles, reducing container weight, improving refrigeration, etc.) (SDIST 5)”. Based on the statistical procedures of the EFA test, SDIST 5 was excluded to ensure that the rigour of the results was not jeopardised. The reason for this may be down to the fact that SDIST 5 covers relatively more technical issues compared to the other SDIST measuring items, which makes it less consistent with the other items within the SDIST variable. It is important to note that we utilised the additional item of SDIST 5 found in Esty and Winston (2009) and incorporated it into the SDIST measure (Section 4.11.4). Although this was recommended by the literature, it appears that SDIST 5 was not a good fit with the sustainable distribution measure, not fully representing this measure, and thus it was disregarded.

5.5.5 Investment recovery (IR) measure

The IR measure consists of three measurement items. The Kaiser-Meyer-Olkin (KMO) measure confirmed the sampling adequacy for principal component analysis, with KMO=0.603, which was greater than the suggested minimum standard of 0.60 (Field, 2009). Factor analysis provided one factor solution for the IR measure with an eigenvalue of 1.734, exceeding the recommended value of 1. Similarly to the SD measure, a loadings plot was not produced in the SPSS output since the desired one factor was extracted among the IR measuring items. The factor loading of the IR measure produced in the SPSS output was 0.58, higher than the recommended level of 0.50 (Hair et al., 2010), indicating the practical significance of the derived factor. Consequently, the total variance explained by the IR measure was 58%, providing sufficient evidence for convergent validity. Hence, the convergent validity of the IR measure was also confirmed.

5.5.6 Environmental performance (EP) measure

The EP scale comprises seven measurement items. The Kaiser-Meyer-Olkin (KMO) measure confirmed the sampling adequacy for principal component analysis, with KMO=0.772, exceeding the suggested minimum standard of 0.60 required for conducting factor analysis (Field, 2009). In addition, the eigenvalue of the EP measure specified in the SPSS output was 2.886, higher than the acceptable value of 1. Similarly to the OEM, SP and SDIST measures, factor analysis provided two factor solutions for the EP measure, indicating that all measuring items are not fully representing the EP measure. Therefore, factor analysis rotation and a loadings plot were produced in the SPSS output (see Figure 5.7), which guided us to identify the measuring item that was not consistent with the other items.

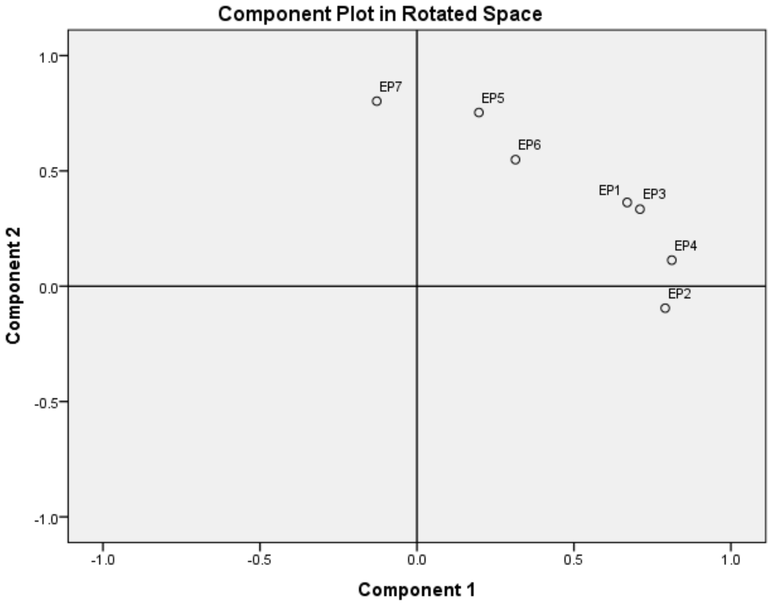


Figure 5.7 EP factor analysis: rotation and loadings plot

As can be seen in Figure 5.7, the two items of EP 7 and EP 2 were relatively distant from the other items, preventing them from converging as one factor. We excluded EP 7 from the EP measure as it was reasonably further distant from other items compared to EP 2, implying that it was more likely that EP 7 was preventing the other items from converging as one factor. The factor analysis was then performed without EP 7, and interestingly resulted in two factor solutions again with another loading plot (see Figure 5.8). As previously discussed, in this case we need to continue modifying the research measure until we reach one underlying factor.

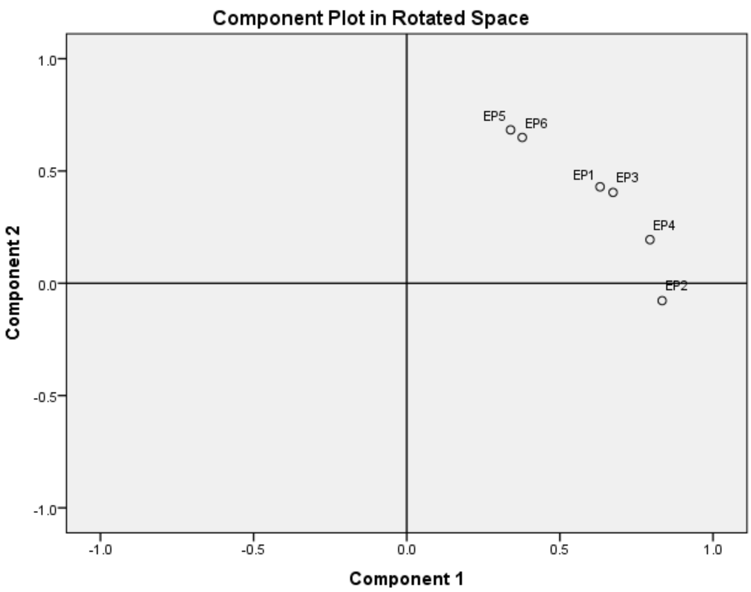


Figure 5.8 EP factor analysis: rotation and loadings plot (with EP 7 excluded)

According to the factor analysis rotation and loadings plot produced in SPSS output (Figure 5.8), EP 2 was then excluded, as it was distant from the remaining items of the EP measure. The factor analysis was then performed again for the EP measure without EP 2 and EP 7, this time resulting in a one factor solution, indicating that all measuring items truly represent the EP measure, accounting for one underlying factor. The factor loading of the EP measure produced in the SPSS output was 0.59, exceeding the recommended level of 0.50 (Hair et al., 2010), indicating the practical significance of the derived factor. Consequently, the total variance explained by the EP measure was 59%, providing sufficient evidence for convergent validity. Therefore, after removing EP 7 and EP 2, the construct validity of the EP measure in terms of convergent validity was also verified.

EP 2 and EP 7 in the survey questionnaire are concerned with the question "please indicate the extent to which you perceive that your company has achieved each of the following during the past year: Reduction of waste emissions (EP 2); Improvement of enterprise's environmental situation (Ep 7)". These two items were excluded from the environmental performance measure based on the EFA statistical procedures, assuring the rigour of the results. The reasoning for this may be because EP 2 is deemed to be relatively associated with EP 1 (Reduction of air emissions) with respect to the comprehension of this concept, i.e. EP 2 and EP 1 may be considered as overlapping issues. As for EP 7, it may be assumed that this item is relatively more vague to respondents compared to other EP measuring items. Thus, EP 7 may not be fully consistent with other respective items and in turn may not truly represent the EP measure. As previously mentioned, it is common in quantitative research to have anomalies within certain measuring items, as the real data collected from the survey may not always fit the measures (Kaplan, 2004).

5.5.7 Cost performance (CP) measure

The last research measure of CP comprises five measurement items. The Kaiser-Meyer-Olkin (KMO) measure confirmed the sampling adequacy for principal component analysis, with KMO=0.771, greater than the recommended 0.60 level (Field, 2009). Factor analysis provided one factor solution for the CP measure with an eigenvalue of 2.542, exceeding the recommended value of 1. Similarly to the SD and IR measure, a loadings plot was not produced in the SPSS output since the desired one factor was extracted among the CP measuring items. The factor loading of the CP measure produced in the SPSS output was 0.61, higher than the recommended level of 0.50 (Hair et al., 2010), indicating the practical significance of the derived factor. Consequently, the total variance explained by the CP measure was 61%, providing adequate evidence of convergent validity. Hence, the convergent validity of the CP measure was also verified.

5.5.8 Exploratory factor analysis (EFA) summary

Overall, factor analysis was separately performed for each research measure using the SPSS software package. Conducting EFA resulted in refining the OEM, SP, SDIST and EP measures, from which the following measuring items were removed to achieve satisfactory representation of their associated measures: OEM 7, SP 6, SDIST 5, EP 2 and EP 7. This ensured that all remaining measuring items accounted for one underlying factor, and thus satisfactory representation of each measure by their associated items was confirmed. This provides sufficient evidence for the self-reporting scales, verifying the construct validity of all of the research measures.

This stage of the prior regression analysis is of paramount importance for conducting rigorous quantitative analysis, as it determines the credibility of the results by ensuring that all measuring items (the instruments for obtaining empirical data) are valid and fully represent their associated constructs (Hair et al., 2010). Accordingly, subsequent to this stage, all the statistical analyses were performed without OEM 7, SP 6, SDIST 5, EP 2 and EP 7. In addition, the exploratory factor analysis which resulted in reducing the number of measuring items from 40 to 35 further consolidated the research decision on the required sample size. As discussed in Section 4.15.1.3, the use of a minimum of five samples per observed variable (measuring items) is recommended for SEM analysis and now with 35 remaining items the required sample size is 175 (35*5), matching the initial sample size that we had already considered.

More importantly, performing EFA prior to the structural equation modelling (SEM) analysis is proven to considerably improve the model fit, as it ensures that all measurement items within a measure are consistent with one another and fully represent their respective measures (Schumacker and Lomax, 2010; Kline, 2011). This research benefits from performing the EFA test because it can assist our SEM analysis in achieving a better level of model fit. Furthermore, according to Hair et al. (2010), conducting EFA not only ensures construct validity but can also improve the reliability of the research constructs. With this in mind, reliability analysis of each of the refined measures was performed on the remaining measuring items after the EFA test, and interestingly, the reliability of the refined measures was further enhanced (see Table 5.4). The results of the reliability analysis of the refined measures are presented in Table 5.4.

Table 5.4. Reliability statistics after EFA

Variable	Cronbach's Alpha[5]
OEM	***0.712***
SP	***0.703***
SD	0.726
SDIST	***0.750***
IR	0.633
EP	***0.751***
CP	0.754

[5] Measure of reliability that ranges from 0 to 1, with values of 0.60 to 0.70 deemed the lower limit of acceptability (Hair et al., 2006; p.102). It is generally used as a measure of internal consistency of variables (Hair et al., 2006).

Although the reliability of the research measures had already been confirmed, the reliability coefficients of the remaining items were also examined, and were found to be higher than the recommended value, indicating sufficient construct reliability. Now EFA had been performed and the convergent validity and reliability of all the research constructs confirmed, structural equation modelling (SEM) could be conducted. However, before performing SEM analysis, the data should be further analysed to check for the common method bias issue, which is discussed in the following section.

5.6 Common method variance (CMV)

In the final step prior to SEM analysis, the common method variance (bias) was addressed. When data is collected from respondents using the same method (survey questionnaire) at the same time, common methods variance (CMV) may be a concern. Podsakoff et al. (2003, p. 879) describe CMV as "variance that is attributable to the measurement method rather than to the constructs the measures represent". In this regard, Chang et al. (2010) assert that CMV can create a false internal consistency among research variables through an apparent correlation among variables produced by their common source, which may lead to inflated estimates of the relationships between the variables. In other words, the fact that respondents are asked to provide their own perceptions on a number of research variables in the same survey is likely to yield false correlations among the items measuring these variables (Kamakura, 2010). Thus, the common method bias is largely concerned with the measurement instruments rather than the variables being measured. Because measuring multiple variables using the same method of multiple-item scales presented within the survey may lead to spurious effects and in turn result in incorrect conclusions (Kamakura, 2010), CMV should be assessed and controlled to ensure that the common method bias is not a problem.

A number of procedural controls were considered when developing the survey questionnaire that ensured the avoidance of the common method bias. In essence, the 'item characteristic' and 'common rater' effects are the key causes of the common method bias that may result in unreliable answers and thus should be avoided (Podsakoff et al., 2003). The 'item characteristic' effects were mitigated through conducting a rigorous pre-test of the questionnaire (see Section 4.14) which resulted in minor modifications assuring that the questionnaire items could be fully understood. Furthermore, 'common rater' effects, which are generally defined as respondents' perceived need to provide consistent or socially desirable responses, were also mitigated by assuring the confidentiality of participants and anonymity of their responses when developing the online survey (see Section 4.15.3). In addition, all of the research variables were based on pre-existing valid measures and directly adopted from existing and published studies, ensuring the quality of the scales and in turn alleviating the risk of the common method bias. In this regard, based on Field's (2009) recommendation, the use of Likert-type scale questions also reduces the likelihood of common method variance. These procedural controls should reduce the possibility of the common method bias as common approaches recommended for controlling CMV (Kamakura, 2010, Chang et al., 2010).

However, we also statistically assessed the potential risk of common method variance to investigate whether or not common method bias existed in the survey data. Harman's single factor test, the most common approach for assessing CMV (Podsakoff et al., 2003), was performed using SPSS software to examine the possibility and extent of the common method bias issue. This method is widely used by many scholars when examining the common method bias issue, e.g., Sarkis et al. (2010), Inman et al. (2011), Taylor and Taylor (2013), Yu and Ramanathan (2015), etc. Harman's single factor test requires all measuring items from each of the research variables to be loaded into an EFA to check whether one single factor accounts for a majority of the total variance across the variables. If a single factor emerges for the majority of the total variance between the variables, then a substantial amount of CMV is present within the dataset (Podsakoff et al., 2003).

In this test, we ran a factor analysis with all of the measuring items (40 items) by constraining the number of factors to one and using the unrotated factor solution. We observed that the maximum variance that was explained by a single factor was 25.9%, less than the recommended 50% (Podsakoff et al., 2003). This indicates that approximately 26% of variance was explained by a single factor, meaning that a single factor had not emerged for the majority of the total variance. Thus, we can conclude that the survey data did not suffer from the common method bias issue, as there was no evidence that one factor emerged for the majority of the total variance among all the variables, given that the variance explained by a single factor was less than 50%. Hence, the common method bias was not present within the survey data and the claim that CMV is not a problem was supported.

5.7 Structural equation modelling (SEM)

5.7.1 Philosophical foundation of SEM

This section aims to present an overview of the SEM method in a logical sense so that readers can follow the rationale of the process, enabling a better comprehension of this multivariate technique. The SEM method was first presented as a general framework that combines factor analysis and path analysis, by Jöreskog (1973), Keesling (1973) and Wiley (1973) at the "Structural Equation Models in the Social Sciences" conference, which then developed and significantly contributed to various fields of social sciences such as behavioural sciences, business and management, education, sociology and psychology (Kline, 2011). SEM is a multivariate technique for testing measurement, functional, predictive and causal hypotheses (Hair et al., 2010).

From a holistic perspective, and following Bagozzi and Yi (2012, p. 12), the SEM method provides a useful forum for sense-making, linking the philosophy of science criteria to theoretical and empirical research. In particular, this sense-making forum encompasses theoretical meaning, empirical meaning and spurious meaning. Figure 5.9 illustrates the ideas behind the holistic construal of the SEM concept, covering theoretical, empirical and spurious meanings in structural equation models.

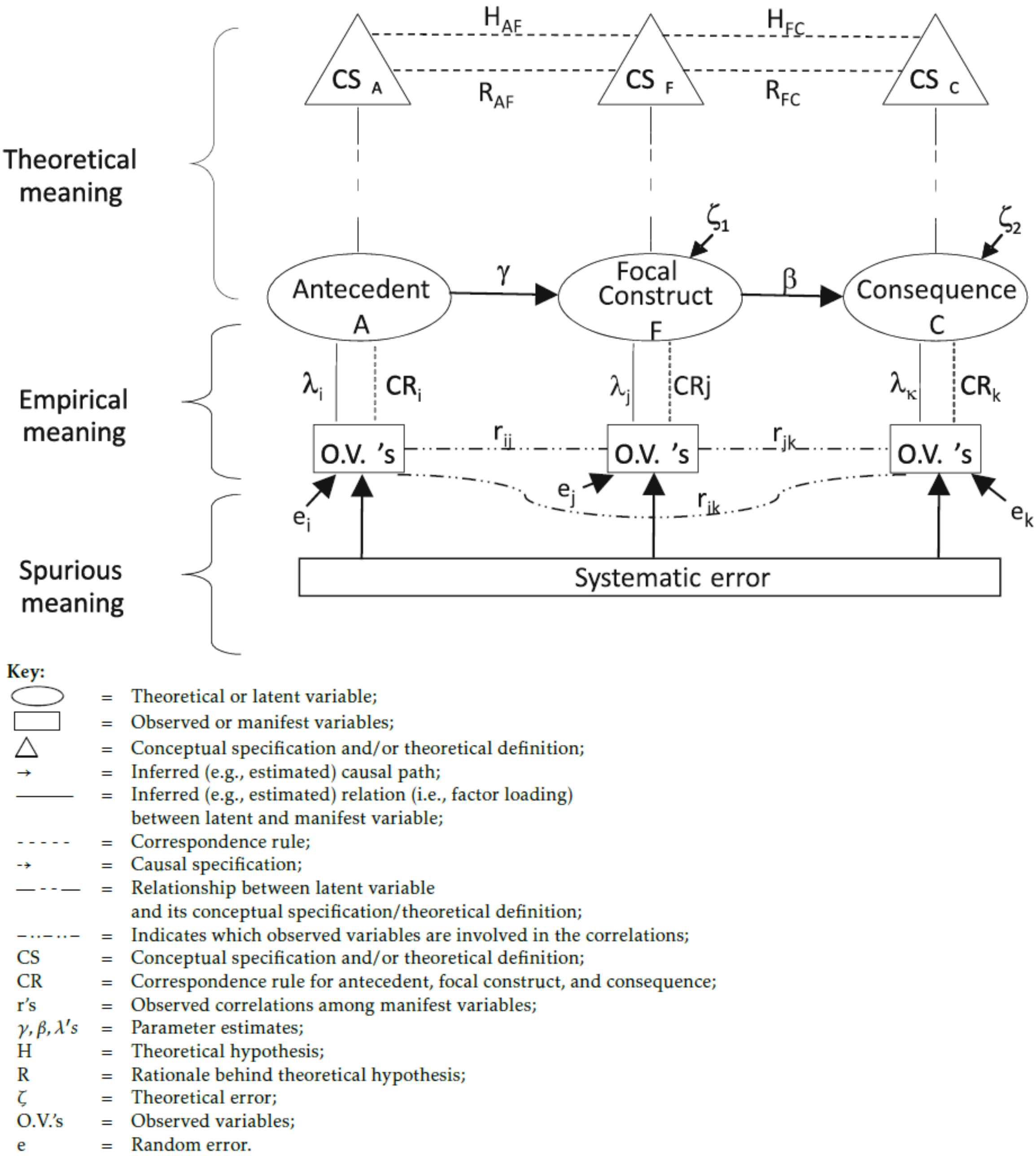


Figure 5.9 A holistic view of the SEM concept: consideration of theoretical, empirical and spurious meaning (source: Bagozzi and Yi, 2012)

For a simple example of structural models, let us assume that a focal construct (F) is a mediator of the relationship of the antecedent (A) construct with the consequence (C) construct. SEM seeks to explain the relationships among these constructs through the synergistic incorporation of theoretical meaning, empirical meaning and spurious meaning. Theoretical, empirical and spurious meanings are interdependent and inform each other. In terms of theoretical meaning, in SEM, the theoretical concepts of these constructs are interpreted via construct specification and operationalisation, which are presented as triangles containing CS in Figure 5.9 (Bagozzi and Yi, 2012). As depicted in Figure 5.9 (see H and R), in SEM, theoretical meaning is incurred via the connections that each theoretical construct has with other theoretical constructs in a logical network, which is linked by the rationale behind the theoretical hypothesis and expressed through theoretical hypotheses.

In terms of empirical meaning, Bagozzi and Yi (2012, p. 13) suggest that:

"Empirical meaning refers to the observational content affiliated with theoretical constructs after spurious meaning, if any, has been removed."

This is executed by linking theoretical constructs to observed variables that can be measured through indicators, specifying correspondence rules, i.e. joining theoretical concepts to observational concepts.

In terms of spurious meaning, Bagozzi and Yi (2012, p. 13) maintain that:

"Spurious meaning refers to contamination of empirical meaning and resides in one or more of three sources: random error, systematic error, and measure specificity."

Basically, this is about the possible error incurred in measuring observed variables. Hair et al. (2010) proffer that systematic error and measure specificity are small in comparison with random error and can be ignored in multiple regression analysis. Spurious meaning can be minimised using a number of statistical methods such as exploratory factor analysis (EFA) or confirmatory factor analysis (CFA), during the initial step of the measurement model (Kline, 2011).

Drawing on Figure 5.9, a series of structural equations that explain the relationships among the constructs is provided below, demonstrating how SEM is presented.

$F = \gamma A + e_j$

$C = \beta F + e_k$

where F (focal construct) is the dependent variable, γ is the parameter estimates, i.e. the regression coefficient, which represents the effect of exogenous (independent) variable A on endogenous (dependent) variable F. γ represents the amount the dependent variable F changes when the independent variable A (antecedent) changes by one unit (Hair et al., 2010). e_j is the random error term associated with the value of the independent variable A. In the second equation, where C (consequence) is the dependent variable, β is the parameter estimates, which represents the effect of endogenous variable F on endogenous variable C. While β represents the amount the dependent variable C changes when the independent variable F changes by one unit, e_k is the random error term associated with the value of the dependent variable F.

Generally in SEM, γ represents the effect of exogenous variables on endogenous variables, and β represents the effect of one endogenous variable on another endogenous variable (Bagozzi and Yi, 2012). In SEM, the exogenous variable is pre-determined and is not dependent upon other variables, while the endogenous variable can be independent and dependent in other respective dependence relationships (Kline, 2011). For instance, SEM treats our research model in the following way: OEM is exogenous and considered a pure independent variable (is given outside the equations system), where SP, SD, SDIST and IR are endogenous and jointly considered as dependent variables in the dependence relationship with OEM and then as independent variables in the correspondence relationship with performance outcomes.

Considering this and in view of the proposed model presented in Figure 3.5, effective SEM analysis should yield the following equations:

$SP = \gamma_1 OEM + e_1$

$SD = \gamma_2 OEM + e_2$

$SDIST = \gamma_3 OEM + e_3$

$IR = \gamma_4 OEM + e_4$

$EP = \beta_{11} SP + \beta_{12} SD + \beta_{13} SDIST + \beta_{14} IR + e_5$

$CP = \beta_{21} SP + \beta_{22} SD + \beta_{23} SDIST + \beta_{24} IR + \beta_{25} EP + e_6$

(Key: OEM = organisation environmental management; SP = sustainable procurement; SD = sustainable design; SDIST = sustainable distribution; IR = investment recovery; EP = environmental performance; CP = cost performance)

Referring to our theoretical model in Figure 3.5, it is contended that the SEM approach is in line with the focus of the research model on antecedent and outcome effects, further justifying the selection of the data analysis approach. Furthermore, it is useful to provide such a sound foundation on the SEM method, as our main results in the next chapter will be generated through this technique. We realise that SEM involves more complex statistical issues, but they could not be dealt with in depth within the scope of this study. However, we have sought to provide a concise background of SEM technique, enabling broad comprehension of this concept. More details of various SEM procedures are discussed in the next section.

5.7.2 SEM analysis

Since each of the research measures has been separately assessed and statistically validated in previous sections, their causal relationships can now be tested using the structural equation modelling technique, allowing the theorised model to be assessed as a whole. As previously discussed, the SEM method is broadly regarded as a conflation of factor analysis and the path analysis model (Kline, 2011). With this in mind, the SEM technique is generally categorised into two main parts when is applied to any structural model: the measurement model and the structural model, i.e. latent variable model (Kaplan, 2000).

The measurement model is generally considered to be a sub-model of the structural model, which aims to examine relationships between the latent variables and their associated measuring items, enabling the researcher to assess how well the measuring items contribute to their variables (Hair et al., 2010). This ensures that the structural model is tested by latent variables that are consistent with the theoretical nature of their associated constructs, leading to credible results. The chief purpose of the measurement model is to validate the research measures (latent variables) and their associated measuring items within the context of the whole model from a holistic perspective (Kline, 2011). However, this requires each research measure to be individually validated prior to the full measurement model assessment (Hair et al., 2010). That is why the EFA test is considered to be an important prerequisite for SEM analysis.

In essence, the measurement model is statistically tested by conducting confirmatory factor analysis (CFA), which is a crucial part of SEM analysis that determines the inclusion of the latent variables in the research model (Kaplan, 2000; Schumacker and Lomax, 2010). It is worth remembering that the latent variables represent theoretical constructs that are not directly observed, and are thus operationalised by linking them to a number of measuring items that represent them (Hair et al., 2010). On the other hand, Hair et al. (2010, p. 634) define the structural model as a “set of one or more dependence relationships linking the model construct” that describe the correspondence relationships amongst research constructs. The structural model, which is also referred to as the latent variable model, aims to examine the causal relationships between the latent variables in the research model (Kline, 2011).

Generally, before conducting SEM analysis, a number of specific assumptions must be met for the SEM to be valid and to make accurate inferences (Kaplan, 2000; Schumacker and Lomax, 2010; Kline, 2011). These underlying assumptions are normally distributed data; no missing data; and appropriate sample size. All of these specific assumptions have already been met in this study (see Sections 5.2, 5.3, and 4.15.1.3), ensuring the valid conduct of the SEM and accurate inferences.

According to Gerbing and Anderson (1988) and Kaplan (2000), there are two main approaches to conducting SEM analysis: the one-step approach and two-step approach. The one-step approach to SEM requires the measurement model and the structural model to be estimated simultaneously. The one-step approach is broadly employed for research models with pre-validated hypotheses and well-established constructs, and thus can be of lower accurate inference for newly developed models that have not been previously tested (Hair et al., 2010). However, in the two-step approach, the measurement model is validated in the first step and then the structural model is estimated in the second step. In other words, once the measurement model has been validated, i.e. all the relationships between the latent variables and their associated measuring items are validated, the causal relationships between the latent variables in the structural model can be examined. The two-step approach is the most commonly used in SEM analysis, because a structural model that has already been validated by achieving a required level of model fit in the first step is likely to yield more accurate and credible results (Anderson and Gerbing, 1988). In addition, the two-step approach ensures that the structural model is not tested by bad measures as part of its first stage to evaluate the validity of the research measures. Hence, the two-step approach to SEM was employed in this research.

We followed the six-stage procedure recommended by Hair et al. (2010) (see Figure 5.10) in employing the two-step approach of SEM analysis. These six stages are widely used in SEM analysis and ensure the proper conduct of SEM to achieve accurate inferences (Kline, 2011). Many scholars have employed the six-stage procedure when performing their SEM analysis, e.g., Inman et al. (2011), Green et al. (2012a,b), Zhu et al. (2013), Yu and Ramanathan (2015), etc.

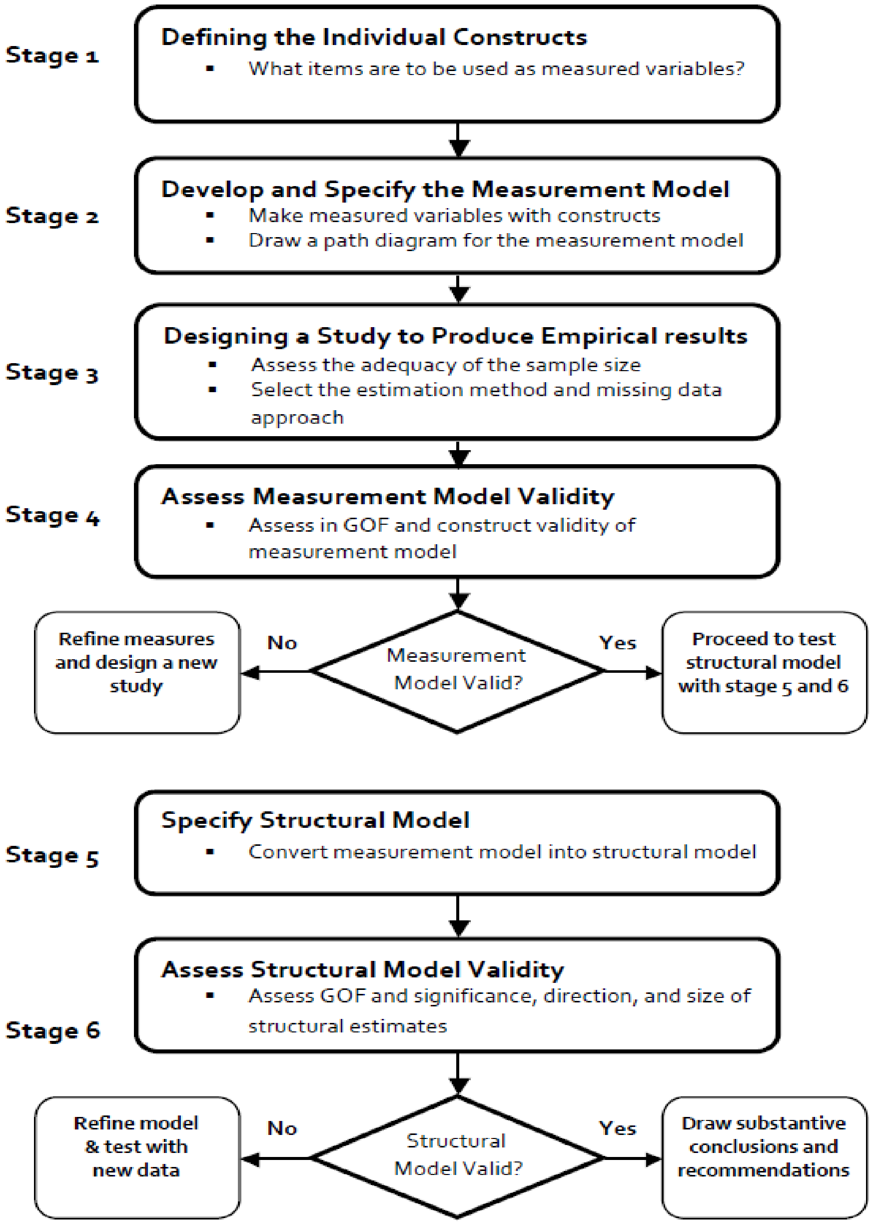


Figure 5.10 Six-stage procedures in Structural Equation Modelling (SEM) analysis (source: Hair et al. 2010, p. 654; Note: GOF=Goodness of fit).

Stages 1 to 3 have been addressed and assured in previous chapters. Stage 1 was attained in this research when all the research constructs were based on pre-existing valid measures and directly adopted from existing and published studies. The details of the measurement scale development were presented in Section 4.11.4. The main part of Stage 2 was also established in the conceptual development chapter where the structural model was developed. As previously discussed, the difference between the measurement model and structural model lies in the relationships between the latent variables and their associated measuring items. This will be automatically considered when the conceptual model is drawn in the SEM software, and is discussed in the next section. Stage 3 is concerned with a number of methodological implications of the research, mainly the adequacy of the sample size, effects of missing data and assessment of the normality of data, which have been covered in this chapter and Chapter 4.

Furthermore, Stage 4 deals with the assessment of the validity of the measurement model in terms level of goodness of fit (GOF) and construct validity within the context of the whole model. Stage 4 is commonly conducted using confirmatory factor analysis (CFA), which is part of structural equation modelling (SEM) and is presented in the next section. Stages 5 and 6 are mainly concerned with SEM analysis, where the causal relationships between latent variables (research constructs) are examined and the validity of the structural model is also assessed. These latter stages are presented after the CFA section.

Several software programs are recommended for SEM analysis, including LISREL, AMOS, Mplus, Stata, etc. Although each has some advantageous and downsides, LISREL has been more commonly used as it was the first software developed specifically for SEM analysis (Jöreskog and Sörbom, 1997). LISREL (linear structural relations) is considered to be advanced SEM software that can survive complex models and high levels of statistical sophistication (Schumacker and Lomax, 2010; Inman et al., 2011). In addition, the main distinctive feature of LISREL is the effectiveness of its graphical user interface compared to other SEM programs, which enables the researcher to draw the causal relationships among research constructs and their associated measuring items along with their respective error terms. It also produces the important model fit information for both the measurement model and the conceptual model, and also suggests modification indices for a better model fit (Schumacker and Lomax, 2010). Although this feature can also be seen in other similar software such as AMOS, the modification indices suggestions provided in LISREL are more extensive compared to AMOS (Byrne, 1998). Therefore, this research used LISREL software to perform SEM analysis, also because it is widely employed in published studies (Inman et al., 2011; Green et al., 2012a,b; Hsu et al., 2013; Green et al., 2015). Moreover, LISREL offers a free student edition. Consequently, LISREL 8.80 software was used to perform the CFA test necessary to evaluate the measurement model and also the structural analyses of causal relationships in the structural model, while also producing important model fit information.

5.7.2.1 Confirmatory factor analysis (CFA)

At this stage, CFA analysis was performed to test whether the measurement model statistically fit the collected data and further assess the construct validity of the theoretical constructs within the context of the whole model. CFA is another type of factor analysis commonly employed to examine whether the measuring items of research constructs are consistent with a researcher's understanding of the theoretical nature of those constructs (Schumacker and Lomax, 2010). In some respects, CFA is somewhat similar to EFA, but philosophically they are quite different, as in CFA a model is previously supported by theory or existing research, whereas EFA can be conducted without considering a theory or the ability to define research constructs ahead of time (Hair et al., 2010). Therefore, CFA assesses construct validity within the context of the full measurement model in a complete model, while EFA can only assess the construct validity separately for each construct regardless of the consideration of the whole model. In addition, CFA, as the first part of a complete test of a structural model, can provide researchers with model fit information and explain how well the collected data fit the model (Kaplan, 2000).

