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Environmental Orientation of Government Procurement in Singapore

A thesis submitted in fulfilment of the requirements for the Degree of Doctor of Philosophy (PhD)

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April 2013

DECLARATION

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed.

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Sujak Bakir

April 2013
RMIT University
Melbourne, Australia

DEDICATION

This thesis is a dedication to my wife and my three children - Ghariza, Ilyas and Iyadh - whom I love greatly. Their unconditional love, support and most importantly their patience have been essential to the completion of my doctoral degree. This dissertation focused on environmental sustainability achieved through government procurement policy. Throughout the research journey, I have realised that our environment is indeed worth protecting for future generations.

I thank my children who learned the meaning of separation during various stages of this journey. They inspired and pushed me to finish my thesis. They believed in me all the way and for that I am forever thankful to them. This PhD journey was often fraught with difficult moments, unanticipated trials, anxiety and stress. Without the love and encouragement from the family, I would not have reached this milestone. I am indebted to my wife and companion in life, Rukiah Othman, for her unwavering love, support and commitment throughout this long journey.

Last but not least, this dissertation is also a dedication to my parents, Hjh Nepsiah Rapiyee and Hj Bakir Hj Taher, whom I love very much.

ACKNOWLEDGEMENTS

After spending more than 20 years in the corporate world, I have never considered myself much of an academic. This is most certainly reflected in my PhD study where the focus of research has its applicability in the real world. It has been an uphill task and an eye opener which have often brought feelings of inadequacy. At times, it required a re-valuation of the direction to take in this PhD journey. I thank all who have guided me and provided constructive criticisms along the way, enabling me to redefine, re-conceptualise and re-structure my thought processes to synthesise complex issues in an already complex world.

The PhD journey presents a kind of paradigm shift. It is without a doubt the most challenging and pressuring part of this experience – teaching and working on the thesis at the same time. The completion of this thesis would have not been made possible without the encouragement and support from many people. I would like to extend my heartfelt gratitude to my two Supervisors: Professor Shams Rahman and Dr Shahadat Khan for their guidance, insight and assistance in meeting the challenges in the writing of this thesis. The loose and broken threads in this dissertation would most certainly not have been discovered without my supervisors' theoretical and methodological insight, wealth of knowledge and constructive criticism. Without a doubt, this thesis would not have come to be without their encouragement, understanding and fellowship.

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WORK IN PROGRESS

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ABSTRACT

This study focuses on sustainable procurement in public organisations in Singapore using structural equation modelling (SEM). A total of 570 questionnaires were distributed, 370 were returned and 295 were used for analysis representing 52% response rate. Results of the SEM showed that out of ten hypotheses constructed, eight hypotheses are supported. The results of the SEM showed that Waste Management (WM), Organisational Systems and Processes & Policies (OSPP) and Organisational Values (OVALUES) are determinants of environmentally-oriented government procurement in Singapore.

The determinant - WM consists of reverse logistics, recycling and packaging. It influences environmentally-oriented procurement practices in public organisations. Public organisations in Singapore are focussing on the benefits of reverse logistics, recycling and packaging as measures of care for the environment. The determinant - OVALUES consists of entrepreneurship, commitment, learning capability and innovation. These could shape and strengthen the culture of public organisations towards environmentally-oriented procurement practices vis-à-vis value for money and cost efficiency, which have been the guiding principle of public procurement in the long run. This determinant is expected to have an impact on the marketplace where more innovative environmentally-oriented products could be manufactured. The determinant - OSPP which encompasses the established framework of ISO 14001, eco-labelling, product design and life cycle analysis, could further strengthen sustainable procurement practices in public organisations. The adoption of an established framework of systems, processes and policies would guide government officers in making decisions to procure sustainable products. This determinant would also facilitate their learning capability and shorten the learning curve.

This study contributes valuable insight into the determinants of environmentally-oriented procurement in public organisations in Singapore. Both managers and researchers would find it useful to know that WM, OSPP and OVALUES could provide a basis in developing a managerial framework to procure environmentally-oriented products in public organisations.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

α	Cronbach alpha
Amos	Analysis of Moment Structures - an add-on module for SPSS.
AVE	Average Variance Extracted
AGFI	Adjusted Goodness of Fit Index
BIODEGT	Biodegradability factor
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
COMMITT	Commitment factor
C.R.	Critical Ratio
CSR	Corporate Social Responsibility
df	degrees of freedom
EFA	Exploratory Factor Analysis
ECOLABLT	Eco-Label factor
ENCONT	Energy Conservation factor
ENFCON	Energy Conservation + Energy Efficiency factor
ENFT	Energy Efficiency factor
ENTORGINNOV	Entrepreneurship + Organisational Learning + Innovation factor
ENTRPNT	Entrepreneurship factor
ENVIRONMT	Environment factor
ENVFIN	Environment + Financial factors
ENVORIENT	Environmental Orientation construct
EMS	Environmental Management System
EO	Environmentally-Oriented/Environment Orientation/Environmental Orientation
Eta	The Greek letter η
EU	European Union
FINANCLT	Financial factor
GDP	Gross Domestic Product
GFI	Goodness-of-Fit Index
HAZARDT	Non-Hazardous Materials factor
IEMA	Institute for Environmental Management and Assessment
IFI	Incremental Fit Index
IMCSD	Inter-Ministerial Committee on Sustainable Development
INNOVNT	Innovation factor
INTELGDISS	Intelligence Gathering + Intelligence Dissemination factor
INTELGT	Intelligence Gathering factor
INTELLDISST	Intelligence Dissemination factor

IPA	Integrated Product Attributes construct
ISO	International Standardization Organisation
ISOECO	ISO 14001 + Eco-Label + Product Design factor
ISOT	ISO 14001 factor
Items	Questions in the questionnaire (Appendix 3)
JIT	Just-in-Time
KMO	Kaiser-Meyer-Olkin
LCA	Life Cycle Analysis/Assessment
LCYCT	Life Cycle Analysis factor
LSR	Logistics Social Responsibility
M	Mean
MEWR	Ministry of Environment and Water Resources
MO	Market Orientation
MLE	Maximum Likelihood Estimation
MINDEF	Ministry of Defence
MND	Ministry of National Development
MOF	Ministry of Finance
n	number of observations
NEA	National Environment Agency
NFI	Normed-Fit Index
OECD	Organisations for Economic Cooperation and Development
OPERF	Organisational Performance construct
OPERNT	Operational factor
OPSFIN	Operational + Financial factor
ORGLT	Organisational Learning factor
OSPP	Organisation Systems, Processes and Policies construct
OVALUES	Organisational Values construct
PACKGT	Packaging
PCLOSE	The p value generate by a PCLOSE test.
PRDGNT	Product Design
PSR	Purchasing Social Responsibility
p	p-value
RECYCLT	Recycling factor
RESPONST	Responsiveness factor
RFI	Relative Fit Index
RLOGT	Reverse Logistics
ROI	Return on Investment

RMR	Root Mean square Residual
RMSEA	Root Mean Square Error of Approximation
RPACK	Reverse Logistics + Packaging factor
SD	Standard Deviation
S.E.	Standard error
SEM	Structural Equation Modelling
SMC	Squared Multiple Correlations
SME	Small and Medium Enterprise
SOCIALT	Social factor
SP	Sustainable Procurement
SPSS-Amos	An add-on module to SPSS software for Structural Equation Modelling (SEM)
Std	Standardised
t	t-test value
UNCED	United Nations Conference on Environment and Development
TLI	Tucker Lewis Index - sometimes called Non-Normed Fit Index (NNFI)
UNEP	United Nation Environmental Program
Unstd	Unstandardised
WCED	World Commission on Environment and Development
WM	Waste Management construct
x^2/df	normed Chi-Square

LIST OF ABBREVIATED CONSTRUCTS & FACTORS

<table>
<tr><th>Constructs</th><th>Initial Factors</th><th>Final Factors</th></tr>
<tr><td rowspan="4">IPA =
Integrated Product Attributes</td><td>BIODEGT =
Biodegradability</td><td></td></tr>
<tr><td>ENCONT =
Energy Conservation</td><td rowspan="2">ENFCON=
Energy Conservation + Energy Efficiency</td></tr>
<tr><td>ENFT =
Energy Efficiency</td></tr>
<tr><td>HAZARDT =
Non-Hazardous Materials</td><td></td></tr>
<tr><td rowspan="3">WM =
Waste Management</td><td>PACKGT =
Packaging</td><td rowspan="2">RPACK =
Packaging + Reverse Logistics</td></tr>
<tr><td>RLOGT =
Reverse Logistics</td></tr>
<tr><td>RECYCLT=
Recycling</td><td></td></tr>
<tr><td rowspan="4">OSPP =
Organisational Systems, Processes and Policies</td><td>ECOLABLT =
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Environmental Orientation</td><td>INTELGT =
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Organisational Performance</td><td>ENVIRONMT =
Environment</td><td rowspan="3">ENVFIN = Environment + Financial</td></tr>
<tr><td>FINANCLT =
Financial</td></tr>
<tr><td>OPERNT =
Operational</td></tr>
<tr><td>SOCIALT =
Social</td><td></td></tr>
</table>

GLOSSARY

constructs	are the core elements of the theoretical model developed in this thesis. (See:the *list of abbreviated constructs & factors* on pagexix.)
determinants	shape a higher order concept, for example, the determinants of “Environment-Oriented Government Procurement” are “Integrated Product Attributes”, “Waste Management”, “Organisation Systems”, “Processes and Policies, and Organisational Values”.
factors	are behaviours that are clustered to create a construct. (See:the *list of abbreviated constructs & factors* on page xix.)

CHAPTER ONE

THE ENVIRONMENTAL ORIENTATION OF GOVERNMENT PROCUREMENT

1.1 Introduction

Environmental orientation refers to the recognition, integration and implementation of environmental practices, initiatives and systems in organisations to address environmental issues (Chen, 2005; Vastag et al., 1996; Buysse & Verbeke, 2003). Environmentally-oriented procurement is concerned with the characteristics of products that are green, eco-friendly or sustainably designed to minimise environmental impacts during their life cycle (Albino et al., 2009; Baumann et al., 2002). The concept of environmental orientation for this study has its origin in market orientation – MO (Jaworski & Kohli, 1993; Kohli & Jaworski, 1990**.** It relates to the behaviour and performance of organisations (Narver & Slater, 1998; Sinkula et al., 1997). Sanchez et al., (1996) stated that it is also a systematic gathering, analysis and use of information in the organisations to formulate strategy and strengthen capabilities.

Procuring environmentally-friendly products is inseparable from the principles of corporate social responsibility (Carroll, 1991; Carroll, 1999; Carter, 2005; Ciliberti et al., 2008; Walker& Brammer, 2009). As part of corporate social responsibility, organisations are recognizing the value of adopting and implementing environmental policies and systems in their operations (Hall, 200; Sarkis, 1998; Zhu & Sarkis, 2006) by integrating green product attributes during product design (Allenby, 1993; Gupta, 1995), production processes (Klassen & McLaughlin, 1996; Porter & Linde, 1995), manufacturing practices (Ellram et al., 2008; Sarkis, 2001) and procurement processes (Carter & Jennings, 2004; Handfield et al., 1997). Governments are also concerned with the environment. By increasing demand for environmental products through procurement policy, the government plays an important role in promoting a greener public sector. In doing so, governments are playing their part in contributing to the economic, environmental and social dimensions of sustainable development (Ho et al., 2010; Parikka-Alhola, 2008; Walker & Brammer, 2009).

This study applies two theoretical foundations: the resource-based theory and the stakeholder theory in order to understand the role played by governments with regard to sustainable procurement practices. The resource-based approach seeks to provide an insight into governments' capabilities in ensuring effective implementation of policy because the procuring of products, when environmental considerations are taken into account, requires new skill sets to be integrated and implemented as part of the decision-making process (Barney, 1991; De Bakker & Nijhof, 2002; Ollavarrieta, 1997). Government procurement is a complex issue not only in terms of its budgetary size, but also the involvement of diverse stakeholders. From the stakeholder perspective, governments have to take into consideration the concerns of businesses and other organisations (Delmas, 2002; Delmas, 2001; Donaldson & Preston, 1995; Elijido-Ten, 2007; Enquist et al., 2006; Fineman & Clarke, 1996; Maignan & McAlister, 2003). Procuring environmentally-friendly products is also inseparable from the domain of corporate social responsibility (CSR) which also encompasses the elements of philanthropy, support for women and indigenous businesses, minimum wage requirements and child labour (Carroll, 1999; Carroll, 1991; Carter, 2005a; Ciliberti et al., 2008a; Walker & Brammer, 2009).

1.2 The Research Environment

The Kyoto Protocol has gained world-wide acceptance (Kolk, 2008). During the APEC conference in Sydney in 2007, 21 Pacific Rim countries including Australia, US, China, Canada, Japan, Russia and Singapore adopted the declaration on climate change to reduce energy use by at least 25% by 2030 (MEWR & MND, 2009). According to Crosbey & Cameron (2008), one of the main responses to the Kyoto Protocol has been to consider the procurement role of government as a mechanism for mitigating the impacts on climate. As governments are generally the single largest buyers of goods and services in any nation, the environmental orientation of government procurement has a very significant impact on environmental sustainability.

Table 1.1 shows that the estimated value of government procurement ranges from US$11.4 billion to nearly US$1,700 billion (Public Citizen, 2012). Countries under the regional grouping of ASEAN also showed a sizable size of procurement expenditure. The World Bank (2010) estimated that the expenditure of governments in Asia ranged from 9% - 13% of the GDP.

Table 1.1: Estimated size of government procurement in selected countries*

Countries	US$ (billion)
Singapore	11.4
Malaysia	27.1
Vietnam	21.1
USA	1,677.0
Japan	654.0
Australia	132.0

Source: Public Citizen (2012)
*The years of measurement are: 2009 for Vietnam; 2008 for Australia, Japan, Malaysia and the United States; 2007 for Singapore

Devarajan et al., (1996) argued that government spending has a direct impact on economic growth as government procurement of goods and services benefits all sectors of the economy. According to Li & Geiser (2005), the government has an extensive and direct influence on suppliers through the acquisition of environmentally-friendly products. Government procurement guidelines are implemented to achieve environmental policy objectives (Bolton, 2008; Day, 2005). Due to increasing automobile ownership, industrialisation, and electricity generation to meet the demands of a modern and industrialised society, an unprecedented amount of carbon dioxide is released into the atmosphere causing an imbalance in the ecosystem that impacts, in particular, on the climate (Ravishankar, Daniel & Portman, 2009). Studies have shown that carbon dioxide emissions have caused the depletion of the protective ozone layer (Hartmann et al., 1999). This has, in turn, caused natural disasters and severe health problems for mankind. Increasing rate of modernisation in the long run will lead to increased carbon emissions which will impact on the world's climate (Shindell, Rind & Lonergann, 1998; Ishizawa, 2011). According to Tan (2008), Asia's carbon emission contribution is projected to increase from 17% of the world's total carbon dioxide emissions to 34% in 2015.

Demand for water is also growing at a rapid rate because of population growth, industrialisation and urbanisation. A ready supply of water, especially drinkable water, is critical to the survival and growth of societies. The UN Taskforce on Water estimated that about 1% of the Earth's natural water supply is fresh water and about one in six of the world's population still lacks access to clean water. As populations and economic activities increase, many cities will face water scarcity and this could curtail economic development (Tan, 2008). The situation is further aggravated by contamination of ground water in the developed and developing countries (Yang et al., 2012; Adelekan &

Abegunde, 2011; Chan, 2006). A study conducted in Singapore by Kazutaka & Tsuyoshi (1997) showed an increase in occupational diseases such as dermatitis among workers in metal products, machinery and equipment factories using solvents and coolants. The study also found increasing cases of similar occupational diseases in Thailand, China and the Asia Pacific region in general.

There are many ways to preserve and enhance the quality of the environment. Apart from utilising resources efficiently and minimising waste, it is important for governments to consider the environment as a major policy issue. Regulations to protect the environment are issued and enforcement measures are conducted to ensure that organisations meet the basic requirements of environmental standards. According to Kazashka-Hristova & Nath (2005), in the long run, when the environment is neglected, environmental degradation becomes a global problem affecting governments, businesses, and the general population.

The US Intelligence Agencies have made a bleak assessment of the impact of global warming on national security. One of the most vulnerable regions is Africa. Droughts have cut agricultural yields, concurrently causing illegal immigration and humanitarian disasters (Straits Times, 2008). The report also estimated that about 50 million people could face hunger by 2020 and between 120 million to 1.2 billion people in Asia will continue to have an inadequate water supply. The impact of an unsustainable environment could produce internal conflict and changes in government, thereby creating political instability (Straits Times, 2008).

Debates on government procurement have moved on to a new phase. The impact of government procurement is no longer seen only in the context of the issues of financial efficiency, transparency and accountability; it is also linked to the concept of sustainability. The concepts of value for money, transparency and accountability are integrated into the value of 'environmentally preferable procurement'. Coggburn & Rahm (2005) used the abbreviation EPP to represent 'environmentally-friendly practices' in the government procurement process that have a direct impact on the quality of life. Forster & Miller (2004) defined sustainable procurement as a process that adopts steps that could be implemented by organisations in their acquisition of goods and services. These steps not only have little adverse impact on the environment, but also they benefit people. They further argued that sustainable procurement exhibited the following characteristics: repair and re-use, products are made from using renewable energy, recycled materials, adherence to life costing methods and the disposal of products with no impact on the environment. Carter & Ellram (1998) considered environmental procurement as buying activities characterised by reducing and recycling material. According to Sarkis (2003), the decision to procure would also impact on the green supply chain through the purchase of materials that can be recycled or re-used.

Due to the large-scale procurement power of governments and their related agencies, the adoption of an environmentally-friendly procurement policy has a substantial influence on manufacturers and suppliers of products and services to governments. A number of measures have been identified to address environmental problems. Many governments take the view that procurement is an important policy instrument for dealing with environmental issues (OECD, 2003). Mulder (1998) suggested that, to be effective, a policy instrument should be clear in terms of the definition, characteristics and evaluation of sustainable products. A clear definition of sustainable products would cover product certification, specific products attributes and the life cycle of the products that would assist manufacturers in areas of product standardisation and compliance (Cooper & Fava, 2006).

Bolton (2008) suggested that the large government expenditure on goods and services provides a unique policy tool with which to achieve policy goals. In addition, Edler et al., (2005) proposed that government preference for sustainable products would send signals to manufacturers and suppliers, thus initiating a major shift in the market to develop innovative and environmentally-friendly products. According to Audet (2002) and Bolton (2008), governments, recognising that they are the single largest buyer of products and services, have started using procurement as a catalyst for change. Governments are well-positioned to implement measures that support social responsibility by enacting legislations, issuing policies, directives and adopting proactive approach as pro-environment institutions (Bowersox, 1998; Murphy & Poist, 2002). Drawing from Banerjee (2002), it can be argued that governments can also benefit from the experience of businesses with regard to integrating the environment into their strategic and operational decision-making.

1.3 Research Justification

Sustainable government procurement is a growing area of research (Preuss, 2009; Walker & Brammer, 2009). According to Jones (2002), studies in government procurement have so far focused on the financial aspects. There is limited research on the importance of environmental factors in influencing government procurement in Singapore. It is estimated that the value of government procurement in Singapore is more than US$11.4 billion annually (Public Citizen, 2012). The Inter-Ministry Committee on Sustainable

Development (IMCSD) Report which was released in 2009 clearly stated the importance of the government in using its substantial procurement spending for the benefit of the environment (Ministry of the Environment and Water Resources & Ministry of National Development, 2009). The government's focus on the environment is also based on the following rationale:

1. The value of government procurement in Singapore is even larger than the US$11.4 billion when the revenue contributed by government-owned companies to the GDP, which amounted to 48% (Chakravarty & Chua, 2012), is taken into consideration. In comparison, the figure is 3% in Australia and 14.5% in Thailand (Chakravarty & Chua, 2012). Therefore, the Singapore government has a far-reaching influence in using procurement as a policy tool.
2. The government's plan to make Singapore a global and liveable city, a financial hub, a logistics hub, and an arts and cultural hub. Hence, the city has to be clean and green (Economic Development Board, 2012).
3. Singapore is focussing its attention on clean and renewable energy which would have an impact on sustainable procurement (Economic Development Board, 2013).

As well as addressing this research gap, it is also envisaged that this study will act as an impetus for future research in the area of government procurement, especially in the Southeast Asian region where rapid economic development is taking place, often with a negative impact on the environment. Research on the environmentally-oriented government procurement would provide new findings, especially in terms of comparative analysis of government procurement policies in the Southeast Asian region. Findings of this study would also provide insights into the level of influence of critical factors impacting on government environmental procurement. These factors could be incorporated into government procurement policy without sacrificing its financial objectives.

1.4 Research Questions and Objectives

The objectives of this study are two-fold. The first is to identify the critical determinants of environment-oriented government procurement practices in Singapore. The second is to develop a conceptual and managerial framework that could be suggested to be integrated into the government's procurement process.

Two research questions on the extent of environmental orientation of government procurement in Singapore were developed for this study:

1. What are the determinants influencing the environmental orientation of government procurement in Singapore?
2. Do the determinants of the environmental orientation influence the performance of public organisations in Singapore?

1.5 Research Methods and Assumptions

A Structural Equation Modelling (SEM) approach has been used in this study. Prior to data collection, the content validity of the survey instrument was established by means of the literature review. Considering the recommendations by Dillman (1978), the measurement instrument for this study was pre-tested by a panel of experts and members of academia involved in the areas of procurement, logistics and operations for questionnaire structure, readability, ambiguity and completeness. The final survey instrument incorporated minor changes to remove ambiguity in sentence construction and meanings when read by respondents who are involved in government procurement process. Before the final study was conducted, the instrument was pre-tested on a panel of experts from government institutions who were practitioners in the area of procurement. The purpose of the pre-test was to ensure clarity, readability and comprehensibility of the instrument used. Based on comments and suggestions from the panel, the instrument was subsequently improved.

Issues concerning validity have been considered when developing the survey instrument to ensure that items and the scale measure are meaningful (Churchill, 1979; Litwin, 1995). Construct validity consists of convergent validity and discriminant validity. Construct validity refers to three related issues: uni-dimensionality, convergent validity, and discriminant validity. Each critical factor of the research constructs has been evaluated by using a reliability test denoted by the value of Cronbach alpha (α).

A survey questionnaire with a 5-point Likert scale was developed and distributed to managers and officers who are engaged in government procurement, to collect their responses on the extent to which they believed that environmental issues are considered in the procurement process in Singapore.

The revised survey questionnaires were then distributed to government officers in various government institutions who were directly involved in procurement activities. A total of 570 survey questionnaires were distributed and 370 survey questionnaires were returned, representing a response rate of 65%. Due to missing data and incomplete responses, 348 responses were usable. Finally, 295 survey questionnaires were used after assessing for normality and skewness. This effectively represents a 51.7% response rate. The data collected was entered into SPSS version 18 for analysis. AMOS version 18 was used for confirmatory factor analysis and structural path modelling.

1.6 Findings of this Study

Ten hypotheses have been constructed for this study. Results of SEM analysis shows that eight hypotheses are supported, indicating a significant relationship between constructs. The results of the SEM show that Waste Management, Organisational Systems, Processes and Policies, and Organisational Values have positive and significant relationships with environmentally-oriented government procurement practices. Hypothesis on the relationship between the Integrated Product Attributes on environmentally-oriented government procurement was not supported.

The model proposed in this study provides an integrated and holistic approach to the government procurement process. The adoption of environmentally-oriented procurement practices does not undermine the tenets of professionally competent government procurement. On the contrary, it upholds the principles of value-for-money, transparency and accountability. Organisationally, the core competencies of government institutions in delivering quality public services are further strengthened with the emphasis on building organisational culture steeped in sustainability. Organisational Systems, Processes, Policies and Organisational Values, methodically measured and validated, are critical determinants from the perspectives of government institutions in Singapore as well as from those of other government institutions in the region that are taking initial steps to incorporate environmental considerations in their development plans.

1.7 Contribution of this Study

The study identifies critical determinants driving environmentally-oriented procurement practices in public organisations in Singapore. This study contributes to the existing body of knowledge and research on environmentally-oriented procurement practices in public organisations in several ways.

i. Academic contribution

Firstly, it enhances our understanding of how the determinants influence environmentally-oriented procurement which also impact on the performance of public organisations. Secondly, the study synthesises previous work, which tends to be fragmented, on a number of constructs that influence environmental procurement in public organisations. Thirdly, by employing the analytical power of SEM, relationships between the determinants of environmentally-oriented procurement and their impact on performance are examined and established.

ii. Practical contribution

In terms of practical contribution, this study provides a framework for policy-makers in public organisations to consider integrating the determinants when formulating procurement policy and developing programmes that adhere to sustainable procurement practices.

1.8 Organisation of the Thesis

This thesis is arranged into eight chapters. Chapter 1 presents the introduction which includes the research problem, its scope and rationale, and the objectives of the research. Chapter 2 provides an overview of government procurement and discusses the principles, methods and influence of government procurement. The thesis then discusses the bureaucratic culture in Singapore and its procurement processes and sustainability initiatives, as well as environmental management, in the government sector. Chapter 3 discusses the theoretical foundation of the thesis and presents an analysis of the determinants of environment-oriented government procurement and sets out the hypotheses of this thesis. This chapter then provides a conceptual framework for the thesis. Chapter 4 describes the methodology, data collection process, ethical considerations, the operationalization of constructs and the instruments used to test the constructs and hypotheses using SEM. Chapter 5 discusses the methodology, sampling, layout of the questionnaire (the survey instrument), data collection procedures, coding and cleaning of data. It also provides an analysis of the initial findings including descriptive analysis, reliability and factor loading analysis. Chapter 6 discusses instrument validation and measurement. Chapter 7 presents the research findings and results of hypotheses testing. Chapter 8 provides a discussion of the research questions, contributions and limitations of the research, suggestions for future research, and concluding remarks.

1.9 Summary

In summary, Chapter 1 provides the background on the importance of government procurement in terms of environmental concerns. As one of the largest buyers, governments have the ability to influence manufacturers and suppliers to conform to their environmental procurement requirements. This is one of the recommendations of The Kyoto Protocol which advocates a greater role of government procurement. The literature review discusses the application of theories that are linked to the principles of CSR which underpin this study. This chapter also explains the motivation for the research and contribution of the thesis, and acknowledges its limitations.

CHAPTER TWO

BACKGROUND

2.1 Introduction and Overview of Government Procurement

Hochschorner & Finnveden (2006) defined organisational procurement as the process used by an organisation to enter into contracts for the supply of goods and services which are purchased, leased or rented. The term 'procurement' is applicable to both the government and businesses. Procurement plays a strategic role in supply chain networks, impacting on both the financial and non-financial aspects of organisations (Baily et al., 2008; Michelsen & de Boer, 2009; Monczka et al., 2005).

A review of the literature indicates that research on procurement tends to revolve around its importance of procurement in delivering strategic goals of organisations (Deepen, 2007; Holcomb & Hitt, 2007). Procurement is also concerned with cost efficiency which is identified as being value for money (Kumar & Ozdamar, 2005; Kunzlik, 2003). Procurement processes and transparency have been the focus of research in government procurement (Callender & Matthews, 2002). Thai (2001) and Thomson & Jackson (2007) investigated at procurement processes in order to improve efficiency and transparency in government procurement. Cooper & Zmud (1990) argued the importance of e-procurement or online government procurement as a means of achieving efficiency. Apart from the importance of transparency, Jones (2002) also stressed the need to understand the challenges of centralised and decentralised procurement processes. Jones (2002) further argued that a balance between centralised and decentralised procurement processes is required without sacrificing value for money and probity. Cox & Furlong (1997) investigated the new procurement rules implemented by the European Union to achieve greater transparency in the public utility sector. Bajari & Tadelis (2001), on the other hand, focused on incentives versus transaction cost affecting procurement contracts. Gelderman, Ghijsen & Brugman (2006) categorised explanations of non-compliance of EU directives in the tendering process. Giunipero & Pearcy (2000) developed a framework for world class procurement by focusing on the skills and procurement model. Other studies focused on factors such as centralisation and co-ordination of the procurement function for strategic advantage (Rozemeijer & van Weele, 2003), procurement trends in supply management (Trent & Monczka, 1998) and the strategic role of procurement in Singapore (Goh et al., 1999). The depth and breadth of procurement as critical functional activities are well-entrenched in business organisations. Therefore, procurement plays a significant strategic role in effecting the strategic direction of organisations either government or businesses.

2.2 Principles, Methods and Influence of Government Procurement

Perera et al., (2007) used the term 'government procurement' to refer to processes used by government institutions to purchase goods and services ranging from stationery, ICT equipment, furniture, food and beverages to the contracting of works, building construction and commissioning of infrastructure developments. Government, as the single largest buyer of any economy, can directly influence the sustainability of the environment, which is a growing area of research (Carter, 2005; Preuss, 2007; Walker & Brammer, 2009; Walker et al., 2008).

Public procurement is highly structured and formalised (Hochschorner & Finnveden, 2006). Martin, Hartley & Cox (1997) studied the methods of procurement in the public sector in member countries of the EU. Four types of procurement methods were identified: open, open-restricted, restricted and negotiated. The study also indicated that the majority of procurement methods were either open or restricted. Thomson & Jackson (2007) identified four distinct stages, especially for quotation-based and tender-based procurement: pre-tender, specification, award and execution of contract. Some of the tasks involved during the stages include specifying buyer requirements, selecting the candidates, awarding the contract and monitoring and reviewing the performance of the contract. The method of procurement depends on the financial value of the goods or services (Jones, 2002). Jones (2002) further argues that Singapore's procurement methods are classified into small-value items that can be procured directly, quotation-based, tender-based procurement for open, selective, both open and selective and limited closed tender.

Evenett & Hoekman (2005)opined that public procurement in developing countries could be quite sizable when measured in terms of their gross national output. This implies that governments have the purchasing power to influence manufacturers, suppliers and other sub-contractors that have a business relationship with the government in order to achieve desirable public policy (McCrudeen, 2004; Weiss & Thurbon, 2006). The standards and requirements are passed through legislation and the issuance of policy directives. The legislation and policy directives, among other things, include product quality and specifications which include environmental requirements with which manufacturers and suppliers must comply.

The government, when calling for quotes and tenders, either limited or closed, could specifically indicate their preference for the supply of products which are environmentally -compliant. The government's preference for purchasing such products sends a signal to suppliers and manufacturers. Figure 2.1 shows the far-reaching influence that governments have on the supply chain. The government issued directives or enacted a law that require manufacturers, suppliers and sub-contractor to supply environmentally-friendly goods.

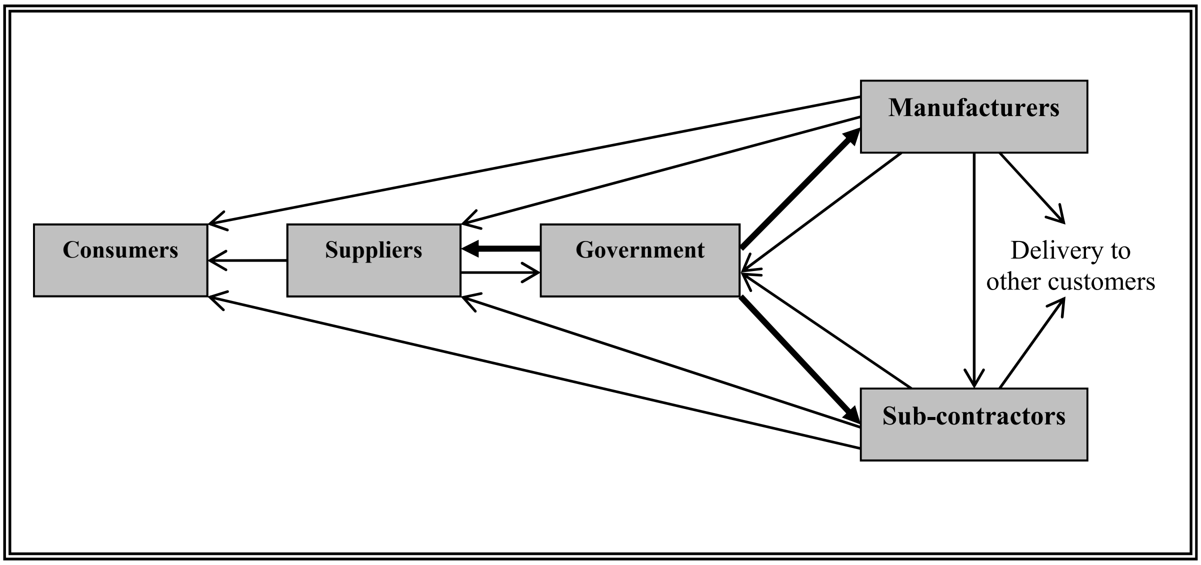


Figure 2.1: The Influence of Government Procurement

Source: Government of Victoria (2006)
Legend:
Environmental regulations, standards and requirements
Deliver environmentally preferable products

In South Africa, for example, the government passed a law to procure environmentally-friendly goods (Hank et al., 2008). Due to the government's buying power, manufacturers realign their production processes meet the request for environment-friendly products. When the manufacturers, suppliers and sub-contractors responded to government requirements (Department for Environment, Food & Rural Affairs, 2007, 2006), consumers on the whole benefitted from sustainable procurement practices.

Scholarly works have addressed the importance of environment in the context of the supply chain network (Zsidisin & Siferd, 2001). Zsidisin & Hendrick (1998) examined the link between the role of procurement and its impact on the environment. Mulder (1998) found that green procurement in the IT sector has stimulated suppliers to manufacture products that do not have an adverse impact on the environment. Sarkis (2001), on the other hand, argued that environmental strategy formed an integral part of manufacturing operations by taking advantage of win-win solutions of implementing environmentally conscious practices. Carter (2005b) also found that organisations that are environmentally responsible contributed to the overall organisational performance. Walton, Handfield & Melynk (1998) in their research on five furniture manufacturers found that procuring environmentally-friendly materials impacted on other areas of business operations such as product design, supplier evaluation and other logistical processes. Handfield et al., (2002), used the Analytical Hierarchy Process (AHP) to analyse the decision-making process of organisations that care for the environment. They found that using the AHP that has environmental criteria such as product attributes, waste management, labelling and certification, packaging and reverse logistics, compliance to government regulations and suppliers' commitment to the environment, would help managers in their procurement decision.

Concern for the environment runs parallel to the principles of CSR (Carroll, 1999; Carroll, 1991; Carroll, 1979). Thorpe et al., (2008) stressed that sustainable procurement contributes to and enhances the quality of the environment. Researchers have used a number of terms to describe concern for the environment with regard to procurement such as using sustainable procurement practices and using sustainable materials in their production (Thomson & Jackson, 2007). Other researchers used the term ‘environmentally preferable purchasing’ (Coggburn & Rahm, 2005), ‘environmental purchasing’ (Carter & Carter, 1998), ‘green purchasing’ (Melynk et al., 1996) and ‘purchasing social responsibility’ (Carter, 2005b). Handfield et al., (2002) used the term ‘environmentally-conscious purchasing’.

The government also can play the role in protecting the environment through the provision of environmental standards and regulatory frameworks. Figure 2.1 illustrates the extent of government influence through legislation and other policy directives that could exert pressure on manufacturers, suppliers and contractors to supply environmentally friendly goods and services. For example, approximately 15% of the Australian Government’s tenant light and power is consumed by office equipment (Government of Victoria, 2006). This contributes greenhouse emission equivalent to about 60,000 tonnes of CO2. By purchasing energy-efficient equipment, the government could cut power consumption by up to 80% (Department of Environment and Heritage, 2005).

The procurement of environmentally friendly products is gaining momentum. This is evident from the value of purchases made by local councils in Victoria. Spending on environmentally-friendly goods purchased by the local councils across the State of Victoria has increased from $5.9 million in 2001 to $36.9 million in 2004 (Government of Victoria, 2006). A study by Mickaityte et al., (2008) on the refurbishment of public buildings in Europe showed that the refurbishment of public buildings provides an excellent opportunity to reduce energy consumption and implement environment protection to ensure sustainable refurbishment. According to Griffith (2006), in England, the Commission for Sustainable Development has aimed for a carbon neutral public sector where hospitals and healthcare buildings contribute to zero carbon emissions. British

Petroleum in Sydney started an initiative to purchase ceramic mugs instead of disposable cups which effectively reduced waste by 10% and more than 150,000 polystyrene cups per annum did not go into landfill which would contribute to the discharge of environmentally-harmful methane gas (Government of Victoria, 2006). In addition, terms such as 'sustainable public procurement' (Walker & Brammer, 2007, Walker & Brammer, 2009) and 'green government procurement' (EU, 2003) have been used to describe government procurement that subscribes to environmental requirements.

These definitions imply that the process of government procurement is no longer a clerical function of buying goods and services with the objective of saving money for the government; rather, it has a strategic dimension intended to achieve environmental and social objectives (Cavianto, 1999; Ellram & Carr, 1994; Monczka et al., 2005; Sadikin, 2008). Notwithstanding the definition provided by the Marakesh Task Force, environmental procurement is concerned with the characteristics of products that are considered to be green, eco-friendly or sustainable designed to minimise environmental impacts during its entire life cycle (Albino et al., 2009; Baumann et al., 2002).

The review of the literature indicates that research on environmental practices has now become a major focus for organisations because environmental factors are considered as one of the strategic elements of organisations wishing to maintain their competitive advantage. Coggburn & Rahm (2005) found that environmental purchasing is widely practiced in the US both at the state and federal levels. Coggburn & Rahm (2005) also found that environmental considerations such as energy efficiency, recycled materials and the use of non-hazardous materials featured heavily in the procurement process. On the other hand, Day (2005) in her research on the role of public authorities in procuring sustainable products, found that when purchasing authorities consider lifecycle costs, they often come to the conclusion that environmentally friendly products impose less of a financial burden on the budget than their conventional counterparts. Studies such as that of Nissinen et al., (2009) considered green government procurement as an important policy instrument in the Nordic countries. A study by Walker & Brammer (2009) and Preuss (2009) showed the key role of public authorities in procuring sustainable products and services. While these studies have enriched the field of government procurement, there is still limited research that focuses on critical factors that relate to the environment and their influence on government procurement. In conclusion, a review of the available literature suggests that there has been extensive research on sustainable procurement in the private sector. However, there is scant information and research on sustainable procurement in the public sector.

Porter & van der Linde (1995) stressed that properly designed environmental standards could trigger innovations that lower the total cost of a product or improve its value. Carraro & Siniscalco (1994) argued that an environmental policy has an impact on technological and organisational innovation because organisations have to find solutions to address environmental problems. A survey conducted in New Zealand revealed strong support from businesses for the government to play an active role in green procurement (New Zealand Business Council, 2006). The survey revealed that 71% support a green public procurement policy, 59% support developing and maintaining specifications for sustainable products and services, and 54% support the development of green and other sustainability labels aimed at both the business procurement and consumer markets (New Zealand Business Council, 2006).