In SEM analysis, there are several assessment criteria for the model fit, known as goodness of fit (GOF) indices, guiding researchers on the different levels of acceptable fit of their research models. All of the fit indices for SEM that can be used as the criteria guidelines for acceptable fit for both a measurement model and a structural model are summarised in Table 5.5. According to the literature (Byrne, 1998; Kaplan, 2000; Hair et al., 2010; Kline, 2011), among the fit indices presented in Table 5.5 the following five are central for goodness-of-fit in SEM, as they are adequate for explaining the model validations: the relative Chi-square or χ^2 ratio, root mean square error of approximation (RMSEA), comparative fit index (CFI), non-normed fit index (NNFI) and incremental fit index (IFI).

Table 5.5. Goodness-of-fit (GOF) indices in structural equation modelling (SEM)

Fit index	**Description**	**Acceptable fit**
Absolute Fit Indices		
Relative Chi-square (χ^2/degree of freedom)	Chi-square statistics are only meaningful taking into account the degree of freedom. This is concerned with a test of the fitness of the model and the data. It is the traditional measure for evaluating overall model fit that assesses the magnitude of the discrepancy between the sample and fitted covariances matrices. The test of the null hypothesis that the estimated variance-covariance matrix deviates from the sample.	Value of 3 or less
Root mean square error of approximation (RMSEA)	Represents a comparison of the square residuals for the degree of freedom. It tells us how well the model, with unknown but optimally chosen parameter estimates, would fit the populations covariance matrix. In recent years, it has come to be regarded as one of the most informative fit indices due to its sensitivity to the number of estimated parameters in the model.	$0.05 < \text{Value} < 0.08$
Incremental Fit Indices		
Normed Fit Index (NFI)	Represents a comparative index between the proposed and more retracted, nested baseline model (null hypothesis) not adjusted for the degree of freedom.	Value > 0.90

Non-normed Fit Index (NNFI) identical to Tucker-Lewis Index (TLI)	Comparative index between proposed and null models adjusted for the degree of freedom. Can avoid extreme underestimation and overestimation and robust against sample size. Highly recommended as the index of choice.	Value > 0.90
Comparative Fit Index (CFI)	Comparative index between proposed and null models adjusted for the degree of freedom. Interpreted similarly as NFI but may be less affected by sample size. Highly recommended as the index of choice, particularly when a large sample size is not available.	Value > 0.90
Incremental Fit Index (IFI)	Comparative index between proposed and null models adjusted for degree of freedom. Highly recommended as the index of choice, particularly when a large sample size is not available.	Value > 0.90

(Source: adapted from Schumacker and Lomax, 2010; Byrne, 1998; Kaplan, 2000; Hair et al., 2010; Kline, 2011)

Although there are some other fit indices for SEM, researchers are advised to report the main five indices of relative Chi-square, RMSEA, CFI, NNFI and IFI, as they provide adequate evidence of model fit (Schumacker and Lomax, 2010; Hair et al., 2010; Kline, 2011). Now the criteria guideline for assessing the model fit has been provided, CFA can be performed using the LISREL software. To do this, first we updated our dataset based on the EFA results that had led to the removal of OEM 7, SP 6, SDIST 5, EP 2 and EP 7, and created another dataset in SPSS without these items. The new dataset was then imported into the LISREL software and the research constructs were developed. Subsequently, relationships between the research constructs and their measuring items were drawn, together with error terms for each construct and measuring item. This is regarded as Stage 2 of the SEM analysis (see Figure 5.10), which involves the specification and development of the measurement model.

After the measurement model had been specified, the CFA results were then produced in LISREL output (see Figure 5.11), showing fairly good model fit for some indices and unsatisfactory fit for other indices. As can be seen from Figure 5.11, while the relative Chi-square value of 2.37 (1278.74/539) is below the 3.00 maximum recommended by Kline (2011), the RMSEA value of 0.084 falls slightly outside the acceptable range of 0.05-0.08 (Schumacker and Lomax, 2010). In addition, the output produced by LISREL also includes incremental fit indices of NFI (0.864), NNFI (0.876), CFI (0.928) and IFI (0.930), in which the Normed Fit Index (NFI) and Non-normed Fit Index (NNFI) values were below the recommended 0.90 level, raising concern about the model fit (Byrne, 1998). This is quite normal in social science research, as it is very rare to develop a theoretical model that perfectly fits with the real data collected from the survey (Kaplan, 2004; Hair et al., 2010). At this stage, researchers are generally advised to make some adjustments to the research model in order to achieve satisfactory model fit indices (Byrne, 1998; Schumacker and Lomax, 2010; Kline, 2011).

Generally, when the CFA is performed, the LISREL software suggests a number of modification indices to add covariance between measuring items where it is possible for that to lead to a decrease in the Chi-square, which ultimately improves the model fit (Byrne, 1998; Inman et al., 2011). In view of this, a number of modification indices for co-varying certain measuring items were suggested in the LISREL output. We co-varied those measuring items that are related to the same variables, by which their associated covariance sustained a greater decrease in the Chi-square. It is important to note that the co-varying of the suggested measuring items was carried out by trial and error, as modification indices suggestions were provided in a non-sequential order. Therefore, based on trial and error, the best possible co-varying suggestions were adopted, which are presented below.

- OEM1 and OEM2 → co-varied
- SP4 and SP5 → co-varied
- SDIST3 and SDIST4 → co-varied
- SD1 and SD4 → co-varied
- CP3 and CP5 → co-varied

Considering these adjustments to co-vary the above measuring items, the measurement model was modified to achieve a better level of model fit. After these changes were applied and the measurement model had been re-specified, the CFA results were produced in LISREL output (see Figures 5.12 and 5.13), now showing relatively good model fit indices. As can be seen from Figure 5.12, the relative Chi-square value of 2.21 (1183.65/534) is well below the 3.00 maximum recommended by Kline (2011), and the RMSEA value of 0.072 falls within the acceptable range of 0.05-0.08 (Schumacker and Lomax, 2010). In addition, the NFI (0.922), NNFI (0.936), CFI (0.961) and IFI (0.962), all exceeded the recommended 0.90 level after the adjustments were made (Byrne, 1998).

In effect, based on the goodness-of-fit indices, the results relating to the fit of the measurement model generally support a claim of a good model fit, implying that the research model statistically fits with the real data collected from the survey. Table 5.6 summarises the results of this confirmatory factor analysis specified in the LISREL 8.80 output that computed the standardised coefficients of each measuring item along with their representative t-values and model fit indices.

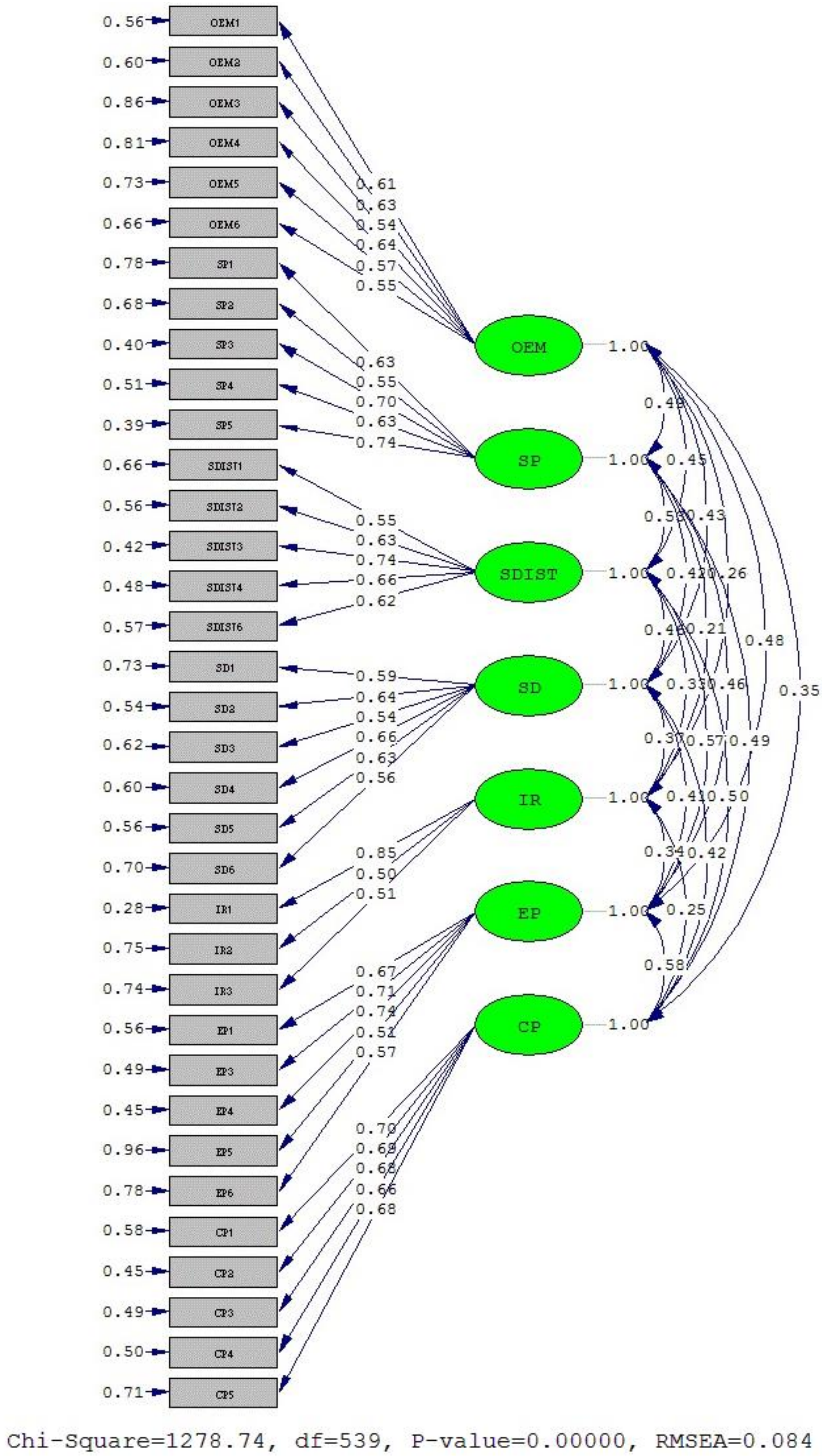
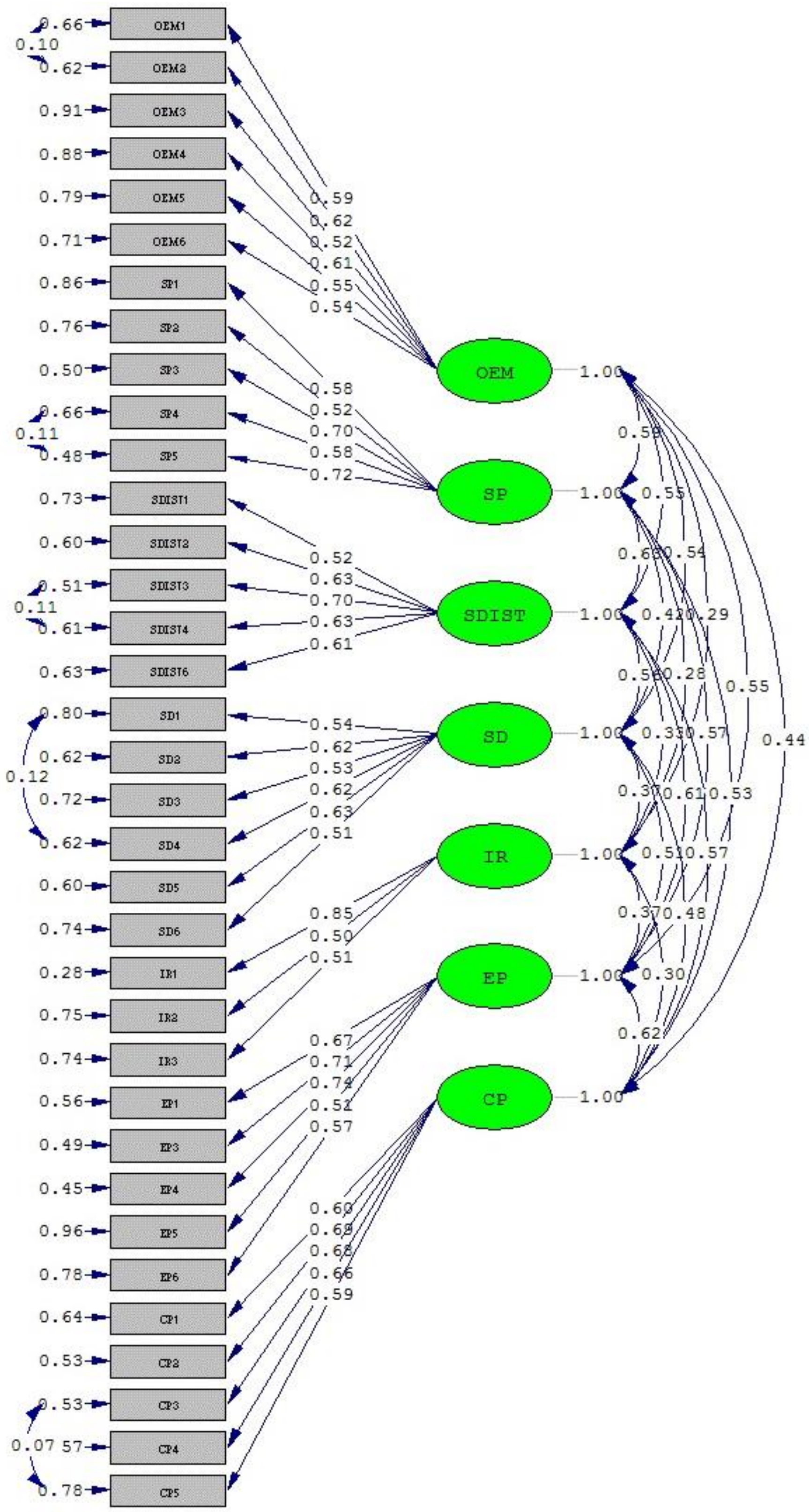


Figure 5.11 Initial measurement model – LISREL output



Chi-Square=1183.65, df=534, P-value=0.00000, RMSEA=0.072

Figure 5.12 Measurement model after adjustments – LISREL output of standardised coefficients

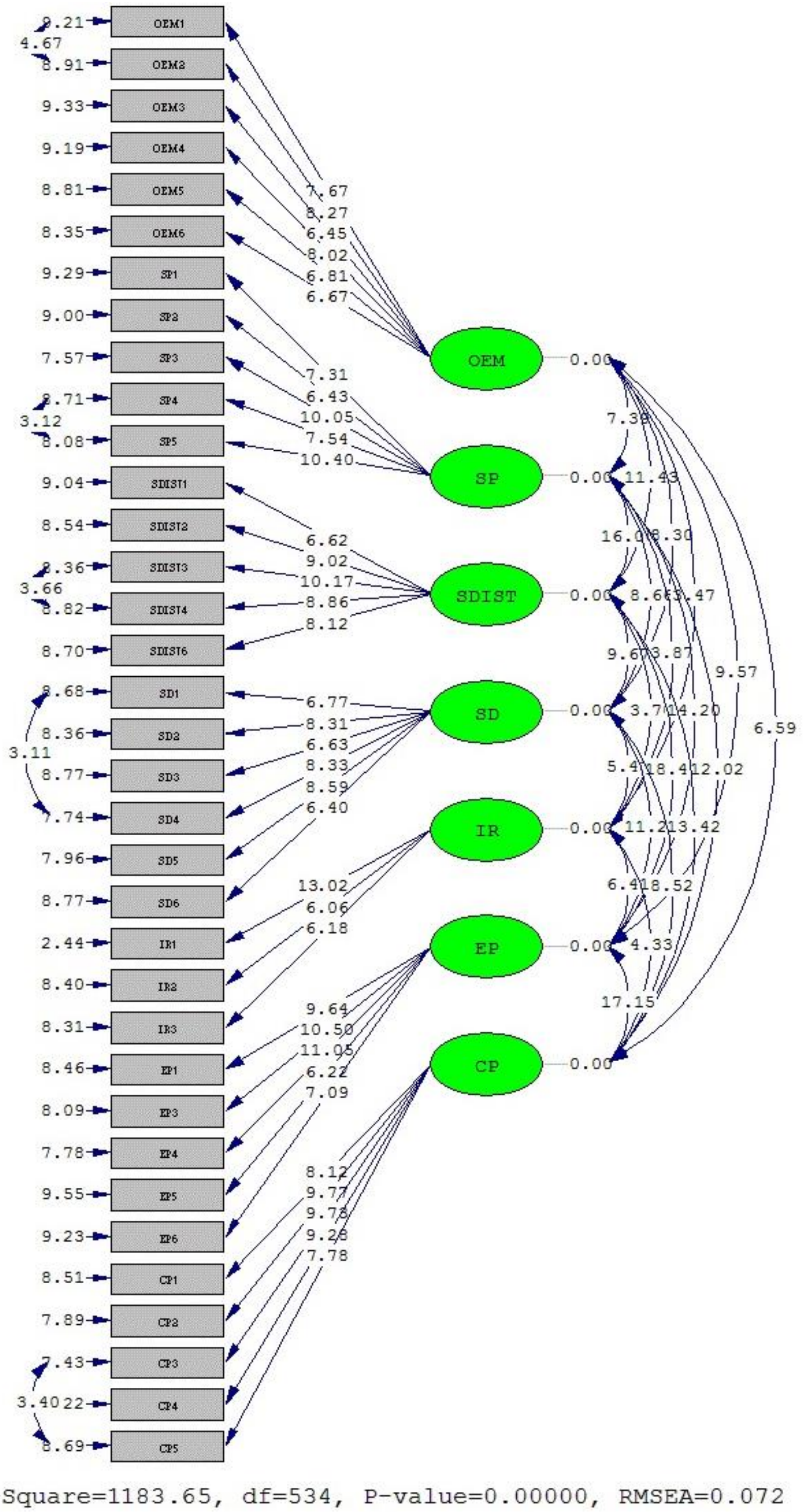


Figure 5.13 Measurement model after adjustments – LISREL output of t-values

Table 5.6. Measurement model results

Measuring items	Standardised coefficients	t-values
Organisation Environmental Management		
OEM1	0.59	7.67
OEM2	0.62	8.27
OEM3	0.52	6.45
OEM4	0.61	8.02
OEM5	0.55	6.81
OEM6	0.54	6.67
Sustainable Procurement		
SP1	0.58	7.31
SP2	0.52	6.43
SP3	0.70	10.05
SP4	0.58	7.54
SP5	0.72	10.40
Sustainable Distribution		
SDIST1	0.52	6.62
SDIST2	0.63	9.02
SDIST3	0.70	10.17
SDIST4	0.63	8.86
SDIST6	0.61	8.12
Sustainable Design		
SD1	0.54	6.77
SD2	0.62	8.31
SD3	0.53	6.63
SD4	0.62	8.33
SD5	0.63	8.59
SD6	0.51	6.40
Investment Recovery		
IR1	0.85	13.02
IR2	0.50	6.06
IR3	0.51	6.18
Environmental Performance		
EP1	0.67	9.64
EP3	0.71	10.50
EP4	0.74	11.05
EP5	0.51	6.22
EP6	0.57	7.09
Cost Performance		
CP1	0.60	8.12
CP2	0.69	9.77
CP3	0.68	9.73
CP4	0.66	9.28
CP5	0.59	7.78
Fit indicators: Chi-square Ratio=2.216; RMSEA=0.072; NFI=0.922; NNFI=0.936; CFI=0.961; IFI=0.962.		

Drawing on Table 5.6, the measurement model fits the data well with a relative Chi-square value of 2.21, an RMSEA value of 0.072, a CFI value of 0.961, a IFI value of 0.962, a NNFI value of 0.936, and a NFI value of 0.922. Even though the convergent validity was assured by the EFA, the CFA also confirmed the convergent validity of all of the constructs, as all of the standardised coefficients for measuring items outlined in Figure 5.12 (also Table 5.6) exceeded the recommended 0.50 minimum (Hair et al., 2010), ranging from 0.50 to 0.85, providing adequate evidence of convergent validity. In addition, the t-values for the measuring items' coefficients can be used as another indication of convergent validity (Byrne, 1998). According to Byrne (1998), if the t-value of factor loading is higher than 2.575, this indicates the practical significance of the derived factor at a 0.01 level with a 99% confidence level. Since all of the t-values were greater than the recommended value of 2.575 (see Figure 5.13) ranging from 6.06 to 13.02, all factor loadings were significant at the 0.01 level and thus convergent validity was further ascertained. When performing CFA when testing the measurement model, the relationships between variables are treated in such a way that each research variable is assumed to be associated with each other variable with no distinction being made between independent and dependent variables (Schumacker and Lomax, 2010; Hair et al., 2010). These relationships are represented as simple correlations with a two-headed curved arrow, as presented in Figure 5.12.

Furthermore, the standard output produced by most SEM software, as with LISREL, includes standardised residuals. Hair et al. (2006, p. 796) describe residuals as "the individual differences between the fitted covariance terms and the observed covariance terms". In terms of model fit, the smaller the residuals, the better the model fit (Kline, 2011). The standardised residuals are generally computed by dividing the raw residuals by the standard error of the residual (Hair et al., 2010). According to Hair et al. (2006, p. 797), standardised residuals with values greater than 4.00 suggest a problem concerning a potentially unacceptable degree of error. None of the standardised residuals exceeded the 4.00 maximum recommended by Hair et al. (2006), ranging from -1.28 to 2.36, indicating that there is no concern regarding a potential unacceptable degree of error.

Referring to the philosophical foundation of SEM presented in Section 5.7.1, a better understanding of SEM can now be inferred by pointing out the following: research constructs broadly represent the theoretical meaning of SEM, measuring items constitute the empirical meaning of SEM, while error terms maintain the spurious meaning.

Moreover, the execution of CFA was also yielded the correlation matrix, providing the correlation coefficients of all the research constructs. Correlation is generally referred to as the strength of the association between any two variables, and is usually reported as part of the prior regression analysis results (Kaplan, 2004). When a correlation coefficient value is positive and significant, it indicates that as one variable grows larger, the other variable grows larger (smaller for negative values). Table 5.7 outlines the correlation coefficients specified in the LISREL output.

Table 5.7. Correlation matrix (diagonal type)

	OEM	SP	SDIST	SD	IR	EP	CP
OEM	1						
SP	0.588**	1					
SDIST	0.549**	0.631**	1				
SD	0.538**	0.420**	0.560**	1			
IR	0.297**	0.281**	0.330**	0.372**	1		
EP	0.554**	0.573**	0.612**	0.518**	0.377**	1	
CP	0.440**	0.536**	0.570**	0.479**	0.307**	0.619**	1

Notes: ** indicates significance at the 0.01 level (2-tailed); OEM=Organisation Environmental Management; SP=Sustainable Procurement; SDIST=Sustainable Distribution; SD=Sustainable Design; IR=Investment Recovery; EP=Environmental Performance; CP=Cost Performance

Drawing on Table 5.7, all of the correlation coefficients were positive and significant at the 0.01 level for all of the hypothesised relationships in the research model. Arguably, using well-established measurement scales, performing exploratory factor analysis (EFA), and model adjustments contributed in obtaining these results. The two-headed curved arrows displayed in

Figure 5.12 represent these correlation coefficients for all variable pairings. Although the results indicate that there is a certain degree of association between the variable pairings, they do not report regression weights or directions (Field, 2009). It is worth mentioning that a significant correlation between two variables denotes a significant association only in a pair-wise relationship, which however may be different in the context of the full research model where other variables pose influential effects (Hair et al., 2010).

This is a commonly used technique before reporting regression results that determines whether a relationship exists between any paired variables, as the lack of a significant association makes the regression analysis redundant, while the presence of a significant association allows us to proceed to further examine that linkage in the context of the full model (Kaplan, 2004; Kline, 2001). Therefore, at this stage we can confirm that there is a relationship between each variable pairing. In addition, as can be seen from Table 5.7, all of the correlation coefficient values were below the recommended maximum of 0.80, alleviating any concerns related to the multi-collinearity problem. Despite this, the potential threats of multi-collinearity issues are thoroughly addressed and statistically assessed in Section 5.7.2.3.

5.7.2.2 Discriminant validity

In the next step in assessing construct validity, CFA analysis was further performed to examine discriminant validity. Following Gerbing and Anderson (1988) and Garver and Mentzer (1999), the test of discriminant validity of the research constructs was executed using CFA through a Chi-square difference comparison. Discriminant validity is commonly evaluated by a Chi-square difference test, which is conducted by fixing the correlation between a pair of two research constructs to the perfect value of 1.0, and then re-estimating the fixed model. Discriminant validity is satisfied if there is a significant difference in the Chi-square statistics between the fixed and the unconstrained models (Gerbing and Anderson, 1988). Therefore, a statistically significant difference in Chi-squares denotes that discriminant validity is established (Garver and Mentzer, 1999).

With this in mind, this test was separately performed for each research construct using the LISREL software, which involved pairing all possible combinations of the constructs along with fixing their respective correlations to the perfect value of 1.0 and comparing the Chi-square values. This pair-wise comparison resulted in substantial increase in the Chi-square values for all pairs ($p < 0.05$) ranging from 5.63 to 32.64, suggesting that the discriminant validity of the research constructs is satisfied. The results of the discriminant validity test are outlined in Table 5.8.

Table 5.8. Discriminant validity test

Research constructs	**Chi-square difference**	**Significant level**
OEM vs. SP	16.28	p-value = 0.013
OEM vs. SD	12.30	p-value = 0.010
OEM vs. SDIST	18.05	p-value = 0.015
OEM vs. IR	9.57	p-value = 0.031
OEM vs. EP	20.41	p-value = 0.018
OEM vs. CP	24.33	p-value = 0.005
SP vs. SD	16.92	p-value = 0.032
SP vs. SDIST	12.88	p-value = 0.027
SP vs. IR	5.63	p-value = 0.029
SP vs. EP	9.13	p-value = 0.012
SP vs. CP	11.43	p-value = 0.023
SD vs. SDIST	18.52	p-value = 0.009
SD vs. IR	10.95	p-value = 0.024
SD vs. EP	12.68	p-value = 0.011
SD vs. CP	32.64	p-value = 0.003
SDIST vs. IR	6.34	p-value = 0.038
SDIST vs. EP	8.41	p-value = 0.017
SDIST vs. CP	10.06	p-value = 0.006
IR vs. EP	13.46	p-value = 0.029
IR vs. CP	14.38	p-value = 0.022
EP vs. CP	28.15	p-value = 0.004

Note: significant at the 0.01 level (p-value < 0.01); significant at the 0.05 level (p-value < 0.05); OEM=Organisation Environmental Management; SP=Sustainable Procurement; SD=Sustainable Design; SDIST=Sustainable Distribution; IR=Investment Recovery; ENV=Environmental Performance; ECP=Economic Performance

Drawing on Table 5.8, the Chi-square difference tests for the pairings of each construct with the other research constructs returned significant differences at the 0.05 level, indicating sufficient discriminant validity for all of the research constructs. Many scholars have used this technique to assess the discriminant validity, e.g., Inman et al. (2011), Zhu et al., 2013, Green et al. (2012a,b), Yu and Ramanathan (2015), etc. Now the discriminant validity of the research constructs had also been confirmed, we could conclude that the construct validity was thoroughly supported through confirming convergent validity using both EFA and CFA, and discriminant validity using CFA. Therefore, the overall validity of the research model was attained, owing to the content and face validity that have already been subjectively confirmed as well as the construct validity that has now been empirically verified through assuring convergent and discriminant validity.

Once the measurement model had been satisfactory validated and the claim of good model fit supported, and the construct validity had also been assured through confirming the convergent and discriminant validity, the structural analysis of the causal relationships between research constructs could be examined. However, before performing structural analysis, the data should be further analysed to check for the multi-collinearity problem, discussed in the following section.

5.7.2.3 Multi-collinearity (collinearity)

Multi-collinearity is broadly referred to as a phenomenon in which two or more research variables are highly correlated (interrelated) with each other in a research model (Field, 2009). With the presence of collinearity, the coefficient estimates of the regressions may change unpredictably. Therefore, multi-collinearity can be a threat for structural models, as its presence can distort the effects of an individual construct, leading to incorrect estimations of regression weights (Hair et al., 2010). According to Hair et al. (2010), the common measure for assessing the existence of multi-collinearity in a path analysis is the variance inflation factor (VIF), which quantifies the severity of collinearity in regression analyses and refers to the extent to which each predictor variable[6] is explained by other predictor variables. Based on Field's (2009) recommendations, a VIF value threshold of less than or equal to 10.0 is a commonly used benchmark for determining the presence of multi-collinearity.

Consequently, as part of the prior regression analysis, we tested for multi-collinearity by calculating the VIF value for each regression coefficient using the SPSS software and its collinearity diagnostics function. All of the VIF values were less than 2.0, ranging from 1.218 to 1.896, significantly below the recommended threshold of 10.0, providing evidence against the potential threat from multi-collinearity and hence suggesting that multi-collinearity does not pose a problem for our model.

5.7.2.4 Structural equation modelling (SEM) results

Having validated the measurement model and attained convergent, discriminant, and construct validity as well as assuring the absence of the common method bias and multi-collinearity problem, it was now possible to examine the causal relationships in the theorised model using the SEM technique. This section therefore ascertains whether the proposed research hypotheses are supported by the data, reporting the results of the hypothesis testing with the full SEM model.

By specifying the measurement model and satisfying its validity in Section 5.7.2.1, the structural model can be specified (serving as Stage 5 in Figure 5.10) and then be examined for structural estimate and model validity (Stage 6 in Figure 5.10). To perform the SEM analysis, we first converted the measurement model that was previously specified in LISREL into the structural model by drawing the relationships between research constructs, to subsequently assess the significance, direction and size of structural estimates, i.e. the regression weights, as

[6] A variable used in regression to predict another variable (Hair et al., 2010). It is also known as an independent variable or regressor.

well as the validity of the structural model. After the structural model of latent variables depicted in Figure 3.5 had been specified, the complete SEM analysis was performed and the results were produced in the LISREL output (see Figure 5.14).

Figure 5.14 shows the LISREL output covering the results that are represented in the form of both the structural model and structural equations. Such an extensive output was provided because a number of standardised coefficients overlapped and were not shown in the structural model output. It should be noted that previous adjustments for the measurement model were included when specifying the structural model, following Schumacker and Lomax's (2010) and Kline's (2011) recommendation. This will also improve the model fit of the structural model and facilitate achieving the required level of model fit (Schumacker and Lomax, 2010; Kline, 2011).

When performing the structural analysis to test the structural model, unlike with CFA, a distinction is made between independent and dependent variables (Byrne, 1998; Kline, 2011). While independent variables have no arrows entering them in the structural model, dependent variables are determined by other variables, as represented by the pattern of single-headed arrows that point to the dependent variables (Hair et al., 2006, p. 881). As previously discussed in Chapter 4, the main distinctive feature of the SEM method is that it allows the estimation of a series of separate causal relationships simultaneously, by treating certain variables as independent and then dependent in another dependence relationship (Hair et al., 2010).

Thus, all the variables presented in Figure 5.14 were treated as both independent and dependent in their respective dependence relationships except for OEM, which is considered a purely independent variable, given outside the equations system necessary for executing SEM (constrained to a perfect value of one) (Kaplan, 2000, Schumacker and Lomax, 2010). In this regard, OEM was treated as an independent variable and SP, SDIST, SD and IR as dependent, while in the other dependence relationships, these focal variables served as independent variables to dependent performance variables, whereas EP was treated as the independent and CP as the dependent variable, allowing these series of causal relationships to be simultaneously estimated.

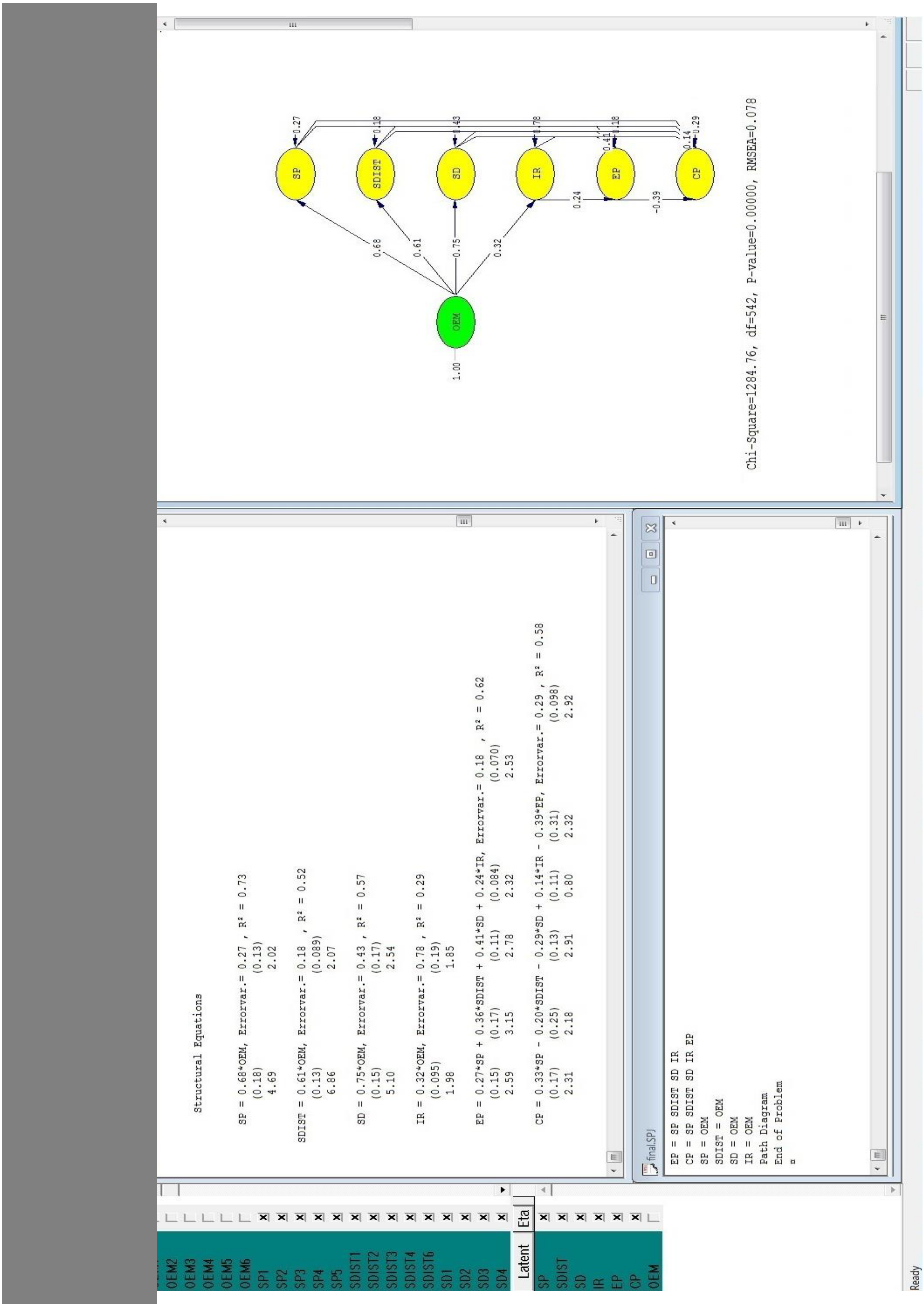
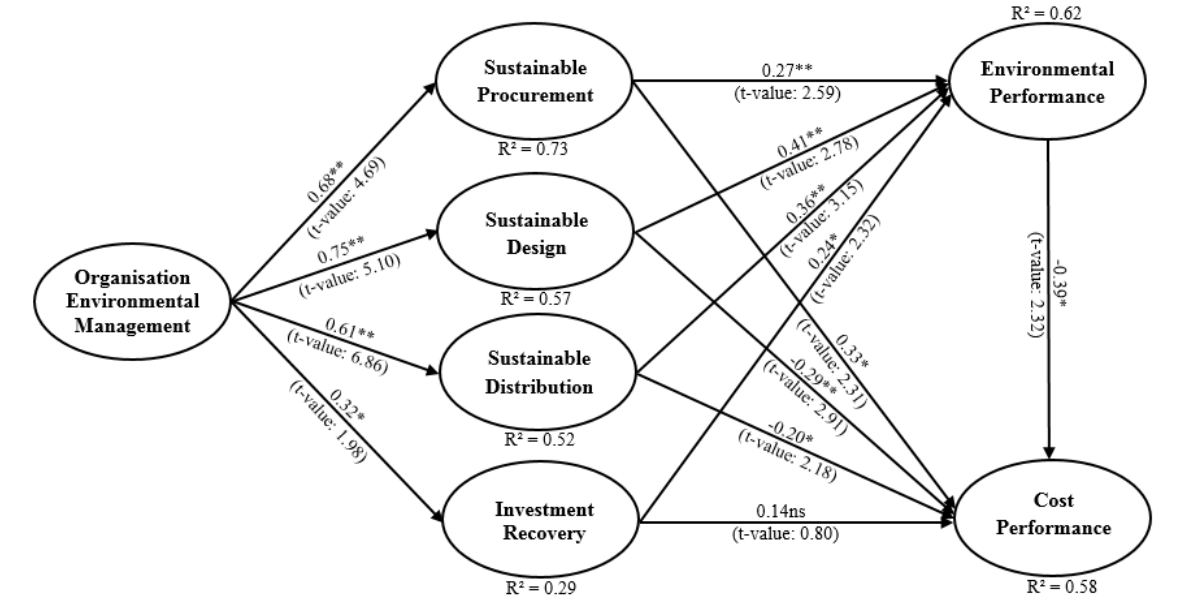


Figure 5.14 Structural model and structural equations – LISREL output

The method of assessing the validity of the structural model is similar to the evaluation criteria used to evaluate the validity of the measurement model (Hair et al., 2010). Drawing on the LISREL output for the structural model (Figure 5.14), the relative Chi-square value of 2.37 (1284.76/542) is less than the 3.00 maximum recommended by Kline (2011), and the RMSEA value of 0.078 falls within the acceptable range of 0.05-0.08 (Schumacker and Lomax, 2010). In addition, in terms of goodness-of-fit indices, the NFI (0.914), NNFI (0.925), CFI (0.947) and IFI (0.947) all exceed the recommended 0.90 level (Byrne, 1998). These goodness-of-fit indices denote that the fit of the model is acceptable. In effect, based on the criteria guideline for acceptable model fit, the results relating to the fit of the structural model generally support a claim of a good model fit. Furthermore, none of the standardised residuals exceeded the 4.00 maximum recommended by Hair et al. (2006), ranging from -1.04 to 2.18, assuring that there is no concern regarding a potential unacceptable degree of error. It is important to note that performing exploratory factor analysis (EFA), and the adjustments on the measurement model contributed in obtaining a satisfactory model fit.

The execution of SEM also generated a number of modification indices in the LISREL output, suggesting adding relationships between research constructs where possible that may lead in some cases to improving the model fit. Interestingly, the modification indices produced in the LISREL output did not suggest any potential extra path linkages between the research constructs. This is a crucial indication that all possible relationships between the research constructs had already been developed, providing evidence that there were no other significant linkages between constructs, at least not on statistical grounds. This is another distinctive feature of SEM that has recently become popular in structural model assessment, which ensures that the researcher does not miss any other linkages among the research variables by statistically maximising all potential relationships in the model (Kline, 2011). This assured that all possible relationships among the research constructs had already been considered in the research model.

Now the claim of good model fit has been supported for the structural model, confirming satisfactory validity, the results of the hypothesis testing can be reported. We incorporated the results produced in the structural model and structural equation output (Figure 5.14) into the proposed research model, providing a more comprehensive view of the results of this research investigation. Figure 5.15 illustrates the SSCM drivers-practices-performance model with SEM results (specified in the LISREL output).



Notes: ** significant at the 0.01 level (t-value > 2.575); * significant at the 0.05 level (t-value > 1.960); ns: not significant (t-value < 1.960).
Fit Indicators: Chi-Square ratio = 2.370; RMSEA = 0.078; NFI (0.914); NNFI (0.925); CFI (0.947); IFI (0.947).

Figure 5.15 SSCM drivers-practices-performance model with SEM results

When reporting the hypothesis testing results of multivariate analysis, the regression coefficient (β), t-value, and R-squared (R^2) are central (Hair et al., 2010). According to Hair et al. (2006, p. 174), "the regression coefficient represents the amount of change in the dependent variable for a one-unit change in the independent variable". Referring to the philosophical foundation of the SEM (see Section 5.7.1), the regression coefficients above the arrows between OEM and the focal SSCM constructs represent the effect of the independent variable on the dependent variables (γ). The other regression coefficients among the focal SSCM and performance constructs represent the effect of the dependent variables on other dependent variables (β) that were also treated as independent variables in the other respective dependence relationships.

On the other hand, the t-value serves as an indication of the regression significance and is generally computed by dividing the parameter estimate by the standard error (Field, 2009). Coefficient regressions with t-values greater than 1.96 are significant at the 0.05 level (Byrne, 1998). The last main statistic that should be reported is the R-squared, which is defined as the statistical "measure of the proportion of the variance of the dependent variable that is explained by independent (predictor) variable" (Hair et al., 2006, p. 170). The R-squared is also known as the coefficient of determination, serving as an indication of how close the observed data are to the fitted regression line (Field, 2009). Thus, the higher the R-squared value (ranging from 0 to 1), the greater the explanatory power of the regression attained as well as the better the prediction of the variables (Hair et al., 2006). All of these main statistics were computed using SEM analysis and specified in the LISREL output in a series of separate causal relationships (see Figure 5.14). The structural equations are presented below.

$$\begin{array}{llll} SP = & 0.68*OEM, & Errorvar.= 0.27, & R^2 = 0.73 \\ & (0.18) & (0.13) & \\ & 4.69 & 2.02 & \end{array}$$

$$\begin{array}{llll} SDIST = & 0.61*OEM, & Errorvar.= 0.18, & R^2 = 0.52 \\ & (0.13) & (0.089) & \\ & 6.86 & 2.07 & \end{array}$$

$$\begin{array}{llll} SD = & 0.75*OEM, & Errorvar.= 0.43, & R^2 = 0.57 \\ & (0.15) & (0.17) & \\ & 5.10 & 2.54 & \end{array}$$

$$\begin{array}{llll} IR = & 0.32*OEM, & Errorvar.= 0.78, & R^2 = 0.29 \\ & (0.095) & (0.19) & \\ & 1.98 & 1.85 & \end{array}$$

$$\begin{array}{lllllll} EP = & 0.27*SP & + 0.36*SDIST & + 0.41*SD & + 0.24*IR, & Errorvar.= 0.18, & R^2 = 0.62 \\ & (0.15) & (0.17) & (0.11) & (0.084) & (0.070) & \\ & 2.59 & 3.15 & 2.78 & 2.32 & 2.53 & \end{array}$$

$$\begin{array}{llllllll} CP = & 0.33*SP & – 0.20*SDIST & – 0.29*SD & + 0.14*IR & – 0.39*EP, & Errorvar.= 0.29, & R^2 = 0.58 \\ & (0.17) & (0.25) & (0.13) & (0.11) & (0.31) & (0.098) & \\ & 2.31 & 2.18 & 2.91 & 0.80 & 2.32 & 2.92 & \end{array}$$

In the above equations, the statistics given with each variable represent the regression coefficients (weights). Below each regression coefficient is the standard error in parenthesis, while the associated t-value is listed below each parenthesis (Schumacker and Lomax, 2010). Drawing on the structural equations, all of the hypothesised relationships are significant at the 0.05 level, since all of the associated t-values are greater than the minimum 1.96 recommended by Byrne (1998), with the exception of CP→IR with a t-value of 0.80. In terms of R-squared values, although there is no perfect value criterion for R-squared, the R-squared values between 0.50 and 0.75 imply the strong explanatory capability of the research model (Hair et al., 2006). Since the majority of R-squared values presented in the above equations are greater than 0.50 and below 0.75, we can confirm that the model has a moderately strong explanatory capability. The highest R-squared value is 0.73 (see the first equation), which indicates that 73% of the SP variable's variance is explained by its predictor variable (OEM). The lowest R-squared is 0.29 (see the fourth equation), implying that 71% of the IR variable's variance is left unexplained, largely due to potential random error, which is acceptable given the complexity of the structural model and the number of posited variables (Schumacker and Lomax, 2010).

Having discussed these main statistics, we now report the results related to individual hypothesis tests. A comprehensive overview of the outcome of the hypothesis testing are summarised below in Table 5.9. All hypotheses are positive and significant with the exception of *H3b* (SD → CP), *H3c* (SDIST → CP), *H3d* (IR → CP), and *H4* (EP → CP). Drawing on Table 5.9, *H1a*, *H1b*, *H1c* and *H1d* are all positive and significant, indicating that organisation environmental management (OEM) is a necessary precursor to the implementation of SSCM practices. On statistical grounds, changes in OEM influence change in the SP, SD, SDIST and IR constructs, and since all the dependence relationships among them are positive and significant, it is contended that without OEM the SSCM practices cannot be implemented.

Furthermore, *H2a*, *H2b*, *H2c* and *H2d*, which predict positive associations between the implementation of SSCM practices and environmental performance, are positive and significant as expected. On the other hand, *H3a*, *H3b*, *H3c* and *H3d*, which predict positive associations between the implementation of SSCM practices and cost performance, are not positive and significant, with the exception of *H3a* (SP → CP). Investment recovery does not impact on cost performance, given its non-significant relationship, while both sustainable design and sustainable distribution negatively impact on cost performance. Lastly, *H4* is interestingly negative and significant, meaning that environmental performance negatively impacts on cost performance.

Table 5.9. Overview of structural model results

Model link	Standardised coefficient	Support
Hypotheses tests		
OEM →		
SP	0.68 **	H1a: Supported
SD	0.75 **	H1b: Supported
SDIST	0.61 **	H1c: Supported
IR	0.32 *	H1d: Supported
SP →		
EP	0.27 **	H2a: Supported
CP	0.33 *	H3a: Supported
SD →		
EP	0.41 **	H2b: Supported
CP	- 0.29 **	H3b: Not supported
SDIST		
EP	0.36 **	H2c: Supported
CP	- 0.20 *	H3c: Not supported
IR →		
EP	0.24 *	H2d: Supported
CP	0.14 ns	H3d: Not supported
EP →		
CP	- 0.39 *	H4 : Not supported

Notes: ** significant at the 0.01 level; * significant at the 0.05 level; ns: not significant;
Chi-square ratio=2.370; RMSEA=0.078; NFI (0.914); NNFI (0.925); CFI (0.947); IFI (0.947);
OEM=Organisation Environmental Management; SP=Sustainable Procurement; SDIST=Sustainable Distribution; SD=Sustainable Design; IR=Investment Recovery; EP=Environmental Performance; CP=Cost Performance

Overall, out of 13 research hypotheses, 9 hypotheses are supported and 4 study hypotheses, i.e. *H3b*, *H3c*, *H3d*, and *H4*, are not supported. Given the rigour of the research process and the robustness of the study's statistical analyses, the credibility of the results is maintained, leaving little doubt as to the validity of the results. This offers new valuable research findings and directions that can contribute to the existing knowledge in the SSCM field. Detailed discussions based on the results will be presented in the next chapter.

5.8 Chapter summary

This chapter has presented the results of the data analysis. In the first step, the data administration processes have been addressed, then the data distribution has been statistically assessed, preparing the data for statistical analysis. Thereafter, the chapter has broadly addressed data quality issues concerning reliability, face validity, content validity, construct validity, convergent validity and discriminant validity, establishing the truthfulness and credibility of the results. The reliability, face validity and content validity of the constructs have been assessed in the earlier part of this chapter, whereas the convergent validity and discriminant validity have been evaluated in the latter part. Furthermore, exploratory factor analysis (EFA) has been conducted to statistically determine whether the measuring items truly represent their associated measures. The execution of EFA resulted in removing the OEM 7, SP 6, SDIST 5, EP 2 and EP 7 items, which confirmed the convergent validity. In addition, this chapter has addressed the common method variance (CMV) and statistically assessed its related bias issue, with the results proving that the data has not suffered from the common method bias issue and thus CMV was not a problem.

Furthermore, the philosophical foundation of structural equation modelling (SEM) has been presented along with a multiple-stage procedure required to properly perform SEM analysis. Thereafter, confirmatory factor analysis (CFA) has been performed and consequently the measurement model has been validated. In addition, the discriminant validity of the constructs has been assured as part of the CFA analysis, where the overall construct validity was attained through confirming convergent validity and discriminant validity. This chapter has also verified that the multi-collinearity issue did not pose a problem in the research model. Lastly, the SEM analysis was performed and the hypotheses testing results have been reported. The results relating to the fit of the proposed research model supported the claim of good model fit, indicating that the theorised model statistically fit with the real data collected from the survey. The outcome of hypothesis testing showed that out of 13 research hypotheses, 9 hypotheses were supported and 4 were not supported, offering novel research findings that will be discussed in the next chapter.

Additional note:

We further attempted to perform an SEM analysis without including the OEM variable, to verify our argument that the existence and response to driving forces will cause the relationships between implementing SSCM practices and performance outcomes to vary. To do this, the structural model was re-specified by excluding OEM, and the SEM analysis was then executed again using the LISREL software. The results of this test are presented in Figure 5.16. As can be seen from Figure 5.16, both the magnitudes of the regression coefficients and the significance of the hypothesised relationships varied when the OEM variable representing the driving forces cluster was excluded. For example, the absence of the OEM construct caused SP→EP to vary from (β=0.27, significant at the 0.01 level) to (β=0.48, fairly significant at the 0.05 level), or SDIST→CP to alter from (β=-0.20, significant at the 0.05 level) to (β=0.26, not significant). These results indicate that the existence of and response to the driving forces cluster definitely causes the relationships between SSCM practices and performance outcomes to vary. Therefore, our argument is confirmed, further justifying the importance of developing the conceptual model from such a holistic and integrated perspective.

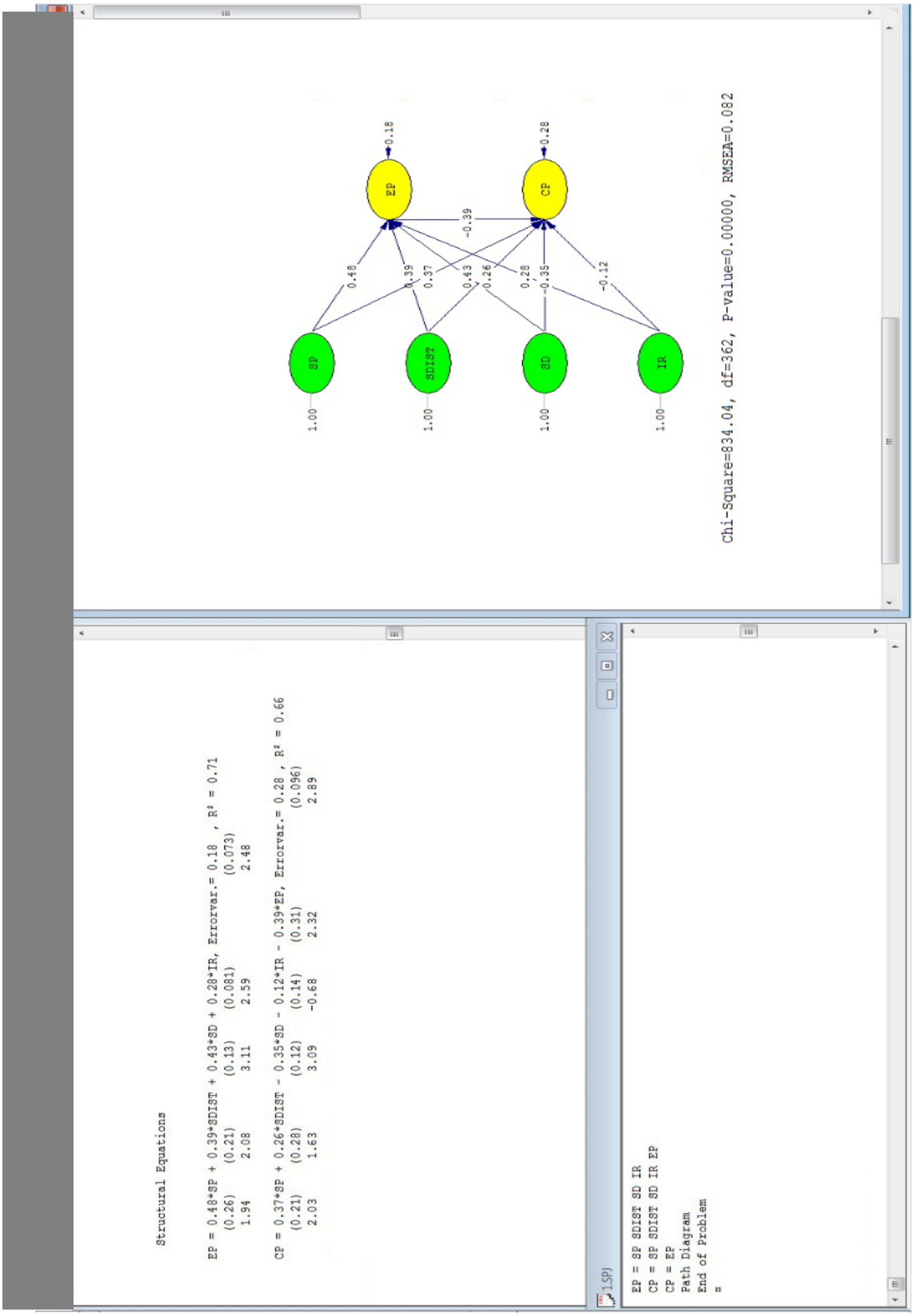


Figure 5.16 Structural model and structural equations – LISREL output without OEM construct

CHAPTER 6

DISCUSSION

6.1 Introduction

This chapter presents the research findings stemming from the results presented in the previous chapter. Thus far, the hypothesised relationships between the driving forces and adoption of SSCM practices together with performance outcomes have been statistically assessed and in turn empirical results have been presented. Therefore, since the survey data has been analysed, the purpose of this chapter is to relate it back and report on the findings. In this respect, detailed discussions concerning the results of this research investigation are addressed in this chapter, offering important insights. In addition, the research findings are further discussed in this chapter in relation to the related literature, reporting where either a measurement or a discovery (new research finding) has been made within the existing knowledge in the SSCM area.

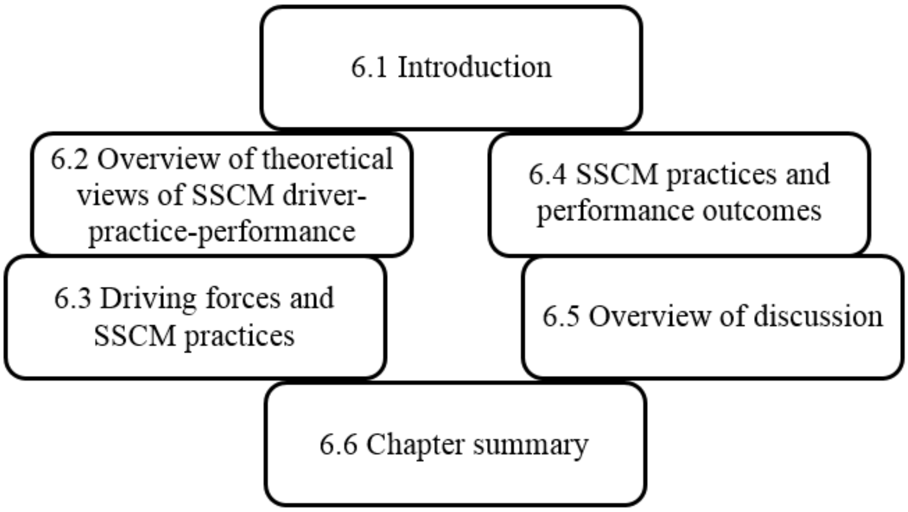


Figure 6.1 Structure of Chapter 6

As depicted in Figure 6.1, the chapter begins by revisiting the outcome of the hypothesis testing concerning the proposed research model, discussing whether a measurement or a discovery has been made within the existing knowledge, then presents an overview of theoretical views of SSCM driver-practice-performance elicited from this research investigation. Section 6.3 then draws on the findings of the causal relationship testing regarding the driving forces and adoption of SSCM practices, breaking them down into more detail. Thereafter, Section 6.4

extensively discusses the research findings concerning the theoretical relationships between implementing SSCM practices and the commensurate performance outcomes, demonstrating the new theoretical views of SSCM practice-performance attained from this research investigation. A concise overview of the discussions of the research findings that shed interesting light on existing thinking in the area of SSCM is then presented in Section 6.5. Lastly, Section 6.6 completes this chapter with a summary. The position of this chapter in the thesis is illustrated in Figure 6.2.

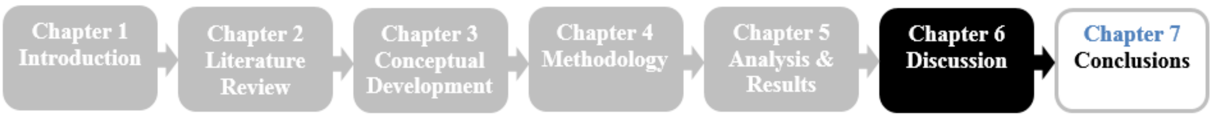


Figure 6.2 Position of Chapter 6 in this thesis

6.2 Overview of the theoretical views of SSCM driver-practice-performance

This section presents an overview of the research findings, which will be further broken down into more detail in the following sections. Referring back to the results of the data analysis, whilst not all of the individual research hypotheses were supported, the theoretical model holds together reasonably well, in accordance with the good fit of the structural model and the relative statistical support for the majority of the hypotheses (Chi-square ratio=2.370; RMSEA=0.078; NFI (0.914); NNFI (0.925); CFI (0.947); IFI (0.947)). In view of this, we believe that the proposed SSCM drivers-practices-performance model is a good representation of the theoretical relationships among the posited constructs, reflecting the study’s main research clusters, i.e. driving forces, SSCM practices, and performance outcomes. The final research model that has been informed by the study findings is presented in Figure 6.3, illustrating the organisation environmental management associated with implementing SSCM practices and their relationships with the environmental and cost performance.

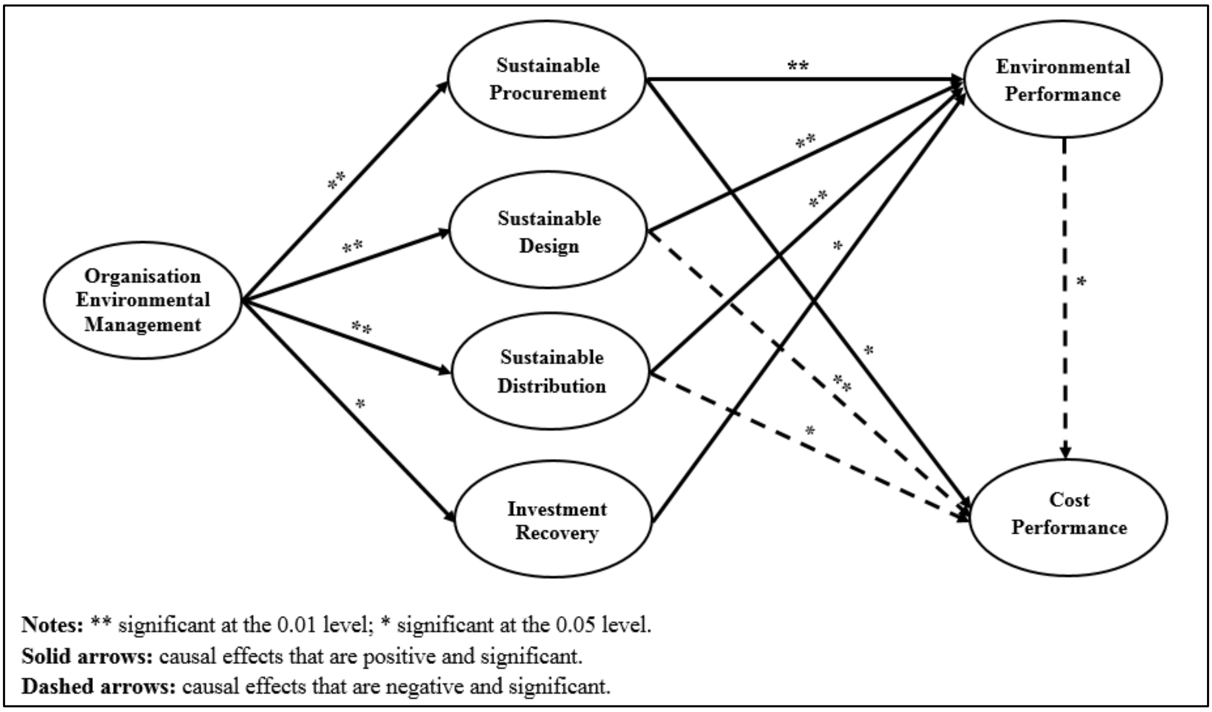


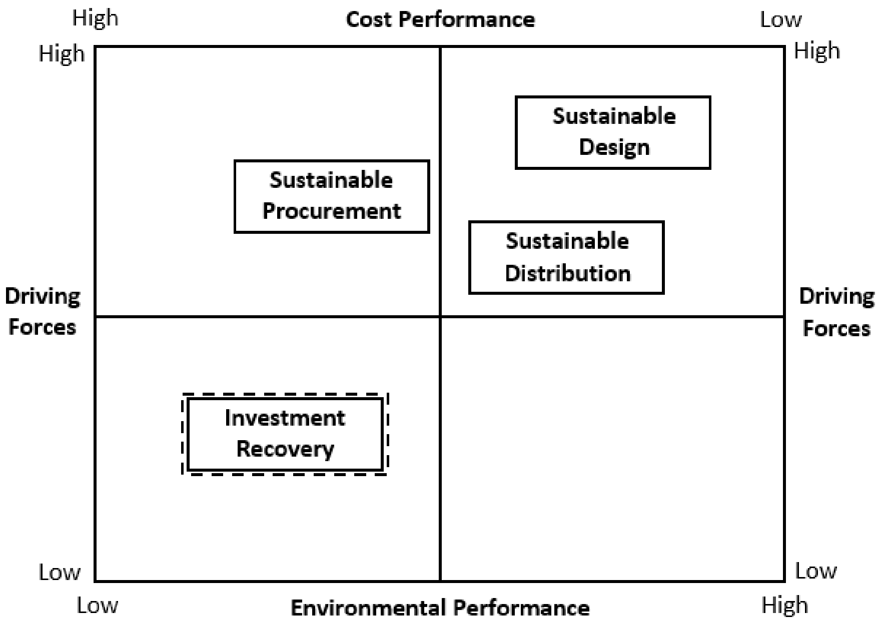
Figure 6.3 Final conceptual research model

The empirical results demonstrate relatively strong and significant linkages between the driving forces, the implementation of SSCM practices and the environmental performance of car manufacturing firms operating in the UK. As the final research model depicts (Figure 6.3), organisation environmental management (OEM), which represents the driving forces research cluster, is positively and significantly associated with the focal SSCM practices and also appears as a necessary antecedent to the successful implementation of sustainable procurement, sustainable design, sustainable distribution and investment recovery.

Thus, without the endogenous commitment and support from top-level management and exogenous environmental regulations that form the OEM construct, car manufacturing firms will not be as likely to embark upon the adoption of SSCM practices. These results confirming the research hypotheses imply that we have made a measurement (Kaplan, 2004), contributing to current literature by reporting conclusive results through reaching a consensus on recent findings. In addition, although organisation environmental management does not have a direct impact on environmental and cost performance, it does indirectly impact on performance outcomes through its effect on driving sustainable procurement, sustainable design, sustainable distribution and investment recovery.

On the other hand, the results related to the linkage between SSCM implementation, driven by the driving forces cluster represented by the OEM construct, and cost performance are not as clear-cut. This lies in the fact that we found evidence that the implementation of SSCM practices does not necessarily lead to improved cost performance, as only sustainable procurement positively affects cost performance. Drawing on Figure 6.3 and based on the empirical findings, sustainable procurement is positively and significantly associated with both environmental and cost performance. Both sustainable design and sustainable distribution are positively linked to environmental performance, whilst being negatively and significantly associated with cost performance. While investment recovery is found to be positively associated with environmental performance, it is not significantly linked to cost performance. Interestingly, environmental performance is significantly and negatively associated with cost performance, providing important insights concerning the potential trade-off between improved environmental performance and the associated increased costs.

These findings that are contrary to the research hypotheses will be the major contribution of this study to the existing knowledge within SSCM field, offering new research discoveries and research directions concerning contemporary theoretical views of SSCM driver-practice-performance. The following diagram is provided in an effort to bring the narrative together, demonstrating the research findings. Drawing on Figure 6.4, in terms of what we found, the implementation of each SSCM practice has been placed in relation to their associated driving forces, environmental and cost performance.



Note: Box emphasises the implementation of each practice;
Dashed box emphasises not significant association with cost performance.

Figure 6.4 Matrix of findings

In the context of sustainable procurement, we found that the implementation of this practice leads to the desired high level of environmental and cost performance, associated with relatively high level of driving forces compare to other SSCM practices. The most significant level of driving forces is behind the implementation of sustainable design, which implies the importance of this practice in the SSCM context. Such high level of driving forces associated with sustainable design resulted in the highest level of environmental performance while sustaining a low level of cost performance. In terms of sustainable distribution, we found roughly similar results to those for sustainable design, with relatively lower levels of environmental performance and driving forces. The empirical results further indicate that investment recovery is associated with the lowest level of driving forces, sustaining a moderately low level of environmental performance compared to the other main SSCM practices. In addition, the implementation of investment recovery does not affect cost performance.

These findings offer salient theoretical views to the SSCM body of knowledge that may open new research directions in this area. The theoretical views of SSCM drivers-practices-performance attained from our empirical observations are summarised in Table 6.1, contributing to the existing knowledge by revealing various theoretical linkages between SSCM driving forces, the implementation of proactive SSCM practices and cost and environmental performance.

Table 6.1. Theoretical views of SSCM drivers-practices-performance

Driving Forces	**SSCM Practices**	**ENV Performance**	**Cost Performance**
Environmental Regulations ☑	Sustainable Procurement	↑	↑
	Sustainable Design	↑	↓
Firms' Commitment and Support ☑	Sustainable Distribution	↑	↓
	Investment Recovery	↑	Ns
Overall theoretical view			
Implementation of SSCM practices →		ENV Performance ↑	Cost Performance ↓
Note: ☑: presence of driving forces; ↑: high level of performance; ↓: low level of performance; Ns: not significant			

Overall, the findings of the hypothesis testing show that theoretical relationships exist between the driving forces, implementation of SSCM practices, environmental and cost performances. This supports the merit of the idea that a symbiotic combination of endogenous and exogenous driving forces associated with top-level management commitment and environmental regulations give rise to the adoption of SSCM, which in turn delivers environmental benefits and can be capable of gaining partially improved cost performance (SP→CP; β=0.33, sig. at the 0.05 level). This further emphasises that both external regulatory pressures and internal firm commitment drivers should be present to drive the adoption of SSCM practices.