The above are some instances where the government could play a leading role in environmental procurement. As discussed earlier, governments, with their vast purchasing power are instrumental in creating a market for innovative sustainable products. The cases mentioned also indicate that government need to consider factors such as cost considerations, resources and capabilities of government institutions, commitment, influence and perceptions of stakeholders. These factors should be taken into considerations when developing environmental procurement policies to ensure their effectiveness (Allsopp et al., 2001; Griffiths, 2006; McMahon, 2002).

2.3 The Culture of Government Institutions in Singapore

Singapore is a city state with a land area of more than 700 sq. km and a total population of over 5 million people. In 2011, its GDP was US$239 billion (World Bank, 2011). The Singapore Civil Service experienced critical phases of growth from the 1960s until the 2000s (Lim, 1997). Table 2.1 illustrates the phases of growth and the related challenges. In the early 1960s, nation-building was at the top of the agenda. Singapore had self-government in 1959 and independence from the Federation of Malaysia in 1965. Post-independence Singapore underwent rapid industrialisation in the 1970s and 1980s. In the 1990s and through to the 2000s, the civil service was preoccupied with new challenges arising from new technology and emerging issues such as climate change and the importance of sustainable development.

Table 2.1: Themes and challenges of public organisations in Singapore		
Period	**Theme**	**Major Thrusts**
1960s	Survival	Changing mind-set and nation building
1970s	Efficiency	Selective foreign investments, efficient structures
1980s	People	Productivity, Talent, Value-Added Investments
1990s	Change	Uncertainties – Technology and Talents
2000s	No definitive theme	There is no definitive themes but there are issues such as technology, digital divide, globalisation, sustainability income disparity, security and instability issues

Source: Lim (1997) and discussion with government officers

The civil service is focused on recruiting talents, especially scholars, to provide leadership and direction. An efficient, flexible and enterprising public service is important in order to anticipate problems, work out solutions and implementing programmes. In the 2000s, the bureaucracy, with the guiding philosophy of meritocracy and transparency, was faced with new challenges of globalisation and the issue of climate change due to greenhouse gas emissions. Singapore is considered as one of the highest contributors of C02 emissions per capita with 12.08 tonnes produced in 2007 (United Nations, 2007). Therefore, as one of the signatories to the Kyoto Protocol, Singapore has to play its role in addressing the issue of climate change. Table 2.2 illustrates the guiding philosophy of the civil service which aims to be pragmatic, efficient and professional, with a well-entrenched philosophy and ethics of meritocracy. Quah (1996) attributed the efficiency of Singapore's civil service to three factors:

- the ability of political leaders to influence and continuously change the mindset of civil servants through various programs;
- uncompromising stand and intolerance of corruption and patronage; and
- the culture of public organisations is based on talent, merit and competitive reward.

The government institutions in Singapore have undergone tremendous change by adapting and transforming themselves into an efficient government machine by recognising and implementing changes. The vision is to develop Singapore as a financial and logistics hub. It also has an integrated plan to develop the city-state as a sustainable city by means of strategies, plans and programmes that focus on concern for the environment.

Table 2.2: The guiding philosophy of public organisations in Singapore

Philosophy	Principles
Solidarity of hearts and minds	Leadership
	Vision and direction to mobilize people
	Government must have good share of national talent
Reward for work, work for reward	Eschew corruption and nepotism
	Meritocracy for best use of talent
	Maximum investment in education
	Focused subsidies with co-payment in education, health and housing. Assets enhancement not subsidies for consumption
	Limited welfare not handouts: each has responsibility for own well-being which means attitude of self-reliance
Test for results, not political correctness	Pragmatism not dogma in economics
	Learn by doing and adjust as we go
	Secure opportunities through nimbleness, flexibility and adaptability
Clean and effective public service	Fair and impartial in serving the public but not neutral about executing government policy
	Instincts of what are national concerns and interest and good understanding of national imperative

Source: Lim (1997)

2.3.1 Environmental Initiatives in Singapore

In 2006, Singapore's Ministry of Environment and Water Resources (MEWR), which leads the climate change program, developed a National Climate Change Strategy as part of the Singapore Green Plan 2012. The strategy was developed using the consultative approach with multi-stakeholders, the aim of which was to respond to climate change in sustainable ways (Ministry of the Environment and Water Resources, 2005). The unveiling of Singapore's IMCSD in 2009 reflects the government's commitment to sustainability. The Report is an affirmation of the government's commitment to the environment as a pre-requisite for growth. The Committee's objectives are to formulate strategies to achieve a sustainable and quality living environment consistent with economic development. It aims to build new competencies and facilitate collaborative efforts between stakeholders in developing Singapore as an ecological hub (IMCSD, 2009). The Singapore government's initiatives run parallel to those of the World Commission on Environment and Development (WCED, 1987) which is also known as the Brundtland Commission. It also accepted recommendations made by the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, commonly referred to as "The Earth Summit" (UNCED, 1992) under the Kyoto Protocol in 1997 with the objective of addressing the problems of climate change (Grubb et al., 1999)

In 2008, the Inter-Ministerial Committee on Sustainable Development (IMCSD) was set up to develop a national framework and strategies for Singapore's sustainable development. The IMCSD has identified four strategies for Singapore's continued sustainable development. The strategy focussed on resource efficiency, creating a clean and green environment, community engagement to enhance the quality of the environment and harnessing clean technology and organisational capability (IMCSD, 2009). Singapore's sustainable development policy adopted a whole-government approach (IMCSD, 2009). Waste management is one of the areas recommended by the IMCSD to be adopted by various ministries and other government-related agencies. Waste came from ministries, government departments and statutory boards, hospitals and public development projects (Bai & Sutanto, 2002). Waste management in Singapore is governed by the Environmental Pollution Control Act. According to Low (1990), waste in Singapore is broadly classified into domestic, industrial and institutional refuse.

In land-scarce Singapore, setting aside land to be used as a landfill is uneconomical and costly. The Semakau Landfill, costing some $600 million; and covering an area of 350 hectares, is a man-made offshore landfill with a capacity to hold 63 million cubic metres of solid waste with a life-span of 35 to 40 years (Bai &Sutanto, 2002). Other than disposing of the waste in landfill, waste generated is also incinerated. Singapore has four incineration plants, the newest and largest being the Tuas South Incineration Plant (TSIP) that is a waste-to-energy plant. The plant, built at a cost of S$900 million, is able to incinerate 8,200 tonnes of refuse daily (MEWR, 2012).

As a major healthcare provider, the government also generates a sizable volume of healthcare waste. With a pyramid-like health structure of 2,000 private medical clinics, 18 polyclinics and 29 private and public hospitals, public health services support primary and intermediate care, secondary care and tertiary care of a population of 4.9 million in 2009 (Singapore Department of Statistics, 2009). Healthcare waste is classified as infectious waste, pathological waste, contaminated sharps, routine clinical waste, cytotoxic waste, radioactive waste, pharmaceutical waste, chemical waste and general waste. Infectious waste, pathological waste, contaminated sharps and other contaminated waste are considered as bio-hazardous waste which needs special handling and disposal (NEA, 2008). Pharmaceutical wastes are further classified into general pharmaceutical waste such as vitamin tablets, paracetamol tablets, creams and special pharmaceutical waste such as antibiotics, vaccines, other immunological products, and controlled drugs such as cocaine. Special pharmaceutical waste needs special disposal by incineration. General pharmaceutical waste can be disposed of as general refuse (NEA, 2008). Singapore generated approximately 1.4 million litres of pathogenic waste in 2006 (3RKH, 2008). Therefore, the implementation of environmental procurement is of major importance if the potential of environmental improvements is to be realised.

2.3.2 Government Procurement in Singapore

In the 2011 financial year (FY), the Singapore government's total expenditure was $47.54 billion. This is an increase of 4.9% from the previous year. This largely reflects the government's long-term commitment to invest in education, healthcare, and transport infrastructure (Ministry of Finance, 2010). This higher government spending has an impact on government procurement activities. Although the bulk of the government's procurement activities is decentralised to individual ministries, departments and statutory boards, there are still instances of centralised procurement. The procurement activities undertaken by various ministries, departments, organs of state and statutory boards should adhere to central procurement guidelines established by the Ministry of Finance (Ministry of Finance, 2012). The key principles are transparency, open and fair competition and value for money. The procurement guidelines do not clearly specify the importance of environmental considerations in the procurement process. However, it is possible to integrate environmental considerations in the procurement process from the perspective of value for money. The central system of government in Singapore is the Civil Service consisting of 13 Ministries subdivided into various departments. In addition to government departments, there are more than 30 statutory boards. The Prime Minister's Office controls and directs all Ministries and statutory bodies. In 2012, there were more than 130,000 employees in the Civil Service and on statutory boards (Public Service Division, 2012).

Table 2.3: Methods of Procurement	
Types	**Value**
1. Small value purchases	Up to US$2,460** up to S$3,000
2. Quotation from 3 or more suppliers	US$2,461 – US$57,377 S$3001 – S$70,000
3. Tender-based	Above US$57,377 S$70,001 and above
a. Open	Posted on the GeBIZ website inviting any supplier who may be interested to bid based on the requirements specified. Price and value for money are the key requirements.
b. Selective i) Short-listing of applicants – shortlist applicants based on their capabilities via an open pre-qualification exercise. ii) Invitation to bid – shortlisted applicants are then invited to submit their tenders.	Large scale and complex requirements.
d. Limited tender	Submission is based on invitation. This may be due to national interest.

Source: Ministry of Finance (2012)
** S$1.22 = US$1.00

The types and limits of Singapore's government procurement are represented in Table 2.3. The procurement has three distinct categories: the small value purchase, quotation and a tender-based system. The procurement policies are established by the Ministry of Finance (MOF). The policies are structured to give public agencies the flexibility to decide on detailed operational procedures. The execution of procurement activities is largely decentralized to each line agency. Therefore, each ministries and statutory board has its own procurement requirements. There are no special procurement rules in relations to military and telecommunication equipment because all government procurement must adhere to the guidelines issued by the MOF. Procurement activities in the private sector conform to the procurement policies of demand aggregation, eProcurement system, best sourcing initiative, centre for shared services, public private partnership arrangements and other related MOF budgetary and procurement policies initiatives are applied in the procurement process (Civil Service College, 2010).

In the areas of public works and infrastructural development, for example, the private-public partnership (PPP) policy is an extension of best sourcing initiative. It is where a public sector awarded a PPP contract to the private sector to design, build and operate buildings, plant or other infrastructures. Examples of PPP are the desalination plant, NEWater Plant (MEWR), Incinerator Plant (MEWR), Sports Hub (MCD), TradeXchange (Home Affairs) and a Technical College (Education). However, there is an exception in the procurement of drugs, medical, non-medical equipment and services for public healthcare institutions. The procurement for drugs is carried out centrally by the Group Procurement Office (Pharma) of the Singapore Health Services (SingHealth). The procurement of medical and non-medical equipment is undertaken by SingHealth Group Purchasing office (Non Pharma) and the National Healthcare Group (Global Legal Group, 2010).

There is no specific provision for environmental requirements in the process of procurement. However, since the government of Singapore adopted the principles of Kyoto Protocol and sustainable development, procurement has been identified as a tool that could be integrated into the government procurement process to take care of the environment (Bolton, 2008; Crosby & Cameron, 2008).

2.4 Summary

Chapter 2 begins by discussing the background of organisational procurement. It also provides broad definitions of procurement and sustainable procurement. This chapter also examines environmental procurement in general. This is followed by a discussion on principles, methods and influences of government procurement. It then shows the degree of influence of government on businesses to supply environmentally-friendly goods. A study conducted by the International Institute for Sustainable Development (IISD) indicated that government procurement has the potential to influence the demand for sustainable goods and services thereby sending the right signal to the market that sustainable development is preferred in the economy (Perera et al., 2007). It provides a general discussion of the culture of public organisations in Singapore which is based on secularism, talent and meritocracy. It also touches on the themes and challenges such as faced by public organisations, one of which is concern for the environment and the initiatives needed to address environmental issues. Finally, the chapter provides a general description of the methods of government procurement in Singapore.

CHAPTER THREE
LITERATURE REVIEW
THEORETICAL FOUNDATION, CONCEPTUAL FRAMEWORK & HYPOTHESES DEVELOPMENT

3.1 Introduction

This chapter begins by reviewing the literature on the theoretical foundation of this study: the resource-based theory and the stakeholder theory. The resource-based theory could provide insights on how government using its resources and organisational capabilities to develop sustainable procurement practices. The stakeholder theory, on the other hand, explains how governments with many stakeholders develop and implement sustainable procurement policy. This study leverages the strength of both theories in order to better understand complex issues. Halldorsson et al., (2007) argued that the use of a single theory, either resource or stakeholder-based, has inherent limitations due to the in-built assumptions about the nature of firms. Utilising two theories to explain sustainable government procurement provides a more comprehensive insight into and more rigorous of complex issues from different perspectives as it is a multi-displinary approach. From a conceptual standpoint, it also provides a direction and tools enabling an in-depth insight into the interaction of a multitude of factors that produce a phenomenon.

Furthermore, the use of two theories has its advantages in providing comprehensiveness in theoretical development which extends beyond intellectual discourses. It also allows practitioners to be multi-disciplinary in their approach when addressing emerging issues in their domain of interest, in this case, specifically the use of procurement to enhance environmental sustainability. Many procurement problems can occur and the solutions might depend on a mix of different theoretical backgrounds. This provides a far more robust theoretical foundation as complex issues are better explained from multiple perspectives which can give greater insight into the dynamics of complex structures and inter-organisational relationships in organisations.

The chapter also provides a brief discussion on corporate social responsibility (CSR) as concern for the environment is an element in the framework of CSR. The chapter then focuses on conceptualising the determinants that influence the environmental orientation of government procurement in Singapore. It then constructed hypotheses describing the relationships between the constructs. The chapter then presents its conceptual framework indicating constructs for this study. It then develops and presents the hypotheses, and concludes with a chapter summary.

3.1.1 Resource-Based Theory

This study applies the resource-based theory to provide an insight on how resources and capabilities of government instructions are utilised in the area of environmental procurement. The resources and capabilities could be analysed in the context of organisational values and government purchasing power. Resource-based theory argues that an organisation's internal and external resources which are a source of competitive advantage that leads to better performance (Barney, 1991). Resources can be either tangible or intangible. Tangible resources are financial resources, and buildings and machinery, while intangible resources are aspects of human capital such as organisational training, the culture of the organisation, intelligence, relationship such as collaboration and quality of employees. Barney (1991) considered these resources and capabilities as the assets, processes, attributes and knowledge controlled by an organisation. By maximising the strength of internal resources, strategic decisions are made by businesses regarding cost, efficiency, allocation of resources and positioning to remain viable and competitive (Menguc & Ozanne, 2005; Russo & Fouts, 1997; Sharma & Vrendenburg, 1998).

The theory also stipulates that an organisation's ability to survive depends largely on its ability to maximise internal and external capabilities. Resources and capabilities such as creativity, innovation, patents, design, contracts, technological and managerial resources, can also be internally and externally derived (Das & Teng, 2000). According to Ireland et al., (2004), Lober (1998) and Smith et al., (1996), the strength of an organisation is supported internally by corporate culture and organisational values such as entrepreneurship, learning capabilities, commitment and innovation. Capabilities refer to factors such as strategic alliance collaboration, trust, and the power relationship between organisations (Akkermans et al., 2004; Handfield & Bechtel, 2004; Hingley, 2005). The theory focuses on the maximisation of resources and capabilities of organisations with the objective of achieving and sustaining competitive advantage (Barney, 1991; Ghosal & Moran, 1996; Penrose, 1959; Russo & Fouts, 1997). Morris & Jones (1999) assert that while the notion of profitability and competitive advantage could be alien to government institutions, providing efficient and quality service is critical because government institutions generally operate in dynamic, hostile and complex environmental conditions. This inevitably forces government institutions to be pro-active, innovative and entrepreneurial in order to meet the expectations of multiple stakeholders and a demanding population (Coggburn, 2004).

In the context of responsible supply chain management, De Bakker & Nijhof (2002) argued that organisations have to collaborate with other organisations regarding resources and capabilities that are not present in their own organisation so as to achieve competitive advantage. The theory also stipulates that an organisation's resources and capabilities need to be aligned as a source for direction (Grant, 1991). The allocation and utilisation of resources and capabilities implies that these resources are not easily transferable to other uses. These resources are designed to address specific needs to meet consumer demand, markets and environmental pressures. The resources and capabilities have the characteristics of imperfect mobility, imitability and substitutability. Hence, businesses must cooperate within their network in order to access resources which they themselves do not have (Das & Teng, 2000). Collaboration, allocation and utilisation of resources are not unique to businesses. Government institutions are also faced with similar circumstances. Government institutions are required to collaborate with external parties as they are not producers of goods and services. Government institutions too have to re-invent and streamline their modes of operations by developing a creative and entrepreneurial culture to maximise their allocation and utilisation of resources and capabilities (Bartlett & Dibben, 2002; Boyett, 1996).

The use of eco-labels, certifications and environment-friendly products such as packaging and recycled materials are achieved through external collaborative arrangement. Amacher et al., (2003) suggest that collaboration provides a strategic tool for a firm to differentiate its products and services from those manufactured by other firms that do not make the necessary green investments. The integration of environmental factors in the formulation of strategy is explained from a resource-based perspective. In this context, management perceives environmental factors as being a matter of strategic policy rather than ethical consideration (Aragon-Correa et al., 2004; Banerjee, 2001). Studies have shown that firms that adopted proactive environment strategies beyond the regulatory requirements showed positive financial performance when supported by organisational capabilities (Marcus & Gefen, 1998; Russo & Fouts, 1997; Sharma & Vrendenburg, 1998). The greater the resources and capabilities such as organisational learning (Smith et al., 1996), entrepreneurial and innovation (Gonzalez-Benito & Gonzalez-Benito, 2005; Keogh and Polonsky, 1998; Lober, 1998; Menguc & Ozanne, 2005), the higher the readiness of these organisations, both public and businesses, to adopt and integrate proactive management practices into their modes of operations.. Resource-based theory has been widely used to analyse the behaviour of firms in terms of governance structures and the rationalisation of costs when making investment decisions. Ollavarrieta (1997) argued that the resource-based approach has distinct advantages in providing an explanation of strategy and performance because it considers the resources and capabilities of firms. The theory can be applied when analysing the resources and capabilities of government institutions.

3.1.2 Stakeholder Theory

Government has to interact with many stakeholders before developing and implementing policy. The consultative approach where diverse opinions from multi-stakeholders are taken into account could ensure that certain policies will be effectively implemented. In essence, the stakeholder theory was defined as ”those groups without whose support the organisation would cease to exist” and originally included shareowners, employees and customers (Freeman, 1984). Organisations have stakeholders with the potential to influence them both positively and negatively. Likewise, the activities of organisation impact on individuals and collectives whose interests may be affected either favourably or adversely (Polonsky, 1995). According to Buysse & Verbeke (2003), González-Benito & González-Benito (2008) and Santos et al., (2006), in governments and businesses, both the management and employees are stakeholders whose decisions could affect the environment.

Stakeholders play a critical role in determining the direction of organisations. According to Freeman (1984), individuals or groups who have a stake or interest in an organisation are considered stakeholders. The stakeholder concept, originally applied to business organisations, can provide an insight into the role of stakeholders. An integrated supply chain network has a number of stakeholders. As one of the key stakeholders in the supply chain, government institutions have an interest in almost all spheres of activities: economic, social, political and environmental. The government has the power to influence and exert pressure on businesses to adhere to environmental requirements. This is achieved through legislation, directives and other policy instruments as a means of protecting and enhancing the quality of environment (Figure 2.1, p 17). The ability to exert influence is displayed through the government's procurement policy where government's preference for sustainable products has caused manufacturers to reorganise their production processes to conform to such requests. The government's environmental procurement policy would ultimately impact on the supply chain which would cause manufacturers to evaluate their production process by subscribing to ISO 14001 and other environmental standards and the greening of the supply chain (Chien & Shih, 2007; Rao, 2002; Zhu et al., 2008a).