Furthermore, the primary theoretical view elicited from this empirical investigation is that the implementation of SSCM practices leads to improved environmental performance (sig. at the

0.01 level: SP→EP, β=0.27; SD→EP, β=0.41; SDIST→EP; β=0.36; IR→EP; β=0.24, sig. at the 0.05 level), while the cost performance is somewhat compromised, sustaining a negative trade-off in terms of cost performance (SD→CP, β=-0.29 sig. at the 0.01 level; SDIST→CP, β=-0.20 and EP→CP, β=-0.39 sig. at the 0.05 level). This denotes further that SSCM practices indeed lead to higher levels of environmental performance, but do not necessarily lead to improved cost performance and short-term profitability. This also calls for the further development of a more proactive stance on environmental practices within the context of SCM to arrive at better environmental performance together with achieving economic gains. A detailed discussion of these salient research findings contributing to the contemporary theoretical views of SSCM drivers-practices-performance are presented in the following sections.

6.3 Driving forces and SSCM practices

The empirical findings of this research investigation show that the environmental regulations together with top-level management commitment and support that form the OEM construct generally relate to UK car manufacturers implementing SSCM practices including sustainable procurement, sustainable design, sustainable distribution and investment recovery. Organisation environmental management (OEM) directly impacts all of these SSCM practices and indirectly impact firms' environmental and cost performances through the SSCM practices. In this study, OEM is found to be a major driving force that leads manufacturing firms to pursue SSCM practices, indicating the critical role of both external pressures and internal drivers in giving rise to the adoption of an SSCM agenda.

This result highlights that relying on stringent regulatory pressure can only take SSCM adoption so far and that it further requires internal commitment and support within various levels of the firm. This denotes that external regulatory pressures and internal firm commitment drivers should be in place before SSCM practices are adopted. Thus, it is contended that a symbiotic combination of both exogenous environmental regulations and endogenous top-level management commitment and support is identified as necessary and sufficient for adopting SSCM practices, given the empirical evidence concerning the statistical significance of the theoretical relationships between the driving forces and adoption of SSCM practices.

The statistical results indicate that organisation environmental management is most largely and significantly associated with sustainable design, with standardised coefficients of β=0.75 (sig. at the 0.01 level), followed by sustainable procurement (β=0.68, sig. at the 0.01 level), sustainable distribution (β=61, sig. at the 0.01 level) and lastly investment recovery (β=0.32, sig. at the 0.05 level). This observation is generally consistent with the findings of previous studies (Diabat and Govindan, 2011; Green et al., 2012a; Hsu et al., 2013), and can be explained by the fact that those SSCM practices that are more external to the focal firm normally demand more effort in their adoption due to the need for further collaboration with external groups or partners such as suppliers, customers and partner firms. Therefore, investment recovery and sustainable distribution, which are relatively more external to the firm, require more effort to be successfully implemented, represented by the magnitudes of their coefficients being relatively lower compared to other SSCM practices that are more internal to the firm.

Arguably, organisational practices that demand more effort to be implemented require more powerful driving forces to be undertaken in practice (Sarkis et al., 2010). That is why the magnitude of certain practices' coefficients are relatively lower compared to other SSCM practices that can be managed independently by individual focal firms, given the fact that typical (less severe) environmental regulation and top-level management commitment may not be enough to give rise to adopting those practices that require more effort. To further support this finding, leading manufacturing firms in developed countries such as Japan only started to initiate the implementation of SSCM practices, particularly those practices that are more external to the focal firm, after the enactment of stringent environmental regulations such as the extended manufacturer responsibility law (Zhu et al., 2010). Moreover, based on our observation, driving forces that encompass both external regulatory pressures and the internal commitment of top-level management tend to initiate the adoption of SSCM practices that are more internal to the firm (e.g. sustainable design) earlier than other practices, mainly due to the greater control that focal firms have over internal matters.

According to our empirical findings, the practice of sustainable design, which is most closely associated with the product design stage, is found to sustain the largest impact from the driving force of OEM (OEM→SD; β=0.75, sig. at the 0.01 level). The reason for this lies with the fact that most of the environmental impact of a product and its related processes are 'locked' into the product at the design stage, where the product performance concerning the energy/material saving and recycling capability is mostly determined, irrespective of where the product lies in the product life cycle (Grote et al., 2007; Zhu et al., 2013). Therefore, environmental regulatory bodies mainly attempt to enact strict related SSCM environmental regulations at the product design stage as the most effective measure to mitigate products' negative environmental impact (Hsu et al., 2013).

Moreover, sustainability-related commitment associated with the top-level management also leads the firm to target and pay more attention to the product design stage in an attempt to maximise the reduction of environmental impacts, owing to the fact that achieving environmental excellence primarily starts during the initial product design phase (Rice, 2003). In addition, since the focal firm is able to exercise greater control over the internal practice of eco-design, the commitment and support of the firm can be more effective in giving rise to adopting this SSCM practice. This observation is consistent with the findings of Zhu et al. (2013) and Green et al. (2012a), who respectively report that environmental coercive pressures and internal environmental management lead manufacturing firms to pursue eco-design initiatives. Overall, it is contended that external environmental regulations together with the internal commitment of the top-level management have caused most UK car manufacturers to adopt sustainable design practice earlier and more thoroughly than other SSCM practices, sustaining the largest impact from the driving force of OEM.

Furthermore, based on the empirical findings, sustainable procurement is found to sustain the second largest impact from the driving force of OEM (OEM→SP; β=0.68, sig. at the 0.01 level). This observation is not surprising, since this practice plays an important role within the SSCM context, as it is fairly feasible for firms to undertake (Zhu and Sarkis, 2007). Basically, sustainable procurement deals with the acquisition of environmentally friendly inputs to develop products and services that are environmentally sustainable, mitigating environmental impacts (Seuring and Muller, 2008b). Therefore, governmental environmental bodies enact purchasing-related environmental regulations mainly in the forms of various environmental compliances or EU directives to lessen negative environmental impact (Koh et al., 2012). In this respect, regional and national resource-saving and conservation regulations and their associated compliance issues have led UK car manufacturers to pursue sustainable procurement, which allows the initiation of the development of environmentally friendly products or services (Bevis, 2011).

In addition, top-level management is found to be totally committed to and supportive of sustainable procurement, as this practice usually requires relatively low organisational efforts for implementation and can be feasibly outsourced (Lee et al., 2012). It appears that both environmental regulations and top-level management commitment pay close attention to this practice, as it is relatively easy to implement (green purchasing initiatives have been in practice in the UK for over a decade), while its output is considerably significant in mitigating negative environmental impact (achieving the maximum desired outcome with minimum effort) (Walker and Jones, 2012). This empirical observation is also consistent with the findings of

Zhu et al. (2013) and Green et al. (2012a), who respectively report that coercive pressures and internal environmental management have caused firms to undertake green purchasing initiatives. Overall, it is contended that the driving force of OEM, encompassing external environmental regulations and the internal commitment of the top-level management, have led UK car manufacturers to adopt sustainable procurement practices relatively earlier and more thoroughly than some other SSCM practices.

Moreover, the empirical findings further show that the driving force of OEM is significantly and positively associated with sustainable distribution (OEM→SDIST; β=0.61, sig. at the 0.01 level). During the past few years, the UK government, in order to improve sustainable distribution and the better design of processes and logistics, has enacted stringent regional and national environmental regulations seeking to limit the use of non-renewable resources such as diesel and petrol during product transportation (Yu and Ramanathan, 2015). The UK government has also offered financial incentives such as grants and tax reductions to encourage manufacturers to embark upon using bio-fuels for their transportation systems in order to mitigate the logistical impact of material flows and product transportation (SMMT, 2015).

In addition, top-level management plays a considerable role in undertaking this practice and impacts how seriously the SSCM agenda is incorporated as a key part of the firm's mission statement. The results reveal that despite sustainable distribution generally requiring greater organisational efforts for its effective adoption due to the need to collaborate and develop plans with green third-party logistics providers, top-level management is found to be totally committed to and supportive of sustainable distribution, so that this area sustains a relatively large impact from the complementary driving forces of OEM. Therefore, it is asserted that both environmental regulations and top-level management commitment, forming the driving force of OEM, have pushed UK car manufacturing firms to adopt sustainable distribution practices. This observation is consistent with the findings of Rao and Holt (2005) and Zhu and Sarkis

(2007), who respectively suggest that greening the outbound side of the supply chain and embracing environmentally friendly packaging and distribution characteristics is largely associated with the coercive pressures behind environmental regulation and internal environmental management.

Lastly, according to the empirical findings, the practice of investment recovery is found to be significantly and positively associated, although to a lesser extent, with the driving force of OEM (OEM→IR; β=0.32, sig. at the 0.05 level). This can be explained by the fact that the practice of investment recovery is generally more external to firms, meaning that the firm has less control over the implementation of this practice (Zhu et al., 2012). Thus, regulatory bodies may not greatly influence manufacturing firms to embark upon such externally oriented SSCM practices.

In terms of senior management commitment and support, investment recovery may be fairly new to manufacturers and thus it has received relatively lower attention within top-level management compared to other SSCM practices (Green et al., 2012a). In addition, from a practical perspective, the practice of investment recovery has received less attention in practice within UK manufacturers, particularly in the car manufacturing sector (Bevis, 2011), sustaining the lowest impact from the driving force of OEM. Such empirical observations are generally consistent with the findings of Zhu et al. (2013), who report that coercive pressures exerted from government agencies are partially associated with investment recovery. Therefore, both environmental regulations and top-level management commitment as they fall within the driving force of OEM have moderately led UK car manufacturers to pursue and undertake investment recovery practices.

Overall, these research findings suggest that exogenous environmental regulations together with the endogenous commitment and support of top-level management cause most UK car manufacturing firms to embark upon SSCM implementation and should be in place before

SSCM practices are expected to be adopted. In effect, the driving forces of OEM, which encompass both external regulatory pressures and the internal commitment of the top-level management, are found to be necessary and sufficient for the adoption of SSCM practices, since all of the dependence relationships among them are positive and significant. The claim of this being necessary and sufficient is grounded in the statistical findings that show that the OEM construct positively and significantly affects all of the SSCM constructs, causing the SSCM practices to be implemented successfully on statistical grounds (one-unit change in OEM influences changes in the SP, SD, SDIST and IR constructs).

Thus, we can say that the driving force of organisation environmental management is identified as a necessary precursor to the implementation of the SSCM practices of sustainable procurement, sustainable design, sustainable distribution and investment recovery, meaning that without OEM, the SSCM practices cannot be successfully implemented. This is also in line with the focus of the research conceptual framework on antecedent and outcome effects discussed in Section 3.2 as well as the methodological foundations of the study's data analysis approach presented in Section 5.7.1. In addition, the above discussions denote an important research understanding that exogenous environmental regulations can only take SSCM adoption so far and to a limited extent, and actually the top-level management commitment and support is also required to fully and successfully drive the implementation of SSCM practices. Referring back to the SSCM triggers discussed in Chapter 2, it is worth remembering that we have treated customer pressure as a sub-attribute of governmental pressure incurred in the form of environmental regulations, given the fact that customer pressures are largely accrued within the coercive pressure of government agencies.

6.4 SSCM practices and performance outcomes

The research findings of this empirical investigation show that the SSCM practices generally relate to both the environmental and cost performance of UK car manufacturers, with the exception of IR→CP. As the final research model depicts (See Figure 6.3), all of the SSCM practices are positively and significantly associated with environmental performance, indicating that the implementation of SSCM practices leads to improved environmental performance. It appears, then, that UK car manufacturing firms have experienced greater improvements in their environmental performance, as measured by reductions in energy usage, solid waste, air emissions, effluent wastes, waste emissions and the consumption of toxic substances and harmful materials (Green et al., 2012a; Zhu et al., 2008a).

Thus, it is maintained that the implementation of sustainable procurement, sustainable design, sustainable distribution and investment recovery has reasonably reduced material consumption, generated waste, emissions, energy usage and excessive inventory, leading to the minimisation of negative environmental impacts. This demonstrates that the SSCM practices have fully accomplished their intended aim in respect of firms' environmental performance. However, the observations surrounding the impact of SSCM implementation on cost performance are less clear-cut, shedding some important light on the existing knowledge of SSCM. The research findings concerning each individual theoretical linkage between the SSCM practices and performance outcomes are discussed below, along with their relation to the position of the current literature, offering novel insights into theoretical views of SSCM practices-performance.

6.4.1 Sustainable procurement implementation and environmental and cost performance

The empirical findings show that sustainable procurement significantly and positively impacts both environmental and cost performance, with standardised coefficients of $\beta=0.27$ (sig. at the 0.01 level) and $\beta=0.33$ (sig. at the 0.05 level), respectively. The theoretical view of SSCM practices-performance obtained from this observation denotes that the implementation of sustainable procurement has led to the improved environmental performance and better cost performance of UK car manufacturers. The reason for this lies with the fact that sustainable procurement is an environmentally friendly practice by nature that facilitates the development of environmentally friendly products and services through the acquisition of relevant environmentally friendly inputs, decreasing the levels of wastes and emissions (Luthra et al., 2014).

Although the raison d'être of sustainable procurement adoption is to enhance environmental performance (Zhu et al., 2010), Green et al. (2012a) find no significant relationship between these two measures. However, the study findings here are consistent with the majority of prior studies such as those of Zhu and Sarkis (2007), De Giovannia and Vinzi (2012), Zhu et al. (2013) and Green et al. (2015) that find that the undertaking of green purchasing initiatives within the SCM context delivers environmental improvements. This consolidates the position of our findings, which are consistent with the majority of recent studies, attaining conclusive results as more studies report similar findings.

From an economic standpoint, this observation can be explained by the fact that the undertaking of sustainable procurement practice may lie with the suppliers rather than the focal firm in practice (Green et al., 2012a). Therefore, it is less costly for the car manufacturers to implement compared to other SSCM practices, as it does not require capital investment. The other reason for such a positive causal relationship between sustainable procurement and a firm’s cost performance can be offered by the fact that the UK government has recently advanced its environmental protection policies by offering financial incentives to environmentally friendly suppliers in the form of subsidies or tax reductions, playing a more active role in the transition to a more sustainable society (SMMT, 2015).

In this regard, as part of the ECO programme supply chain, the UK government provides such financial incentives to those suppliers that offer environmentally friendly inputs with relatively lower prices, even marginally, than suppliers that are not comparatively environmentally friendly (Yu and Ramanathan, 2015). This policy motivates environmentally friendly suppliers to give marginally lower price quotations compared to other suppliers so that they can benefit from the various financial incentives offered by the UK government such as environmentally related subsidies, grants and tax reductions. Arguably, this also encourages other suppliers that have less environmentally cautious processes and are not comparatively environmentally friendly to incorporate sustainable inputs so that more sustainable products and services can be developed, promoting sustainability across the supply chain. This observation is in line with the work of Zhu and Sarkis (2007), Green et al. (2012a), De Giovannia and Vinzi (2012) and Lee et al. (2012) that find that adopting green purchasing initiatives leads to improved economic performance, consolidating the study findings and diminishing any potential contradictory research directions.

6.4.2 Sustainable design implementation and environmental and cost performance

The research findings reveal that while sustainable design significantly and positively impacts environmental performance (SD→EP; β=0.41, sig. at the 0.01 level), interestingly it significantly and negatively impacts cost performance (SD→CP; β=-0.29, sig. at the 0.01 level). The theoretical view obtained from this observation denotes that the implementation of sustainable design has led to improved environmental performance with the trade-off of cost performance and profitability. It appears that the capability of eco-design to decrease environmental impacts is counterbalanced by increases in the associated costs. In essence, the SSCM practice of sustainable design is developed with a focus on the elimination of a product's environmental impacts (Grote et al., 2007). Arguably, such environmental impact minimisation leads to higher levels of the environmental performance of UK car manufacturers, yielding environmental improvements. This is consistent with the findings of Zhu and Sarkis (2007) and Green et al. (2012a, 2015).

Furthermore, as suggested by Grote et al. (2007, p. 4100) the chief aim of eco-design initiatives is to “reduce a product’s environmental impacts without creating a negative trade-off with other design criteria, such as functionality and costs”. This implies that the sustainable design practice has not fully accomplished its intended aim from the economic perspective in regards to the cost performance of UK car manufacturing firms. It is contended that this may be because current sustainable design-related practices require further development and improvement in such a way that does not harm the firm’s financial bottom line, while maintaining the desired functionality and mitigating environmental impacts. Furthermore, another reason for such negative association between sustainable design and cost performance may lie with the fact that eco-design requires capital investment, while direct cost savings are yet to be obtained in the short term (Zhu et al., 2013).

In addition to this, the practice of sustainable design typically involves both investment requirements and at the same time more time for additional training and more need for supporting technologies concerning proactive eco-design initiatives (Zhu and Sarkis, 2007). This observation sheds important light on the current theoretical views of SSCM practices-performance within the existing knowledge in this area. Interestingly, the theoretical linkages involving sustainable design are relatively strong and significant, with standardised coefficients of 0.75 for OEM→SD, 0.41 for SD→EP, and -0.29 for SD→CP. This indicates the powerful and critical role of sustainable design practices in the implementation of the SSCM approach. In light of this, the sustainable design construct appears to be the linchpin in the proposed SSCM drivers-practices-performance model.

6.4.3 Sustainable distribution implementation and environmental and cost performance

The research findings further show that while sustainable distribution is significantly and positively linked to environmental performance (SDIST→EP; β=0.36, sig. at the 0.01 level), it negatively impacts cost performance (SDIST→CP; β=-0.20, sig. at the 0.05 level). The theoretical view attained from this observation states that the implementation of sustainable distribution within UK car manufacturers leads to improved environmental performance while the cost performance is compromised. Similar to sustainable design but to a lesser extent, it appears that the capacity of environmentally friendly distribution to reduce logistical impacts is counterbalanced by increases in the associated costs, perhaps related to technological upgrades.

The positive causal relationship between sustainable distribution and environmental performance is not surprising, since this SSCM practice is generally focused on decreasing the logistical impact of material flows and the levels of environmental pollutants within product transportation (Lakshmimeera and Palanisamy, 2013). In turn, such environmental impact minimisation yields environmental improvements among UK car manufacturing firms, leading to improved environmental performance. This finding is consistent with the work of Rao and Holt (2005), Zhu et al. (2012), and Green et al. (2012a,b), consolidating the position of our findings by providing evidence for a consensus within existing knowledge to reach conclusive results.

From an economic perspective, we would argue that the lack of appropriate green infrastructures hinders the benefits of sustainable distribution initiatives from being reaped in terms of cost performance and profitability (Lakshmimeera and Palanisamy, 2013). Thus, it is contended that sustainable distribution has not fully accomplished its intended aim in bringing economic benefits while at the same time mitigating negative environmentally logistical impacts, as it requires more supporting technologies concerning environmentally friendly packaging and green distribution characteristics. This also necessitates further infrastructure investment concerning sustainable distribution initiatives in order to tackle the potential lack of green capabilities and environmentally friendly distribution characteristics. In addition, we further argue that the undertaking of sustainable distribution often involves significant process and distribution channel redesigns, sustaining increases in the associated costs (Alvarez-Gil et al., 2007).

Moreover, another reason for such a negative causal association between sustainable distribution and cost performance is down to the fact that third-party logistics providers with green expertise and capabilities tend to give higher price quotations than those that are comparatively less environmentally friendly (Pagell and Wu, 2009). Since UK car manufacturers often employ third-party or external logistics providers with green expertise and capabilities, implementing sustainable distribution practices has negatively affected the cost performance (Bevis, 2011). This observation offers salient insights concerning the contemporary theoretical views of SSCM practices-performance within the body of knowledge in this area, that the implementation of sustainable distribution leads to better environmental performance with the negative trade-off in terms of cost performance.

6.4.4 Investment recovery implementation and environmental and cost performance

Furthermore, the empirical findings exhibit that while investment recovery positively and fairly significantly impacts environmental performance (IR→EP; β=0.24, sig. at the 0.05 level), interestingly it is not significantly associated with cost performance (IR→CP; β=0.14, not sig.). The theoretical view attained from this observation denotes that the implementation of investment recovery moderately leads to the improved environmental performance of UK car manufacturers, while direct cost savings have yet to be achieved. Such a positive causal relationship between investment recovery and environmental performance can be explained by the fact the investment recovery practice is generally focused on the surplus sale of scrap/used materials and the divestment of unproductive assets of the firm (Zhu et al., 2008a).

Arguably, once firms have dispensed with their unproductive assets through effective surplus sales, the wastes and emissions associated with these assets are eliminated, along with the energy usage involved in their maintenance. Collectively, such waste and emission minimisation along with the energy usage reduction incurred in the implementation of investment recovery initiatives lead to higher levels of environmental performance. It appears that investment recovery has relatively accomplished its intended aim in respect to enhancing environmental performance, yielding environmental improvements among UK car manufacturing firms.

Although Zhu and Sarkis (2007) find that investment recovery does not directly impact environmental performance, our empirical result here is consistent with the findings of recent work by Zhu et al. (2012) and Green et al. (2012a, 2015), consolidating the position of the study in clarifying the existing contradictory directions. In addition, the opposing result may be attributable to differences in the samples, perhaps in terms of different sample sizes and regions. The research sample is relatively extensive, being made up of UK manufacturers, while the sample employed in Zhu and Sarkis's (2007) study is fairly limited in size and made up of Chinese manufacturers. In this regard, the difference can be further explained by the fact that UK manufacturers are generally more conformity oriented and thus more responsive to any coercive changes related to undertaking new environmental initiatives such as investment recovery (Walker and Jones, 2012).

On the other hand, the direct impact of investment recovery on cost performance appears to be minimal and insignificant, leveraged through environmental performance. From the economic standpoint, the reason for the non-significant relationship between the SSCM practice of investment recovery and cost performance may be that most UK car manufacturers are still at the early stage of initiating their investment recovery related initiatives (Bevis, 2011). As Bevis (2011) advocates, UK car manufacturers have only recently started to consider undertaking investment recovery initiatives, and the adoption progress still lags behind being thoroughly implemented. This may also be explained by the fact that the practice of investment recovery has received less attention in practice among UK manufacturers, particularly in the car manufacturing industry (Yu and Ramanathan, 2015).

Although the SSCM practice of investment recovery can moderately contribute to the firm's financial bottom line through surplus sales of unproductive assets such as excess inventories or scrap/used materials, the cost savings appear to be difficult to trace back in practice. This peculiar observation maintains important insights concerning the existing theoretical views of SSCM practices-performance that the implementation of SSCM practices does not necessarily lead to improved cost performance, implying that an SSCM agenda may not be necessarily profitable, or at least not on a short-term basis.

6.4.5 Environmental performance and cost performance

Lastly, the research findings interestingly reveal that environmental performance significantly and negatively impacts on cost performance (EP→CP; β=-0.39, sig. at the 0.05 level). This salient theoretical view attained within this observation demotes that the implementation of SSCM practices relatively enhances environmental performance, delivering environmental improvements within UK car manufacturing firms, while the commensurate cost performance sometimes deteriorates. It appears that the desired 'win-win' opportunity for both environmental performance and economic benefits in implementing SSCM practices have not been achieved.

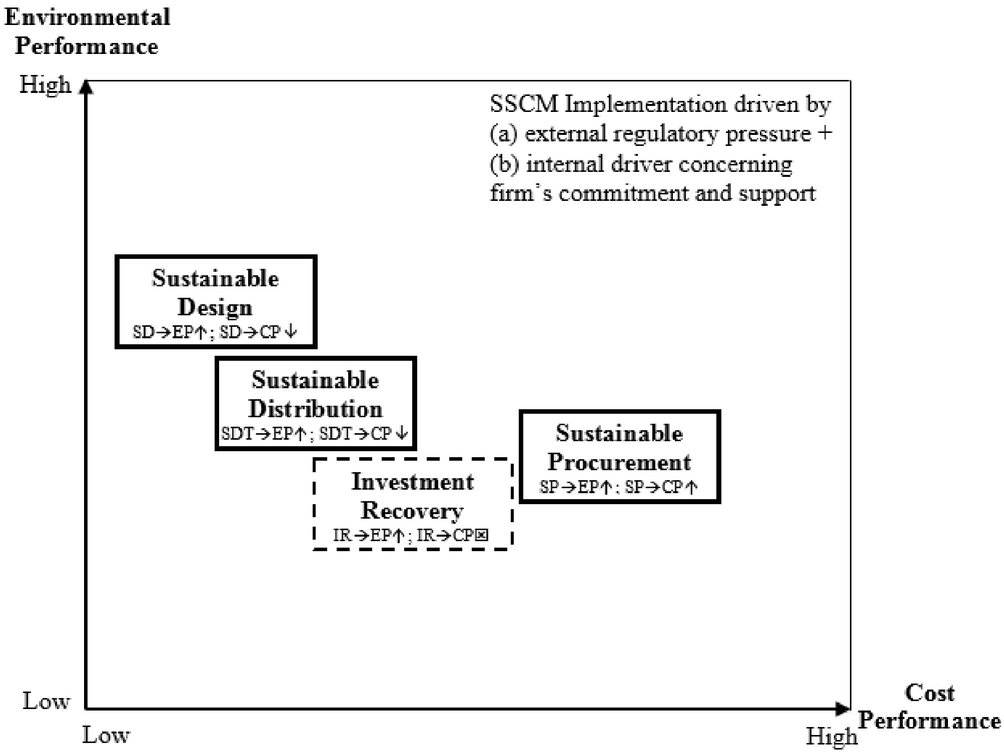
This negative causal association between environmental performance and cost performance may be down to the following main reasons: the need for capital investment requirements, the greater need for supporting technologies to support the diverse array of proactive SSCM initiatives, and the lack of appropriate green infrastructures, mainly concerning environmentally friendly packaging and green distribution characteristics. Arguably, these shortcomings hinder the merits of improved environmental performance from being reaped in terms of short-term profitability and greater cost performance.

Furthermore, based on the statistical findings and on statistical grounds, this negative association is sustained from the negative and insignificant causal relationships between some of the SSCM practices and cost performance, i.e. SD→CP, SDIST→CP, and IR→CP. This observation gives interesting insights concerning the contemporary theoretical view of SSCM performance that the implementation of SSCM practices leads to improved environmental performance while the cost performance is somewhat compromised. This demonstrates that the capability to attain higher levels of environmental performance within UK car manufacturers is moderately counterbalanced by the negative trade-off of increased cost.

6.5 Overview of discussion

Overall, the empirical findings of this research investigation suggest that the implementation of SSCM practices indeed leads to higher levels of environmental performance of UK car manufacturers, yielding environmental improvements, but does not necessarily lead to improved cost performance, as only sustainable procurement results in a positive impact on cost performance. This implies that SSCM implementation increases environmental and ecological benefits and potentially has the capacity to enhance cost performance, although its commensurate economic benefits might not be being translated into profitability on a short-term basis. This can be further discussed in accordance with the research findings that at least one of the proactive SSCM practices, i.e. sustainable procurement, enhances cost performance delivering economic benefits, while cost performance is sometimes compromised when undertaking other SSCM practices.

The research findings further maintain the idea that a symbiotic combination of both exogenous and endogenous driving forces associated with environmental regulations and top-level management commitment and support cause UK car manufacturing firms to embark upon the adoption of a SSCM agenda. This emphasises that both external regulatory pressures and internal firm commitment drivers should be present before the adoption of SSCM practices. Therefore, the research findings make a strong case that driving forces that encompass both external environmental regulations and the internal commitment of the top-level management give rise to the implementation of SSCM practices, which in turn attain performance gains in environmental protection while cost performance is partially compromised. An overview of the research discussion is presented in Figure 6.5, showing a visual representation of the research findings.



Note: Dashed box emphasises not significant association with cost performance.

Figure 6.5 Overview of the research discussion

As depicted in Figure 6.5, different levels of environmental and cost performance have been incurred in the implementation of SSCM practices, driven by a synergetic combination of both external environmental regulations and internal commitment and support of the top-level management. The research findings are largely in favour of a prediction of high levels of environmental performance along with low levels of cost performance when implementing SSCM practices, except for in the case of sustainable procurement.

Based on the SEM results, and considering the magnitude of the coefficients in the research model, the implementation of sustainable design is identified to have high levels of environmental performance and low levels of cost performance. Whilst the empirical results relatively show a similar trend for the implementation of sustainable distribution and investment recovery with a lower magnitude, the implementation of sustainable procurement is found to have marginally higher levels of both environmental and cost performance of the firm. It is worth mentioning that Figure 6.5 has been provided in an effort to demonstrate the outcomes of SSCM implementation in relation to the environmental and cost performance, summarising the research findings. Although the results presented in this figure approximately represent the statistical results, they are not entirely accurate in some cases, as Figure 6.5 is provided for the sake of visual presentation.

Furthermore, the research findings of this empirical investigation are generally consistent with the majority of prior studies, and where contradictory results exist, our findings stand with more recent studies reporting similar results (De Giovannia and Vinzi, 2012; Green et al., 2012a; Zhu et al., 2013; Green et al., 2015). This consolidates the research findings and diminishes existing contradictory directions, reaching relatively conclusive results on the topic of SSCM and its fundamental aspects of drivers, practices and performance. In addition, the new research discoveries and research directions attained within this set of empirical observations bridge the mixed theoretical views of SSCM practices-performance within the existing knowledge, giving rise to novel insights.

6.6 Chapter summary

This chapter has presented a detailed discussion of the research findings attained from the empirical examination of the hypothesised theoretical relationships that sought to answer the proposed research questions. This chapter began by addressing the final research model informed by the outcome of hypotheses testing and then proceeded to provide an overview of theoretical views of SSCM driver-practice-performance elicited from this empirical investigation. Thereafter, the research findings related to driving forces and the adoption of SSCM practices were discussed, followed by empirical findings concerning the theoretical linkages between implementing SSCM practices and the commensurate performance outcomes, contributing to the contemporary theoretical views of SSCM drivers-practices-performance. These theoretical views attained from the empirical findings were individually addressed, revealing new measurements and discoveries that have been made, giving rise to valuable insights in the area of SSCM. In this respect, the research findings were also discussed in relation to the position of the current literature, demonstrating consensus with recent studies' findings, thus being able to report conclusive results. The next chapter concludes this thesis and highlights the study's contributions, the managerial implications, research limitations and future directions.

CHAPTER 7

CONCLUSIONS

7.1 Introduction

This final chapter concludes this research project by revisiting the research objectives and proposed questions and drawing out the study's main contributions along with the key managerial implications stemming from the research findings. In addition, the limitations of the research are outlined and recommendations for future research opportunities proposed. As depicted in Figure 7.1, the chapter begins by providing a synopsis of this research study in Section 7.2, followed by Section 7.3 revisiting the research objectives. Section 7.4 then presents the answers to the research questions, revisiting the questions and addressing how they have been answered. A holistic view together with a long-term vision of SSCM is then addressed in Section 7.5, providing an overall picture of the SSCM agenda whilst delineating the future of SSCM. Thereafter, the key managerial implications elicited from this empirical investigation are presented in Section 7.6. Section 7.7 then outlines the primary theoretical, methodological and empirical contributions offered by this research, specifying a wide range of the study's significances. The research limitations and the recommendations for future research are highlighted in Sections 7.8 and 7.9 respectively, providing further directions and opportunities for future research. Lastly, Section 7.10 finishes the chapter with a summary.

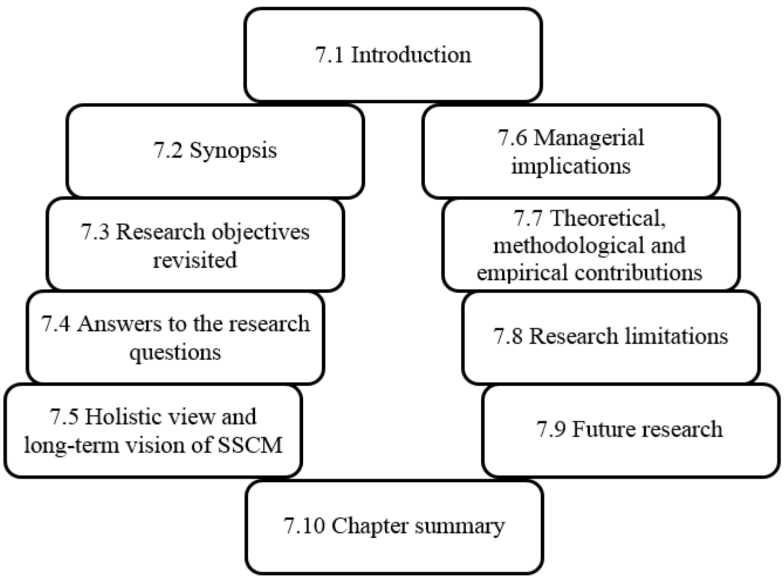


Figure 7.1 Structure of Chapter 7

7.2 Synopsis

Sustainable supply chain management (SSCM) as a thriving sub-field of SCM has been a developing topic for the past two decades, receiving increasing attention from both academics and practitioners (Linton et al., 2007; Sarkis et al., 2011). Over this time, SSCM has emerged as a popular approach by which manufacturing firms can gain economic benefits by reducing environmental risk and impacts while mitigating environmental damage (Zhu et al., 2008d; Pagell and Wu, 2009). However, during this period, considerable complexities have been observed in managing and implementing this approach (Walker et al., 2008), and most recently a number of new debates have been opened up, throwing doubt on whether the adoption of the SSCM agenda will enhance environmental protection and ultimately translate into improved profitability (Shi et al., 2012). Attempting to understand these complexities and uncertainties is necessary and of significance from both an academic and a practical perspective. In light of this and to further enhance understanding of this topic in general, this research project has theorised and empirically assessed a comprehensive model relating theoretical linkages among the fundamental research clusters of SSCM driving forces, implementation of SSCM practices and the commensurate performance outcomes.