The ability of a stakeholder is also maximised through the use of an effective communication channel, enabling co-operation and co-ordination among the diverse stakeholders, ranging from government, businesses, consumers and non-government organisations. It facilitates consensus of opinion on what between stakeholders in organisations (Donaldson & Preston, 1995; Freeman, 1984; Mitchell et al., 1997). Deegan & Blomquist (2006) examined various communication strategies employed to influence business organisations to adopt environmental practices. In another study, Sarkis et al., (2010) argued that the influence of stakeholders in pressuring for the adoption of environmental practices has been established in the literature. These results show strong evidence of the relationship between stakeholder pressures and the adoption of environmental practices mediated by training.

Training is essential to enable elements of eco-product design to be incorporated at the early stages of the production process. The elements include energy efficiency, ergonomics, recyclability, use of renewable energy and non-hazardous materials among others. Training is also related to the issue of innovation that further strengthens the organisation's capabilities regarding environmental matters specifically. Sharma (2000) stated that direct stake-holders involvement provide an impetus for management to adoptenvironmental strategies that impact on the competency and motivation of employees. A number of studies have also found the relationship between the involvements of stakeholders and the performance of organisations. Molina-Azor'in et al., (2009) found the impact of green management on financial performance in their study on hotel managers in Spain. Carruthers, Rod & Ashill (2007) argued that active involvement between stakeholders, in this case a relationship between purchaser-provider, resulted in a cooperative relationship in the delivery of healthcare products. Zutshi & Sohal (2003) also found that the involvement of stakeholders in an organisation is important for successful implementation of environmental management systems. In addition, stakeholder theory relates to business ethics which essentially associated with corporate responsibility (CSR) (Enquist, Johnson & Skalen (2007; Jamali, (2008); Maignan & McAlister (2003). The following provides discussion on CSR.

3.2 Corporate Social Responsibility

The concept of CSR originates from the domain of ethics (Davis, 1960; Votaw, 1973). Carroll (1991) conceptualised CSR as a pyramid structure in which economic responsibility serves as a foundation for legal, ethical, discretionary and total responsibility. Studies of sustainable procurement revolve around the principles of CSR which has drawn considerable interest from, and been the focus of, academics and practitioners alike. Carroll's (1979) early work established that CSR is a voluntary initiative of corporations without enforcement mechanisms. The link is evident because businesses consider CSR as an important strategy with which to achieve competitive advantage. There are multiple and various definitions of CSR, just as there are for sustainability. Dahlsrud (2008) identified 37 definitions of CSR which are used in academic research. He categorised them under five dimensions: stakeholder, social, economic, voluntariness and environmental.

Carter & Jennings (2002) conducted a study on logistics social responsibility identifying factors such as environmental issues, diversity, safety and human rights that contributed to the research on sustainability under the umbrella of CSR. They added that CSR has been an integral part of logistic management. CSR also covers the issues of minority recruitment, women and children, job safety and reverse logistics (Kopicki et al., 1993; Stock, 1998; Stock, 1992). Zsidisin & Siferd (2001) defined the environmental supply chain that focuses on the environment which is related to design, acquisition, production, distribution, use, re-use and disposal of goods and services of organisations. Sarkis (2001) outlined the importance of manufacturing strategy and operations and corporate environmental sustainability. Hagelaar & van der Host (2002) considered the application of life cycle assessment in evaluating the performance of environmental supply chain management. Other studies within the framework of CSR are environmental management systems (EMS) (Walker et al., 2007) and the integration of green supply chain (Vachon & Klassen, 2006). The research studies mentioned logistics to CSR where environment is one of the key considerations.

The competitive nature of the business environment has caused organisations to move beyond the traditional offerings of product quality, lower cost, efficient processes and time delivery. In the age of sustainability, business strategies are structured around elements of CSR, encompassing economic, social and environmental concerns as well. These are deemed even more critical to ensure the organisational competitiveness at strategic and operational levels (Porter & Kramer, 2006). Some businesses explicitly position themselves as guardians of the environment by supporting sustainability efforts on conservation and the preservation of the natural environment. These businesses pursue and achieve a corporate strategy that is not at the expense of the environment (Porter & van der Linde, 1995; Sarkis et al., 2010).

Arguments on the applicability of CSR to logistics and the supply chain are linked with resource-based (Aragon-Correa et al., 2008; Elsayed, 2006) and stakeholder theory (Elijido-Ten, 2007; Enquist et al., 2006; Heidrich et al., 2009). The environmental dimension is within the framework of CSR (Ciliberti et al., 2008). The focus on environmental concerns intensified when problems of climate change were highlighted as a major problem in a modern and industrialised society (Kolk, 2008).

Carter & Jennings (2004) expanded the proposition by positioning environment purchasing as a subset of CSR. Ciliberti, Pontrandolfo & Scozzi (2008b) extended the corporate responsibility analysis by developing a taxonomy of purchasing social responsibility that incorporates sustainable managerial practices within the functional areas of organisations such as transportation, warehousing, packaging and reverse logistics. Carter & Carter (1998), on the other hand, looked at inter-organisational factors that affected environmental purchasing activities that facilitated recycling, re-use and resource reduction.

Drawing from discussion on the importance of resource-based and stakeholder theories that relate to issues such as the implementation of environmental management systems, sustainable procurement, green and responsible supply chain, a number of factors that can be considered as sustainable procurement practices have been identified. The following is a discussion of the determinants of environmentally-oriented procurement.

3.3 Determinants of Environmentally-Oriented Procurement

Lambert et al., (2000) argued that procurement is one of the supply chain activities with the greatest potential impact on corporate performance. Khan & Rahman (2009) suggested that there are a multitude of factors, other than price, delivery and warranties, that determine and shape procurement decisions. Literature on logistics and supply chain management lists a wide range of goals for procurement to achieve inventory optimization, cost savings and product quality (Humphreys et al., 1998; Janda & Seshadri, 2001; Monczka et al., 2009). Where environmentally-friendly materials are specified in product development initiatives, the procurement function is empowered to take on a strong environmental orientation (Benedetto et al., 2003). Many manufacturers have systems to select suppliers based on environmental considerations (Handfield & Bechtel, 2002; Humphreys et al., 2003; Noci, 1997). According to Monczka et al., (2005) and Monczka et al., (2009), the process of integration between procurement and other functional areas facilitates the implementation of management philosophies of Just-In-Time, Total Quality Management and Materials Resource Planning. Although not specifically focussing on procurement, a study by Klassen & Wybark (1999) concluded that business organisations that adopt environmental principles in their operations contributed positively to businesses and society.

Other studies focused their attention on organisational culture that is deemed critical in the implementation of environmental measures in organisations. Quazi (1999) identified a number of critical success factors in the implementation of an EMS in an organisation. These are: management commitment, consultants, availability of resources, employee cooperation, strong quality culture and communication. EMSs also impact on the financial aspect of a business organisation. Amutenya et al., (2009) found that an educational institution achieved a savings of US$20,000 through paper recycling activities. A study by Wee & Quazi (2005) of two industries in the manufacturing sector in Singapore revealed critical factors such as the commitment of top management, total involvement of employees, training, green process design, supplier management, measurement, and information management in ensuring the successful implementation of environmental management.

Zhu et al., (2008a), on the other hand, investigated the correlation of two major internal factors, organisational learning and supports, rather than regulatory pressures, that facilitates the development of environmentally-oriented practices among Chinese manufacturing firms. Organisational learning was derived from a firm's experience with programs such as total quality management and environmental management systems such as ISO 14001 and EMS. Management support was defined as support for environmental ideas and practices from top and middle-level management which include cooperation across organisational functions. The study found significant positive relationships between organisational learning mechanisms, organisational support, and the adoption of environmental practices. The study concluded that programmed and well-structured organisational learning regarding environmental practices should be encouraged to instil these practices in organisations.

Some studies looked at specific factors that impact on the environment. Mojo (2007) focused on the concept of biodegradability while Murphy &Poist (2002) considered energy conservation. Carter & Jennings (2002) and Carter & Jennings (2004) classified a number of sustainable practices such as recycling, re-use, the use of life cycle analysis and suppliers commitment to waste disposal. Ciliberti, Pontrandolfo & Scozzi (2008b) studied environmental practices in the areas of transportation, packaging, warehousing and reverse logistics. The importance of ISO certification for organisations was investigated by Quazi (1999) and Alan, Ofori & Briffet (1999). Gallastegui (2002) examined the use of eco-labelling that creates awareness among consumers on the environmental value of a product. Walther & Spengler (2005) studied the treatment of electronic waste and its legal requirements in Germany. Tsai & Chou (2004) looked at various regulatory compliance issues in Taiwan that are concerned with environmental issues. Zheng, Yanful & Bassi (2005) studied waste management, specifically targeting the management of plastic waste in particular the biodegradation of plastic waste.

Literature on the measurement of performance in environmental procurement is broadly classified under operational, organisational and communication. Gonzalez-Benito & Gonzalez-Benito (2006) stated that these procurement practices are shaped by three critical determinants: characteristics of the company, pressure from stakeholders and other external factors. Company features are: the size of the company, its degree of internalization, managerial attitude, motivation and strategic attitude. Stakeholder pressures are seen in the context of external stakeholders, both primary and secondary. Industrial type and location are considered as external factors that shape the company features. Gonzalez-Benito & Gonzalez-Benito (2006) emphasized that these factors are not independent but are mutually reinforcing. Handfield et al., (2001) provided a framework with which to analyse the environmental performance of organisations.

Environmental measures are classified under waste management, packaging, reverse logistics, labelling, certification and government regulations that support environmental procurement (Handfield et al., 2002). Although useful in evaluating environmental practices in businesses, the classification does not address internal conditions and factors necessary for organisations to focus on the environment. Organisations are slowly beginning to understand the need to incorporate environmental concerns in their decision-making process especially in the area of product design (Allenby, 1993; Gupta, 1995), production processes (Klassen & McLaughlin, 1996; Porter et al., 1995), manufacturing practices (Ellram et al., 2008; Sarkis, 2001; Winsemius & Guntram, 1992) and procurement processes (Carter & Jennings, 2002; Handfield et al., 1997). Handfield et al., (2001) proposed that an organisation's focus on environment can be evaluated at two different levels: the corporate level and product/service level. These are indicators of an environmentally responsible organisation.

The problem of assessing an environmentally-oriented organisation arises when there is no clear definition of responsibility providing a guideline for the procurement personnel. For examples: What would be the right amount of recycled material used in the purchased items? Should a check be conducted on the extent of a supplier's activities that are in compliance with the existing government environmental regulations? The framework proposed by Handfield et al., (2001) has provided some insight into how businesses incorporate environmental factors in their operations and the extent to which these processes can be adapted in the analysis of government procurement. Procurement is a key link in an integrated supply chain network where procurement managers have to make decisions on whether to buy from low price suppliers or from more costly but environmentally more responsible suppliers (Murphy et al., 1995). Enarsson (1998) argued that procurement managers are well-positioned to use environmental parameters to evaluate suppliers' commitment to the environment. The framework also looks at other aspects such as leadership in the context of management commitment and provision of training to implement work processes that care for the environment in areas such as waste disposal, energy efficiency, conservation measures and ensuring that the material used can be re-used or recycled.

While the above-mentioned literature has provided an understanding of this issue, there is still a lack of comprehensive analysis to explain government procurement behaviours specifically in the context of proactive environmental procurement activities. In this regard, Enarsson (1998)'s framework can be used to evaluate suppliers in the context of businesses. However, government procurement is far more complex as decisions to buy are not based solely on financial considerations. Fair and open competition, as well as transparency, is the pillar of government procurement. The adoption of determinants of environmentally-oriented procurement such as integrated product attributes, waste management, organisational systems, process and procedures requires a paradigm shift, especially one that encompasses the right organisational values that would support the principle of caring for the environment.

3.3.1 Integrated Product Attributes

Integrated Product Attributes refer to the characteristics of a product that are not harmful to the environment (Rehfeld et al., 2007). The characteristics of the product are voluntarily declared by the manufacturers indicating, amongst other things, that the materials used to manufacture the products are not harmful (Leire & Thidell, 2005). Buyers too are made aware of the environmental attributes of the products, enabling them to make informed procurement decisions.

In the EU countries, integrated product attributes are seen in the context of product policy which is based on the belief that environmentally-oriented products do not contribute to environmental degradation, whether during their manufacture, use or disposal (Rehfeld et al., 2007). Meanwhile, Berkhout & Smith (1999) advocated that the term ‘integrated product policy’ can be defined as a public policy that aims to modify and improve the environmental performance of a product. Berkhout & Smith (1999) further identified that an environmentally-oriented product is designed to achieve the following:

- reducing and managing wastes generated by the consumption of products;
- encouraging innovation of more environmentally sound products;
- creating markets for more environmentally sound products;
- transmitting information up and down the product chain; and
- allocating responsibility for managing the environment through product creation.

The review of the literature suggests that there are four major product attributes that minimise the impact on the environment:

- energy efficiency;
- energy conservation that is important to address climate change;
- biodegradability which reduces reliance on landfills as a method of disposal; and
- the use of non-hazardous materials in the production processes to ensure the health and safety of users.

These attributes are not exclusive. Often products that are environmentally superior have more than one attribute. As an example, an eco-light bulb, apart from its energy efficiency and conservation attributes, is also manufactured using a clean production system. Therefore, in terms of environmental degradation, products that have the characteristics of energy efficiency, energy conservation (Murphy & Poist, 2002), biodegradability (Narayanan, 2009; Mojo, 2007; Zhang, Yanful & Bassi, 2005) and non-hazardous materials (Hsu & Hu, 2009; Mazlin et al., 2009) are critical in protecting the environment. The following section discusses product attributes influencing the environmentally-oriented government procurement.

3.3.1.1 Energy Efficiency

Patterson (1996) defined energy efficiency as the use of less energy to produce the same amount of services or output. Energy efficiency is derived by dividing output by input for processes where energy is an input. The reverse of energy efficiency is input divided by output (Blok, 2005; Patterson, 1996). It is not the intention of this study to focus on the technical aspects of energy efficiency. After World War II, nations were preoccupied with rebuilding their economies. Growth was unstoppable, propelled by the use of fossil fuels which eventually led to the problem of pollution and waste. Unprecedented amounts of carbon emissions also affected the ozone layer, contributing to climate change and global warming (King, 2013). Debate on the problems caused by rapid growth has led governments to espouse the principle of sustainable development. To address pollution and problems posed by climatic change due to carbon emissions, governments of developed and developing countries were urged to re-evaluate their energy consumption to conserve energy and be energy-efficient (International Atomic Energy Agency, 2005).

A clear understanding of the importance of energy efficiency provides a guide on procurement decisions as it influences the amount of carbon emission and hence the quality of the environment. Currently, energy efficiency is an essential component of the agreements contained in the Kyoto Protocol to address greenhouse gas (or 'carbon') emissions (Chang & Wang, 2010; Mlecnik et al., 2010; Wu et al., 2010). The use of fossil fuels or coal to generate electricity has propelled countries in the Asian region to a spectacular economic growth. However, the growth is not without environmental costs. According to Zhang (2008), this has given rise to the government's renewed attention on the importance of energy efficiency. A study by Al-Mofleh et al., (2009)showed that energy requirements will remain very intensive in Malaysia. Energy consumption in commercial and residential buildings, without taking into account the government-owned buildings at the local, state and federal levels, remained high. He further argued that although Malaysia has made some improvements in a bid to lessen consumption, there are opportunities to apply energy conservation strategies to reduce energy consumption in buildings.

Energy efficiency is one of the many measures that need to be adopted by governments to address the climate change because of the greenhouse effect. According to Koh & Lim (2010), Malaysia has been actively looking for alternative fuel to ensure the availability and security of energy for economic growth, especially for electricity generation without damaging the environment. Singapore, on the other hand, is targeting a 35% improvement in energy efficiency from 2005 levels by 2030 (IMCSD, 2009). The European Energy Performance of Buildings Directive was formulated to provide a framework for European countries to develop regulations for the energy efficiency of buildings (European Commission, 2002) since energy efficiency and conservation are relevant to the problem of carbon emission.

It is predicted that the level of carbon emissions is related to economic growth (de Bruyn et al., 1998; Ekins, 1997; Selden & Song, 1994). Economic growth in many parts of the world has been driven by continued reliance on fossil fuels which could triple the global CO2 emissions from the 200l levels by 2100. In 2010, a new milestone was reached when emissions from the non-OECD countries exceeded those from OECD economies. This trend is expected to continue, with non-OECD countries contributing 67% of the global greenhouse gas emissions by 2050 (OECD, 2008). Prospects for developed economies in terms of carbon emission are more promising. According to Dixon et al., (2010), emissions will rise by approximately two-thirds from their 2000 levels by 2100. Singapore is no exception because her economic growth has been driven by the use of fossil fuels. Singapore is targeting a 35% improvement in energy efficiency from 2005 levels by 2030 (MEWR & MND, 2009).

3.3.1.2 Energy Conservation

Blok et al., (1993) defined energy conservation as measures which would lead to decreased consumption of exhaustible primary energy carriers but which do not reduce the level of the activity for which the energy is used. For example, turning off a light is energy conservation. Apart from focusing on being energy efficient, organisations are also investigating measures that can be adopted to conserve energy. Murphy & Poist (2002) stated that energy conservation has been one of the heavily researched environmental issues. The measures used include end-use energy conservation such as wall insulation, efficient power plant and the use of renewable energy sources. Blok et al., (1993) also concluded that energy conservation can reduce carbon emissions.

Energy conservation has attracted much attention because of the threat of resource exhaustion (Meadows et al., 1972) and the escalation of oil prices that impact on every sector of the economy (Deffeyes, 2005; Heinberg, 2003). The use of fossil fuels is considered to be the cause of a number of environmental harm. Energy conservation is believed to be an effective means of reducing carbon emissions to combat global warming. Energy conservation as a strategy is also used by many institutions, both public and private, as the first line of defence in combating global warming (Economics and Business Week, 2008). In other words, governments that have emphasized this aspect of product procurement are expected to play a major role in developing energy conservation programmes, thereby contributing to environmental sustainability. Dincer (2003) argued that energy conservation achieved through energy consumption programmes has reduced the emissions of greenhouse gas into the environment.

Al-Mofleh et al., (2009) looked at energy conservation in terms of the optimum selection of hardware on technical specifications and economic value. In other words, in order to achieve energy conservation goals, it is necessary to use advanced equipment that is commercially available. Fenerty-McKibbon & Khare (2005) outlined the benefits of energy conservation which contributes directly to environmental preservation and energy cost savings. In addition to its environmental and financial impacts, energy conservation contributes to creating an improved working environment that leads to employee satisfaction, thus enhancing the image of an organisation. Government facilities have long been a target for energy conservation. Governments can also take the lead by expanding retrofitting works in their buildings and also by creating new projects by constructing zero energy buildings that could reduce energy consumption (IMCSD, 2009).

Hamza & Greenwood (2009) also contended that the UK government can play a bigger role by taking measures to conserve energy in government-owned buildings and by enacting relevant legislations. Sunnika (2003) concluded that carbon reduction relies on the management of existing buildings. In the USA, the power sector was responsible for 40% of US energy consumption in 2007. About two-thirds of this energy involved thermal losses from electricity conversion in power plants, and about 10% involved thermal losses during delivery through power lines (Energy Information Administration, 2008). Coal accounted for almost 50% of the electricity generated in the US in 2007 (Energy Information Administration, 2008). The situation in US is also applicable to Singapore where the government has direct ownership of power generation using fuel. Therefore, improvements in energy conservation measures through the generation and delivery of electricity are an important means of reducing air pollution and greenhouse gas emissions.