The focus of the research was on the UK automotive industry as one of the main polluters and resource-consuming sectors within manufacturing industries, whilst constituting a major proportion of the UK's overall manufacturing output, i.e. the second largest single manufacturing sector in the UK (SMMT, 2015). In line with the manufacturing focus of the study, the automotive cluster appears to be a good representative of the manufacturing sector because of its high-volume and heavy engineering features consistent with the main characteristics and elements of traditional manufacturing. Through empirical examination, this thesis has found that that causal relationships exist between Driving Forces→SSCM Practices→ Performance Outcomes, and has revealed new measurements and new research discoveries concerning contemporary theoretical views of SSCM drivers-practices-performance.

The complementary driving force of organisation environmental management, which encompasses both external environmental regulations and the internal commitment and support of top-level management, is identified as a necessary precursor giving rise to the effective implementation of the main SSCM practices of sustainable procurement, sustainable design, sustainable distribution and investment recovery. Thereafter, this SSCM implementation driven by a symbiotic combination of both external regulatory pressures and internal firm commitment drivers in turn attains improved environmental performance, while the cost performance is somewhat compromised. The next section revisits the research objectives and proposed questions and how these were achieved and answered.

7.3 Research objectives revisited

This research study had four consecutive objectives:

RO1: To identify the essential SSCM practices along with their associated driving forces.

RO2: To explore the relationships between SSCM driving forces, SSCM practices and environmental and economic performance.

RO3: To develop validated and reflective scales to measure the main research clusters of SSCM driving forces, SSCM implementation and performance outcomes.

RO4: To conceptualise and empirically assess a comprehensive SSCM drivers-practices-performance model.

These research objectives have been thoroughly carried out in this thesis, guiding this study to answer the research questions. To achieve these objectives, this study conducted an extensive literature review of pertinent SSCM literature. In doing this, the relevant literature addressing various SSCM drivers and pressures was reviewed, outlining the triggers for SSCM (RO1), followed by reviewing the most contemporary literature surrounding SSCM performance implications. A systematic literature review approach was also employed across top-tier operations and supply chain management journals over a 23-year time frame[7] to explore and identify essential SSCM practices, resulting in the identification of 35 essential SSCM practices (RO1). A synthesis of these three main research clusters was conducted through an overlapping literature review approach, and accordingly the theoretical relationships between SSCM driving forces, SSCM practices and SSCM performance outcomes were explored and addressed (RO2).

Furthermore, the appropriate scales for measuring these fundamental research clusters have been developed by directly adopting a number of well-established measurement scales from prior research while incorporating additional measurement items found in recent studies (Zhu et al., 2008a; Esty and Winston 2009; Green et al., 2012b). Various statistical assessments were also made to ensure that the employed measures were truly reflective scales which provided sufficient evidence for the self-reporting scales, verifying the construct validity (RO3).

The effective execution of the first three research objectives (RO1-RO3) has enabled this study to achieve the last research objective to theorise a comprehensive SSCM drivers-practices-performance model (RO4). In an effort to empirically assess the theorised model, a quantitative approach was then carried out through a survey questionnaire. Accordingly, this research collected 186 sets of data from knowledgeable and experienced manufacturing managers, ranging through plant managers, supply chain managers, logistics managers, purchasing managers, operations managers, engineering managers, sales managers and industrial waste

[7] This time period was selected because the majority of high-quality research on SSCM-related studies has been published after 1990 (Giunipero et al., 2008; Ashby et al., 2012).

managers, operating within UK car manufacturing firms. Finally, the hypothesised causal relationships in the research model were examined using the structural equation modelling (SEM) technique and research findings stemming from the empirical results were then presented (RO4).

7.4 Answers to the research questions

The study formulated three main research questions:

> **RQ1:** Which factors both endogenous and exogenous to the firm need to be in place before SSCM practices are adopted?
>
> **RQ2:** What impact does the implementation of SSCM practices have on the environmental performance of the firm?
>
> **RQ3:** What impact does the implementation of SSCM practices have on the cost performance of the firm?

This research study endeavoured to answer the research questions through the effective execution of the aforementioned research objectives guiding this study. The results of this study, attained through a rigorous analysis and thorough assessment of the theorised SSCM drivers-practices-performance model, effectively answer the research questions. The model's capability of answering all of the research questions lies in the holistic and integrated nature of the research model in integrating and operationalising the three main SSCM research clusters into one comprehensive model, which has rarely been done before (Sarkis et al., 2010; Zhu et al., 2012; Lee et al., 2012; Hsu et al., 2013). Based on the acceptable model fit indices and the relative statistical significance support for the majority of the hypotheses, it is contended that the proposed model is a good representation of the theoretical relationships among the study's main research clusters, capable of answering the research questions.

Based on the empirical results, the complementary driving force of organisation environmental management, which mainly encompasses external environmental regulations and the internal commitment and support of the top-level management, is found to be a necessary antecedent to the effective implementation of SSCM practices. In effect, these research findings suggest that exogenous environmental regulations together with the endogenous commitment and support of top-level management should be in place before SSCM practices are expected to be adopted, answering RQ1. Therefore, without the endogenous commitment and support from top-level management as internal drivers and exogenous environmental regulations as external pressures, UK car manufacturing firms will not be as likely to embark upon the adoption of SSCM practices. This also confirmed that exogenous regulatory pressures and endogenous drivers concerning commitment and support of the top-level management exist in the adoption of SSCM practices, denoting that a symbiotic combination of both these pressures and drivers are deemed necessary and sufficient for adopting an SSCM agenda.

Furthermore, based on the SEM results, the implementation of SSCM practices is identified as sustaining high levels of environmental performance, yielding environmental improvements among UK car manufacturing firms. As such, these empirical findings indicate that the implementation of SSCM practices leads to the improved environmental performance of the firm and delivers ecological benefits, answering RQ2. With respect to RQ3 and based on the empirical results, the implementation of SSCM practices is identified as sustaining low levels of cost performance, providing evidence that economic benefits have not yet been thoroughly attained. In effect, these novel research findings imply that the implementation of SSCM practices does not necessarily lead to improved cost performance, as only sustainable procurement positively and significantly impacts on cost performance.

Therefore, it is broadly contended that the implementation of SSCM practices leads to improved environmental performance, while the cost performance is somewhat compromised, sustaining a negative trade-off in terms of cost performance. This research study extends current knowledge about SSCM by clarifying the newly opened proposition that undertaking SSCM initiatives is indeed environmentally necessary, enhancing environmental protection, but is not necessarily profitable in the short term, as sometimes economic benefits are not attained, sustaining increases in the associated costs. Based on such novel research findings, this thesis asserts that the desired 'win-win' opportunity for both environmental protection and economic benefits in implementing SSCM practices may not be necessarily achieved, at least not on a short-term basis. An overview of answers to the research questions is outlined in Figure 7.2, illustrating a holistic view of the research findings.

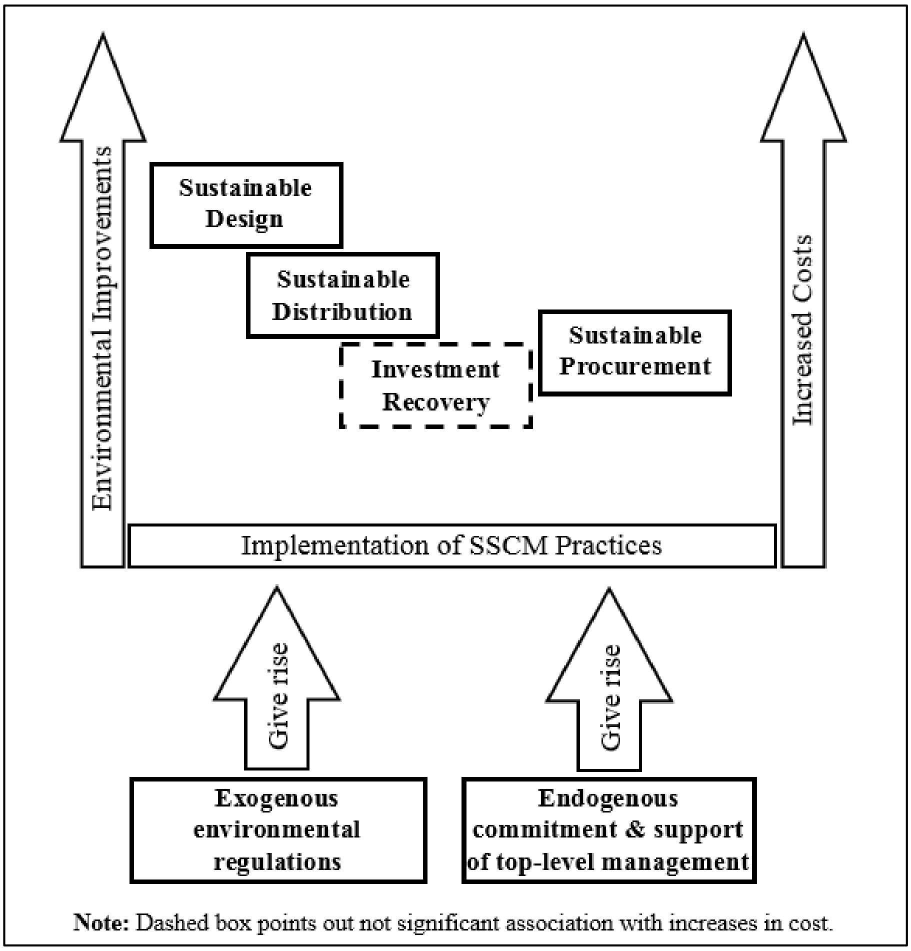


Figure 7.2 Holistic view of research findings

To briefly draw on Figure 7.2, a symbiotic combination of both exogenous environmental regulations and the endogenous commitment and support of top-level management gives rise to the implementation of SSCM practices. This emphasises that both external regulatory pressures and internal firm commitment drivers should be in place before SSCM practices are adopted. In turn, SSCM implementation generally yields environmental improvements while bringing increases in the associated costs. Only the implementation of sustainable procurement is found to deliver ecological improvements without increases in the associated costs. Figure 7.2 is provided for the sake of visual presentation so that a comprehensive understanding of the research findings can be inferred.

Before moving to the next section, the research moderately asserts that the answers to the research questions elicited within this empirical investigation are fairly generalisable and consistent for the UK car manufacturing industry, given the employed random probability sampling technique that allows statistical inference for the overall population (Saunders et al., 2009). This claim is further supported by the fact the collected samples achieved the desired characteristics of a representative sample of the target population, ensuring a sufficient level of certainty that the samples represent the population on statistical grounds. The degree of generalisability of the study may extend to a considerable proportion of other manufacturing sectors, owing to the fact that the main manufacturing characteristics and elements involved in the sector of analysis (automotive industry) are roughly similar to the main manufacturing processes involved in the majority of other manufacturing sectors (Nahm and Vonderembse, 2002; Nunes and Bennett, 2010; Luthra et al., 2014). The automotive industry broadly follows the key principles of manufacturing and also within the UK delimitation contributes to a large share of the total manufacturing output by being the second largest single manufacturing sector in the UK (SMMT, 2015). Thus, it can be a good representative of the broad manufacturing sector to some degree (Bevis, 2011). However, we recognise that in the social sciences, generalisability may not be fully attained given the constraints that are naturally associated with sampling methods, and thus the generalisability of the research findings may not be fully and strongly assured (Saunders et al., 2009).

7.5 Holistic view and long-term vision of SSCM

This section seeks to provide an overall picture of the SSCM agenda from firms' perspective in continuing undertaking such environmental initiatives. Referring back to the prospective options that firms generally encounter when implementing SSCM practices (Section 2.5.1), we can now determine those options based on the outcomes elicited within this research investigation. It is broadly contended that there is a causal chain that brings two sides of the research scope together and further justifies the study choice. The first side emphasises the idea that firms adopt SSCM practices for particular reasons, mainly external pressures and internal drivers. The second side further focuses on the consequences of the implementation of SSCM practices in terms of the environmental and cost performance of the firm. A holistic view can be obtained from joining up these two strands around firms' decision to continue the SSCM agenda. Figure 7.3 illustrates the holistic view of the SSCM agenda based on the empirical findings of this research.

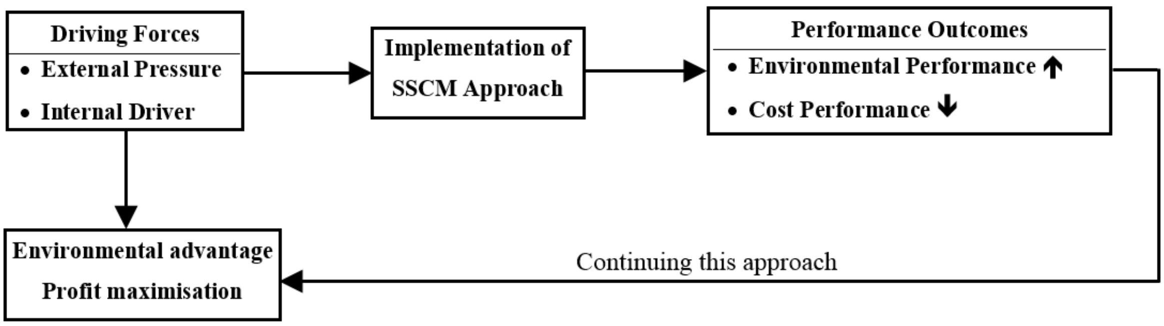


Figure 7.3 Holistic view of the SSCM approach with empirical results

Based on the research findings that suggest particular driving forces cause firms to implement SSCM practices and in turn attain environmental benefits with a negative trade-off in terms of cost performance, we would argue that firms' most likely decision in continuing this approach is as follows. Firms will probably continue undertaking SSCM initiatives in view of regulatory pressures providing a strong imperative to do so, also satisfying key stakeholders, including shareholders and customers. More importantly, from a practical perspective, whether or not firms decide to continue undertaking an SSCM agenda really depends upon the impact on the bottom line (Carter and Rogers, 2008). Arguably, if competitors continue to undertake this approach while the firm decides not to pursue it further, this will make the firm uncompetitive in today's competitive market, likely driving the firm out of business by losing customers and eventually market share (Sarkis et al., 2010).

This can be further argued by looking at the shareholders' role in influencing the firm to continue undertaking an SSCM approach in this situation. Shareholders may often acknowledge that the dividends might be relatively down when undertaking this approach, but as ethical investors they can live with the fact that actually the firm may not make as much money in the short term, because it is doing the right thing – developing services and products that are environmentally sustainable, contributing to their social and environmental responsibility (Karra and Affes, 2014).

Furthermore, even though profit maximisation is not fully accomplished in undertaking an SSCM agenda, environmental protection is attained from implementing this approach, implicitly giving the firm a competitive advantage concerning its corporate image (Paloviita and Luomaaho, 2010). With an increasingly positive environmental image, firms can achieve a range of tangible and intangible economic benefits in the longer term, mainly by reducing environmental risk occurrences that can potentially damage the brand image (Esty and Winston, 2009). This further justifies the holistic view of the SSCM agenda concerning the firm's decision to continue undertaking the SSCM approach.

Moreover, in an effort to conclude the long-term vision of the SSCM agenda, this study provides further discussions in relation to maintaining the benefits of this approach, delineating the future of SSCM. We would argue that while the merits of undertaking an SSCM agenda in terms of short-term economic benefits may not be evident, long-term benefits can be accrued. Although the SSCM approach has not directly delivered considerable cost performance improvements, it has brought environmental benefits that can further help to indirectly obtain economic benefits. Arguably, the improved environmental performance attained from implementing SSCM approaches can enhance the firms' corporate and brand image, which in turn may enlarge their market share, improving economic performance.

In addition, the critical role of government in achieving both environmental and economic benefits is central, through supporting and offering further SSCM-related financial incentives in the form of subsidies, grants or tax reductions to enhance firms' financial bottom line. This promises to allow firms to balance between environmental protection and economic benefits, thus further providing 'win-win' opportunities for both improved environmental performance and better economic performance, minimising trade-offs between environmental and cost performance. To practically accomplish this, manufacturing firms need to undertake SSCM initiatives with a broader consideration of the firm's overall economic objectives (Carter and Easton, 2011). In other words, firms are suggested to continue undertaking an SSCM approach in a bearable and equitable sense that does not harm their financial bottom line, securing 'win-win' propositions. Therefore, it is contended that the merits of the SSCM agenda can be reaped in terms of both ecological improvements and economic benefits, if the firm is able to take a long-term view on the profits gained and the prospect of the SSCM approaches becoming commercially viable.

7.6 Managerial implications

Based on the research findings of this study, the following implications can be advocated to both practitioners and policy-makers. In view of newly emerged uncertainties concerning whether undertaking SSCM initiatives can continue to maintain sustainable operations and competitive advantage in the future, practitioners are given insights into how they can obtain better cost performance from adopting the SSCM approach. In this regard, the research enables managers to better understand the relationships among the internal and external aspects of implementing SSCM practices, ensuring more effective coordination of their respective activities in order to gain a greater improvements in environmental performance so that economic benefits can be attained in the long term, e.g., through enhanced corporate image.

In addition, this research provides business practitioners with a validated framework for evaluating the synergistic impacts of the implementation of SSCM practices on environmental and cost performance. In the resource-constrained European environment, our framework broadly points to the key environmental initiatives in the supply chain that need to be implemented, i.e. sustainable procurement, sustainable design, sustainable distribution and investment recovery. These four distinct dimensions of SSCM practices offer useful guidelines for managers, serving as an audit tool and later on as a benchmarking tool to assess perceptions of SSCM in their organisations. These four dimensions encompass the most important items for the successful implementation of SSCM. Thus, manufacturers are given useful insights into which practices they need to undertake in order to achieve a successful implementation of the SSCM approach. In addition, the specific activities identified within these major dimensions of SSCM practices offer clear direction to manufacturing managers seeking to extend proactive environmental initiatives throughout their supply chains.

Furthermore, the identification of the essential SSCM practices required for the successful implementation of this approach enables managers to gain a better understanding of a diverse array of proactive SSCM initiatives. Arguably, this can help managers to identify those areas of sustainable supply chain management where improvements are required and those areas which should be prioritised. In this regard, given that sustainable design reveals the highest and most significant coefficient in the research model, the implication is that manufacturing managers should pay more attention to this practice when prioritising their SSCM efforts and treat it as the highest priority. Manufacturers are further suggested to invest in eco-design-related capabilities and technologies as valuable resources that can furnish them with strategic economic benefits. In addition, as the research findings suggest that sustainable procurement is the only SSCM practice that leads to improved cost performance, managers are advised to exploit sustainable procurement-related initiatives as a practice that is commercially viable. Thus, manufacturers should start to initiate the implementation of SSCM practices by undertaking sustainable procurement, as it is relatively easier, quicker, and less costly to implement than other practices. This can further motivate managers to pursue the SSCM agenda once they realise the benefits of this approach.

This research is also useful for regulators and policy-makers as it offers further understanding on how to motivate manufacturing firms to embark upon SSCM adoption. On one hand, increasing environmentally related incentive packages in the form of subsidies, grants or tax reductions from governments and related bodies can promote firms undertaking SSCM approaches. This will contribute to balancing environmental protection and economic benefits, supporting 'win-win' opportunities for improved environmental performance and better economic performance. On the other hand, coercive forces are also deemed to be powerful antecedents that give rise to the adoption of SSCM initiatives in the manufacturing context. Thus, it would be beneficial for regulatory bodies and governmental environmental agencies to strengthen regulatory obligations, because it is contended that firms' acceptance of environmentally related regulatory obligations can be a stepping stone to increasing the reliance on the voluntary undertaking of environmental initiatives (Karra and Affes, 2014).

Moreover, policy-makers can further promote the SSCM agenda by creating awareness concerning the benefits and performance gains achieved from implementing this approach through sharing existing successful experiences. Practitioners are also suggested to share their success stories in implementing SSCM practices and to clearly state the specific benefits attained by undertaking such environmental initiatives. Such promotion can exploit the effects of the expected economic benefits of SSCM and also help to minimise the financial risks associated with its implementation, alleviating firms' doubts about adopting this agenda (Hsu et al., 2013). Public policy-makers clearly benefit from this, as this research provides understanding that enables manufacturers to view green initiatives and the SSCM approach in particular as a means to commercial success or at least a long-term business opportunity, rather than a moral or coercive imperative. Policy-makers are further suggested to invest more in appropriate infrastructures that enhance green capabilities and expertise. This will also facilitate the benefits of SSCM practices being reaped in terms of profitability and economic performance, promoting the merits of the SSCM agenda.

In essence, this research can be useful for manufacturers, and car manufacturing firms in particular, that are either keen or required to convert their traditional supply chains into sustainable supply chains. In this respect, manufacturing firms that undertake SSCM initiatives need to ensure that their employees fulfil the overall organisational objectives concerning environmental sustainability, as the environment can also affect and be affected by employees' duties and decisions, which in turn influence firms' environmental and economic performance (Sarkis et al., 2010). Hence, manufacturers will benefit from environmental training programmes that focus on educating and increasing the environmental awareness of the firm's employees, which can further enhance the firm's business performance.

Overall, the research offers both practitioners and regulatory policy-makers interesting and reliable insights into how sustainable supply chain management operates with respect to performance outcomes in the manufacturing context.

7.7 Theoretical, methodological and empirical contributions

In essence, this study was aimed at theorising and empirically assessing a conceptual model of sustainable supply chain management (SSCM) drivers-practices-performance, linking the theoretical relationships between the integrated research clusters of driving forces, implementation of SSCM practices and commensurate performance outcomes. In achieving this overall aim that resulted in effectively answering the proposed research questions, this thesis has offered a number of salient theoretical, methodological and empirical contributions, as presented in the following sub-sections.

7.7.1 Theoretical contributions

This study mainly contributes to the SSCM field by developing a comprehensive model that is capable of assessing the impacts of SSCM implementation on manufacturing firms' performance implications with the inclusion of the effects of SSCM driving forces, using the existing fragmented and disjointed pertinent literature as a basis. Our proposed SSCM drivers-practices-performance model is the first in this area to look at the research phenomenon from a holistic and integrated perspective, integrating the three main SSCM research clusters into one comprehensive model. This has been rarely done within the contemporary SSCM literature, in particular bringing the research cluster of SSCM-related driving forces together with two other main clusters of SSCM practices implementation and its performance implications (Sarkis et al., 2010; Walker et al., 2008; Diabat and Govindan, 2011; Hsu et al., 2013). This may be down to the fact that these three research clusters are from different integrated research streams, which has made it challenging for prior studies to join these various strands together, given their fragmented and disjointed nature. In addition, existing SSCM literature concerning the drivers-practices-performance clusters have been primarily bound by their own domains and looked at their respective issues form their own disciplines (Hu and Hsu, 2010; Zailani et al., 2012; Tseng et al., 2015), whereas this study demonstrates the connections between these clusters and ties them together.

The other major contribution of this study lies in the integrated perspective and comprehensive nature of the conceptualised theoretical model, which allows a thorough understanding and accurate inferences concerning theoretical views of SSCM drivers-practices-performance. In addition, none of the previous studies have developed a theoretical model of SSCM drivers-practices-performance using a comprehensive range of proactive SSCM dimensions, i.e. sustainable procurement, sustainable design, sustainable distribution and investment recovery, which cover the main internal and external functions and activities of SSCM initiatives (Pagell and Wu, 2009; Lee et al., 2012; Hollos et al., 2012; Sarkis et al., 2012; De Giovannia and Vinzi, 2012; Zhu et al., 2012). We believe that the reason for this may lie with the fact that adopting a wide range of SSCM practices has been a challenging task, given the high degree of complexity in properly including all of the key dimensions with the appropriate theoretical justification. Moreover, since these practices are newly developed initiatives, this necessitates an extensive exploration of current studies in such a way as to reach a saturation point to state that all the main SSCM practices are included, as in this study. In this regard, this research extends the boundaries of SSCM research knowledge by providing a new validated conceptual framework for effectively assessing the impacts of the implementation of SSCM practices on the environmental and cost performances of manufacturing firms, while considering the influential effects of SSCM driving forces. This can provide a more holistic view of SSCM drivers-practices-performance clusters that will indicate research directions to improve the maturity of this body of knowledge.

Furthermore, this study brings new insights into the sustainable supply chain management literature by asserting that the implementation of the SSCM approach leads to improved environmental performance, while the cost performance is somewhat compromised, sustaining a trade-off in terms of cost performance and short-term profitability. In effect, this study further contributes to the existing knowledge of SSCM by clarifying the newly opened proposition that undertaking SSCM initiatives is indeed environmentally necessary, enhancing environmental protection, but is not necessarily a profitable business in the short term, as sometimes its economic benefits are not attained, leading to a lack of improvement in cost performance. This constitutes the new theoretical view of the SSCM paradox that the sustainable supply chain is certainly environmentally beneficial but not substantially commercially viable in the short term. This delivers important directions to the SSCM body of knowledge where sustainability is nearing a tipping point and is maintained on many firms' management agendas to stay (Haanaes et al., 2012; Kiron et al., 2013).

In addition, this research contributes to the SSCM literature by bridging the lack of clarity within the contemporary theoretical views of SSCM drivers-practices-performance by reporting conclusive findings through reaching consensus with the recent findings (Green et al., 2012a; Zhu et al., 2013; Green et al., 2015). This sheds light on the mixed theoretical views concerning the impacts of the implementation of SSCM practices on organisational performance at both the environmental and cost levels. Hence, the research findings can be used to refine existing thinking in the area of SSCM, giving rise to novel insights and providing new opportunities for future research.

Furthermore, this research develops an understanding of how a symbiotic combination of both the exogenous and endogenous driving forces associated with environmental regulations and top-level management commitment and support give rise to the adoption of a sustainable supply chain management agenda. Our study extends knowledge about SSCM by developing the valuable research understanding that exogenous environmental regulations can only take SSCM adoption so far and to a limited extent, while its successful undertaking also relies on the internal commitment and support of the top-level management. This emphasises that both external regulatory pressures and internal firm commitment drivers should be in place before SSCM practices are adopted.

In this regard, the research contribution can be further extended by maintaining the research idea that SSCM-related driving forces, encompassing both external regulatory pressures and internal firm commitment drivers, are a necessary precursor to the successful implementation of SSCM practices, leading firms to embark upon undertaking SSCM initiatives. Thus, this study makes a significant contribution to on-going research that relates sustainable practices across the supply chain to performance outcomes in a manufacturing context by the inclusion of the aforementioned complementary driving forces as a major antecedent to the adoption of such environmental initiatives.

7.7.2 Methodological contributions

The methodological contribution of this research broadly lies in the capability of the employed data analysis technique, i.e. SEM analysis, to rigorously examine the impacts of the implementation of SSCM practices on performance outcomes while taking into account the influential effects of the SSCM-related driving forces, generating more credible findings. This distinctive feature offered by the SEM technique has allowed the simultaneous estimation of a series of separate causal relationships, enabling the theorised model to be assessed as a whole, giving rise to more accurate results (Inman et al., 2011; Kline, 2011). In this regard, the SEM method enables a better comprehension of the theoretical relationships between the posited research constructs covering driving forces, SSCM practices and commensurate performance outcomes, compared with other multivariate techniques such as multiple regressions and path analysis, which are restricted to examining a single relationship at a time (Kaplan, 2004; Hair et al., 2010).

The other methodological significance of this research lies with another distinctive feature of the employed SEM method that ensures that all possible relationships between the theoretical constructs are developed, providing evidence that no other significant linkages between constructs have been disregarded (Bagozzi and Yi, 2012). Despite these advantages, Inman et al. (2010) and Hair et al. (2010) state that employing the SEM method is a challenging methodological task as it is computationally intensive, requiring a reasonable level of understanding concerning the language of the SEM concept and also SEM software programs. Thus, fully and effectively performing the SEM technique demands the necessary quantitative expertise, further demonstrating the study's methodological contribution.

Furthermore, the proposed multivariate analysis approach, i.e. the SEM technique, extends the methodological significance, as it assists this study by confirming the research argument that the existence of and response to the driving forces cluster definitely causes the relationships between SSCM practices and performance outcomes to vary. This methodological contribution also supports the study's theoretical contribution by further justifying the necessity of developing the conceptual model from a holistic and integrated perspective that covers the relevant research clusters of SSCM-drivers-practices-performance. Overall, the thorough assessment of applicable methodological implications together with a broad range of widely accepted statistical procedures conducted within this study, i.e. reliability, validity, common method variance (CMV), exploratory factor analysis (EFA) confirmatory factor analysis

(CFA), collinearity and the goodness of fit of the research model maintain the robustness of the study's statistical analyses, constituting the rigour of the methodological significance.

We further argue that this research is of methodological significance because the employed structural equation modelling (SEM) technique specifically supports the rigorous analysis and assessment of comprehensive research models encompassing antecedent, focal and consequence constructs (Schumacker and Lomax, 2010; Kline, 2011). This denotes that the methodological approach of this study is most closely relevant to the focus of the research framework on antecedent and outcome effects, further underpinning the study's methodological significance. Those studies that seek to examine theoretical relationships in their structural frameworks either with a complex model or in an integrated context, will benefit from using the SEM method (Bagozzi and Yi, 2012).

7.7.3 Empirical contributions

The topic of SSCM with a focus on firms' performance outcomes is a relatively unexplored research area in the UK, as little empirical research has been conducted in this field, particularly with regard to UK manufacturing firms and especially in the automotive industry (Nunes and Bennett, 2010; Bevis, 2011; Taylor and Taylor, 2013; Luthra et al., 2014). In essence, the existing studies investigating SSCM implementation and its associated performance gains within the UK are in the relatively early stages of development, largely dealing with anecdotal evidence (Yu and Ramanathan, 2015). Therefore, this research is of practical significance, as it presents a first wave of empirical investigation concerning the impacts of undertaking SSCM initiatives on performance implications for British manufacturing firms, and more specifically UK car manufacturers.

The notable dearth of studies empirically examining the relationships between adopting SSCM practices and performance outcomes within the UK manufacturing sector (Sarkis et al., 2010;

Zailani et al., 2012; Hsu et al., 2013), makes the empirical contribution of this study evident. In particular, those limited empirical research studies that have examined the implications of greening the supply chain within the UK have neglected to consider the influential effects of the role of SSCM driving forces when examining this topic (Walker and Jones, 2012; Yu and Ramanathan, 2015). In addition, even though existing empirical studies conducted outside the UK provide some directions on this topic, they remain inconclusive, as they are somewhat in contradiction with one another (Zhu and Sarkis, 2004; Rao and Holt, 2005; Green et al., 2012a).

Hence, the other empirical contribution offered by this study lies in tackling the concern over the lack of consensus on this topic through conducting a rigorous empirical investigation reporting conclusive results, thus reaching consensus with recent findings. Finally, it is our belief that the primary empirical contribution of this research lies in the valuable essence of the collected data. We would argue that this research is of empirical significance as it benefits from a set of high-quality data collected from a diverse array of experienced and knowledgeable manufacturing managers working within UK car manufacturing firms, which is generally difficult to obtain in practice on such a large scale (approximately 200 UK manufacturing managers).

7.8 Research limitations

As with any research, some limitations are associated with this study that open up several future research avenues, providing further research opportunities. First, we acknowledge that competitor pressures are not reflected within the driving forces construct in the research model, in accordance with the corresponding literature that suggests that competitive pressures do not play a major role in giving rise to SSCM adoption in practice (Sarkis et al., 2010; Zhu et al., 2013). In addition, it is worth mentioning that we do not directly incorporate customer pressures within the driving forces, as these are normally accrued in the form of the coercive pressures of governmental legislations (Porter, 2009). We have treated regulation as a coercive force that can act with other forces such as customer pressures, serving as comprehensive forces that embrace customers' pressures in the context of SSCM (Hsu et al., 2010).

Second, although this research sought to cover the whole premise of SSCM in the model, social performance is not directly reflected in the model. In this research, SSCM performance is mainly defined in terms of its environmental and economic performance dimensions. A direct social performance dimension could not be attained within the scope of this research owing to the dearth of measures for social performance relevant to the SSCM context (Zhu et al., 2008a; Esty and Winston, 2009; Schaltegger et al., 2014). This may be because related initiatives that fall within the social dimension are generally complex and hard to measure within the context of SSCM, which in turn has led SCM scholars to struggle to develop a set of well-established measures for social performance (Zhu and Sarkis, 2004; Wagner and Schaltegger, 2004; Tritos et al., 2013; Yu and Ramanathan, 2015). Having said that, it is beneficial to note that in this research, the social dimension is indirectly attained to some extent by taking the perspective that those firms that are attempting to undertake SSCM initiatives are generally viewed as socially responsible firms contributing to social performance (Lee et al., 2012).

Third, other possible antecedents to the implementation of SSCM practices may exist apart from the driving force of organisation environmental management, such as the importance of market orientation. In essence, the SSCM field has a multi-disciplinary and integrated nature. Evidently, the research does not assert that all possible antecedents have been included in the research model, nor can the model thoroughly enlighten us on all performance dimensions. More constructs could be added to the model, but further theoretical justification is required along with additional data acquisition, greater time and budget, which was not feasible within the current scope of this research. This may also complicate the research model with the inclusion of additional theoretical constructs and relationships.