While it seems simple and obvious to conserve energy through the installation of technically superior equipment, energy conservation requires a change in the way organisations and individuals perceive the importance of conservation. It requires a paradigm shift and a commitment to conserving energy that permeates all levels of an organisation. This can be achieved through various activities that outline the benefits of conserving energy by implementing programmes that develop and encourage commitment, developing a system to assess and evaluate environmental performance according to targets and identifying areas where energy conservation activities can be implemented.

3.3.1.3 Biodegradability

Biodegradability defined as the ability of waste products to be broken down by natural processes is another product attribute. A material is considered to be biodegradable if all of its organic components can be broken down by biological activity (Industrial Lubrication and Tribology, 1992). The terms 'biodegradable' and 'compostable' are used interchangeably and mean that a material or mix of materials can be decomposed, biodegraded and disintegrated in one cycle (Song et al., 2009). Biodegradability is often associated with environmentally friendly products. The speed of biodegradation differs from one product to another. Bread biodegrades easily, while plastic waste and oil lubricants take a longer time to do so. When a biodegradable product breaks down by biological means, it blends into the raw materials of nature and disappears into the environment. These products can be solids biodegrading into the soil (also referred to as 'compostable'), liquids biodegrading into water and biodegradable plastic breaking down when exposed to micro-organisms.

According to the American Society of Testing and Materials (ASTM, 2002) environmentally-degradable plastics degrade easily to carbon dioxide and water through the action of microorganisms such as bacteria, fungi and algae in nature. Essentially, the biodegradation of a sustainable product means that the waste that is generated would return to earth where it is down naturally into the basic building blocks of nature. Every resource produced by nature returns to nature. Even raw crude oil will degrade when exposed to the natural elements of water, air and soil, thus protecting the environment (Green Eco Planet, 2010). In simpler terms, biodegradable products are products that break down naturally and return to their natural building blocks (Mojo, 2007).

In a modern industrial and consumer-oriented society, the types and volume of waste generated increase at an exponential rate annually in the developed, developing and third-world countries. Plastic is probably one of the most engineered materials. Mojo (2007) stressed that the procurement process needs to ensure that the suppliers not only claim but also prove that their products are biodegradable by providing appropriate data and/or explanation. Biodegradability is also considered as one of key measures to manage waste disposal. Zheng, Yanful & Bassi (2005) argued that biodegradation is a possible solution to manage plastic waste disposal because of an increasing use of plastics in human activities.

Plastic waste constitutes the third largest waste volume in Malaysian municipal solid waste. Agamuthu & Faizura (2005) asserted that the ever increasing volume of plastic waste generated puts pressure on the life of landfills when the waste is not easily biodegraded. Biodegradable plastic is considered as one of the options available for managing environmental problems. Biodegradability of plastics means that products or polymers used to manufacture industrial and consumer durables should be biodegradable at the end of their life cycle.

Although biodegradability is one of various alternatives in environmental management, it is not without its drawbacks. Landfills are not a preferred option and there are pressures to reduce them. The European Union Landfill Directive requires reductions in the rate of biodegradable waste going to landfill to 35% by 2016 (Morrissey & Browne, 2004). The objective of the landfill directive is to prevent or reduce, as far as possible, the negative effects on the environment, including the greenhouse effect from the land-filling of waste. Land-filling of waste can cause negative impacts such as the release of landfill gas such as methane. The Irish and English governments' policy on waste management is changing to meet these pressures, with a major emphasis on the management of biodegradable municipal waste that includes food, garden-waste, paper and paperboard which are capable of undergoing decomposition (Dawson & Probert, 2007). The EU Landfill Directives targeted a reduction of biodegradable municipal waste going to landfills to 75% of that produced in 1995 by 2006, 50% by 2009 and 35% by 2016 (Morrissey & Phillips, 2007). In land-scarce Singapore, all wastes are incinerated and the ash generated is sent to the the landfill site. This landfill site is expected to last for forty years. The objective is to eventually have zero landfill in Singapore (MEWR, 2005).

Businesses are also taking steps through innovation to manufacture environmentally-friendly products. New environmental regulations and concern, societal pressure and increased environmental awareness throughout the world have triggered the search for new products and processes that are compatible with the environment (Calcott & Walls, 2005). Among the design criteria are the use of renewable resources and the biodegradability of the product (Narayan, 2009). IBM, for example, has been successful in creating an earth-friendly plastic from plants that could replace petroleum-based products that are tough on the environment (mXNews, 2010).

Data from the manufacturing and industrial sectors found that in 2004, more than 37 million tons of lubricants were used worldwide (Mang & Dresel, 2007). Mang & Dresel (2007) estimated that as much as fifty per cent finds its way back into the environment unchanged. Some of this will degrade but there are potential dangers to the environment such as bioaccumulation and biocidal effects. SKF, a German lubricant manufacturer, developed the 'green grease' which is biodegradable. The green grease is environmentally friendly and it is suitable for agriculture, forestry, water treatment and construction (SKF, 2010). Environmental management standards for biodegradability have been established to evaluate environmental performance. An example of such standards is the DIN V 54900 used in Germany to evaluate testing methods which determine whether or not polymer materials can be composted. In Australia, the Australian Standard AS ISO 14852 is used to determine products' level of biodegradability (Standards Australia, 2005). Information on standards for biodegradability needs to be communicated to institutions and other consumers so that they can play their part in environmental management.

3.3.1.4 Non-hazardous material

Non-hazardous materials are materials that are not dangerous or potentially harmful to our health or the environment. However, it is estimated that every year between 200 to 300 new chemicals used in production systems are introduced into the environment. Manufacturers of products should adhere to the principles of green chemistry by incorporating the use of non-hazardous material. A new ecological paradigm is required to solve environmental problems caused by the use of synthetic chemicals to meet technical specifications (Thornton, 2001). Often, the manufacturers of consumer durables such as television sets use both synthetic plastics and glass that are hazardous (Thornton, 2001). In the production of mobile phones, manufacturers use a combination of hazardous synthetic material because of changes in design and styles dictated by consumer preferences. The synthetic chemicals classified as pollutants where exposure to these pollutants could cause severe health problems and adverse effects on the environment (Science Daily, 2007).

In the health sector, many chemicals which were once thought to be useful and safe in hospitals have later been found to be dangerous for patients and health care workers. These include, among others, chemicals called persistent organic pollutants which are among the most dangerous chemicals to have been created by humans (Sattler & Hall, 2007; World Health Organisation, 2011). Eagan & Kaiser (2002) argued that environmental purchasing represents an innovative approach to mercury control for the health care sector in the United States. The U.S. health care sector produces significant environmental impacts, including the release of toxic substances such as mercury. They argued that the use of The Health Care Environmental Purchasing Tool at nine health care facilities in the Great Lakes region of the United States managed to detect and remove more than 1 kg of mercury from four healthcare facilities. The Health Care Environmental Purchasing Tool has shown to assist health care facilities with other supply chain partners to identify products that have environmental consequences (Sattler & Hall, 2007).

Based on the above discussions, the following hypothesis that relates to integrated product attributes and environmental orientation of government procurement is constructed.

HI: Integrated product attributes are positively associated with environmental orientation of government procurement.

Integrated product attributes provide an initial framework with which a government can formulate a procurement policy that takes into account the capabilities of products to be procured. The capabilities of such products in areas such as energy efficiency and conservation enable organisations to save cost. The use of fuels that generate less carbon and preference for non-hazardous materials or content in products procured consequently enhance the quality of the environment. Biodegradability, as one of the components of integrated product attributes, is closely related to the use of fewer landfills and protection of soil quality. The use of non-hazardous material in the production process ensures the health and safety of workers and protects consumers.

3.3.2 Waste Management

The concept of waste management involves the collection, removal, processing, and disposal of materials considered waste. Waste materials can be solid, gaseous, liquid, or even hazardous and are generally generated through human activity (ecolife, 2012). Waste generation and waste disposal present challenges to develop and developing countries. Wastes are generated in every sphere of human activity as production and consumption create wastes. Governments are constantly looking for solutions to manage these wastes. Waste, when not properly managed, can pose serious health hazards (Miller, 2000). Waste, generated from consumption, is categorised, among others, as solid waste, electronic waste, health-care waste and chemical waste (El-Fadel et al., 1997, Patil & Shekdar, 2001; Rabl et al., 2008). The proper management of waste is critical due to their impact on the environment and health hazards they pose. Sabbas et al., (2003) proposed an integrated waste management system starting from waste generation. The waste is recycled as secondary raw material, deposited into landfills or even re-used. Electronic waste, which is commonly known as e-waste, is a growing problem in many countries due to increasing sales and rapid obsolescence of electronic products. Singapore is no exception. The pro-environment organisation, Earth 911, estimated that the US would dispose of 500 million obsolete computers stored over the years (earth911, 2011).

In Australia, the volume of electronic waste is also rapidly increasing. According to the Australian Bureau of Statistics - ABS (2006), it is increasing at a rate three times that of general municipal waste because Australians are among the greatest users of new technology internationally. Over 2.4 million PCs and more than 1 million televisions are bought annually. The ABS reported that in 2006 that Australia was one of the top ten countries using information and communication technology. The main problem of e-waste is that the materials used in the manufacturing of these products are toxic and detrimental to the environment and human health (Chan et al., 2007). Therefore, it is vital that electronic waste be properly and safely managed.

It is reported that many recyclers exploit cheap labour by sending electronic waste to developing countries like China, India and Pakistan for disassembly and processing. Hong-Gangni & Zeng (2009) indicated that 50 % to 80 % of the electronic waste collected for recycling in the west is shipped to China where it is handled in conditions that harm the workers and the environment. Unwanted parts are thrown into former irrigation ditches. Massive amounts are dumped on river banks and scraps are burned in open fires.

Electronic waste is easily generated with the greater use of electronic and electrical equipment. Land filling is not viable as the toxins contained in the landfills affect the environment. Improper incineration will produce poisonous gases. Therefore, it is critical that these wastes be recycled. There are various indications of electronic waste problems around the world. Therefore, an efficient waste management system through recycling, redesigning, reusing and disposing of used products is critical in managing the environment (Arnold, 2004; Fickes, 2004; Herman et al., 2002). It would require the cooperation of the government, manufacturers, the consumers and the recyclers to effectively deal with the problem.

Other than electronic waste, there are hazards of health-care waste management. Kelkar (1998) stated that when infectious and non-infectious wastes are mixed with municipal waste, the situation becomes hazardous. Health-care waste is far more complicated in its management and treatment. The volume of this waste is increasing every year. Patil & Shekdar (2001) showed that hospitals in India generated about 0.33 tonnes of health-care waste per bed per day. This waste poses a potential danger and an environmental hazard to the public if not properly managed, treated and disposed of. By classifying the waste according to the nature of treatment, they argued that the waste can be properly managed.

Studies of waste management are also seen in the context of regulatory requirements which are the legal mechanisms introduced by government through legislations and policy directives for suppliers and manufacturers to adhere to environmental requirements. Regulatory compliance in the form of legislations was introduced in South Africa to ensure that government procurement officials select suppliers that meet environmental requirements (Bolton, 2008). Regarding policy directives, Walther & Spengler (2005) mentioned that the EU directives for Waste Electrical and Electronic Equipment specified requirements for manufacturers to manage electrical and electronic waste. The other EU directive concerns eco-design specifications for energy-using-products (Matthews, 2007). Tsai & Chou (2004) studied the Waste Disposal Act introduced by the government which effectively managed industrial waste in Taiwan.

Familiarity with the government's environmental policy establishes a common understanding that enables compliance. There were occasions when legislations were passed to ensure that suppliers and manufacturers adhered to environmental requirements. A study by Walther & Spengler (2005) on environmental policies and directives issued by the government to achieve environmental sustainability in Germany found that waste from electrical and electronic equipment is on the rise and new legislations and directives are required to manage this. Matthews (2007) also argued that the EU's directives for eco-design standards for energy-using products for manufacturers to comply with would have an impact on the environment. Furthermore, Bolton (2008) found that the use of legislation has, to a large extent, ensured that contractors' performance meets environmental standards as prescribed by the government. Research conducted by Tsai & Chou (2004) also indicated that the management of industrial waste has an impact on environmental management in Taiwan.

Approaches could be adopted in the area of waste management including: reverse logistics (Murphy & Poist, 1989; Richey et al., 2004; Stock& Lambert, 2001; Tibben-Lembke, 2002), packaging materials that can be recycled (Prendergast & Pitt, 1996; Rosenau et al., 1995) and recycling (Thormark, 2001). Apart from managing solid waste, waste management also refers to the management of bio-hazard waste, especially waste generated by hospital or health institutions. Materials are classified as bio-hazardous waste due to the potential impact on the occupational, health and safety, community health and environmental hazards associated with these materials (Bio-hazard Waste Industry, 2009).

3.3.2.1 Reverse logistics

Reverse logistics refers to a process by which a manufacturer systematically accepts previously used products or parts from the point of consumption for possible reuse, remanufacturing, recycling and/or disposal. Reverse logistics is defined as the flow of product from manufacturers to consumers and back to manufacturers (Lambert & Stock, 1981) . Rogers & Tibben-Lembke (1998) looked at reverse logistics as the process of moving goods from the stage of consumption to the next stage to recapture their remaining value or to the final stage for proper disposal. Murphy & Poist (1989), on the other hand, considered reverse logistics as the movement of goods from a consumer towards a producer in a distribution channel. At the simplest level, reverse logistics can be described as the disposal of returned goods (Tan & Kumar, 2003). In fact, reverse logistics is a complex system requiring extensive technological supports (Richey et al., 2004). Businesses are beginning to understand the importance of reverse logistics (Tibben-Lembke, 2002). Apart from becoming a critical factor in the area of waste management, reverse logistics is an important element in supply chain management (Krumwiede & Sheu, 2002). Furthermore, businesses, from the perspective of management, have considered reverse logistics as part of the strategy where resources, whether financial or non-financial, are galvanised (Giuntini & Andel, 1995), to develop organisational competencies (Hax, 1990; Frery, 2006; Porter, 1996). Environmental measures adopted have also been used as a means of differentiating an organisation from its competitors

(Frery, 2006). Richey et al., (2004) argued that the use of reverse logistics programs in organisations is an indication of their commitment to managing waste generation in the early stages of the production process.

3.3.2.2 Packaging

The EU Packaging Directives defines packaging as all products made of any material to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the consumer (EIONET, 2012). Although there are benefits derived from packaging such as optimising storage and minimising distribution cost, packaging also contributes to waste (Murphy & Wood, 2011; Unilever, 2013). Packaging of a product can be classified into three broad categories:

- primary packaging which is normally in contact with the goods and taken home by consumers;
- secondary packaging that covers the larger packaging such as boxes used to carry quantities of primary packaged goods;
- tertiary packaging which refers to packaging that is used to assist transport of large quantities of goods, such as wooden pallets and plastic wrapping (Davis & Song, 2006).

Packaging waste includes glass, paper, board, metals and wood and makes up over half of our household waste which is growing in volume and weight. It also signifies the growing contribution of packaging in the waste stream (CIWM, 2010). The EU Packaging Directive, among other things, aims to eliminate dangerous materials from packaging, reduce the proportion of packaging waste going to landfills, increase recovery and recycling of packaging waste, and increase the responsibility of manufacturers to recover and recycle packaging waste (CIWM, 2010).

Despite clear guidelines, more than 67 million tonnes of packaging waste is generated annually in the EU, comprising about one-third of all municipal solid waste (Klingbeil, 2000). The amount of packaging waste generated annually in the UK is estimated to be more than 10 million tonnes (Eurostat, 2010). According to data from Wastewatch (2012), in 2001 the amount of plastic waste generated annually in the UK was estimated to be nearly 3 million tonnes; an estimated 56% of all plastics waste was used for packaging. 7% of total plastic waste was being recycled. In developed countries, food packaging accounts 60% (Northwood & Oakley-Hill, 1999) of all packaging. In Singapore, domestic waste constitutes 58% of all waste, one third of which is packaging (NEA, 2010). The Singapore Packaging Agreement signed by businesses indicated their commitment to reducing packaging waste.

Packaging waste has been targeted by policy-makers in a number of countries who recognised it is a serious environmental problem. The use of packaging materials results in greenhouse gas emissions through the production and transportation of material, packaging and through end-of-life management (Hekkert et al., 2001). The UK Government-Industry Forum has strongly recommended greater use of biodegradable packaging applications (DEFRA, 2004, 2002)

3.3.2.3 Recycling

Recycling is often viewed as an important aspect in an efficient solid waste management system. The term ‘recycling’ is defined as the process by which materials previously used are collected, processed, re-manufactured and re-used (Schultz et al., 1995). According to Ketlogetswe & Mothudi (2005), recycling of waste helps to reduce the amount of waste going into landfills and incinerators. The dumping of electronic waste in landfills presents a serious environmental threat. Electronic products such as TVs, computers and mobile phones contain hazardous chemicals when buried in the ground and can contaminate the groundwater. One effective method of dealing with these problems is to recycle electronic waste. There are many benefits in recycling electronic waste. Other than as an effective measure to maximise the use of limited resources in the manufacturing and production process by using recycled materials, recycling also saves cost.

Recycling also produces financial benefits. In a study by Rhodes University in South Africa on the usage of paper, a saving of approximately US$7000 per year was achieved for every 10% reduction in current usage of more than 12,700 reams of paper per year (Amutenya et al., 2009). Amutenya et al., (2009) added that a further 40% reduction in paper usage would save the university approximately US$20,000 per year in direct costs, and more in reduced waste streams, in addition to promoting the environmental image of the university. Korea has adopted and enforced the extended producer responsibility (EPR) policy and has developed technological improvements in the manufacturing of environmentally-friendly and energy-saving technologies by recycling metal from printed-circuit-boards adhering to EU directives for Waste Electrical and Electronic Equipment (Lee et al., 2007).

In the light of the above discussion, the hypothesis regarding the relationship between waste management and environment-oriented government procurement is constructed.

H2: Waste management is positively associated with environmental orientation of government procurement.

3.3.3 Organisational Systems, Processes and Policies

Organisational systems, processes and policies refer to the application of environmental principles, work processes and compliance with environmental policies in the organisations. Systems and standards refer to the international environmental certification of ISO 14001 (Alan et al., 1990; Quazi, 1999; Singh& Perry, 2000) and the use of eco-labels on products (Gallastegui, 2002; Li& Geiser, 2005). The ISO 14001 standard, launched in 1996 and revised in 2004 by the International Organisation of Standardization (Geneva), is an international standard that can be adopted by all kinds of organisations to censure compliance with environmental management systems (Grolleau et al., 2007).

Eco-labels, on the other hand, developed and implemented by individual countries, signify that a product has achieved the prescribed environmental standard. The Blue Angel (Germany), Energy Star, EU Flower (European Union) and Nordic Swan (Finland, Iceland, Norway, Denmark and Sweden) are some examples of eco-labels (Li & Geiser, 2005). Policies refer to environmental regulations which include internal or organisational environmental measures, government environmental policies and directives and international environmental agreements (Hall, 2000; Sarkis, 1998; Zhu and Sarkis, 2006). The implementation of a regulatory environmental framework prompts organisations to adopt appropriate strategies and practices to improve and enhance their environmental performance and government environmental policy (Chien & Shih, 2007).

3.3.3.1 ISO 14001

Launched in 1996 in Geneva by the International Organisation of Standardisation (ISO), the ISO 14001 is a generic standard that could be adopted by organisations regardless of their activity or location (ISO, 2012; Grolleau et al., 2007). It is estimated that more than 60,000 organisations worldwide have implemented ISO 14001 environmental management systems (Schylander & Martinuzzi, 2007). ISO 14001 is not about cost of certification, it is about an environmental policy statement that requires commitment to continually improve and prevent pollution, complying with legislations and regulations, a framework for setting and reviewing environmental goal.

Link & Naveh (2006) argued that the implementation of ISO 14001 has made organisations more aware of the importance of environmental management. Meanwhile, studies in Singapore have shown that organisations that implemented the ISO 14001 have achieved increased usage of reusable packaging, substantial savings in materials used, thereby reducing wastage and pollution (Quazi, 1999). Chen (2005) also argued that environmental procurement is an effective tool in controlling pollution. Therefore, by incorporating environmentally-oriented procurement into the framework of ISO 14001, it can encourage firms to implement pollution prevention from the source.

Alan, Ofori & Briffet (1990) argued that the implementation of ISO 14001 has made businesses more aware of the importance of certification. Moreover, Quazi (1999) argued that businesses with ISO 14001 derived benefits by being able to achieve substantial savings in materials used, prevent pollution and increase their reusable packaging initiatives. On the other hand, Singh & Martin (2000) argued that environmental standards could have a positive impact on the environment of the organisations.

According to Woodside et al., (1998), for the ISO 14001 to be effective organisationally, it must also be communicated to all employees and be available to the public. In addition, Woodside et al., (1998) identified training, empowerment, reward and teamwork as critical factors in gauging the effectiveness of ISO 14001. It also emphasizes the role of management in implementing the environmental management system at corporate level. ISO 1400 also requires that an organisation implements a set of practices and procedures which, when implemented together, result in an effective environmental management system (Sanchez-Rodriguez et al., 2006). The ISO 14001, as an environmental management system, provides a framework to ensure that risks, liabilities and impacts are properly identified, minimized and managed (Darnall et al., 2000). Among the benefits expected from this certification are cost savings from the improved resource use, better workforce management, and enhanced relations with stakeholders (Holt, 1998).

3.3.3.2 Eco-labelling

Eco-labelling refers to the awarding of a label to products that meet specific criteria; it is intended to inform consumers that the products are environmentally sound. Li & Geiser (2005) argued that apart from specifying the environment-friendly attributes of product, the labels indicate manufacturers' commitment to environmental responsibility. The use of eco-labelling or eco-labels creates awareness of environmentally friendly products. On the part of manufacturers, eco-labelling provides information to consumers about the effects that these products have on the environment (Gallastegui, 2002). Gallastegui (2002) further added that the OECD has classified three types of labelling.

Type I eco-labels refer to the environmental quality of a product and aims to encourage consumers to switch towards more environmentally friendly consumption habits.

Certified by a third party certification body, Type I eco-labels are supported by governments (OECD, 1997). Type II eco-labels, on the other hand, are environmental claims made by manufacturers, importers or distributors which refer specifically to attributes of products such as 'CFC free' products (OECD, 1997) in the product declarations based on tests conducted internally on the products. Type III provides quantified information about products based on independent verification. Given that there is not enough experience with such labels, they are rarely found in environmental fields (Markandya et al., 2001). There are many types of eco-labelling depending on the country which developed the eco-labels. Eco-labels are voluntary and they are well communicated within industries and consumers (Li & Geiser, 2005). Consumers understand that the presence of such eco-labelling on a product signifies standard, durability and reliability. Eco-labelling programs by manufacturers and government labelling programs are implemented to assist in assessing the environmental performance of products. Examples of such labelling are Energy Star (USA), Environmental Choice (New Zealand) and Green Mark (Singapore). While the use of eco-labels is voluntary, there are those who are more prescriptive in arguing that since governments have considerable market power, they should implement public green procurement by making eco-labelling mandatory when establishing procurement criteria (Grolleau et al., 2007).

3.3.3.3 Product Design

Product design is an environmental management strategy meaning that whoever designs, produces, sells or uses a product takes responsibility for minimizing the product's environmental impact at all stages of the product's life cycle (Toffel, 2002). Hart (1995) argued that product design considered the total life cycle analysis of a product from the design stage until the end of life of a product. Product stewardship enables firms to select raw materials with minimum environmental hazard, direct product design to minimize the environmental impact of the product, minimize life cycle costs, re-designed existing products to reduce liability and also to develop new products with lower life cycle costs.

Scroufe et al., (2000), on the other hand, refer to product design as the early stages of new product development where environmental issues are included in the design process. They argued that product design, also known as design for the environment, which constitutes a small percentage of total costs, has a significant impact on the success of pollution reduction and elimination as well as reducing disposal costs. It is also argued that the amount of waste generated is a direct consequence of decisions made during product design (Bowman, 1996; Melynk et al., 1996). Product design for disassembly, recycling and re-use is also seen as an important factor in purchasing (Carter, 2055b; Carter et al., 2000, Ciliberti et al., 2008b). Zsidisin & Siferd (2001) considered environmentally conscious products as products that have been designed with the attributes of ease for disassembly, disposability with negative effect on environment, elimination of harmful processes during production, ease of distribution and return, elimination of hazardous materials used, product durability and reliability.

3.3.3.4 Life Cycle Analysis (LCA)

Life cycle analysis is a technique used to assess the potential environmental impact associated with a product (ISO, 2012). The terms ‘life cycle analysis’ (LCA) and ‘life cycle assessment’ are used interchangeably. Hendrickson & Horvath (1998) defined LCA as the environmental impact of materials and products at different stages of fabrication, use, and end-of-life options. They further stated that the application of LCA is critical in the selection of product design, materials used, process, re-use or recycle strategies and final disposal of the products or materials used.

IEMA (2005) considers the life cycle analysis as a system approach that takes an overall view of the impacts of products and services used in the economy where products and services used by consumers have their upstream and downstream environmental impacts. Ansems et al., (2005), on the other hand, views the life cycle analysis as the whole life cycle of a product, and organisations should focus on a reduction of the cumulative impact of a product on the environment, from the cradle to the grave.

The LCA has three components: inventory analysis, impact analysis and improvement analysis. During the inventory analysis stage, extensive information from the early stage of production to the consumption on energy and material requirements, emissions, solid wastes and other residues from a product, process or activity, are collected. The impact analysis then addresses the effects on the environment such as resource depletion, pollution and health impacts quantitatively and qualitatively (Kumaran et al., 2001). A systematic evaluation of needs and opportunities to minimize environmental burdens is related to material and energy use, waste and emissions throughout the life cycle of a product, process or an activity. Other studies looked at the importance of the life cycle analysis of products. Kaebernick, Kara & Sun (2003) proposed the use of life cycle analysis during the design stage of a product.

The early application of life cycle analysis during the design phase of a product takes into consideration of the various environmental aspects of the product from procurement, production and recovery stage. Scharnhorst (2008) also argued that the application of life cycle analysis has resulted in various regulations issued by governments to prevent the disposal of electronic and electric scrap as well as the use of potentially hazardous materials in electric and electronic components. The challenge in adopting LCA is that different products, materials and processes have different stages of life cycle assessment. Skills and training in LCA is critical in ensuring that the right methods and principles of LCA are used. LCAs have been used for the purpose of procurement of building materials (Baldo et al., 2002; Lippiat & Boyles, 2001). In the context of environmental government procurement, the application and implementation of LCA could become a complex procedure when employees are not well trained in using LCA when making purchasing decisions.

The LCA considers all facets of the product, including raw materials used for production, packaging, transportation, storage, consumption and disposal of products and services. As sustainability is central to government procurement, this assessment is important at all levels of the procurement process to ensure that sustainable procurement is achieved. To achieve the desired objective of environmental sustainability, procurement activities undertaken by government and its related agencies, departments and statutory bodies, central and local government should integrate LCA as embodying the same principle of procurement of value for money (Perera, Morton & Preferment, 2009). Studies have shown there is a premium in buying environmentally compliant goods and services but in the longer term, money is recoverable. Using LCA, the environmental benefits from reprocessing all material recovered in Victoria during 2006–07 would be equivalent to saving more than 81 million giga-joules of energy, preventing 4.2 million tonnes of greenhouse gases being emitted into the atmosphere and saving 46 thousand mega-litres of water (Sustainability Victoria, 2008).

It can be concluded that the use of LCA in evaluating products generates real benefits for the environment. In view of the importance of life cycle analysis as one of the critical factors impacting on sustainable government procurement, the following hypothesis is constructed.

H3: Organisational systems, processes and policies are positively associated with environmental orientation of government procurement.

An environmentally-focused organisation is not only up-to-date with information about product attributes capable of managing waste, it also implements various environmental management systems to ensure that environmental measures conform to international standards. However, the adoption of environmental standards would be meaningless without the presence of organisational values that provide the condition necessary to establish a new paradigm which cultivates corporate culture attuned to environmental issues. The following sections discuss organisation values.

3.3.4 Organisational Values

The concept of value is defined and applied from many different perspectives and in various disciplines. Weinstein & Johnson (1999) considered value as an abstract concept and its application depends on the different contexts. Deal & Kennedy (1982) defined organisational values as the guiding principles of actions. The objective of values is to guide decisions and actions for an individual or an organisation to achieve a common purpose (Sullivan et al., 2001). In the context of government procurement, Henriques & Sadorsky (1999) defined organisational values as an organisation-wide recognition and commitment to the importance of environment that influences organisations to act in ways consistent with the interests of the environment.

There are a number of definitions of culture. Often the focus of the definition depends on the orientation, interest, background, training and the academic discipline of the scholars. This suggests an inherent complexity in understanding culture that is closely linked to human behaviour. It also implies that there is no one definition that can easily encompass the meaning of culture. Triandis (2004, 1995) defined culture as an explicit and implicit pattern of behaviour which is either acquired or transmitted by members of the group. Hofstede (1991), on the other hand, defined culture as the collective programming of the mind that distinguishes the members of one group of people from those of another group. The collective programming of the mind is the transmission of values, norms, behaviour and ethics in a culture. These patterns of behaviour and thought processes, to a certain extent, distinguish an individual or a group from others (Hofstede, 1991).

Values are related to culture. Hofstede (1991) considered that values are the foundation of culture. Values can be said to be the inner core or the hardware of a community's culture that gives meaning to behaviour – correct or incorrect, right or wrong, appropriate or inappropriate. The public sector is the institution that engages in activities of government procurement. The organisational culture of the public sector is critical in analysing sustainable government procurement practices. Therefore, an understanding of the meaning and concept of culture is important to gain an insight into the workings of the public sector.

Current government bureaucracy has a distinctive organisational culture that corresponds to Weber's rational-legal bureaucratic model (Weber, 1947). An analysis of bureaucratic culture provides an insight into the nature of governance in a bureaucratic environment. Government bureaucracy is seen as an autocratic, elitist and enlightened institution with a mission to shape public opinion, discerning public needs and defining what is best for the population (Dye & Ziegler, 1970). Simon (1964) asserts that the decision-making process of the bureaucracy is a result of the combination of internal and external factors, political, economic and environmental, which shape bureaucratic responses and judgement. Bureaucratic decision-making tends to be incremental and cautious. Concepts of decision-making such as collaboration (Grandori, 1984), consensus building, and deductive approach of management (Nonaka, 1988) have recently been adopted by the bureaucracy as an appropriate approach to decision-making when dealing with new issues. In a centralised management style, the command and control seek compliance with rules and regulations. The management style causes inertia in making decision and possibly slow adaption to change. The influence of individuals who occupy positions of authority is critical. Each individual carries his or her own value system, orientation, attitudes, education and preferences(Ford & Richardson, 1994). Collaboration and co-ordination between various government agencies to develop, implement and maintain effective and efficient government policies presents a challenge in a bureaucratic environment (Ryan & Walsh, 2004).

Procurement is an important governmental function. Its fundamental role is the provision of essential goods and services in education and health, building infrastructure such as roads and providing other security services such as defence. Government procurement practices have a bearing on economic growth. It is argued that government procurement has facilitated industrial development, enabling industries to be creative and innovative especially in industries such as defence and technology where the government is one of the largest buyers (Raymond, 2008). There are several examples of environmentally-friendly products developed in response to government procurement initiatives, including highly energy-efficient consumer durables and industrial products (Westling, 2000). According to Denyer & Tranfield (2004), the use of life cycle analysis in buying decisions can be integrated in the management of government assets, thus creating value for environment. Literature on organisational culture, therefore, is typically focused on the organisational values of entrepreneurship, commitment, organisational learning and innovation.

3.3.4.1 Entrepreneurship

Entrepreneurship is conceptualised as a process with underlying dimensions of risk-taking and pro-activeness (Bartlett & Dibben, 2002; Morris& Jones, 1999). While the conceptualization has provided a general understanding of entrepreneurship, studies of environmental entrepreneurship are a fairly new development and it is gaining importance (Thomson & Scott, 2010). Entrepreneurship through an environmental lens has been defined as ecopreneurship (Shaltegger 2002) where ecopreneurs combines strong environmental and social values with an energetic entrepreneurial attitude. Environmental entrepreneurship is also described as entrepreneurial activity that benefits the environment (Hendrickson & Tuttle, 1997) and activities centred around environmental management to achieve ecological sustainability (Starik & Rands, 1995). Keogh & Polonsky (1998) categorised three types of individuals in relation to environmental entrepreneurs in procurement centres - policy entrepreneurs, converts and resisters. The presence of policy entrepreneurs and converters shapes the orientation of organisations to focus on the environment.

Organisations which are established with a focus on sustainability have been described as being engaged in environmental entrepreneurship (Schaper, 2005). Allen & Malin (2008) argues that environmental entrepreneurship reflects genuine concern for the environment. He further adds that as more organisations adopt green values, the opportunities for a better society and environment is achievable. Entrepreneurship in the environmental sector can generate significant employment opportunities (Eastwood et al., 2006, 2001). To facilitate the growth of environmental entrepreneurship, Singapore's government has initiated schemes related to energy efficiency, clean energy, green buildings, water and environmental technologies, green transport and shipping, waste minimisation, energy and green-house gas management (GreenBusinessTimes, 2012).

Notwithstanding the definitions and interpretations offered by other scholarly works, environmental issues permeate all functional areas of organisation, including the areas of procurement, product development and production process, and also the management of human resources. Keogh & Polonsky (1998) used the terms 'environmental entrepreneurship' or 'enviropreneurial' to describe organisations that exhibited an orientation towards the environment in which concern for the environment and entrepreneurship are fused, as evident from the measures undertaken to protect the environment.

Further to this argument, enviropreneurialism is considered as a performance indicator that covers social, environmental and economic; it is also an orientation that embodies innovation and technological adoption that values the environment (Menon & Menon, 1997). While innovation and the ability to identify opportunities are the focus, other scholars are more concerned with the specific aspects of the value of entrepreneurship such as product design, also known as design for the environment.

Risk-taking is the other facet of entrepreneurship. This provides an opportunity for us to examine the relationship of entrepreneurship and the government decision-making process specifically the extent to which entrepreneurship, where innovation and opportunities exist in the areas of environmental management, is present or embedded in the buying decision of governments. There is competition within government agencies, differences in value systems, budget constraints, targets and organisational objectives. Competition among government agencies and departments exists. Conflict, misunderstanding and unclear objectives are ever-present in any organisation; the government is no exception.

A clear direction and definition of government policy pertaining to sustainable procurement should be formulated and integrated to address the concerns of all parties - government, citizen, consumers, businesses and stakeholders. Barriers to inter-agency collaboration have to be addressed because the government has to accept the fact that changes are taking place within its environment. Risk-taking is seen as the willingness to pursue new opportunities (Khandwalla, 1997; Lumpkin & Dess, 1996; Mintzberg, 1973) where environmental sustainability presents a new strategic direction for all organisations, both private and public.

There are three types of individuals in relation to environmental entrepreneurs in organisations' buying centres: policy entrepreneurs, converts and resisters. Policy entrepreneurs are the champions of environmental issues. Converts are people within the organisation who embrace the policies put forward by policy entrepreneurs although they may resist those policies initially. Once converted, they believe and promote the virtues of environmentalism. Resisters, on the other hand, are individuals within the organisation who do not consider the environment as important (Keogh & Polonsky, 1998). The presence of policy entrepreneurs and converters shapes the environmental orientation of the organisation.

3.3.4.2 Commitment

Commitment refers to the identification and involvement of individuals in an organisation characterized by a strong belief in the organisation's goals and values (Porter et al., 1974).Commitment contributes to organisational effectiveness where sharing of mutual goals and values facilitate collaboration and trust in achieving mutual goals (Handfield & Bechtel 2002). Procurement is a key link in an integrated supply chain network where procurement managers have to collaborate to make decisions on whether to buy from low price suppliers or from more costly but environmentally more responsible suppliers to be competitive (Murphy et al., 1995). Enarsson (1998) argues that procurement managers are well-positioned to use environmental parameters to evaluate suppliers' commitment to the environment. Organisations that place importance on the environment promote a cleaner environment with minimal cost (Tomer & Sadler, 2007).

Babbar et al., (2008), on the other hand, defined commitment as organisational members being committed to their tasks as well as to each other. Commitment occupies an important and central position in an organisation (Schiele & McCue, 2006). This view is reinforced by Kwon & Suh (2005) who posited that commitment is central to all relational exchanges between a firm and its partners. Without commitment, an organisation would not have the ability to garner support from employees in the organisation to realise its organisational goals. Commitment leads to successful inter-organisational integration enabling staff to work closely to achieve better coordination and mutual goals (Brown et al., 1995; Handfield & Bechtel, 2002). Sahay & Mohan (2003) argued that firms could reap significant benefits by developing relationships with their suppliers and by networking well with their partners. Internally, employees are more committed to the vision of the organisation when they perceive the presence of organisational support (Eisenberger et al., 1990).

The perception of organisational support from top management serves to enhance employee motivation which in turn provides consistency and effectiveness in operations, policies and performance measures (Sankaran & Ubgade, 1994). In general, research shows that organisational performance improves when workers are committed (Adler & Corson, 2003; Molleman, 2000; Shermerhorn et al., 2003). Drawing from organisational theory literature, the concept of commitment encapsulates environmental commitment (Keogh & Polonsky, 1997, 1996). There are three dimensions of environmental commitment: affective which means attachment, identification and involvement to support environment concerns, continuance which is when the organisations understand the cost incurred when disregarding environmental concerns and normative commitment which means a sense of obligation to continuously support environmental concerns (Keogh & Polonsky, 1998).

3.3.4.3 Organisational Learning

Organisational learning is defined as a collective capability based on experience and cognitive processes involving the acquisition of knowledge, sharing of knowledge and how the knowledge is used to benefit an organisation (DiBella et al., 1996; Nevis et al., 1995; Zollo & Winter, 2002). It reflects an organisation's ability to be innovative, either to maintain or improve performance based on acquired knowledge and experience, thus ensuring its survival. The concept of organisational learning is also defined as an organisation-wide activity to create and use knowledge to improve its competitive advantage (Hurley & Hult, 1998a). Research on environment and procurement has highlighted the importance of training as a means of equipping organisations with new knowledge and information. The concept of organisational learning culture is defined as the set of norms and values of an organisation that support information acquisition and information interpretation that can effect a change in behaviour (Liu et al., 2010). Liu et al., (2010) stated that organisations that view environmental issues as opportunities tend to be active in organising environmental training internally and are more proactive in environmental activities.

The importance of organisational learning for effective performance has been strongly emphasised in the literature (Argyris & Schön, 1996; Huber, 1991; Zahay & Handfield, 2004). Several recent works support this positive relationship. Schroeder et al., (2002) developed a resource-based hypotheses and showed a positive relationship between internal and external learning and organisational performance in 164 manufacturing plants from six different countries. Organisational learning has a stronger direct influence on innovation. In addition, innovation has positively and significantly influenced performance (Arago´n-Correa et al., 2007).