Fourth, the theoretical model has been developed mainly with a focus on manufacturing firms without consideration of other organisation types. The research model could be modified to reflect other types of organisation such as retailers, service providers (servitisation) or wholesalers. In addition, the selected geographical area of analysis was the UK and the data were collected form a single country. Therefore, the research findings may not be completely extendable to other manufacturing sectors and other geographical contexts.

Lastly, although the recommended range of sample sizes suitable for structural equation modelling (SEM) analysis is 150-400 (Hair et al., 2010), generally SEM works better with a larger samples (Kline, 2011). In a sense, we somewhat pushed the limits of the SEM technique in an attempt to assess the fit of the whole model with 186 samples. Thus, it would be beneficial for the research model to be assessed using a larger sample and in turn verify the research findings using the additional samples.

7.9 Future research

The aforementioned limitations broadly provide opportunities for further research. In addition, the outcomes elicited within this research open up several future research avenues, providing further research directions. In light of this, the following areas for future work are central: First, with respect to competitor pressure, future research may verify the existence of competitive pressures within the driving forces of SSCM. Moreover, another research direction is to include a separate dimension of customer pressures within the driving forces. However, this may be challenging, given the current situation of SSCM studies being at the early stage in developing appropriate measures of SSCM driving forces (Schaltegger et al., 2014).

Second, considering the dearth of measures for social performance relevant to the SSCM context, further research is warranted to develop and validate a set of relevant measures for the social performance dimension consistent with the SSCM context, so that the whole premise of

SSCM can be reflected. Third, in view of other possible antecedents to the implementation of SSCM practices, future research may examine whether market orientation contributes to a firm's decision to adopt SSCM practices and further explore other possible antecedents.

Fourth, given the manufacturing focus of this study and the research model in particular, future studies may examine the applicability of the proposed theoretical model to different organisation types, e.g. retailers, service providers (servitisation) and wholesalers, and also compare these new findings with the findings from this research. Therefore, future investigation is further warranted, subject to theoretical justification and the acquisition of relevant data.

Fifth, further research is recommended to examine other developed markets to eliminate the potential effect of country-level variance in, for example, market size, legislation systems and economic development. For instance, further research may examine other geographical contexts to investigate whether there are any differences in regulatory structures and managerial norms in different geographical areas. In this regard, repeating this research for comparative analysis in other developed countries would be another research direction which could also consolidate the generalisability of the research. Moreover, future studies may investigate emerging economies such as China, as one of the world’s largest manufacturing countries, and compare the findings there with those for the developed economies.

Sixth, this study has measured economic performance in terms of reduced cost. Future studies can focus on other measurement criteria of economic performance such as market share, share price, brand image, increased profits, growth and return on assets. Thus, in future research, these types of economic measures may be used to assess a firm’s economic performance in an attempt to extend the boundaries of the economic performance dimension, not limiting it to cost performance.

Seventh, the implementation of the SSCM approach is broadly considered within the context of the supply chain and its existing functioning business processes (Green et al., 2012a,b). In view of this contextual perspective, it may be beneficial to integrate other elements into the research model that represent other improvement programmes, such as just-in-time (JIT), Lean and Agile manufacturing. Arguably, these programmes allow firms to largely benefit from the capability of the elimination of waste, which can support efforts in minimising environmental impacts, contributing to SSCM. This would be an interesting extension to SSCM studies, to understand and demonstrate the possible connections of JIT, Lean or Agile manufacturing to SSCM implementation. Another interesting direction could be the investigation of the impact of SSCM implementation that incorporates sub-systems or initiatives of JIT, Lean or Agile manufacturing on performance outcomes, and a comparison of the findings.

Eighth, further research is recommended to conduct longitudinal studies to understand the long-term patterns of the SSCM agenda and also to determine whether economic benefits of undertaking SSCM practices can be accrued in the longer term. In this regard, further longitudinal investigation of relationships identified in this research is a worthy research opportunity to ascertain the long-term economic performance improvement of the increasing environmental image attained from implementing SSCM initiatives.

Ninth, while not the primary focus of this research, it is useful to check whether the firm age and respondents' years of work experience affect the quality of data. Although the one-way analysis of variance (ANOVA) was employed, showing that the assembled dataset is treated as similar in this research irrespective of the firm size, future research may investigate the potential impact of the firm age and respondents' years of work experience on collected data, and also compare the findings with this study.

Lastly, we developed the model regardless of internal and external classifications of SSCM practices. In light of this, we recommend future research to develop the model with a staged implementation of internal and external SSCM practices and then also compare the findings with this study. In addition, future studies may further carry out a comparative analysis between the impacts of internal and external SSCM practices on performance outcomes. While considering the internal and external aspects of SSCM practices may provide a more holistic view of SSCM implementation, it may also complicate the model with additional interrelationships between internal and external practices.

7.10 Chapter summary

The final chapter has concluded the study by revisiting the research objectives, answering the research questions and addressing the key findings, whilst highlighting their managerial implications and theoretical contributions along with the research limitations and future directions. The chapter began with a concise synopsis presenting an overview of the research. It then revisited the research objectives and discussed how they contributed in answering the research questions. The answers to the research questions were also outlined and a comprehensive view of the research findings presented. Furthermore, the chapter discussed the holistic view and the long-term vision of SSCM and contended how the SSCM approach can be sustainable in the long run. Thereafter, a number of useful managerial implications were offered for both practitioners and regulatory policy-makers. The primary theoretical, methodological and empirical contributions offered by this thesis have also been presented, distinguishing the wide range of the study's significances. As final points, the limitations associated with the research were addressed, followed by providing further directions and opportunities for future research, opening up several future research avenues.

APPENDICES

Appendix A

A.1 Systematic review approach

As discussed in Chapter 2, this study attempted to employ a systematic review approach in order to extensively explore and identify the essential sustainable practices required for the effective implementation of SSCM. A systematic review generally refers to a literature review methodology centralised on research questions that attempts to identify, assess and synthesise all high-quality empirical evidence related to the research questions in order to effectively answer them (Petticrew and Roberts, 2006). The systematic review methodology was initially used in medical research and has recently been adopted in business and management studies (Crowther and Cook, 2007). In particular, a systematic review of the literature maximises both research replicability and reliability, as it clearly demonstrates how the review is conducted, providing a high level of transparency (Tranfield et al., 2003).

Accordingly, this study employed a systematic review approach to create a relatively comprehensive database of articles pertinent to SSCM and analyse them to ascertain the essential SSCM practices. A systematic review approach was conducted across top-tier operations and supply chain management journals over a 23-year time frame (1990 to 2013), with the goal of appraising potential consensus in findings and identifying essential SSCM practices. The time period was selected in accordance with the corresponding literature, which suggests that the majority of high-quality research on SSCM-related studies has been conducted after 1990 (Giunipero et al., 2008; Seuring and Muller, 2008a; Ashby et al., 2012).

This thesis recognises that a systematic literature review of the SSCM field may be a strong claim given the broadness of this topic and its multi-disciplinary nature, which requires more time and resources than are commonly available at the PhD level. Therefore, this study has employed a systematic review approach which is not necessarily a thorough systematic literature review, whilst following its chief principles. Such an approach has previously been employed by various scholars in examining operations and SCM literature (Carter and Easton, 2011; Ashby et al., 2012). With this in mind, the following eight journals were selected in order to narrow the scope to a manageable number of articles.

1. Journal of Supply Chain Management
2. Journal of Operations Management
3. International Journal of Operations & Production Management
4. Supply Chain Management: An International Journal
5. International Journal of Production Economics
6. International Journal of Production Research
7. Journal of Cleaner Production
8. International Journal of Physical Distribution & Logistics Management

The abovementioned journals are recognised as the top-tier source of empirical knowledge in the broad field of SSCM research and as being capable of addressing the most pertinent literature relevant to this field (Carter and Ellram, 2003; Giunipero et al., 2008; Ashby et al., 2012). These journals were accessed and explored through the eLibrary[8] service of the University of Birmingham. eLibrary V4.4.2 was used to search the selected journals for relevant SSCM literature following the search protocol discussed in the next sub-section.

Given the multi-dimensional expansion of the SSCM literature, this study focuses on identifying those proactive practices that are associated with core components of SSCM presented in Section 2.4.1, i.e. sustainable procurement, sustainable manufacturing, sustainable distribution and reverse logistics. This assists us in further narrowing the scope to focus on certain practices that fall within these core components, as they represent the main activities and functions within SSCM (Seuring and Muller, 2008b).

[8] The eLibrary is a gateway to all electronic resources including ejournals, at the disposal of students and staff of the University of Birmingham.

A.2 Search protocol

We used eLibrary V4.4.2, available to the author as a doctoral researcher at the University of Birmingham, to search the abovementioned journals in order to identify SSCM practices. The eLibrary provides access to the following databases, Business Source Premier (EBSCO), Emerald Insight, Science Direct, ABI/INFORM Global–ProQuest, Applied Social Sciences Index and Abstracts (ASSIA)–ProQuest, and Web of Science (ISI), which extensively cover empirical and theoretical studies of management, economics, international business, finance, marketing and accounting. The literature search was restricted to peer-reviewed publications.

Recognising the multi-disciplinary nature of the SSCM field, the following subjects that fall beyond the scope of this research were excluded from the review in an attempt to further narrow the scope of the literature: risk management, technical issues surrounding life cycle analysis, change management, supply chain security, technical issues surrounding hazardous materials, policy issues, cost modelling, supply chain safety issues, and papers where sustainability was the only focus of the article, with no connection to SCM. It is worth mentioning that the sustainability literature is extensively wide and rich compared to the SSCM literature, which is still in the early stages of development. However, this review centralised its focus on the SSCM literature in particular, as pure sustainability literature is beyond the scope of this research.

Moreover, our review only included articles that were empirical in nature. Accordingly, empirical approaches encompassing the collection and analysis of primary or secondary data with respect to the use of interviews, case studies, surveys and experiments were included along with systematic literature reviews and conceptual theory building. Articles that conducted non-empirical approaches such as mathematical modelling and papers that were primarily based on anecdotal evidence were excluded from our review.

A.3 Search process

An electronic review of all articles published in the eight abovementioned journals was conducted for 1990-2013, to search for the most up-to-date SSCM studies available as of September 2013. We used keywords in the search process which were based upon the corresponding literature (Ashby et al., 2012), and also on the inputs of a number of academic scholars, industry professionals and manufacturing experts who participated in the following conferences:

- 16th Cambridge International Manufacturing Symposium (September 2012)
- Midlands Regional Doctoral Colloquium (April 2013)
- 9th International Symposium on Global Manufacturing and China (September 2013)

The keywords used in the search process are listed in Table A.1. These keywords facilitated the search process and assisted this study to search and identify the relevant SSCM articles that cover the essential sustainable practices across the supply chain.

Table A.1. Search terms

Keywords used in the search process		
SSCM	GSCM	Sustainability
Environmental management	Sustainable purchasing	Eco-design
Environmental SCM	Industrial sustainability	SCM environmental initiatives
Economic performance	Green purchasing	Financial performance
Sustainable design	Green design	ISO 14000/1
Sustainable distribution	Green distribution	CO2 emission
Corporate social responsibility	Triple bottom line	Carbon footprint
Reverse logistics	Environmental performance	Green packaging
Clean production	Green manufacturing	Sustainable manufacturing

We employed the three databases EBSCO, Emerald Insight, and Science Direct to search in the article titles, abstracts and full texts of the abovementioned journals across a 23-year time frame, using the keywords listed in Table A.1. This electronic search process resulted in the identification of 91 papers, which created our initial database of pertinent SSCM literature. This initial database was further refined based on the criteria presented in the search protocol. In light of our search protocol criteria, we excluded 23 of the identified papers, leaving 68 articles in our database (see Table A.2) to be assessed. The 23 articles were eliminated because they:

- were not empirical in nature, mainly dealing with mathematical modelling as opposed to an empirical methodology
- were purely based on anecdotal evidence or primarily descriptive in nature
- were largely focused on public policy issues rather than the management of the supply chain.

The results of the systematic review approach that form the final database of 68 SSCM pertinent articles are summarised in Table A.2. Drawing on Table A.2, the relative wealth of literature in the SSCM field indicates the academic significance of the research phenomenon.

Table A.2. Results of the systematic review approach – identified articles

Reviewed Journals	**Number of Articles**
Journal of Supply Chain Management	6
Journal of Operations Management	8
International Journal of Operations & Production Management	12
Supply Chain Management: An International Journal	9
International Journal of Production Economics	6
International Journal of Production Research	8
Journal of Cleaner Production	14
International Journal of Physical Distribution & Logistics Management	5

The details of this search process have been given to provide a high level of transparency and for the purpose of maximising replicability. Overall, it may be a strong claim to assume that all research evidence surrounding the SSCM topic was explored, but with the clear provided instructions and rationale, this thesis endeavoured to identify the most pertinent SSCM studies.

A.4 Systematic review output

This section reports the output of our systematic review approach, addressing the identified sustainable practices required for the effective implementation of SSCM. As previously discussed, the search process resulted in the identification of 68 articles, forming our database of pertinent SSCM literature. Each of these 68 articles was individually analysed to identify the essential SSCM practices. In our analysis, we reached a saturation point, at which articles kept reporting similar subjects. In addition, we excluded a number of articles that address similar practices and approaches with different terms. We also found several practices addressed in these 68 articles that are closely linked and similar, so that we did not report similar practices more than once in our results. Furthermore, as some of the identified SSCM practices are of a similar nature and overlap, we synthesised them into a more comprehensive practice, to avoid using similar practices more than once (e.g., use of renewable energy in any mode of product transportation and use of bio-fuels in products delivery were synthesised into the use of renewable energy in product transportation). Consequently, the analysis of our systematic review resulted in the identification of 35 SSCM practices, which are outlined below. Overall, a detailed discussion has been provided concerning the search protocol and the search process involved in conducting the systematic review to maximise the replicability and reliability of this research investigation, demonstrating the rigour of the research process.

Accordingly, 68 pertinent SSCM articles were identified, which further led to the identification of 35 SSCM practices. These 35 essential SSCM practices are concisely outlined below.

Establishing environmental requirements for purchasing items

Various pieces of environmental legislation have been introduced globally and come into force across the world, such as RoHS-UK, RoHS-California, and RoHS-China (Koh, 2012; Hu and Hsu, 2010). Thus, it would be difficult to effectively determine which are hazardous substances without establishing environmental requirements for purchasing items. This emerging issue necessitates a need to formulate green purchasing requirements as a management method to certify that products conform to different environmental legislation and comply with consumers' requirements. Consequently, environmental standards in purchasing initiate constructive dialogue amongst suppliers, underpinned by a joint commitment to improving quality (Lamming and Hampson, 1996). Moreover, this motivates suppliers to be more concerned with the activities of their sub-tier suppliers (Hu and Hsu, 2010). Therefore, establishing environmental requirements for purchasing items is of importance within a SSCM context as it enables firm to remain up to date with environmental requirements and standards (Bowen et al., 2001). Thus, establishing environmental requirements for purchasing items is deemed as one of the essential SSCM practices required for the effective implementation of the SSCM approach.

ISO 14001 certification for firms and suppliers

ISO 14001 refers to an internationally accepted environmentally related standard that provides direction on how to establish an effective environmental management system to enhance a firm's environmental performance (Babakri et al., 2003). The International Organization for Standardization (ISO) based in Geneva issued the ISO 14000 series along with other ISO series as independent guidelines that are accepted worldwide to assist firms in remaining commercially successful without overlooking environmental responsibilities (ISO, 2004). In essence, the ISO 14001 system enables firms to simultaneously undertake social, environmental and financial objectives, potentially without making trade-offs and sacrificing any of these objectives (Morrow and Rondinelli, 2002).

Chiarini (2012) argues that ISO 14001 provides firms with an effective framework that enables them to meet the heightened expectation of their customers around corporate social responsibility along with increasing environmental legislation whilst maintaining their profitability. Basically, the ISO 14001 system offers an opportunity for firms to put an effective environmental management system in place and to obtain third-party certification (Babakri et al., 2003). In view of this, the ISO 14001 system helps firms to provide a simplified, rationalised approach to environmental management across all levels of the firm and also to manage their supply chain with the same principles, existing polices and internal tools (Curkovic and Sroufe, 2011). From a practical perspective, ISO 14001 aids firms to decrease the level of generated waste, emissions and consumption of energy and also introduce a continuous improvement system which is up to date with new technological advancements (Chiarini, 2012; Guoyou et al., 2012).

Today, ISO 14001 is applied for by various manufacturing firms of all sizes and types, and numerous firms have obtained certification of compliance by implementing a certain number of environmentally oriented practices in the form of an effective environmental management system (Guoyou et al., 2012). In conjunction with Curkovic and Sroufe (2011), the chief aim of implementing such an environmental management system offered by ISO 14001 is to continuously enhance firms' environmental performance by reducing negative environmental impacts which ultimately leads to promoting a sustainable supply chain approach.

The ISO 14001 standard involves a series of requirements that form the effective environmental management system. A number of principal requirements involved in the ISO 14001 standard are addressed, as provided by (ISO, 2004): environmental policy; legal and other requirements; resources, roles, responsibility and authority; competence, training and awareness; communication; documentation; control of documents; emergency preparedness and response; monitoring and measurement; evaluation of compliance; nonconformity, corrective action and preventive action; control of records; and internal audit (Chiarini, 2012). Indeed, all these requirements permit firms to demonstrate a rational position on sustainability concerning their supply chain by minimising their negative environmental impacts, which eventually enhances their environmental performance. Furthermore, Babakri et al. (2003), Zhu et al. (2008a) and Curkovic and Sroufe (2011) argue that ISO 14001 certification should also be applied to suppliers in order to ensure their compliance. They further discuss that suppliers' ISO14001 certification plays a vital role within the SSCM context, as it assists focal firms in enhancing their economic and environmental performance.

Therefore, firms' ISO 14001 along with suppliers' ISO 14001 certification are deemed to be one of the essential SSCM practices that significantly facilitates the implementation of the SSCM approach.

Establishing an environmental risk management system

Regarding SSCM risk management, particularly when consumption of harmful or hazardous materials is involved, Walke et al. (2010) and Evans and Johnson (2005) argue that product-specific assessments are essential, to identify parts or sub-assemblies with the greatest risk of environmental compliance along with their relevant suppliers responsible for those parts or sub-assemblies. In order to achieve this, their studies suggest a risk-based supply chain compliance programme which combines both product and suppliers risk in determining the overall situation of risk across the supply chain. Hu et al. (2008) assert that it is imperative for manufacturing firms to establish an environmental risk management system for SSCM initiatives which facilitates distinguishing green components and hazardous substances. As further emphasised by Hu et al. (2008), a novel risk-assessment framework of green components to hazardous substances used in a product has been developed which systematically detects high-risk parts or components. This is highly useful in the quality control process, as it relays data to incoming quality control staff in order to improve the efficiency of inspection of many green components (Varzandeh et al., 2014).

Effective communication within companies and with suppliers

It is paramount to establish an effective communication platform between focal firms and sub-tier suppliers in order to facilitate SSCM practices (Lippmann, 1999). Carter and Easton (2011) and Handfield et al. (2005) assert that focal firms must establish clear, consistent and regular communication with their suppliers and other sub-tier partners covering environmental issues in their supply chain. In-turn, this necessitates suppliers to understand how to implement SSCM initiatives in accordance with the requirements of their clients. Simultaneously, firms also need to communicate their environmental goals within their own hierarchy to ensure that the personnel within the organisation understand how these goals relate to their individual functions, particularly as SSCM implementation involves various and complex issues (Vachon, 2007; Vachon and Klassen, 2006). Consequently, an effective communication platform is required to: 1) increase awareness of SSCM initiatives amongst employees, and 2) to eliminate barriers to the successful implementation of SSCM practices (Linton et al., 2007).

Environmental auditing for suppliers

Integrating auditing into supplier management within a SSCM context can allow suppliers to undertake social and environmental initiatives and also ensure that suppliers implement SSCM practices (Hu and Hsu, 2010). Handfield et al. (2005) proffer that the SSCM approach involves the introduction and incorporation of environmental issues into SCM activities, thereby auditing suppliers via environmental performance metrics. In conjunction with this, Yuang and Kielkiewicz-Yuang (2001) argue that onsite third-party auditing can enhance suppliers' performance; however, some suppliers may be reluctant to make themselves privy to an audit. Therefore, some firms emphasise 'best practice' and adopt a collaborative tone for these audits, furnishing them with an opportunity for shared learning that will strengthen their partnerships with focal firms (Lippmann, 1999). Wee and Quazi (2005) argue that environmental auditing for suppliers can ensure that environmental and social issues are continuously incorporated into suppliers' operations, which enables focal firms to achieve their sustainability vision. Thus, environmental auditing for suppliers is deemed to be one of the critical practices that ensures effective implementation of the SSCM approach.

Environmental policy for SSCM

Environmental policy simply refers to the responsibility and commitment of a firm to the environmental laws, legislations, and other policy mechanisms related to environmental issues (McCormick, 2001). These issues generally comprise solid and effluent waste, emissions, pollution and consumption of hazardous or harmful materials, which are highly significant in a supply chain context where the product life cycle is closely linked with environmental impacts (Faulkner, 2005). Establishing environmental policies ensures the greater effective use of natural resources and the reduction of negative environmental impacts, whilst still meeting customers' expectations concerning cost and quality (Kara et al., 2005). In order to increase and deliver awareness of environmental issues among staff, suppliers and customers, the focal firm needs to draw up a SSCM environmental policy for their suppliers and customers (Yuang and Kielkiewicz-Yuang, 2001). Hence, focal firms can facilitate the implementation of SSCM practices by establishing an environmental policy for their suppliers outlining their position on sustainable procurement, sustainable design and manufacturing, and supplier auditing (Hu and Hsu, 2010). Therefore, the production of an environmental policy is deemed to be one of the critical SSCM practices that facilitates the implementation of the SSCM approach.

Cross-functional integration

The effective implementation of different sustainable practices across the supply chain is complex due to the broad scope of the SSCM context, which necessitates the integration of a cross-functional team of representative personnel within and across the firm's supply chain to achieve optimal synergy (Hu and Hsu, 2010). This approach integrates different groups of personnel with various functional expertise throughout the supply chain, and leads them to work towards a common goal (Krajewski and Ritzman, 2005).

According to Yuang and Kielkiewicz-Yuang (2001), these cross-functional teams should mainly consist of purchasing, sales, R&D, logistics and environmental personnel, alongside personnel from other relevant departments. It should be noted that all of these cross-functional teams can be found in leading manufacturing firms, where the most advanced strategies for sharing sustainability oriented information are established (Zhu et al., 2010). Furthermore, effective implementation of SSCM practices can be successfully achieved through the integration of environmental issues within existing supply chain management strategies applied throughout the procurement, design and distribution processes (Handfield et al., 2005; Kuik et al., 2011). In essence, cross-functional integration on environmental management concerning SSCM practices is vital for the effective implementation of the SSCM approach (Fisal, 2010). Thus, cross-functional integration is deemed as one of the essential SSCM practices required for the effective implementation of the SSCM approach.

Environmental education and training

The initial implementation of sustainable initiatives concerning SSCM practices often brings challenges to manufacturing firms, such as practices often being extremely complex, resulting in most employees not being aware of sustainability principles (Faisal, 2010). To this end, education and training programmes related to sustainability issues should be launched to promote environmental awareness amongst firms' staff and suppliers (Hu and Hsu, 2010). This provides a better understanding of SSCM initiatives and leads to improved perception concerning what constitutes sustainability in a supply chain (Carter et al., 1998).

Walker et al. (2008) assert that environmental education and training programmes provided by focal firms can greatly improve staff's environmental awareness about sustainable practices in SCM. They conclude that effective SSCM implementation requires the support and cooperation of firms' staff and suppliers, which cannot be achieved without environmental education and training. Moreover, as put forward by Lippmann (1999), a broad range of training can enhance suppliers' own environmental management capabilities, which eventually decreases the risks for both focal firms and the network as a whole. In essence, awareness about sustainable practices in the supply chain along with environmental education and training play a vital role in staff and suppliers accepting the necessity of environmental management, which can further lead to the adoption of social and environmental initiatives (Lee et al., 2012). Therefore, environmental education and training is of paramount importance within the SSCM context and is deemed as one of the essential SSCM practices.

Manpower involvement

As previously discussed, SSCM is of a broad nature, and manpower issues are closely involved throughout the supply chain. The effective implementation of SSCM practices is greatly associated with manpower involvement, as the staff of various departments of the focal firm are highly engaged in the whole network of activities throughout the supply chain (Faisal, 2010). Evans and Johnson (2005) proffer that the personnel of various departments should take responsibility for individual requirements and the impact of environmental legislation because they appreciably affect the main activities involved in the procurement, production, distribution and reverse logistics processes. Moreover, achieving such optimal synergy in the successful implementation of SSCM practices depends upon the people and their individual functions operating within and across the firm's supply chain (Linton et al., 2007). Those manufacturing firms which are struggling with a shortage of resources and a lack of manpower are unlikely to effectively adopt and implement sustainable practices across their supply chains (Vachon and Klassen, 2006; Diabat and Govindan, 2011). Therefore, manpower involvement is deemed as one of the important practices that facilitates the implementation of the SSCM approach.

Information system (IS)

Effectively managing a sustainable supply chain involves the collection and integration of relevant information on each division and each stage in a chain within a firm (Zsidisin and Hendrick, 1998). This should include information on materials, assemblies and products as well as documents and reports provided by suppliers (Hu and Hsu, 2010). The concept of the information system has, in the past two decades, received significant attention in the SCM field, particularly within the SSCM context, as it furnishes firms with a wide variety of capabilities. These capabilities that information systems (IS) offer to firms focus on the performance of their supply chain, which can assist firms in monitoring their own business functions and operations as well as those of their suppliers (Grabis et al., 2007). This indeed can improve the environmental performance of firms.

Evans and Johnson (2005) assert that manufacturers must establish a database based upon information received from their suppliers in order to determine their compliance with environmental legislations. Walker and Jones (2012) further emphasise the importance of IS in SSCM and state that several manufacturers are currently implementing enterprise resource planning systems, which will assist in centralising procurement information worldwide and evidently enable the focal firm to closely monitor its suppliers in high-risk business areas. In addition to this, Green et al. (2007) state that the information system is a part of the supply chain infrastructure and also from a practical perspective is of paramount importance within a SSCM context. Therefore, the information system is deemed as one of the essential practices in the implementation of the SSCM approach.

Top management support and commitment

According to Zhu et al. (2008a) and Carter and Carter (1998), top management support is one of the most important practices in the SSCM context. This refers to the practice of accepting and developing SSCM as an essential organisational strategy through the support and commitment of senior managers to mid-level managers within a firm. It has been noted by many leading SCM professionals and environmental consultants that top management acknowledgement of and support for their efforts plays a vital role in the success of the SSCM initiatives of a focal firm (Lippmann, 1999; Rice, 2003). Roberts (2003) and Faisal (2010) assert that when top management provides a clear and meaningful vision of the environmental sustainability within and across the firm’s supply chain, this ensures that SSCM strategies go forward despite the challenges. In addition to this, setting a sustainability vision as an organisational imperative within the strategic level requires the continuous commitment and support of top management. This indeed facilitates the adoption of environmental management programmes and also allows effective implementation of other SSCM practices (Zsidisin and Siferd, 2001).

In conjunction with Wee and Quazi (2005), top-level management assists firms in setting a corporate policy and an environmental vision from an intra-organisational perspective. In light of this, focal firms must establish an overall strategy incorporating environmental and social inputs to direct their efforts in achieving such sustainability vision. Once a sustainability vision has been established within the focal firm as a strategic imperative through the support and participation of top management, social and environmental considerations can be integrated into the firm’s operations and critical business functions (Wee and Quazi, 2005; Green et al., 2012a).

Evans and Johnson (2005) argue that senior management must lead this initial exposure assessment and some senior or mid-level managers must be assigned with the responsibility of directing this effort. In addition, Handfield et al. (2005) maintain that top management within the company must recognise the significance of environmental issues in their supply chain. Top-level management pushes firms to accept the necessity of environmental management and then implement a set of proactive practices and environmental management programmes which promotes a sustainable supply chain strategy (Lee et al., 2012). In other words, the top management support role is considered as a necessary antecedent to the effective implementation of SSCM practices. Therefore, we can conclude that top management support and continuous commitment is highly crucial for the implementation of sustainable supply chain management. The continuous commitment of top-level management is vital in maintaining a sustainability vision within the firm and ensures that sufficient resources are being allocated to implement certain social and environmental initiatives (Wee and Quazi, 2005). Hence, the practice of top management support and commitment is deemed to be one of the most essential practices required for the effective implementation of the SSCM approach.

Establishing an environmental database of products

Zsidisin and Siferd (2001) state that a focal firm should establish a database of information provided by prospective suppliers concerning materials purchases. The rationale for this lies in considering the firm's compliance with environmental legislation and directives, particularly compliance related to the use of hazardous and harmful materials in the product development stage.

In response to scarcity of resources and environmental degradation, regulatory bodies have developed different pieces of environmental legislation, such as the Energy-using Products (EuP) directives, to enhance firms' environmental performance (Kautto, 2007). The EuP directive obliges manufacturers to incorporate eco-design implications into the product design stage and construct eco-profiles for products through a life cycle assessment approach (Hu and Hsu, 2010; Wang and Gupta, 2011). This entails an approach in which the top priority is to gather a comprehensive inventory of environmental data for products throughout their life cycles, which aids as a foundation for generating eco-profiles (Evans and Johnson, 2005).

Therefore, it is fundamental to establish an environmental database that is capable of acquiring systematically large amounts data concerning materials compliance. This facilitates the analysis of the environmental impacts of materials, parts or sub-assemblies, which ultimately aids in assessing the overall environmental impact of the end-product (Chunga and Wee, 2011). Thus, establishing and launching an environmental database of products is also deemed to be one of the critical practices within the SSCM context that facilitates the implementation of the SSCM approach.

Environmental compliance statement

Compliance statement requests are one of the most significant measures within SSCM practices. This involves conforming to environmental laws, standards and requirements (Hsu and Hu, 2008). According to Evans and Johnson (2005), compliance statements should include a date(s) of compliance and outline supplier requirements, such as procedures for verification of compliance – i.e. testing documentation. This process is two-fold: firstly, it acts as a supplier's guarantee that all of the raw materials, parts and products which are manufactured conform to the regulations; secondly, it holds them responsible for any liability incurred (Wee and Quazi, 2005). Luthra et al. (2014) further endorse that environmental compliance is of paramount importance within the SSCM context as it ensures that suppliers guarantee that their operations and services conform to legislation. Hence, the environmental compliance statement is deemed to be one of the essential SSCM practices as it assists firms in the consideration of compliance with the requirements of regulations and directives.

Green purchasing

This involves incorporating sustainable principles into purchasing which can be achieved through cooperation with suppliers with the purpose of developing environmentally friendly products (Carter and Carter, 1998). Handfield et al. (2002) argue that an increased emphasis upon purchasing as a participant in the corporate sustainable enterprise has only recently emerged within the debate on green purchasing, due to the convergence of several developments that have highlighted the purchasing role in effective environmental approaches. Green purchasing practices urge manufacturers to provide design specifications to their suppliers that carry environmental requirements for purchasing items (Zhu et al., 2008a; Zsidisin and Hendrick, 1998). Furthermore, this would help suppliers to make informed decisions concerning who to collaborate with for materials, parts, sub-assemblies, and services that support their environmental purposes (Zsidisin and Siferd 2001; Lamming and Hampson, 1996). Luthra et al. (2014) outline that green purchasing is a part of the sustainable supply chain infrastructure and plays a critical role in this context because it helps firms to develop products that are environmentally sustainable by providing them with materials that support environmental goals. Therefore, green purchasing is deemed to be one of the essential practices required for the implementation of the SSCM approach.

Bill of materials

The bill of materials (BOM), also known as the product structure, is the list of materials, parts, components and sub-assemblies used in manufacturing a final product (Reid and Sanders, 2002). As Hsu and Hu (2008) mention, BOM aids to identify restricted substances in all materials, components and sub-assemblies used in the finished product. Evans and Johnson (2005) also claim that it is imperative for manufacturers to not only know which substances are prohibited in their products, but to also know which substances and materials are used in them, which can be achieved by using the bill of materials. The BOM plays a vital role in inspections of various compliances as it provides the focal firm with the list of all sub-materials used in the product (Chien and Shih, 2007). Therefore, use of the bill of materials is also considered to be one of the critical SSCM factors required for the effective implementation of SSCM.

Supplier evaluation and selection

Today, manufacturers spend a substantial proportion of their revenue on purchasing goods and services from their various suppliers (Vonderembse and Tracey, 1999). This makes a manufacturing firm's success highly dependent on their interactions with suppliers, seeking to establish effective partnerships through strong relationships which benefit both sides. Thus, as is further emphasised by Lamming and Hampson (1996), Godfrey (1998) and Vachon and Klassen (2006), suppliers play a critical role in manufacturing firms' activities, particularly across their supply chain, where firms deal with environmental issues and sustainable practices. Considering the critical role of suppliers in the firm's environmental sustainability and ecological performance, supplier selection is deemed a pivotal activity in the SSCM context (Godfrey, 1998; Jayaraman et al., 1999; Rao, 2002; Chien and Shih, 2007).