According to Hatch & Mowery (1998), organisational learning has an influence on productivity and cost reduction. Organisational learning is not solely derived from internal sources but also externally. Linderman et al., (2004) asserts that learning from innovative suppliers could enhance manufacturer cost performance and product quality. Although research on organisational learning tends to focus on businesses, the concept has its application to government because government are equally concern about cost, quality and impact on environment.

3.3.4.4 Innovation

Studies have shown the importance of innovation and its influence on performance (Arago´n-Correa et al., 2007; Cervera et al., 2001, Subramaniam & Nilakanta, 1996). Azadegan & Dooley (2010) defines innovation as the capability to develop and introduce new products or processes. The Product Development and Management Association defined innovation as a new idea, method, or device (PDMA, 2004). Innovation is becoming more important as it is a basis for organisational growth, expansion and creation of new products, R&D and technological breakthroughs. Innovation encourages the restructuring of internal organisational hierarchies and procedures and cultivates links with suppliers to tap into new knowledge resources and expertise for greater strategic leveraging (Chen & Yuan, 2007).

Chen & Yuan (2007) suggested that innovation provides a firm with the knowledge related to new products or new production process. Ye & Qiu (2004) stated that the urge to innovate largely depends on the motivation of the firm to innovate. According to Afuah (2001), at the stage of technological innovations and R&D, organisations kept their R & D in-house. In contrast, other researchers suggest that alliances and joint ventures, apart from providing new ideas, could help share the costs of new innovations and R&D (Manders & Brenner, 1995; Quinn & Hilmer, 1994).

The issue is now raised: Can innovation exist and flourish in government institutions? A study on innovation and public procurement by the Fraunhofer Institute of Systems and Innovation Research found nine cases of innovation in public procurement in Germany, United Kingdom, Austria, Norway, Netherland and Italy (Edler et al., 2005). The studies, among others, covering cases of sustainable procurement for new lighting systems, electronic file management and energy saving equipment provided evidence of innovation in public procurement which corresponds to market development and technology life cycle. An innovative public procurement is an initiator, where as a buyer of goods and services, it sends signals to potential suppliers about its requirements. Communication on specifications of products between buyers and suppliers occurs at every stage of the procurement process namely, the identification of user's requirements, market intelligence, tender specifications, assessing the tenders, awarding of tenders and managing the contract.

The spirit of innovation can be nurtured and supported. Singapore's National Environmental Agency, a government institution, provided S$ 15 million funding to five projects in waste management for the purposes of eliminating the problem of plastic waste, landfill reclamation and cutting the cost of removing pollutants during the burning of fossil fuels where nitrous oxides and other carcinogenic dioxins are produced (Neo, 2010). The provision of research grants in the long term positively influences the development of environmentally-friendly products and services. This consequently increases the availability of environmental products and services in the procurement market.

Based on the discussions on the influence of organisational values, inclusive of sub-variables, on environmental orientation of government procurement, the following hypothesis is constructed.

H4: Organisational values are positively associated with environmental orientation of government procurement.

Studies by a number of leading scholars in the field organisational culture have opened up new avenues of research opportunities that support important perspectives that would further enhance both the rigour and relevance of organisational values in influencing and shaping environmental orientation. Pettigrew et al., (2001) maintained the importance of organisational values that recognise and guide organisations, both businesses and public organisations, when faced with new challenges. In this context, concern for the environment serves as an organisational goal. The attainment of this goal is dependent upon how this goal is integrated and embodied in the culture of organisations.

3.4 Environmental Orientation and Organisational Performance

Environmental issues are often included in the list of the government's development plan (Hidson & Simon, 2008). Governments, as signatories to the Kyoto Protocol, to which Singapore is also a signatory, understand their critical role in addressing environmental problems, global warming and ozone depletion. Governments are taking steps to alleviate environmental problems through legislation, issuing policy directives and implementing measures to protect and preserve the environment (Bolton, 2008; Botelho et al., 2005; ElTayeb et al., 2010). Given the substantial power that governments possess, they have access to accurate environmental information enabling them to design and execute strategies and measures in response to the ecological issues confronting them. As mentioned in Chapter 2, environmental orientation in this study is a construct derived from the literature of market orientation (Jaworski & Kohli, 1993).

It has been more than 30 years since Jaworski & Kohli (1993) and Narver & Slater (1998) used the term market orientation. Market orientation is grounded in marketing (Han et al., 1998a; Hurley& Hult, 1998b; Narver & Slater, 1998). Market orientation is an organisational culture that effectively creates superior business performance. It can be deduced that market orientation is critical to the achievement of organisational performance in trading organisations (Lin et al., 2008; Mavondo & Farrell, 2003; Mavondo et al., 2005; Narver & Slater, 1990). Market orientation is also described as the ability of an organisation to create an organisational culture which is conceptualised as being customer-oriented, competition-oriented supported by inter-functional co-ordination to achieve superior performance (Narver & Slater, 1998).

Market orientation can be measured using the MARKOR scale, consisting of intelligence generation, intelligence dissemination and responsiveness (Kohli & Jaworski, 1990). The extent of market orientation is also influenced by top management, inter-departmental dynamics and other external factors which invariably affect employees' commitment and the performance of the organisation. Lafferty et al., (2001) synthesised market orientation as a concept that focuses on managerial and cultural considerations to achieve competitive advantage.

The conceptual and empirical foundation of market orientation has its relevance in this study by giving it an environmental focus (Jaworski & Kohli, 1993, Kohli & Jaworski, 1990). The concept is adapted to eco-orientation by Stone & Wakefield (2000). Eco-orientation represents a new paradigm in the way the performance of organisations is evaluated. Eco-oriented organisations are those exhibiting a culture focused on the environment where environmental information is gathered and disseminated with a high degree of responsiveness by which their performance is evaluated (Gonzalez-Benito & Gonzalez-Benito, 2006; Stone et al., 2004; Stone & Wakefield, 2000).

Top and middle management in the business and public sectors are also concerned about environmental matters. Meanwhile, businesses are taking measures to ensure that environmental factors are integrated into their operations by adopting a life cycle approach (Ansems et al., 2005; Asapagic, 1999; Blengini, 2009; Hauschild et al., 2005) implementing ISO and other environmental management standards (Darnall, 2006; Darnall et al., 2000; Miles et al., 1999). Rao (2006, 2002) argued for the importance of greening the supply chain. Other studies considered the integration of environmental factors into business operations as a matter of business strategy with direct implications for profit (Perrini et al., 2007; Perry & Singh, 2001; Quazi, 2001; Porter et al., 1995).

The components of market orientation are relevant to the study of sustainable government procurement. In public organisations, the use of marketing tools to get closer to the citizens through information gathering and getting feedback prior to policy implementation can be considered as a market orientation of public organisations (Cervera et al., 2001; Clarke & Stewart, 1994). Drawing from studies on market orientation, environmental orientation is an organisation-wide effort to generate intelligence on current and future environmental needs of the organisation where the information is disseminated and shared across various departments within the organisation. The information is then used to develop programmes and strategies intended to enhance the quality of the environment and reflect organisational response to the importance of the environment (Banerjee & Solomon, 2003; Gonzalez-Benito & Gonzalez-Benito, 2006; Harrison-Walker, 2001; Stone & Wakefield, 2000). The literature on market orientation suggests that environmental orientation is an organisation-wide effort to generate ecological intelligence pertaining to current and future societal environmental needs, disseminating information throughout organisations and being responsive to these needs by adapting and developing programmes which create and foster organisational and public perception of ecological concerns (Stone et al., 2004; Stone & Wakefield, 2000). The following discussion focuses on indicators of performance in relation to the environmental orientation of government procurement.

3.4.1 Indicators for Organisational Performance

Boland & Fowler (2000) stated that in the public service there is no profit maximization focus, little potential for income generation and generally no bottom line against which financial performance can ultimately be measured. Public sector organisations pursue political and social goals rather than simple commercial objectives. The concept of profitability cannot easily be applied when measuring performance in the public sector because financial reports on profit and loss of government operations are not available. Further, the operations of government are not equated with profit-driven motives. Nevertheless, the absence of financial information does not imply that governments are not concerned about performance.

Cervera et al., (2001) argued that organisational performance is equally as important in the public or government sector as in businesses that are profit-driven. Although a government operates differently from business enterprises in terms of performance measurement, it is to a certain extent similar to business enterprises. They further argued that public organisations implemented measures to gather and disseminate information and to be responsive and deliver their services to various demands from many stakeholders such as citizens, businesses and public organisations. An effective information-gathering exercise, communication and leadership shown by government for environmentally-oriented procurement have impact on performance and for the betterment of society (Hidson & Simon, 2008; Lavallee & Plouffe, 2004; Qiao & Wang, 2011). Timely information-gathering and communication enable the government, interacting with organisational dynamics of senior management characteristics, inter-department relationships and organisational systems, to be responsive (Kohli & Jaworski, 1990; Slater

& Narver, 1995) and to be involved and engaged in the process of managing and improving the quality of the environment (Cervera et al., 2001).

Gonzalez-Benito & Gonzalez-Benito (2005) argued that researchers utilised subjective and objective indicators to measure performance. Vorhies et al., (1999), on the other hand, argued that subjective measures were equally used because absolute performance measures such as ROI and profit levels, sales volume, and market share are difficult to compare between organisations of different sizes and operating in different markets. Performance could also be indicated by the amount of cost savings and greater efficiency. This is evident from results achieved after organisations implemented environmental strategies that eliminated environmentally hazardous in the production processes, redesigning existing product systems to reduce life cycle impacts, and developing new products with lower life cycle costs (Hart, 1995). Carter et al., (2000) specifically analysed the impact of environmental purchasing on performance. Filbeck & Gorman (2004) stated that the implementation of environmental measures also contributed to organisational efficiency which involves reducing excessive wastes, material, and energy use for competitive advantage.

The measurement of performance is a key challenge facing organisations, both public and private. Without measures of performance, organisations faced difficulties in setting priorities, track progress, analyse problem areas, or create incentives and reward performance. Performance, by definition, is a measure used to assess the degree to which an organisation has attained its objectives in terms of environmental and business performance. Ilinitch et al., (1998) classified corporate environmental performance in terms of organisational systems and stakeholder relations as well as on the outcome due to measures such as regulatory compliance. Studies of environmental performance have centred on business organisations rather than government institutions (Ilinitch et al., 1998; Lundberg et al., 2009; Srebotnjak, 2007).

In a review of 32 research studies on organisations that are concerned with the environment, Molina-Azorín et al., (2009) concluded that environmental management refers to measures undertaken by organisations for the purpose of reducing environmental impacts on the natural environment. These measures, among others, are related to strategic considerations such as integrating environmental issues into the strategic planning process and implementing product, process and technologies to reduce pollution. As for the performance variables, the study identified variables such as emissions, toxic waste, oil and chemical spills, and releases recovered, treated or recycled. In a study of electronic and electrical firms in Taiwan, Chien & Shih (2007) posited that environmental performance is evaluated using two indicators known as Operative Performance Indicator which measures energy management, waste and emission production. The Management Performance Indicator, on the other hand, evaluates environmental performance in terms of measures undertaken, policies, directives and systems implemented to support initiatives in environmental management (Chien & Shih, 2007). A study by Chien & Shih (2007) also found that electrical and electronic firms in Taiwan which implemented ISO 14001 showed favourable environmental and financial performance.

Public authorities are often regarded as having the power to promote sustainable development by encouraging the use of more energy efficient, less polluting production techniques and renewable resources because of their considerable purchasing power (Brännlund et al., 2009). Accordingly, the role that environmental criteria play in procurement has grown in importance especially in the developed economies at both national and municipal levels (DTLR, 2001). According to Hanks et al., (2008), developing economies are also taking steps to implement measures focussing on sustainable public procurement.

The European Commission developed measures to show how public procurement as a policy instrument could contribute to sustainability. The European Commission has emphasized that governments, in procuring products and services, should comply with the EU's Integrated Product Policy (European Commission, 2012, 2005). In guiding the process of procurement, a handbook was published to assist public authorities to implement green public procurement (European Commission, 2012, 2005). Brännlund et al., (2009) and Varnäs (2008) argued that although pursuing environmental policies through the implementation of green public procurement could be a complex task, environmental parameters could be incorporated at three stages of procurement process: prequalification and evaluation procedure, the prequalification of the tenderers based on compliances with the tender documents and finally to evaluate the tenders on environmental criteria. The use of environmental criteria in public procurement contracts was proposed by Nissinen et al., (2009) and Kippo-Edlund et al., (2005). According to Kippo-Edlund et al., (2005), environmental issues are often taken into consideration in the procurement of construction contracts in Sweden. It is argued that the government has evolved from a bureaucratic organisation into an environment-oriented institution subscribing to the value of environmental sustainability. A hypothesis of the relationship is constructed below.

H5: Environmental orientation of government procurement is positively associated with organisational performance.

Since the study aims to provide a conceptual and managerial framework to investigate the determinants of environmental orientation of government procurement in Singapore, the conceptual framework also hypothesised relationships among constructs – the independent variables (IPA, WM, OSPP and OVALUES). The following are the discussion on the relationship betrween the constructs.

3.4.2 Integrated Product Attributes and Waste Management

The importance of IPA was discussed in Section 3.3.1. Research has shown that manufactured goods contribute to environmental problems whether from their production process, use or disposal (EC, 2003). Berkhout & Smith (1999) argued that the EU product policy was developed to reduce and manage waste. They further added that the policy has the impact of encouraging innovation of more environmentally sound products thereby creating markets for more environmentally-sound products. Rehfelda, Rennings and Ziegler (2007), on the other hand, maintained that the policy aims to achieve a broad reduction of all environmental impacts along a product's life cycle. By addressing the IPA which have the characteristics of energy efficiency, conserving energy(Murphy & Poist 2002), biodegradability (Min & Galle 2001; Mojo 2007) and non-hazardous materials (Mazlin, Goh & Murad, 2009; Hsu & Hu, 2009), waste can be managed and the environmental impact is lessened.

Organisations that focus on energy efficiency and conservation have reduced emissions of greenhouse gases and other pollutants into the environment (Dincer, 2003). One of the components of integrated product attributes is biodegradability. Biodegradability is an effective instrument to manage waste generated. Biodegradability means less need for landfill. Research conducted has shown that landfill contributes to the greatest environmental impact (Mazzanti & Zoboli, 2009) due to the discharge of hazardous methane gas that can cause fire and explosion (Pearce, 2004; El-Fadel et al., 1997). Electronic waste which is commonly known as e-waste is a growing problem in many countries. Studies have shown that e-waste has a high percentage of hazardous materials (Choi et al., 2006; Zhou & Qiu, 2010; Thornton, 2001). It has been reported that many recyclers are by exporting electronic waste to developing countries like China, India and Pakistan for disassembly and processing. These wastes are being handled under conditions that are harmful to the workers and the environment (Ewaste, 2011; Science Daily, 2013). In China, electronic waste dumped into former irrigation ditches (Hong-Gangni & Zeng, 2009). A waste- printed circuit board (WPCB) consists of both non-hazardous and hazardous materials. The non-hazardous material contained in WPCBs are worthwhile to be recycled by, developing a non-polluting, efficient, and low-cost processing technology for recycling of WPCBs. This prevents environmental pollution and also helps to recycle valuable resources (Zhou & Qiu, 2010). The use of non-hazardous material has the potential for recycling. In Mauritius, due to problems caused by solid waste disposal recycling and the setting up of a compostable plant were recommended to manage non-hazardous waste (Foolmaun, Chamilall & Munhurrun, 2011). Based on the above discussion, a hypothesis regarding the relationship between IPA and WM is constructed below.

H6: Integrated product attributes are positively associated with waste management.

3.4.3 Organisation Systems Processes and Policies; and Integrated Product Attributes

The importance of OSPP has been discussed in Section 3.3.3. OSPP provides a framework to understand the environmental attributes of a product. Measurement standards refer to international environmental certification such as ISO 14001 (Alan et al., 1990; Quazi 1999; Singh & Perry, 2000) and the use of eco-labels on products (Gallastegui 2002; Li & Geiser 2005), product design (Stevels, 2001) and life cycle analysis (Ross & Evans, 2002).

Eco-labels, developed and implemented by individual countries signify that a product has achieved the prescribed environmental standard. Examples of eco-labels are: The Blue Angel (Germany), Energy Star, EU Flower (European Union) and Nordic Swan (Finland, Iceland, Norway, Denmark and Sweden (Li & Geiser 2005). Eco-labelling is an effective way of informing consumers about the environmental impact of products so that they could make informed buying decision. An eco-label makes the customer more aware of the benefits of certain products such as toxic-free cleaning agents, and promotes energy efficiency and biodegradability (IISD, 2013). Individuals with a strong interest in environmental protection make their buying decision based on the presence of labels (Granvist, Dahlstrand & Biel, 2004). The Standards and Industrial Research Institute of Malaysia (SIRIM) in 1996 launched the national eco-labelling program verifying products according to environmental criteria such as Environmentally Degradable, Non-toxic Plastic Packaging Material, Hazardous Metal-Free Electrical and Electronic Equipment, Biodegradable Cleaning Agents and Recycled Paper (Nik, 2009). A study showed a positive correlation between adherence to green design principles and a reduction of the environmental impacts of production of polymers (Tabone, et al., 2010).

H7: Organisational systems, processes and policie are positively associated with integrated product attributes.

3.4.4 Organisation Systems, Processes and Policies; and Waste Management

As discussed in Section 3.3.3, OSPP comprising of ISO 4001, eco-labels, product design and life cycle analysis are one of the identified determinants that influenced the environmental orientation of government procurement. Measurement standards refer to international environmental certification such as ISO 14001 (Alan et al., 1990; Quazi 1999; Singh & Perry, 2000) and the use of eco-labels on products (Gallastegui 2002; Li & Geiser 2005), product design (Ammenberg & Sundin, 2005; Stevels, 2001) and life cycle analysis (Ross & Evans, 2002; Yuracko & Morris, 2001). According to Del Borghi, Carlo & Del Borghi, (2009) the approach to waste management is based on three principles: waste prevention, recycling and reuse and improving the final disposal and monitoring. In this aspect, they argued that the use of LCA in analysing waste management is suitable as it provided a comprehensive view of the processes and environmental impacts.

LCA has been used in many organisations. Fuji-Xerox adopts a life cycle analysis in its product development. It has four re-manufacturing, reuse and recycling facilities in Japan. Thailand, China and Australia achieved 90% of product recovery process (Fuji-Xerox, 2013). Organisations used LCA in evaluating the environmental impact of a product. Blue Scope Steel (2012) used LCA is used to analyse waste generated during production and designing a product with recycling capability. Sustainability Victoria (2007) used LCA in evaluating the life cycle of plastic bags. The study found that reusable bags have lower environmental impacts. The reusable and green plastic was found to achieve the greatest environmental benefits. Recycled content of the bags led to lowering the overall environmental impact. The study concluded that the end-of-life destination is crucial, with greater environmental savings achieved from recycling all bags at the end of their useful life.

Blengini (2009) found that LCA has been effectively used in decontamination and decommissioning (D&D) work in the government and industry sectors. LCA saves money prevents environment problems from occurring and protects human health. Ross & Evans (2002) found that LCA is a strategy which indicated the importance of recycling and packaging. This can lead to a minimisation of the environmental problem caused by the manufacture, use, and disposal of products. A study conducted by Bleghini (2009) found that using LCA the recycling of building waste in Italy is sustainable, economically feasible and profitable. A study conducted in Korea on the benefits of design for the environment (DfE) in the product design stage and green procurement found that DfE improved environmental performance of electronic equipment such as PCs. It also increased the rate of recycling thereby reducing the environmental burden (Choi et al., 2006). Based on the above discussion, a hypothesis is constructed indicating the relationship between OSPP and WM.

H8: Organisation systems, processes and policies are positively associated with waste management.