Basically, it involves a process of evaluating and approving potential suppliers through various assessments to identify the appropriate suppliers in terms of cost, quality, reliability and service (Gordon, 2008). Such process also extends to monitor and measure current suppliers' performance for the purposes of mitigating risk, reducing costs, maintaining consistent quality and driving continuous improvement (Monczka et al., 2008).

According to Yuang and Kielkiewicz-Yuang (2001), if appropriate consideration of supplier selection is not in tandem with environmental requirements and legislation, a focal firm may be at risk of a disrupted supply chain, which may eventually lead to a remarkable loss in terms of both financial and corporate matters. For instance in 2001, the Netherlands government blocked more than 1.3 million boxes of PlayStation2 games consoles made by Sony Corporation due to the high level of the toxic substance cadmium in the cables of the gamepads, which exceeded the allowed amount. This incident caused over $130 million losses, and led to the re-inspection of more than 6,000 manufacturing plants (Esty and Winston, 2006). Consequently, Sony Corporation established a new supplier management system that involves a supplier selection process with a focus on environmental criteria and requirements (Luthra et al., 2014).

Hence, leading manufacturing firms have recently exerted pressure on their suppliers to both achieve improved environmental performance and implement a supplier rating-system which enables them to recognise high-risk suppliers in their supplier selection process (Zhu et al., 2005; Hu and Hsu, 2010). Chien and Shih (2007) and Luthra et al. (2014) assert that supplier evaluation and selection is of paramount importance within the SSCM context, as it is highly associated with both the environmental and economic performance of the firm. This can be explained in the sense that suppliers play a critical role in purchasing management and can significantly impact the environmental and economic aspects of the supply chain by providing firms with materials that support environmental goals at a clearly competitive price. Therefore, supplier evaluation and selection is deemed to be one of the most essential practices within the SSCM that facilitates the effective implementation of the SSCM approach.

Cooperation with customers

Customer cooperation is of paramount importance for firms when investing in any strategic changes in their existing practices to adopt new policies and practices such as proactive environmental management programmes (Zhu et al., 2010; Luthra et al., 2014). Lakshmimeera and Palanisamy (2013, p. 48) further endorse this by arguing that in today's customer-driven market, any change in organisational level concerning the environmental practices of a firm cannot be accomplished unless they are substantiated by good cooperation from customers. Moreover, they assert that environmental practices are highly dependent upon cooperation from customers. The success of the effective implementation of SSCM practices requires cooperation with customers throughout the whole supply chain, including the procurement, design, production and distribution chains (Chien and Shih, 2007; Green et al., 2012a). Therefore, cooperation with customers is deemed to be one of the most essential SSCM practices required for the effective implementation of the SSCM approach.

The practice of cooperating with customers is made up of a number of SSCM sub-practices including cooperation with customers to use less energy during product transportation; cooperation with customers on green packaging; cooperation with customers on cleaner production; and cooperation with customers on eco-design.

Use of renewable energy

Today, many forward-thinking organisations and leading manufacturing firms are using modes of renewable energy in their product development, packaging and transportation (Zhu et al., 2010). Renewable energy is commonly referred to the sort of energy generated from resources which are naturally replenished around the globe, including rain, geothermal heat, wind and sunlight (Ellabban et al., 2014).

The use of renewable energy has enabled humankind to replace conventional types of fuels in a number of major distinct areas such as motor fuels, hot water heating, electricity generation, rural or off-grid energy services, and space heating (Boyle, 2012). Moreover, the use of renewable energy helps manufacturing firms to enhance their packaging and logistics characteristics, which can lead to a reduction in the associated negative environmental impacts (Ellabban et al., 2014). Hence, the implementation of practices surrounding renewable energy is of importance within a SSCM context, as it helps firms to increase their energy efficiency and enhance their environmental performance.

Zhu et al. (2010) highlight the role of renewable energies concerning firms' packaging and logistics characteristics within the context of SSCM. They argue that these renewables help firms to reduce their energy consumption by providing space heating, natural lighting and electricity generation during the process of product packaging. Furthermore, the use of renewable energy in the form of bio-fuels such as bio-diesel can help firms to enhance their environmental performance in their distribution processes, as the use of bio-diesel improves fuel consumption level whilst reducing emissions (Boyle, 2012; Yung et al., 2008). Thus, the use of renewable energy is deemed to be one of the vital SSCM practices that facilitates the implementation of the SSCM approach. The use of renewable energy practices includes two

SSCM sub-practices as follows: the use of renewable energy in product transportation; and the use of renewable energy in the process of product packaging.

Tracking the development of directives

Various pieces of environmental legislation such as End of Life Vehicle (ELV), Waste Electrical and Electronic Equipment (WEEE), Energy-using Products (EuP), Restriction of Hazardous Substances (RoHS), and so forth, have spread across the world, particularly within Europe where the emerging issue of developing environmentally sustainable products has been rapidly picked up and adopted (Koh, 2012; Boysere and Beard, 2006). Moreover, Turner (2007) endorses this by indicating that UK, Germany and France are forerunners in developing environmentally friendly products within the EU. Gerrard and Kandlikar (2007) argue that these environmental legislations which are imposed by EU as directives, enhance firms' environmental performance and enable them to demonstrate a rational position on environmental sustainability.

Therefore, it is imperative for focal firms to track the development of environmental legislation and directives and cross-check them with their suppliers as these directives are continuously updated. For instance, with respect to the emerging hazardous materials legislation, firms are encouraged to track the restricted substances and exemption annex of the RoHS directive to verify compliance with the latest updates on environmental requirements (Evans and Johnson, 2005; Wright and Elcock, 2006). In the absence of a systematic mechanism for collecting updates concerning information on environmental legislation, firms cannot avert the risk that their end-products do not comply with the up-to-date environmental legislation and the allowed limit of chemicals and hazardous substances (Hu and Hsu, 2010). Bowen et al. (2001) further endorse that firms must track the development of directives to remain as up to date as possible with increasing environmental requirements and standards. Thus, tracking the development of directives is deemed to be one of the critical SSCM practices required for the effective implementation of the SSCM approach.

Eco-design

Today firms face the emerging trend of sustainability, and in response to this on-going movement they attempt to address key environmental issues in their product development process (Hu and Hsu, 2010). This is normally carried out in firms through the eco-design practice, also known as sustainable or green design. Eco-design is generally referred to as a systematic approach by which firms can decrease the negative environmental impacts of their processes and products by incorporating green issues and sustainable practices into their product development (Luthra et al., 2014). However, this systematic method must simultaneously adhere to the environmental and economic objectives. In other words, eco-design aims to minimise negative environmental impacts while simultaneously cutting the costs and increasing the marketability of products (Hu and Hsu, 2010).

The practices surrounding eco-design approaches primarily deal with the consideration of environmental concerns in designing a service or product (Zhu et al., 2005). Eco-design practices aim to minimise negative environmental impacts through the adoption of various manufacturing processes dealing with the reduction of resource use, waste and emissions (Lewis and Gretsakis, 2001). Zhu et al. (2008a) further endorse this and argue that the eco-design approach requires manufacturing firms to design their products and services in a way that minimises the consumption of materials and energy and also facilitates recovery, reuse and recycling processes. Moreover, eco-design practices require firms to avoid or decrease the use of harmful materials and hazardous substances within their manufacturing processes (Green et al., 2012a). The eco-design approach is of paramount importance in the SSCM context as it assists firms in minimising the environmental impacts of their product life cycle, which can lead to enhancing their environmental performance (Chien and Shih, 2007; Finnveden et al., 2009). Therefore, eco-design is deemed to be one of the most essential SSCM practices required for the effective implementation of the SSCM approach.

Eco-design practices encompass a number of SSCM sub-practices including design of products for reduced consumption of material and energy; design of products for recovery, recycle, and reuse of materials, by-products, and component parts; and design of products to avoid or reduce the use of hazardous substances and harmful materials in their manufacturing process (Zhu et al., 2008a; Zhu et al., 2010; Green et al., 2012a).

Applying LCA to carry out eco-reporting

The Energy-using Products (EuP) directive came into force within the EU in 2003, and was the first European Commission directive to particularly focus on sustainable design practices. The chief aim of EuP is to decrease negative environmental impact by clearly identifying products related to energy use, i.e. energy-using products (Kautto, 2007). EuP requires manufacturing firms to decrease environmental impacts related to all stages of the product life cycle for their energy-using products (Grote et al., 2007). The directive includes the establishment of a set of mandatory ecological requirements concerning energy-using products developed within the EU's member states. The EuP directive was introduced to ensure the security of the EU's limited energy supply as one of its main long-term goals (Yung et al., 2008).

Grote et al. (2007) indicate that the principles of life cycle assessment (LCA) were used in building the basis of the EuP directive. Furthermore, Yung et al. (2008) and Hu and Hsu (2010, p. 595) assert that the EuP directive is closely associated with LCA in respect of the 'whole life cycle' concept. Life cycle assessment, which is also known as cradle-to-grave analysis, is referred to as an appropriate tool for assessing environmental impacts associated with all of the stages of a product's life from the early stage of product development to its end-of-life stage

(Wang and Gupta, 2011; Finnveden et al., 2009). It entails all of the stages involved throughout the supply chain, including raw material extraction, processing, manufacturing, transportation, use and disposal (Chunga and Wee, 2011; Grote et al., 2007). From an SSCM perspective, LCA is an essential practice as it simultaneously constructs the eco-profile of products and ensures their compliance with the EuP directive within the design stage (Hansen et al., 2005; Wang and Gupta, 2011). Therefore, applying life cycle assessment to carry out eco-reports of products can be deemed to be one of the essential SSCM practices.

Collaboration on products recycling with the same industry sector

Environmental legislation such as the ELV and WEEE directives endorse criteria for the collection, treatment and recovery of end-of-life vehicles and waste electrical and electronic equipment and task manufacturing firms for financing these activities (Gerrard and Kandlikar, 2007; Turner, 2007). According to Koh (2012), in order to achieve the most efficient recycling, end-of-life products must be recycled within the same industry sector. This proposition is further endorsed by the existence of various environmental directives for different industry sectors, which indicates the need of product recycling within the same industry sector. These environmental directives aim at the reduction of waste arising from product recycling, which eventually supports reverse logistics from a holistic perspective (Van-Hock, 2000). It is worth mentioning that recycling within the same industry sector is a part of the reverse logistics recycling sub-process which aims to recapture the value of unused or end-of-life products (Mollenkopf et al., 2007). Indeed, a reverse logistics programme can be cost-effective for manufacturing firms by emphasising resource reduction, thereby bringing value from recovered products or reducing disposal costs (Jayaraman and Luo, 2007). Hence, we can conclude that collaboration on product recycling within the same industry sector is deemed to be one of the essential SSCM practices as it significantly facilitates the recycling operations in the reverse logistics process which can ultimately support and enhance firms' environmental performance.

Produce disassembly manuals

According to Gungor and Gupta (1999, p. 828), disassembly is, "a systematic method for separating a product into its constituent components, parts, and sub-assemblies". Sustainable manufacturing has recently become an increasing challenging issue in the manufacturing context throughout the world. Producing disassembly manuals of products is one of the proactive sustainable practices that manufacturers are implementing in response to this challenge in greening their supply chains (Gupta and Taleb, 1994; Koh, 2012). Wright and Elcock (2006) argue that manufacturers are obligated to provide customers with information concerning the recycling and recovery options available to them, including discouraging them from disposing of certain products together with general waste. Kara et al. (2005) suggest that to facilitate end-of-life disassembly, disassembly workers should refer to product disassembly manuals in order to contribute to environmental benefit in the following ways: 1) implementing the non-destructive detachment of parts or components, and 2) acquiring the recovery of original functionality. Thus, we can conclude that the production of product disassembly manuals is of great importance within the SSCM context as it contributes to environmental benefits by presenting the recycling options to customers and explaining how to dispose of end-of-life products (Kara et al., 2005; Wright and Elcock, 2006). Hence, product disassembly manuals are also deemed as one of the critical SSCM practices.

Joining local recycling organisations

Environmental legislation such as the EU's End of Life vehicle (ELV) or waste electrical and electronic equipment (WEEE) directives necessitate manufacturers in the European Union to retrieve their products from consumers and ensure that they are disposed of in an environmentally sound method (Turner, 2007; Widmer et al., 2005). To this end, manufacturing firms may choose to either undertake the recovery of used products themselves, or establish networks via local or further afield partnerships, who collect and recycle products across the same region (Tsoulfas and Pappis, 2006). In essence, recycling operations involve complex processes and varying systems which can eventually lead to the improved environmental performance of firms (Prahinski and Kocabasoglu, 2006). Given the varying and complex recycling systems, firms are advised to join local recycling organisations (Dowlatshahi, 2005). This indeed facilitates the operations involved in the recycling, refurbishment, reuse, and recovery of unused or end-of-life materials and products. Therefore, joining local recycling organisations is deemed to be one of the critical SSCM practices required for the effective implementation of the SSCM approach.

Product testing reports

In order to comply with today's environmental legislation such as the Restriction of Hazardous Substances (RoHS) directive, manufacturers should request documentation from both suppliers and sub-tier suppliers for any materials, parts, assemblies or equipment which they have been provided with (Wright and Elcock, 2006). Hu and Hsu (2010) assert that the testing report of a product is paramount in determining where RoHS-restricted substances exist within its parts and components. Moreover, according to Hu et al. (2008), compliance testing reports are being adopted by manufacturing firms as an essential requirement for ensuring that parts and components used in a product do not contain prohibited substances, and also do not exceed their allowed limits in the usage of chemical substances. Hence, providing product testing report helps to determine who is responsible if a product violates environmental regulation (Chien and Shih, 2007). Thus, we can conclude that the product testing report is deemed to be one of the critical SSCM practices as it assists firms in confirming their products' compliance with regulations and directives.

Investment recovery

Investment recovery generally refers to the process of recovering and recapturing the value of unused or end-of-life assets through effective reuse or surplus sales. It requires the sale of excess capital or non-capital equipment, scrap and used materials, by-products, and excess inventories (Zhu et al., 2008a). The practice of investment recovery has been adopted by many firms both in Europe and the US and is considered as a critical aspect for the SSCM approach (Zsidisin and Siferd, 2001). According to Zhu et al. (2005) and Zhu et al. (2008d), investment recovery within a SSCM context occurs at the back end of the supply chain cycle attempting to close the supply chain loop by reusing and recycling used or end-of-life products. This assists firms in minimising the environmental impact of their product life cycle, which can lead to enhancing their environmental performance.

It should be noted that the investment recovery approach, which aims to maximise the value of unused or end-of-life assets, not only includes surplus sales and divestment of excess capital or non-capital assets but also deals with the effective reuse, recycling and refurbishment of unused or end-of-life products (Emmett and Sood, 2010). Zhu et al. (2005) assert that investment recovery is an emerging environmental practice that has a significant influence on SSCM approaches because it assists firms to enhance their environmental performance. In light of this, surplus sales and divestment of excess capital or non-capital assets, scrap, used materials, and by-products can lead to reduction of emissions caused by these excess products and assets (Zhu et al., 2008a). In addition to this, the amount of carbon footprint that is left behind can decrease because the divestment and surplus sale of these excess assets enables firms to get rid of them. This lack of presence of these excess assets leaves a lower carbon footprint and reduces carbon emissions. Furthermore, the effective reuse, recycling and refurbishment of unused or end-of-life products can lead to a significant decrease in the consumption of materials and energy (Zhu et al., 2010). Thus, we can conclude that surplus sales and the divestment of excess capital or non-capital assets along with effective reuse, recycle, and refurbishment of unused or end-of-life products can enhance firms' environmental performance. Therefore, investment recovery is deemed to be one of the essential SSCM practices that facilitates the implementation of the SSCM approach. The investment recovery practice comprises a number of SSCM sub-practices including the sale of excess materials or inventories; the sale of scrap and used materials or by-products; and the sale of excess capital or non-capital equipment.

REFERENCES

Alvarez-Gil, M.J., Berrone, P., Husillos, F.J. and Lado, N. (2007), “Reverse logistics, stakeholders’influence, organizational slack, and managers’ posture”, *Journal of Business Research,*Vol. 60, No. 5, pp. 463-473.

Anderson, D.L., Britt, Frank F.F, Favre, D.J. (1997), "The 7 Principles of Supply Chain Management." *Supply Chain Management Review*, 1(1), pp. 31-41.

Armstrong, J.S. and Overton, T.S. (1977), “Estimating nonresponse bias in mail surveys”, *Journal of Marketing Research*, Vol. 14 No. 3, pp. 396-402.

Ashby, A., Leat, M. and Hudson-Smith, M. (2012), "Making connections: a review of supply chain management and sustainability literature", *Supply Chain Management: An International Journal*, Vol. 17 Iss: 5, pp.497 - 516.

Babakri, K.A., Bennett, R.A. and Franchetti, M. (2003), “Critical factors for implementing ISO 14001 standard in united states industrial companies”, *Journal of Cleaner Production*, Vol. 11 No. 7, pp. 749-52.

Bagozzi, R. and Yi, Y. (2012), “Specification, evaluation, and interpretation of structural equation models”, *Journal of the Academy of Marketing Science,* 40(1), pp. 8-34.

Barbier, E. (1987). "The Concept of Sustainable Economic Development". *Environmental Conservation*, Volume: 14, Issue: 2, pp.101-110.

Bell, S. and Morse, S. (2008). *Sustainability Indicators. Measuring the Immeasurable?* 2nd edition. London: Earthscan. ISBN 978-1-84407-299-6.

Bevis, K. (2011), “The challenges for sustainable skills development in the UK automotive supply sector: *Policy and implementation” Management Research Review,* Vol. 34, No. 1, pp. 133-147.

Blewitt, J. (2014), *Understanding Sustainable Development*, 2nd edition, Routledge, ISBN-13: 978-0415707824.

Boström, M., Jönsson, A.M., Lockie, S., Mol, A., and Oosterveer, P. (2015) “Sustainable and responsible supply chain governance: challenges and opportunities”, *Journal of Cleaner Production Volume,* Volume. 107, pp. 1-7

Bowen, F.E., Cousine, P.D., Lamming, R.C. and Faruk, A.C. (2001), "Horses for courses: explaining the gap between the theory and practice of green supply", *Greener Management International*, Vol. 35, pp. 41-59.

Boyle, G. (2012), *Renewable Energy: Power for a Sustainable Future*, 3rd edition, OUP Oxford.

Boysere, J. and Beard, A. (2006), "Halogen-free laminates: worldwide trend, driving forces and current status", *Circuit World*, Vol. 32, No. 2, pp. 8-11.

Brandenburg, M., Govindan, K., Sarkis, J., and Seuring, S. (2014). Quantitative models for sustainable supply chain management: Developments and directions. *European Journal of Operational Research*, 233(2), pp. 299-312.

Bratic, D. (2011), "Achieving a Competitive Advantage by SCM", *IBIMA Business Review*, pp. 1-13.

Bryman, A. (2001), *Social Research Methods*, 1st edition, OXFORD University Press.

Bryman, A. and Bell, E. (2015), *Business Research Methods*, 4th edition, OUP Oxford.

Burrell, G., and Morgan, G. (2000). *Sociological paradigms and organizational analysis*. Aldershot: Ashgate publishing.

Byrne, B.M. (1998), *Structural Equation Modeling with LISREL, PRELIS, and SIMPLIS*, Lawrence Erlbaum Associates, Mahwah, NJ.

Caniëlsa, M.C.J., Gehrsitzb, M.H. and Semeijn, J. (2013), "Participation of suppliers in greening supply chains: An empirical analysis of German automotive suppliers", Journal of Purchasing and Supply Management, Vol. 19, Issue 3, pp. 134–143.

Cantor, D.E., Morrow, P.C., and Montabon, F., (2012), "Engagement in Environmental Behaviors Among Supply Chain Management Employees: An Organizational Support Theoretical Perspective," *Journal of Supply Chain Management*, Vol. 48, Issue 3, pp. 33-51.

Carter, C. and Rogers, D. (2008), "A framework of sustainable supply chain management: moving toward new theory", *International Journal of Physical Distribution and Logistics Management*. Volume 38, pp. 360-387.

Carter, C.R. (2004), "Purchasing and social responsibility: a replication and extension", *The Journal of Supply Chain Management*; 40(4), pp.4-16.

Carter, C.R. (2005), “Purchasing social responsibility and firm performance: the key mediating roles of organizational learning and supplier performance”, *International Journal of Physical Distribution & Logistics Management*, Vol. 35, No. 3, pp. 177-94.

Carter, C.R. and Easton, P.L. (2011), “Sustainable supply chain management: evolution and future directions”, *International Journal of Physical Distribution & Logistics Management*, Vol. 41, No. 1, pp. 46-62.

Carter, C.R. and Ellram, L.M. (2003), “Thirty-five years of the Journal of Supply Chain Management: where have we been and where are we going?”, *Journal of Supply Chain Management*, Vol. 39, No. 1, pp. 38-50.

Carter, C.R. and Jennings, M.M. (2004), “The role of purchasing in corporate social responsibility: a structural equation analysis”, *Journal of Business Logistics*, 25(1), pp.145-86.

Carter, C.R., Ellram, L.M. and Ready, K.J. (1998), “Environmental purchasing: benchmarking our German counterparts”, *International Journal of Purchasing & Materials Management*, Vol. 34, No. 4, pp. 28-38.

Carter, C.R., Kale, R., Grimm, C.M. (2000) “Environmental purchasing and firm performance: an empirical investigation”. *Transportation Research Part E - Logistics and Transportation Review*, 36(3), pp. 219-228.

Carter, J., and Narasimhan, R. (2000). “Sourcing’s Role in Environmental Supply Chain Management.” *Supply Chain Management Review*, 3 (4): pp. 78-88.

Carter, R.C. and Carter, J.R. (1998), “Interorganizational determinants of environmental purchasing: initial evidence from the consumer products industry”, *Decision Sciences*, Vol. 29, No. 3, pp. 28-38.

Chalmers, A. F. (1999). *What is this thing called Science?* (Vol. Third Edition). Berkshire: Open University Press.

Chang, S.J., Witteloostuijn, A.V., and Eden, L. (2010), "From the Editors: Common method variance in international business research", *Journal of International Business Studies*, 41, pp. 178-184.

Chen, C.C. (2005), “Incorporating green purchasing into the frame of ISO 14000”, *Journal of Cleaner Production*, Volume 13, Issue 9, p. 927-933

Chiarini, A. (2012),"Designing an environmental sustainable supply chain through ISO 14001 standard", *Management of Environmental Quality: An International Journal*, Volume. 24 Issue: 1, pp. 16-33.

Chicksand, D., Watson, G., Walker, H., Radnor, Z. and Johnston, R. (2012), 'Theoretical perspectives in purchasing and supply chain management: an analysis of the literature', *Supply Chain Management: An International Journal*, 17(4), pp. 454-472.

Chien, M.K. and Shih, L.H. (2007), "An empirical study of the implementation of green supply chain management practices in the electrical and electronic industry and their relation to organisational performances", *International Journal of Environmental Science & Technology*, Vol. 4 No. 3, pp. 383-94.

Chien, M.K. and Shih, L.H. (2007), "An empirical study of the implementation of green supply chain management practices in the electrical and electronic industry and their relation to organizational performances", *International Journal of Environmental Science and Technology*, 4(3), pp. 383-394.

Chunga, C.J and Wee, H.M. (2011), "Short life-cycle deteriorating product remanufacturing in a green supply chain inventory control system" *International Journal of Production Economics,* Volume 129, Issue 1, pp. 195-203.

Churchill, G.A. and Iacobucci, D. (2002), *Marketing Research: Methodological Foundations*, 8th ed., South-Western, Cincinnati, OH.

Colby, S., Kingsley, T. and Whitehead, B.W. (1995), "The real green issue", *McKinsey Quarterly*, No. 2, pp. 132-43.

Cousins, P.D., Lamming, R.C. and Bowen, F. (2004) "The role of risk in environment-related supplier initiatives", *International Journal of Operations & Production Management*, Vol. 24, Issue 6, pp. 554-565.

Crainic, T., Gendreau, M. and Dejax, P. (1993), "Dynamic and stochastic models for the allocation of empty containers," *Operations Research*, 41, pp. 102-126.

Creswell, J.W. (2003), *Research design: qualitative, quantitative, and mixed methods approaches* (2nd ed.). Thousand Oaks: Sage publications.

Crowther, M.A. and Cook, D.J. (2007), "Trials and tribulations of systematic reviews and meta-analysis", *Hematology*, pp. 493-7.

Croxton, K.L., García-Dastugue, S.J., Lambert, D.M. and Rogers, D.S. (2001),"The Supply Chain Management Processes", *The International Journal of Logistics Management*, Vol. 12, Issue: 2, pp. 13-36.

Curkovic, S. and Sroufe, R. (2011), "Using ISO 14001 to promote a sustainable supply chain strategy", *Business Strategy and the Environment*, Vol. 20, No. 2, pp. 71-93.

Davis, L. and Markley, J. (2007), "Exploring future competitive advantage through sustainable supply chains", *International Journal of Physical Distribution & Logistics Management*, Vol. 39, pp. 763-774.

de Bakker, F., Fisscher, O. and Brack, A. (2002), "Organizing product-oriented environmental management from a firm's perspective", *Journal of Cleaner Production*, 10(5): 455-464.

De Burgos Jimenez J, and Cespedes Lorente, J.J.(2001), "Environmental performance as an operations objective", *International Journal of Operations & Production Management*; 21(12), pp. 1553-72

De Giovannia, P. and Vinzi, V. E. (2012), "Covariance versus component-based estimations of performance in green supply chain management", *International Journal of Production Economics*, 135, pp. 907-916

De Vaus, D. (2009), *Research Design in Social Research*, Sage Publications Ltd.

Diabat, A. and Govindan, K. (2011), "An analysis of the drivers affecting the implementation of green supply chain management", *Resources, Conservation and Recycling*, 55(6): 659-667.

Dobson, P.J. (2002), "Critical realism and information systems research: why bother with philosophy?", *Information Research*, Vol. 7, No. 2, pp. 1-9.

Doll, W.J. and Vonderembse, M.A. (1991), "The evolution of manufacturing systems: Towards a post-industrial enterprise". *International Journal of Management Science*, 19(5): 401-411.

Dowlatshahi, S., (2005), "A strategic framework for the design and implementation of remanufacturing operations in reverse logistics", *International Journal of Production Research*, 43 (16), pp. 3455-3480.

Doyal, L. (1993), *Discovering knowledge in a world of relationships*. In: Kitson A (Ed) Nuring. Art and Science. London, Chapman and Hall.

Elkington, J. (1998), *Cannibals with Forks: The Triple Bottom Line of the 21st Century*, New Society Publishers, Stoney Creek, CT.

Elkington, J. (2004), “Enter the triple bottom line”, in Henriques, A. and Richardson, J. (Eds), The Triple Bottom Line: Does It All Add up?, Earthscan, London, pp. 1-16.

Ellabban, O., Abu-Rub, H. and Blaabjerg, F. (2014), “Renewable energy resources: Current status, future prospects and their enabling technology”, *Renewable and Sustainable Energy Reviews* , Voluem: 39, pp. 748-764.

Emmett, S. and Sood, V. (2010), *Green Supply Chains: An Action Manifesto*, 1st edition, John Wiley & Sons.

Enarsson, L. (1998), “Evaluation of suppliers: how to consider the environment”, *International Journal of Physical Distribution & Logistics Management*, Vol. 28 No. 1, pp. 5-17.

Esty, D.C. and Winston, A.S. (2009), *Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build a Competitive Advantage*, rev. and updated ed., Wiley, Chichester and Hoboken, NJ.

Evans, H. and Johnson, J. (2005), “10 Steps toward RoHS directive compliance”, *Circuits Assembly*, Vol. 16 No. 2, pp. 68-70.

Faisal, M. (2010), “Sustainable supply chains: a study of interaction among the enablers”, *Business Process Management Journal*, Vol. 16, pp. 508-529.

Faulkner, D., Carlisle, Y.M. and Viney, H.P. (2005) "Changing corporate attitudes towards environmental policy", *Management of Environmental Quality: An International Journal*, Vol. 16, Issue: 5, pp. 476 - 489.

Field, A. (2009), *Discovering Statistics Using SPSS.* Third Edition, SAGE Publications Ltd.

Figge, F., Hahn, T., Schaltegger, S. and Wagner, M. (2002), “The sustainability Balanced Scorecard - linking sustainability management to business strategy”, *Business Strategy and the Environment*, Vol. 11, No. 5, pp. 269-84.

Finnveden, G., Hauschild, M., Ekvall, T., Guinee, J., Heijungs, R., Hellweg, S., Koehler, A., Pennington, D. and Suh, S. (2009), "Recent developments in Life Cycle Assessment". *Journal of Environmental Management,* Volume 91, Issue 1, pp. 1-21.

Flynn, B.B., Sakakibara, S., Schroeder, R.G., Bates, K.A. and Flynn, E.J. (1999), “Empirical research methods in operations management”, *Journal of Operations Management,* 9(2): 250-284.

Fombrun, C.J., (2005), *The leadership challenge: building resilient corporate reputations*. In: Doh, J.P., Stumpf, S.A. (Eds.), Handbook on Responsible Leadership and Governance in Global Business. Edward Elgar, Cheltenham, pp. 54-68.

Forza, C. (2002), "Survey research in operations management: a process-based perspective", *International Journal of Operations & Production Management*, 22(2), pp. 152-194.

Garver, M.S. and Mentzer, J.T., (1999), "Logistics research methods: employing structural equation modeling to test for construct validity", *Journal of Business Logistics,* 20 (1): 33-57.

Geffen, C. and Rothenberg, S. (2000), "Suppliers and environmental innovation: the automotive paint process", *International Journal of Operations & Production Management,* Vol. 20, No. 2, pp. 166-86.

Gerbing, D.W. and Anderson, J.C. (1988), "An updated paradigm for scale development incorporating unidimensionality and its assessment", *Journal of Marketing Research*, Vol. 25, No. 2, pp. 186-92.

Gerrard, J. and Kandlikar, M. (2007), "Is European end-of-life vehicle legislation living up to expectations? Assessing the impact of the ELV Directive on 'green' innovation and vehicle recovery", *Journal of Cleaner Production,* Vol. 15, Issue 1, pp.17-27.

Gilbert, S. (2001), *Greening supply chain: Enhancing competitiveness through green productivity*, Asian Productivity Organization, ISBN-10: 9283322908.

Gimenez, C. Sierra, V. and Rodon, J. (2012), "Sustainable operations: Their impact on the triple bottom line", *International Journal of Production Economics,* Volume 140, Issue 1, pp. 149-159.

Giunipero, L.C., Hooker, R.E., Joseph-Matthews, S., Yoon, T.E. and Brudvig, S. (2008), "A decade of SCM literature: past, present and future implication", *Journal of Supply Chain Management,* 44(4), pp. 66-86.

Godfrey, R. (1998), *Ethical purchasing: developing the supply chain beyond the environment,* in Russel, T. (Ed.), Greener Purchasing: Opportunities and Innovations, Greenleaf Publishing, Sheffield.

Golicic, S. and Davis, D.F. (2012), "Implementing mixed methods research in supply chain management", *International Journal of Physical Distribution & Logistics Management*, Vol. 42, Issue: 8/9, pp.726 - 741

Gordon, S.R. (2008), *Supplier evaluation and performance excellence: a guide to meaningful metrics and successful results*. J. Ross Publishing. ISBN 978-1-932159-80-6.

Govindan, K., Kaliyan, M., Kannan, D., and Haq, A. N. (2014), "Barriers analysis for green supply chain management implementation in Indian industries using analytic hierarchy process", *International Journal of Production Economics*, Vol. 147, pp. 555-568.

Grabis, J., Chandra, C., and Tumanyan, A. (2007), "Problem taxonomy: a step towards effective information sharing in supply chain management", *International Journal of Production Research*, Vol. 45, No. 11, pp. 2507-2544.

Green, K., Morton, B. and New, S. (1998), "Green purchasing and supply policies: do they improve companies' environmental performance?", *Supply Chain Management: An International Journal*, Vol. 3, No. 2, pp. 89-95.

Green, K.W., Toms, L.C. and Clark, J., (2015),"Impact of market orientation on environmental sustainability strategy", *Management Research Review*, 38(2), pp. 217-238.

Green, K.W., Whitten, D. and & Inman, R.A. (2007), "The impact of timely information on organisational performance in a supply chain", *Production Planning & Control: The Management of Operations*, 18(4), pp. 274-282.

Green, K.W., Whitten, D. and Inman, R.A. (2008), "The impact of logistics performance on organizational performance in a supply chain context", *Supply Chain Management: An International Journal*, Vol. 13, No. 4, pp. 317-27.

Green, K.W., Zelbst, P.J., Bhadauria, V.S. and Meacham, J. (2012b),"Do environmental collaboration and monitoring enhance organizational performance?", *Industrial Management & Data Systems*, Vol. 112, Issue 2, pp. 186-205.

Green, K.W., Zelbst, P.J., Meacham, J. and. Bhadauria, V.S. (2012a), "Green supply chain management practices:impact on performance", *Supply Chain Management: An International Journal*, Vol. 17, Issue: 3, pp. 290-305.

Grote, C., Jones, R., Blount, G., Goodyer, J.J. and Shayler, M.M. (2007), "An approach to the EuP Directive and the application of the economic eco-design for complex products", *International Journal of Production Research*, Vol. 45, No. 18/19, pp. 4099-117.

Gummesson, E. (1999), *Qualitative Methods in Management Research*, second edition, SAGE Publications, Inc.

Gungor, A. and Gupta, S.M. (1999), *"Issues in environmentally conscious manufacturing and product recovery: a survey"*, Computer & Industrial Engineering, Vol. 36, pp. 811-853.

Guoyou, Q., Saixing, Z., Xiaodong, L. and Chiming, T. (2012), "Role of internalization process in defining the relationship between ISO 14001 certification and corporate environmental performance", *Corporate Social Responsibility and Environmental Management*, Vol. 19 No. 3, pp. 129-40.

Gupta, S.M. and Taleb, K.N. (1994), "Scheduling disassembly". *International Journal of Production Research*, 32(8), pp. 1857-1866.

Haanaes, K., Reeves, M., Velken, I.S., Audretsch, M., Kiron, D. and Kruschwitz, N. (2012), "Sustainability Nears a Tipping Point", *MIT Sloan Management Review,* 53 (2): pp. 69-74.

Hair, J.F., Anderson, R.E., Tatham, R.L., Black, W.C., (2010), *Multivariate Data Analysis*, Seventh ed. Prentice-Hall, New Jersey.

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E. and Tatham, R.L. (2006), *Multivariate Data Analysis*, 6th ed., Pearson/Prentice-Hall, Upper Saddle River, NJ.

Hair, J.F., Hult, G.T.M., Ringle, C.M. and Sarstedt, M. (2014), A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM), Sage Publication, Los Angeles.

Hair, J.F., Ringle, C.M. and Sarstedt, M. (2011), "PLS-SEM: Indeed a Silver Bullet". Journal of Marketing Theory and Practice, Vol. 19, No. 2, pp. 139–151.

Hamel, G. and Prahalad, C.K. (1989), "Strategic intent", *Harvard Business Review*, Vol. 67 No. 3, pp. 63-76.

Handfield, R., Sroufe, R. and Walton, S. (2005), "Integrating environmental management and supply chain strategies", *Business Strategy and the Environment,* Vol. 14, No. 1, pp. 1-19.

Handfield, R.B. and Nichols, E.L. (1999), *Introduction to Supply Chain Management*, New Jersey: Prentice Hall.

Handfield, R.B., Walton, S.V., Sroufe, R. and Melnyk, S.A. (2002), "Applying environmental criteria to supplier assessment: a study in the application of the analytical hierarchy process", *European Journal of Operational Research*, Vol. 141 No. 16, pp. 70-87.

Hansen, S., Grobmann, J. and Abele, E. (2005), "The Directive on Energy using Products - an approach for an efficient implementation in industry", *Proceedings of the 4th International*

Symposium on Environmentally Conscious Design and Inverse Manufacturing, Tokyo, pp. 642-48.

Harrison, F. (2001), *Supply Chain Management Workbook*, Routledge.

Harrison, J., Hitt, M., Hoskisson, R. and Ireland, R. (2001), “Resource complementarity in business combinations: extending the logic to organizational alliances”, *Journal of Management*, Vol. 27, No. 6, pp. 679-90.

Hervani, A.A., Helms, M.M., and Sarkis, J. (2005), “Performance measurement for green supply chain management,” *Benchmarking: An International Journal*, Vol. 12, No. 4, pp. 330-353.

Hollos, D., Blome C., & Foerstl, K. (2012), “Does sustainable supplier cooperation affect performance? Examining implications for the triple bottom line”, *International Journal of Production Research*, Vol. 50, Issue: 11, pp. 2968-2986.

Hsu, C.C, Tan, K.C., Zailani, S.H.M. and Jayaraman, V. (2013), "Supply chain drivers that foster the development of green initiatives in an emerging economy", *International Journal of Operations & Production Management*, Vol. 33, Issue, 6, pp.656-688.

Hsu, C.W. and Hu, A.H. (2008), “Green supply chain management in the electronic industry”, *International Journal of Environmental Science and Technology*, Vol. 5, No. 2, pp. 205-16.

Hsu, W. and Hu, H. (2009), “Applying hazardous substance management to supplier selection using analytic network process”, *Journal of Cleaner Production*, Vol. 17, pp. 255-264.

Hu, A.H. and Hsu C.W. (2010), "Critical factors for implementing green supply chain management practice: An empirical study of electrical and electronics industries in Taiwan", *Management Research Review*, Vol. 33, Issue, 6, pp.586 - 608.

Hu, A.H., Hsu, C.W., Kuo, T.C. and Wu, W.C. (2008), “Risk evaluation of green components to hazardous substance using FMEA and FAHP”, *Expert Systems with Applications*, Volume 36, Issue 3, Part 2, pp. 7142–7147.

Inman, A., Sale, S., Green, K.W. and Whitten, D. (2011), "Agile manufacturing: Relation to JIT, operational performance and firm performance", *Journal of Operations Management,* Volume 29, Issue 4, pp. 343-355.

International Organisation for Standardization (ISO) (2004), ISO 14001 Environmental Management Systems-Specification with Guidance for Use, ISO, Geneva.

Jayaraman, V. and Luo, Y., (2007), “Creating competitive advantages through new value creation: a reverse logistics perspective”. *The Academy of Management Perspectives*, Vol. 21, No. 2, pp. 56-73.

Jayaraman, V., Klassen, R. and Linton, J.D. (2007), “Supply chain management in a sustainable environment”, *Journal of Operations Management*, Vol. 25, No. 6, pp. 1071-4.

Jayaraman, V., Srivastava, R. and Benton, W.C. (1999), "Supplier Selection and Order Quantity Allocation: A Comprehensive Model", *Journal of Supply Chain Management* Volume 35, Issue 1, pp. 50-58.

Jöreskog, K.G. (1973), *A general method for estimating a linear structural equation system*, in A.Goldberger and O.Duncan, eds, ‘Structural Equation Models in the Social Sciences’, Academic Press.

Jöreskog, K.G. and Sörbom, D. (1997), *LISREL 8 user’s reference guide*, Scientific Software International, Lincolnwood, IL.

Kamakura, W.A. (2010), Common Methods Bias. *Wiley International Encyclopedia of Marketing*. 2.

Kaplan, D. (2000), *Structural Equation Modeling Foundations and Extensions*: SAGE Publications.

Kaplan, D. (2004), *The SAGE Handbook of Quantitative Methodology for the Social Sciences*, SAGE Publications.

Kaplan, R.S. and Norton, D.P. (2001), *The Strategy-focused Organization: How Balanced Scorecard Companies Thrive in the New Business Environment*, Harvard Business School Press, Boston, MA.

Kara, S., Pornprasitpol, P. and Kaebernick, H. (2005*),"A selective disassembly methodology for end-of-life products"*, *Assembly Automation*, Vol. 25, Issue 2, pp. 124-134.

Karra, I. and Affes, H. (2014), "The Impact of Stakeholders' Pressures on Green Strategic Intent: An Empirical Study", *British Journal of Economics, Management & Trade*, Vol. 4, Issue. 6, pp. 967-977.

Kautto, P. (2007), "Industry-government interaction in the preparation of a new directive: Nokia, industry associations and EuP" *European Environment*, Volume 17, Issue 2, pp. 79-91.

Keesling, J.W. (1973), Maximum Likelihood Approaches to Causal Analysis, Ph.d. dissertation, University of Chicago, Department of Education, Chicago.

Kiron, D. and Kruschwitz, N., Haanaes, K., Reeves, M. and Goh, E. (2013), "The innovation bottom line. How companies that see sustainability as both a necessity and an opportunity, and change their business models in response, are finding success", MIT Sloan Management Review/Boston Consulting Group, Boston.

Klassen, R. D., and Jacobs, J. (2001), Experimental comparison of Web, electronic and mail survey technologies in operations management. *Journal of Operations Management*, 19(6): 713-728.

Kline, R. B. (2011), *Principles and Practice of Structural Equation Modeling, Methodology in the Social Sciences*, third edn, The Guildford Press, London.

Koh, S.C.L. (2012), "Cross-tier ripple and indirect effects of directives WEEE and RoHS on greening a supply chain", *International Journal of Production Economics*, Vol. 140, Issue 1, pp. 305-317.

Koplin, J., Seuring, S. and Mesterharm, M. (2007), "Incorporating sustainability into supply management in the automotive industry: the case of the Volkswagen AG", *Journal of Cleaner Production*, Vol. 15, No. 11-12, pp. 1053-62.

Koufteros, X.A. (1999), "Testing a model of pull production: a paradigm for manufacturing research using structural equation modeling", *Journal of Operations Management*, Vol. 17, No. 4, pp. 467-88.

Kovacs, G. and Spens, K.M. (2005), "Abductive reasoning in logistics research", *International Journal of Physical Distribution & Logistics Management*, 35(2), pp. 132-144.

Krajewski, L. J. and Ritzman. L. P. (2005), *Operations Management: Processes and Value Chains.*7th edition, Upper Saddle River, N.J. : Pearson Prentice Hall.

Krause, D.R., Vachon, S. and Klassen, R.D. (2009), "Special Topic Forum on Sustainable Supply Chain Management: Introduction and Reflections on the Role of Purchasing Management", *Journal of Supply Chain Management*, Volume 45, Issue 4, pp. 18-25.

Kuik, S., Amer, Y., and Nagalingam, S. (2011), "Sustainable supply chain for collaborative manufacturing", *Journal of Manufacturing Technology Management*, Vol. 22, pp. 984-1001.

Lai, K.H, Wu, S.J. and Wong, C.Y.W. (2013), "Did reverse logistics practices hit the triple bottom line of Chinese manufacturers?", *International Journal of Production Economics*, Vol. 146, pp. 106-117

Lakshmimeera, B.L. and Palanisamy, C. (2013), "A Conceptual Framework on Green Supply Chain Management Practices" *Industrial Engineering Letters*, Vol.3, No.10, pp. 42-52.

Lambert, D.M. and Cooper, M.C. (2001), "Issues in Supply Chain Management," *Industrial Marketing Management*, Vol. 29, No. 1, pp. 65-83.

Lambert, D.M. and Harrington, T.C. (1990), "Measuring nonresponse bias in customer service mail surveys", *Journal of Business* Logistics, Vol. 11, No. 2, pp. 5-25.

Lambert, D.M., Cooper, M.C. and Pagh, J.D. (1998), "Supply chain management: implementation issues and research opportunities", *International Journal of Logistics Management*, Vol. 9, No. 2, pp. 1-19.

Lamming, R. and Hampson, J. (1996), "The environment as a supply chain management issue", *British Journal of Management*, Vol. 7, No. 1, pp. 45-62.

Layder, D. (1988), "The Relation of Theory and Method: Causal Relatedness, Historical Contingency and Beyond", *Sociological Review*, 36(3): pp. 441-463.

Lee, S.M., Kim, S.T. and Choi, D. (2012), "Green supply chain management and organizational performance", *Industrial Management & Data Systems*, Vol. 112, Issue 8, pp.1148-1180.

Levy, D.L. (1995), "Heterogeneity and change in environmental strategy: technological and political responses to climate change in the global automobile industry", in Hoffman, A. J. and Ventresca, M.J. (Eds), Organizations, Policy and the Natural Environment: Institutional and Strategic Perspectives, Stanford University Press, Stanford, pp. 173-93.

Lewis, H. and Gretsakis, J., (2001), *Design+Environment: A Global Guide to Designing Greener Goods*. Greenleaf Publishing, Sheffield, UK.

Likert, R. (1932), "A technique for the measurement of attitudes", *Archives of Psychology,* 22(140), pp. 1-55.

Lin, L.H. and Lan, J.F. (2013), "Green supply chain management for the SME automotive suppliers", *Int. J. Automotive Technology and Management*, Vol. 13, No. 4, pp.372-90.

Linton, D., Klassen, R. and Jayaraman, V. (2007), "Sustainable supply chains: an introduction", *Journal of Operations Management*, Volume. 25, pp. 1075-1082.

Lippmann, S. (1999), “Supply chain environmental management: elements of success”, *Corporate Environmental Strategy,* Vol. 6, No. 2, pp. 175-182.

Lozano, R. (2008), “Developing collaborative and sustainable organisations”. *Journal of Cleaner Production*, Vol. 16, pp. 499-509.

Lu, L.Y.Y., Wu, C.H., and Kou, T., (2007), Environmental principles applicable to green evaluation by using multi-objective decision analysis, *International Journal of Production Research*, 45(18-19), pp. 4317-4331.

Lumsden, K., Dallari, F. and Ruggeri, R. (1999), "Improving the efficiency of the Hub and Spoke system for the SKF European distribution network", *International Journal of Physical Distribution & Logistics Management*, Vol. 29, No. 1, pp. 50-64.

Luthra, S., Garg, D. and Haleem, A. (2014), “Critical success factors of green supply chain management for achieving sustainability in Indian automobile industry”, *Production Planning & Control: The Management of Operations,* Volume 26, Issue 5, pp. 339-362.

Malhotra, M. K., and Grover, V. (1998), “An assessment of survey research in POM: from constructs to theory”. *Journal of Operations Management*, 16(4): pp. 407-425.

Mangan, J, Lalwani, C. and Gardner, B (2004), “Combining quantitative and qualitative methodologies in logistics research”, *International Journal of Physical Distribution & Logistics Management*, 34(7), pp. 565-578.

Matos, S. and Hall, J. (2007), “Integrating sustainable development in the supply chain: the case of life cycle assessment in oil and gas and agricultural biotechnology”, *Journal of Operations Management*, Vol. 25, No. 6, pp.1083-1102.

McCormick, J. (2001), *Environmental Policy in the European Union (The European Union Series)*, Palgrave Macmillan.

McIntyre, K., Smith, H., Henham, A. and Pretlove, J. (1998), “Environmental performance indicators for integrated supply chains: the case of Xerox Ltd”, *Supply Chain Management: An International Journal*, Vol. 3, No. 3, pp. 149-56.

McKinnon, A.C. (2005), "The economic and environmental benefits of increasing maximum truck weight: the British experience", *Transportation Research Part D: Transport and Environment*, Volume 10, Issue 1, pp. 77-95

Mentzer, J.T. and Kahn, K.B. (1995), “A framework of logistics research”, *Journal of Business Logistics*, 16(1), pp. 231-250.

Min, H. and Galle, W.P., (2001), “Green purchasing practices of US firms”, *International Journal of Operations and Production Management*, 21(9), pp. 1222-1238.

Moffatt, I. (2004), “Global warming: scientific modeling and its relationship to the economic dimensions of policy”, in Owen, A.D. and Hanley, N. (Eds), The Economics of Climate Change, Chapter 2, Routledge, London, pp. 6-34.

Mollenkopf, D., Russo, I., Frankel, R. (2007), "The returns management process in supply chain strategy", *International Journal Physical Distribution Logistics Management*, Vol. 37, No. 7, pp. 568-92.

Monczka, R.M., Handfield, R.B. and Giunipero, L. (2008), *Purchasing and Supply Chain Management*. 4th Edition, Cengage Learning. ISBN 978-0-324-38134-4.

Moore, D. and Babu, A.S. (2008), Perspectives, practices, and future of supply chain flexibility, *International Journal of Business Excellence*, 1(3), pp. 302-336.

Morrow, D. and Rondinelli, D. (2002), “Adopting corporate environmental management systems: motivations and results of ISO 14001 and EMAS certification”, *European Management Journal*, Vol. 20, No. 2, pp. 159-71.

Murray, G. (2000), “Effects of a green purchasing strategy: the case of Belfast City Council”, *Supply Chain Management: An International Journal*, Vol. 5, No. 1, pp. 37-44.

Nahm, A.Y. and Vonderembse, M.A. (2002), “Theory Development: An industrial/post-industrial perspective on manufacturing”. *International Journal of Production Research*, 40 (9): pp. 2067-2095.

Nelson, D. M., Marsillac, E., and Rao, S. S. (2012), “Antecedents and Evolution of the Green Supply Chain” *Journal of Operations and Supply Chain Management*, Special Issue, ISSN: 1984-3046, pp. 29-43.

Nunes, B. and Bennett, D (2010),"Green operations initiatives in the automotive industry", *Benchmarking: An International Journal*, Vol. 17, Issue: 3, pp. 396 - 420.

Office for National Statistics (ONS) (2015), UK manufacturers' sales by product (PRODCOM), 2014 intermediate results and 2013 final results [Online]. Available from: http://www.ons.gov.uk/ons/dcp171778_428240.pdf [Accessed 19 July 2015]

Pagell, M., and Wu, Z. (2009), “Building a more complete theory of sustainable supply chain management using case studies of 10 exemplars”. *Journal of Supply Chain Management*, 45(2), pp. 37-56.

Paloviita, A. and Luomaaho, V. (2010), “Recognizing definitive stakeholders in corporate environmental management”. *Management Research Review*, 33(4), pp. 306-316.

Paulraj, A., Lado, A. and Chen, I. (2008), “Inter-organizational communication as a relational competency: antecedents and performance outcomes in collaborative buyer-supplier relationships”, *Journal of Operations Management*, Vol. 26, No. 1, pp. 45-64.

Petticrew, M. and Roberts, H. (2006), *Systematic reviews in the social sciences*. Wiley Blackwell.

Phillips, E.M. and Pugh, D.S. (2005), *How to get a PhD* (3rd edition). Maidenhead: Open University Press.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y., and Podsakoff, N.P. (2003), “Common method biases in behavioral research: A critical review of the literature and recommended remedies”, *Journal of Applied Psychology*, 88(5): pp. 879-903.

Porter, M.E. and van der Linde, C. (1995), “Green and competitive: ending the stalemate”, *Harvard Business Review,* Vol. 73, No. 5, pp. 120-134.

Porter. M.E. (2008), "The Five Competitive Forces that Shape Strategy", *Harvard Business Review*, pp.86-104.

Prahinski, C. and Kocabasoglu, C. (2006), “Empirical research opportunities in reverse supply chains”, *OMEGA: The International Journal of Management Science*, 34(6), pp. 519-532.

Preuss, L. (2001), “In dirty chains? Purchasing and greener manufacturing”, *Journal of Business Ethics*, Vol. 34, No. 3-4, pp. 345-59.

Pullman, M., Maloni, M., and Carter, C. (2009), “Food for thought: Social versus environmental sustainability practices and performance outcomes”, *Journal of Supply Chain Management*, 45(4), pp. 38-54.

Rao, P. (2002), “Greening the Supply Chain: A New Initiative in South East Asia.” *International Journal of Operations and Production Management,* 22 (6): pp. 632-655.

Rao, P. (2005), “The greening of suppliers in the South East Asian context”. *Journal of Cleaner Production*, 13(9): pp. 935-45.

Rao, P. and Holt, D. (2005), "Do green supply chains lead to competitiveness and economic performance?", *International Journal of Operations and Production Management*, Volume 25, pp. 898-916.

Reid, R.D. and Sanders, N.R., (2002), *Operations Management,* New York: John Wiley & Sons. ISBN 0-471-32011-0

Rice, S. (2003), "Commitment to excellence: practical approaches to environmental leadership", *Environmental Quality Management,* Vol. 12, No. 4, pp. 9-22.

Rivera, J. (2004), "Institutional pressures and voluntary environmental behavior in developing countries: Evidence from the Costa Rican hotel industry", *Society & Natural Resources,* Vol. 17, No. 9, pp. 779-97.

Roberts, S. (2003), "Supply chain specific? Understanding the patchy success of ethical sourcing initiatives", *Journal of Business Ethics,* Vol. 44, pp. 159-170.

Robson, C. (2002), *Real World Research* (2nd edn). Oxford: Blackwell.

Rogers, D. and Tibben-Lembke, R., (2001), "An examination of reverse logistics practices", *Journal of Business Logistics,* 22(2), pp. 129-148.

Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2007), *An Introduction to Sustainable Development,* Routledge, ISBN-10: 1844075206

Sachan, A. and Subhash, D. (2005), "Review of supply chain management and logistics research", *International Journal of Physical Distribution & Logistics Management,* 35(9), pp. 664-705.

Sarkis, J. (1999), *How Green is the Supply Chain?: Practice and Research*. Worcester, MA: Graduate School of Management, Clark University.

Sarkis, J. (2001), "Manufacturing's role in corporate environmental sustainability concerns for the new millennium", *International Journal of Operations &Production Management,* 21(5-6): pp. 666-686.

Sarkis, J. (2006), *Greening the Supply Chain,* Springer, London.

Sarkis, J. (2012),"A boundaries and flows perspective of green supply chain management", *Supply Chain Management: An International Journal*, Vol. 17, Issue: 2, pp. 202-216.

Sarkis, J., Gonzalez-Torre, P. and Adenso-Diaz, B. (2010), “Stakeholder Pressure and the Adoption of Environmental Practices: The Mediating Effect of Training” *Journal of Operations Management*, Volume 28, Issue 2, pp. 163-176.

Sarkis, J., Zhu, Q. and Lai, K.H. (2011), "An organizational theoretic review of green supply chain management literature", *International Journal of Production Economics*, Vol. 130 (1), pp. 1-15.

Saunders, M., Lewis, P. and Thornhill, A. (2009), *Research Methods for Business Students*, 5th edition, Pearson Education.

Schaltegger, S., Burritt, R., Varsei, M., Soosay, C., Fahimnia, B. and Sarkis. J. (2014), “Framing sustainability performance of supply chains with multidimensional indicators”. *Supply Chain Management: An International Journal*, 19(3), pp. 242-257.

Schumacker, R.E. and Lomax, R.G. (2010), *A Beginner’s Guide to Structural Equation Modeling*, Third Edition, Routledge.

Seuring, S. and Gold, S. (2013), “Sustainability management beyond corporate boundaries”, *Journal of Cleaner Production*, 56, pp. 1-6.

Seuring, S. and Muller, M. (2008a), “From a literature review to a conceptual framework for sustainable supply chain management”, *Journal of Cleaner Production*, Vol. 16, No. 15, pp. 1699-710.

Seuring, S., and Muller, M. (2008b), “Core issues in sustainable supply chain management - A Delphi study”, *Business Strategy and the Environment*, 17(8), pp. 455-466.

Shi, V.G., Koh, S.C.L., Baldwin, J. and Cucchiella, F. (2012),"Natural resource based green supply chain management", *Supply Chain Management: An International Journal*, Vol. 17, Issue: 1, pp. 54-67.

Simpson, D., Power, D. and Samson, D. (2007),"Greening the automotive supply chain: a relationship perspective", *International Journal of Operations & Production Management*, Vol. 27, Issue 1, pp. 28 - 48.

Skinner, W. (1985), The Taming of lions: How manufacturing leadership evolved 1780-1984. In K.B. Clark, R. Hayes and C. Lorenz (eds.), The Uneasy Alliance: Managing the Productivity-Technology Dilemma (Boston: Harvard School Press), pp. 63-114.

Slack, N., Chambers, S. and Johnston, R. (2010), *Operations Management (6th Ed)*, Financial Times/Prentice Hall.

Snir, E.M., (2001), "Liability as a catalyst for product stewardship", *Production and Operations Management*, 10 (2), pp. 190-206.

Soni, G. and Kodali, R. (2012), "A critical review of empirical research methodology in supply chain management", *Journal of Manufacturing Technology Management*, 23(6), pp. 753-779.

Srivastava, S.M. (2007), "Green supply-chain management: A state-of-the-art literature review", *International Journal of Management Reviews*, Volume 9, Issue 1, pp. 53-80.

Stock, J.R. and Lambert, D.M. (2001), *Strategic Logistics Management*, New York, NY: McGraw-Hill.

Storey, J., Emberson, C., Godsell, J., and Harrison, A. (2006), "Supply chain management: theory, practice and future challenges", *International Journal of Operations & Production Management*, Vol. 26, Issue: 7, pp.754-774.

Sue, V. M. and Ritter, L.A. (2007), *Conducting online surveys*. London: SAGE.

Svensson, G. (2007),"Aspects of sustainable supply chain management (SSCM): conceptual framework and empirical example", *Supply Chain Management: An International Journal*, Vol. 12, Issue: 4, pp. 262-266.

Tan, A.W.K., Yu, W.S. and Kumar, A. (2002), "Improving the performance of a computer company in supporting its reverse logistics operations in the Asia-Pacific region". *International Journal of Physical Distribution & Logistics Management*, 33, pp. 59-74.

Taylor, A. and Taylor, M. (2013), "Antecedents of effective performance measurement system implementation: an empirical study of UK manufacturing firms", *International Journal of Production Research*, Vol. 51, No. 18, pp. 5485-5498.

The Society of Motor Manufacturers and Traders (SMMT) (2015), 2015 Automotive Sustainability Report - The 16th edition [online]. Available from: http://www.smmt.co.uk/wp-content/uploads/sites/2/SMMT-16th-Sustainability-Report-final.pdf [Accessed 26 July 2015]

Tranfield, D., Denyer, D. and Smar, P. (2003), "Towards a methodology for developing evidence-informed management knowledge by means of systematic review", *British Journal of Management*, Vol. 14, No. 3, pp. 207-222.

Tritos, L., Adebanjo, D. and Tan, k.C. (2013),"Green supply chain management practices and performance", *Industrial Management & Data Systems*, Volume 113, Issue 8, pp. 1088-1109.

Tseng, M. L., Lim. M. and Wong, W.P. (2015), "Sustainable supply chain management", *Industrial Management & Data Systems*, Volume 115, Issue: 3, pp. 436-461.

Tsoulfas, G.T. and Pappis, C.P. (2006), "Environmental principles applicable to supply chains design and operation", *Journal of Cleaner Production*, Vol. 14, No. 18, pp. 1593-602.

Tu, Q., Vonderembse, M., and Ragu-Nathan, T.S. (2001), "The impact of time-based manufacturing practices on mass customization and value to customer", *Journal of Operations Management*, 19, pp. 201-217.

Turner, M. (2007), "UK to finally implement the WEEE Directive", *Computer Law and Security Review*, Vol. 23, Issue 1, pp.73-76.

Vachon, S. (2007), "Green supply chain practices and the selection of environmental technologies", *International Journal of Production Research*, Volume. 45, pp. 4357-4379.

Vachon, S. and Klassen, R. (2007), "Supply chain management and environmental technologies: the role of integration", *International Journal of Production Research*, Vol. 45, No. 2, pp. 401-23.

Vachon, S. and Klassen, R.D. (2006), "Extending green practices across the supply chain: the impact of upstream integration", *International Journal of Operations & Production Management*, Vol. 26, No. 7, pp. 795-821.

Vachon, S. and Klassen, R.D. (2008), "Environmental management and manufacturing performance: the role of collaboration in the supply chain", *International Journal of Production Economics*, Vol. 111, No. 2, pp. 299-315.

Van-Hock, R.I. (2000), "From reversed logistics to green supply chains", *Logistics Solutions*, Volume. 2, p. 28-33.

Varzandeh, J, Farahbod, K. and Zhu J. (2014), "An empirical investigation of supply chain sustainability and risk management", *Journal of Business and Behavior Sciences*, Vol. 26, No. 2, pp. 119-126.

Vonderembse, M.A. and Tracey, M. (1999), "The Impact of Supplier Selection Criteria and Supplier Involvement on Manufacturing Performance", *Journal of Supply Chain Management*, Volume 35, Issue 2, pp. 33-39.

Vonderembse, M.A., Ragunathan, T.S., and Rao, S.S., (1997), "A post-industrial paradigm: To integrate and automate manufacturing", *International Journal of Production Research,* Volume 35, pp. 2579-2599.

Wagner, M. and Schaltegger, S. (2004), "The effect of corporate environmental strategy choice and environmental performance on competitiveness and economic performance: an empirical study of EU manufacturing", *European Management Journal*, 22(5), pp.557-572.

Walke, R. C., Topkar, V. and Kabiraj, S. (2010), "Managing Risk for Green Supply Chain Management: Competitive Strategies for Manufacturing Companies", *Skyline Business Journal*, Vol. 6, Issue 1, pp. 1-10.

Walker, H., and Jones, N. (2012), "Sustainable supply chain management across the UK private sector", *Supply Chain Management: An International Journal*, Volume. 17, pp. 15-28.

Walker, H., Di Sisto, L. and McBain, D. (2008), "Drivers and barriers to environmental supply chain management practices: lessons from the public and private sectors", *Journal of Purchasing and Supply Management*, 14(1): pp. 69-85.

Walley, N. and Whitehead, B. (1994), "It's not easy being green", Harvard Business Review, Vol. 72, No. 3, pp. 46-52.

Wang, H.F. and Gupta, S.M. (2011), *Green Supply Chain Management: Product Life Cycle Approach*, McGraw-Hill Professional.

Wee, Y.S, and Quazi, H.A. (2005), "Development and validation of critical factors of environmental management", *Industrial Management & Data Systems*, Vol.105, pp. 96-114.

Widmer, R., Oswald-Krap, H., Sinha-Khetriwal, D., Schnellmann, M. and Boni, H. (2005), "Global perspectives on e-waste", *Environmental Impact Assessment Review,* Vol. 25, No. 5, pp. 436-58.

Wiley, D.E. (1973), The identification problem for structural equation models with unmeasured variables, in A.Goldberger and O.Duncan, eds, 'Structural Equation Models in the Social Sciences', Academic Press., New York.

World Commission on Environment and Development (WCED) (1987), Our Common Future. Oxford University Press, New York.

Wouters, M., Selto, F.H., Hilton, R.W. and Maher, M.W. (2012), *Cost Management: Strategies for Business Decisions*, International Edition, McGraw-Hill.

Wright, R. and Elcock, K. (2006), “The RoHS and WEEE directives: environmental challenges for the electrical and electronic products sector”, *Environmental Quality Management*, Vol. 15, No. 4, pp. 9-24.

Wu, H., and Dunn, S., (1995), "Environmental responsible logistics systems", *International Journal of Physical Distribution and Logistics Management*, 25(2), pp. 20-38.

Yin, R.K. (2003), *Case study research: design and methods*, (3rd edition), London: SAGE.

Yu, W. and Ramanathan, R. (2015), “An empirical examination of stakeholder pressures, green operations practices and environmental performance”, *International Journal of Production Research*, 53(21), pp. 6390-6407.

Yuang, A. and Kielkiewicz-Yuang, A. (2001), “Sustainable supply network management”, *Corporate Environmental Management*, Vol. 8, No. 3, pp. 260-8.

Yung, W.K.C., Chan, H.K., Choi, A.C.K., Yue, T.M. and Mazhar, M.I. (2008), “An environmental assessment framework with respect to the Requirements of Energy-using Products Directive”, *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, Vol. 222, No. 5, pp. 643-51.

Zailani, S.H.M., Eltayeb, T.K., Hsu, C.C. and Tan, K.C. (2012), “The impact of external institutional drivers and internal strategy on environmental performance”, *International Journal of Operations & Production Management*, Vol. 32, No. 6, pp. 721-745.

Zhou, K., Li, J., Zhou, N. and Su, C. (2008), “Market orientation, job satisfaction, product quality, and firm performance: evidence from China”, *Strategic Management Journal*, Vol. 29, No. 9, pp. 985-1000.

Zhu, O., Sarkis, J. and Geng, Y. (2005), “Green supply chain management in china: pressures, practices and performance”, *International Journal of Operations & Production Management*, Vol. 25, No. 5, pp. 449-68.

Zhu, Q. and Sarkis, J. (2004), “Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises”, *Journal of Operations Management*, Vol. 22, No. 3, pp. 265-89.

Zhu, Q. and Sarkis, J. (2006), “An inter-sectoral comparison of green supply chain management in China: drivers and practices”, *Journal of Cleaner Production*, 14(5): 472-486.

Zhu, Q. and Sarkis, J. (2007), “The moderating effects of institutional pressures on emergent green supply chain practices and performance”, *International Journal of Production Research,* Vol. 45, No. 18-19, pp. 4333-4355.

Zhu, Q., Hashimoto, S., Fujita, T., and Geng, Y. (2010), “Green supply chain management in leading manufacturers: Case studies in Japanese large companies”, *Management Research Review,* Volume. 33, No. 4, pp. 380-392

Zhu, Q., Sarkis, j. and Lai, K. (2007), "Green supply chain management: pressures, practices and performance within the Chinese automobile industry", *Journal of Cleaner Production,* Volume 15, Issues 11-12, pp. 1041-1052.

Zhu, Q., Sarkis, J. and Lai, K. (2008a), “Confirmation of a measurement model for green supply chain management practices implementation”, *International Journal of Production Economics*, Volume. 111, No. 2, pp. 261-273.

Zhu, Q., Sarkis, J. and Lai, K.H. (2008d), "Green supply chain management implications for “closing the loop”", *Transportation Research Part E: Logistics and Transportation Review* Volume 44, Issue 1, pp. 1-18.

Zhu, Q., Sarkis, J. and Lai, K.H. (2012), “Examining the effects of green supply chain management practices and their mediations on performance improvements”, *International Journal of Production Research*, Vol. 50, No. 5, pp. 1377-1394.

Zhu, Q., Sarkis, J. and Lai, K.H. (2013), “Institutional-based antecedents and performance outcomes of internal and external green supply chain management practices”, *Journal of Purchasing and Supply Management,* Volume. 19, pp. 106-117.

Zhu, Q., Sarkis, J., Cordeiro, J.J. and Lai, K. (2008b), “Firm-level correlates of emergent green supply chain management practices in the Chinese context”, *Omega,* Vol. 36, pp. 577-591.

Zhu, Q., Sarkis, J., Lai, K. and Geng, Y. (2008c), “The role of organizational size in the adoption of green supply chain management practices in China”, *Corporate Social Responsibility and Environmental Management*, Vol. 15, No. 6, pp. 322-37.

Zsidisin, G.A. and Hendrick, T.E. (1998), ‘‘Purchasing’s involvement in environmental issues: a multi-country perspective’’, *Industrial Management & Data Systems,* 98 (7), pp. 313-20.

Zsidisin, G.A. and Siferd, S.P. (2001), “Environmental purchasing: a framework for theory development”, *European Journal of Purchasing & Supply Management,* Vol. 7, pp. 61-73.