3.4.5 Organisational Values and Waste Management

The importance of organisational values in influencing environmental orientation of government procurement was discussed in Section 3.3.4. The concept of value is defined and applied in many different perspectives and disciplines (Weinstein & Johnson, 1999).

Deal & Kennedy (1982) defined organisational values as the way we do things. The objective of values is to guide decisions and actions either for individual or organisation to achieve a common purpose (Sullivan et al., 2001). Therefore, in the context of government procurement, organisational values can be defined as an organisation-wide recognition and commitment to the importance of environment that influences organisations to act in ways consistent with the interest of environment (Henriques & Sadorsky, 1999).

Organisations that are committed to environmental issues engaged in a number of activities such as writing an environmental plan, regularly communication of this plan to employees, training their employees to take a long-term perspective of environmental issues by using strategies and policies and allocating resources that support this view (Henriques & Sadorsky, 1999; Hunt & Auster, 1990; Roome, 1992). The organisational values of entrepreneurship, commitment, organisational learning and innovation can influence the adoption of measures that can minimise the waste generated that, if not managed properly, can pose serious health hazard (Miller, 2000).

Governments are taking steps by developing and implementing measures to address environmental issues. Regulatory compliance in the form of legislations (Bolton 2008) was introduced in South Africa to ensure that government procurement officials select suppliers that meet environmental requirements. The other EU directive on eco-design provides specifications for energy-using-products – EuP (Matthews, 2007). Tsai & Chou (2004) argued that the Waste Disposal Act introduced by government have an impact on the management of industrial waste in Taiwan. Familiarity of government environmental policy establishes common understanding which enables compliance. There are occasions where legislations are passed to ensure that suppliers and manufacturers adhere to environmental requirements (McCrudeen, 2004). A study by Walther & Spengler (2005) on environmental policies and directives issued by government to achieve environmental sustainability in Germany found that waste from electrical and electronic equipment would be on the rise and new legislations and directives are required to manage the waste. On the other hand, Bolton (2008) found that the use of legislation, to a large extent, has ensured that contractors' performance meets environmental standard as prescribed by the government. A study conducted by Nilsson et al., (2010) found that an approach to the design of public sector buildings combining participatory design techniques with sustainable design achieved an integrated, holistic design outcome for public sector building. Material and furniture used for the buildings met environmental requirements and therefore did not impact on the environment. Based on the above discussion, a hypothesis on the relationship between organisational values and waste management is constructed.

H9: Organisational values are positively associated with waste management.

3.4.6 Organisational Systems, Processes and Policies; and Organisational Values

In this study, OSPP consists of four components: ISO 14001, eco-labels, product design and life cycle analysis. The importance of OSPP has been discussed in Section 3.3.3. OSPP refers to international environmental certification such as ISO 14001 (Alan et al., 1990; Quazi 1999; Singh & Perry 2000) and the use of eco-labels on products that can influence buyer s buying decision (Gallastegui 2002; Li & Geiser 2005). Organisations implemented the ISO 14001 to inform consumers that their operations are not contributing to environmental problems (Grolleau et al., 2007). As discussed earlier, eco-labels signify that a product has achieved the prescribed environmental standard. Examples of eco-labels are Environmental Choice (Canada), Eco Mark (Japan), Green Mark (China), Eco Mark (India) and Green Label (Singapore) (Ecolabelindex, 2013; Ecospecifier, 2013). Research showed that buying decisions are influenced by on the presence of eco-labels on the products (Leire & Thidell, 2005; Li & Geiser, 2005).

Dyer & Ziegler (1970) considered government institutions as bureaucratic and elitist with a belief that she understands the need of the public. Therefore, it is not surprising that decision-making tends to be based purely on rational, economic and financial considerations (Allison, 1971; Ansoff, 1987; Porter, 1990). Grandori (1984), on the other hand, argued that bureaucratic decision-making tends to be incremental and cautious. Government responses to a number of issues are shaped by internal and external factors such as political, economic and environmental considerations (Simon, 1964).

The management of public sector has evolved since then. In new public sector management, it has been suggested that when dealing with new issues, government institutions have to be risk-takers, innovative and committed to their vision and strategy (Boyett, 1996. However, government institutions prefer adopt a cautious in their decision-making because of the scrutiny placed in the decision making (Mulgan, 2000). This is because they have to be accountable and transparent in the decision-making. A study conducted by Mirabella, Rigamonti & Scalbi (2013) found that LCA was effectively used in the Italian public sector to evaluate environmental impact of mining and transportation projects. Procurement is an important governmental function tends to attract greater scrutiny because of the use of taxpayers' money. By using well-established systems, processes and policies such as the application of ISO14001, eco-labels and the value of product design that promote recycling and the life cost analysis provided government institutions rationale and premises for decision made. Based on the discussion above, the hypothesis of relationship between organisation systems, processes and policies with orghanisational values is constructed.

H10: Organisation systems, processes and policies are positively associated with organisational values.

The proposed conceptual framework is presented below indicating the determinants that influenced the environmental orientation of government procurement in Singapore.

3.5 Proposed Conceptual Framework

Figure 3.1 provides a proposed theoretical framework for the environmental orientation of government procurement. The four major independent constructs are:

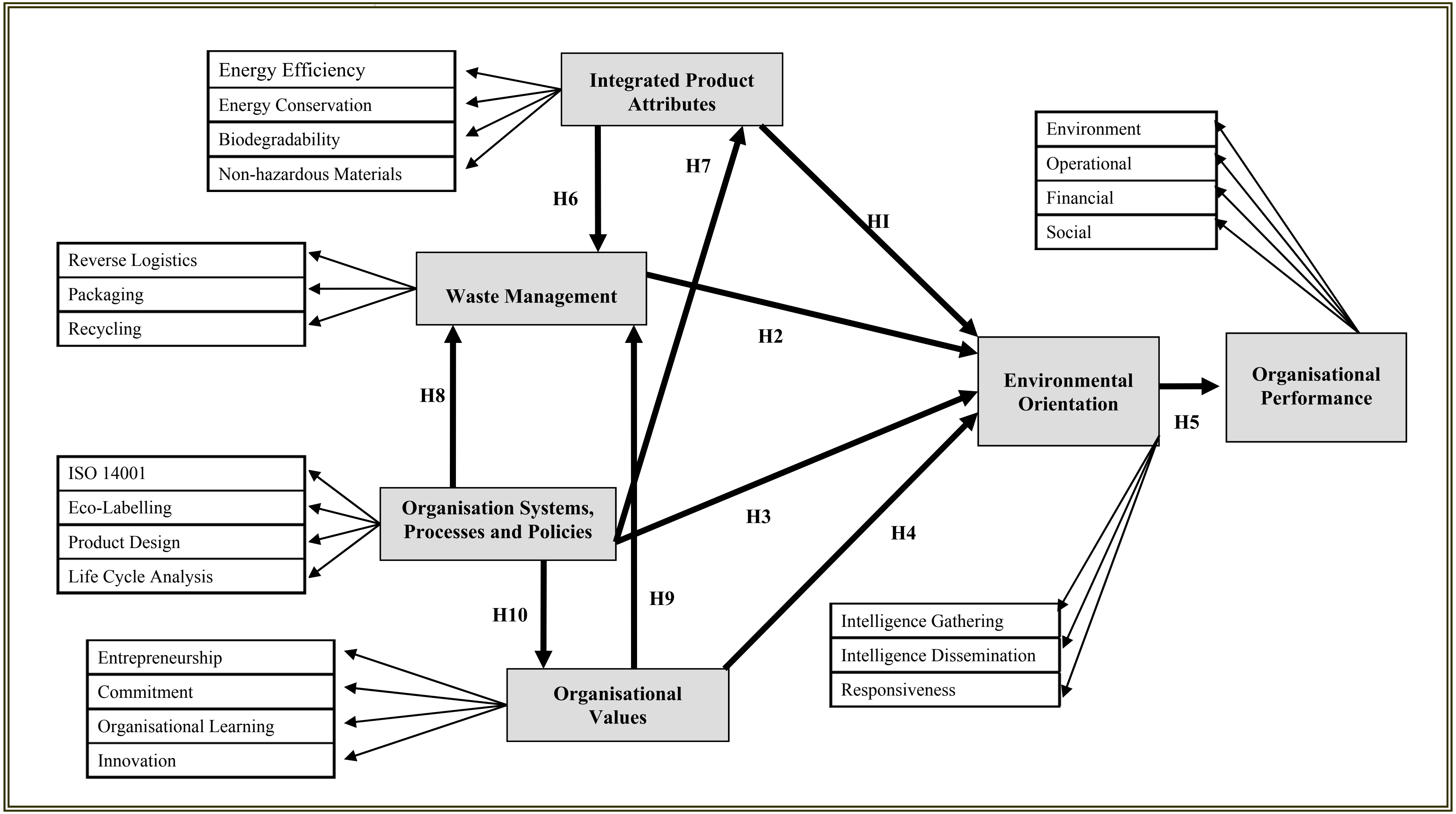
- Integrated Product Attributes (IPA);
- Waste Management (WM);
- Organisational System, Processes and Policies (OSPP); and
- Organisational Values (OVALUES).

The IPA, WM, OSPP and OVALUES are hypothesised to have significant relationship on environmental orientation of government procurement (ENVORIENT). ENVORIENT is hypothesised to be significantly related to organisational performance (OPERF). Although studies concurred that performance as an outcome has to be measured, there are differences on the methods to measure and operationalise performance. There are various views on the method of measurement to be employed to ascertain performance. Numerical indicators such as profit and loss, return-on-investment and return-on-assets have usually been used. However, subjective indicators showing level of acceptance, satisfaction and improvement have also been utilised to measure performance.

Within the logistics and supply chain framework, researchers have been more concerned with both objective (actual financial data such as profits, sales growth, ROI) and subjective (respondents' opinion on financial and market measures) evaluations. Gonzalez-Benito & Gonzalez-Benito (2005) stated that researchers use both subjective and objective measurements. On the other hand, Vorhies et al., (1999) used subjective measures because absolute performance measures such as ROI and profit levels, sales volume, and market share could be problematic if used as a basis for comparison. Besides, varying sized firms and also different accounting standards could be used (Fisher & McGowan, 1983).

Similar arguments arise when evaluating the performance of public organisations. Comparisons become more complex when quantitative measurement is used to measure government performance. This thesis used subjective evaluation to measure the performance of public organisations. Subjective evaluation is used because public organisations tend to have multiple and conflicting goals which make them difficult to measure (Alford & O'Flynn, 2009; Boyne et al., 2005, Rainey & Bozeman, 2000). Government institutions tend to have multiple goals and programmes as a matter of public policy. Because some issues cover a broader range of objectives that cannot be quantitatively measured (Boyne et al., 2005) and because of the multi-objective nature of the public sector (Greiling, 2006; Peng & Cai, 2008; Umashev & Willett, 2008), quantitative measurement such as return on investment is considerably more complex to establish as no single indicator can capture all the complexities of public organisational performance. In this study, subjective evaluation is used to measure organisational performance which has four indicators: environment, operational, financial and social.

Figure 3.1: Proposed Conceptual Framework of Environmental Orientation of Government Procurement



3.6 Summary

This chapter outlines the theoretical foundation of this study. Elements derived from resource-based and stakeholder theories form the theoretical basis for this study. The use of resource-based and stakeholder theories provides an in-depth analysis on the complexity of environment-oriented government procurement. Each theory has its own weakness. Therefore, the use of different theories enriches the analyses of this study. This chapter also focuses on the link between environment-oriented procurement and the concept of CSR, with environmental matters being one of the dimensions of CSR. This chapter then focused its discussion on environment-oriented government procurement, supported by studies in the area of procurement. This chapter then examines, conceptualizes, synthesizes, and integrates research relating to determinants that influence environmentally-oriented government procurement and its influences on organisational performance that is supported by the literature. It then proposes a conceptual framework. The discussion culminated with the establishment of ten testable hypotheses.

Drawing from the in-depth discussion on the critical determinants, hypotheses were constructed. Table 3.1 presents the ten hypothesised relationships. Four main constructs (independent variables): Integrated Product Attributes (IPA), Waste Management (WM) and Organisational Systems, Processes and Policies (OSPP), and Organisational Values (OVALUES) are hypothesised to be positively associated with environment-oriented government procurement. The first construct is Integrated Product Attributes (IPA) which includes energy efficiency, energy conservation, biodegradability and non-hazardous materials. The second construct is Waste Management (WM) which has factors of reverse logistics, packaging and recycling. The third construct is Organisational Systems, Processes and Policies (OSPP) which cover factors such as ISO 14001, eco-labels, product design and life cycle analysis. The fourth construct is Organisational Values (OVALUES) with factors of entrepreneurship, commitment, organisational and innovation. The four independent construct has significant influence on environmental orientation of government procurement. The environmental orientation has three factors: Intelligence Gathering, Intelligence Dissemination and Responsiveness which impact on the performance of public organisation in Singapore. The performance is measured in terms of environmental, operational, financial and social indicators. It is also hypothesised that there are positive relationship between the independent constructs. Table 3.1 summarises the hypotheses constructed for this study.

Table 3.1: Summary of Hypothesised Relationships

Hypotheses	Hypothesised relationships
HI	Integrated product attributes are positively associated with environmental orientation of government procurement.
H2	Waste management is positively associated with environmental orientation of government procurement.
H3	Organisation systems, processes and policies are positively associated with environmental orientation of government procurement.
H4	Organisational values are positively associated with environmental orientation of government procurement.
H5	Environmental orientation of government procurement is positively associated with organisational performance.
H6	Integrated product attributes are positively associated with waste management.
H7	Organisation systems, processes and policies are positively associated with integrated product attributes
H8	Organisational systems, processes and policies are positively associated with waste management.
H9	Organisational values are positively associated with waste management.
H10	Organisational systems, processes and policies are positively associated with organisational values.

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

The selection of a research methodology, to a large extent, is influenced by the research questions and the aims of this study. The availability of resources, especially in relation to data accessibility and other factors such as time and other resources, also determine the methodology to be used. This study uses the quantitative approach in analysing the data collected. As this thesis focuses on the procurement processes of government institutions, survey questionnaires have been used to gather data from public organisations such as from the ministries, statutory bodies and government-related agencies. The diverse government bodies provide a better sample. It also provides diversity of opinion into public procurement practices undertaken in different government institutions.

4.2 Epistemological Issues

In undertaking any social research, two main approaches are used: positivist and interpretive (Bryman, 2006; Bryman & Bell, 2007). The positivist approach is associated with many social theories (Chen & Hirschheim, 2004). Positivism researchers prefer quantitative data and employ experiments, surveys, and statistics. Rigorous measures are used in such studies and research hypotheses are tested by carefully analysing numbers from the data. A positivist approach implies that a researcher begins with a general cause-effect relationship that he or she logically derives from a possible causal law in general theory. Positivism links the abstract ideas of the relationship to precise measurement of the social world. In this situation, the researcher remains neutral and objective. Finally, this process leads to empirical testing of the laws of social life as outlined in a theory (Neuman, 2003).

The central themes of positivism are:

- Similarity between the natural and social sciences. Like scientific research, positivism investigates the causal relationship between phenomena; and
- Positivists consider that knowledge be based on what can be objectively observed and experienced.

However, critics argue that positivism reduces people to numbers and that abstract findings are not relevant to the circumstances of the real world (Neuman, 2003). The interpretive approach, on the other hand, is a basis for those research techniques that are sensitive to context. In other words, these techniques employ a variety of methods to gain insight into how others see the world (Neuman, 2003). Interpretive researchers engage in observation and field research and spend considerable time in direct personal contact with those being studied. This study adopts a positivist approach and employs convenient samples, operationally-defined variables, and statistical analysis.

This chapter presents issues and discussions on the research methodology and research design employed in this study. It seeks to answer research questions in a systematic and organised manner. The intention of this study is to answer the following research questions:

- What are the determinants influencing the environmental orientation of government procurement in Singapore?

- Are critical determinants of the environmental orientation of government procurement a source for organisational performance?

In addition to the above, this study also aims to achieve the following research objectives:

- To investigate the critical determinants of the environmental orientation of government procurement in Singapore; and
- To develop an integrated and holistic managerial framework that could be integrated into the government's procurement process. The managerial framework could be used to improve a procurement decision-making process that supports environmentally-oriented procurement practices.

This chapter aims to provide a premise and rationale for the selection of a particular research methodology. Before deciding on the methodology to be adopted, it is appropriate to explore available methods that are useful in answering the research questions, thus achieving the objectives of this research. The subsequent section discusses and justifies various research methodologies, sampling and sampling technique and the method of data collection. The construction of measurement instruments and measures of constructs are also discussed.

Environment-oriented government procurement has four constructs related to environmental orientation. A total of four latent constructs with 15 factors are identified. They are considered to have influence on the environmental orientation of government procurement. The conceptual framework shows six main constructs of which four are independent constructs and two are dependent constructs in this study. Altogether, there are 22 factors (latent and dependent constructs) in this study.

The first part of this chapter deals with the research design which constitutes the data collection method, sampling design and the operational definitions of the constructs. It then provides information on the development and construction of the survey questionnaire, and its distribution and administration. This section also focuses on aspects of reliability and validity of the questionnaire. The remainder of this chapter provides discussions on data analysis and preparation, the ethical issues considered in this study, and the conclusion.

Thereafter, the selection of measurement instruments for this research and the structure of the questionnaire design will be discussed. In addition, the data analysis section will describe various measurement techniques for this study. The study has considered constraints that needed to be addressed such as the specific time required to complete the research and the availability of various government ministries, departments, statutory bodies and government-owned companies that were willing to participate in the project. Lastly, the research limitations and ethical considerations are discussed, followed by a conclusion of this chapter.

4.3 Research Design

In an academic research environment, researchers are confronted with epistemological issues. There is on-going debate on the research paradigm with its underlying assumptions to understand complex social issues. Researchers often deliberate on the advantages and disadvantages of qualitative versus quantitative techniques (Walle, 1997), positivist versus interpretive paradigms (Guo & Sheffield, 2008) to answer research questions, while others advocate the efficacy of a mixed method, a combination of quantitative and qualitative methods to investigate and provide answers to the research in question (Johnson & Onwuegbuzie, 2004).

Rigorous debate on research methods, the use of quantitative and qualitative research methods or a combination of both, is unavoidable and acceptable (Cresswell, 2009; Cresswell & Plano, 2007; Cresswell & Tashakkori, 2007; Fidel, 2008). The interpretive school of thought favours the qualitative technique as a means of providing deeper insight into and understanding of complex social situations. According to this school of thought, intangibles such as cultural values, norms, motivations, expectations, perceptions and behaviour differ from individual to individual and from society to society. Hence, the use of the qualitative method, where data is collected by using open-ended questions through interviews that are either semi-structured or structured, is more suitable (Crabtree & Miller, 1992; Sekaran, 1992).

While methodological triangulation in qualitative analysis provides an understanding of how individuals are different in the way they perceive and make decisions on a range of issues (Creswell, 2009), the positivist or quantitative approach considers that knowledge could be generated, analysed and understood through statistical analysis of observed reality (Sobh & Perry, 2006). Positivism usually involves deductive methods such as experiments, survey and testing of hypotheses (Hines, 2000; Perry et al., 1999). The positivists, using statistical analysis, are deductive in their orientation, separating the researcher from the object of research. This proves useful as bias is avoided, thereby providing greater reliability (Cavana et al., 2001). The quantitative technique uses the survey questionnaire which is the standard procedure for data collection. This provides a systematic measurement, thus increasing the possibility of replicating the study.

Furthermore, the theoretical proposition outlined reveals values and preferences as well as context-specific phenomena. This suggests that a phenomenological paradigm using quantitative methodology can be applied to understand the concept of values and preferences in relation to procuring environmental products. The literature review reveals that although orientation is a subjective concept, it can be operationalised using quantitative methods.

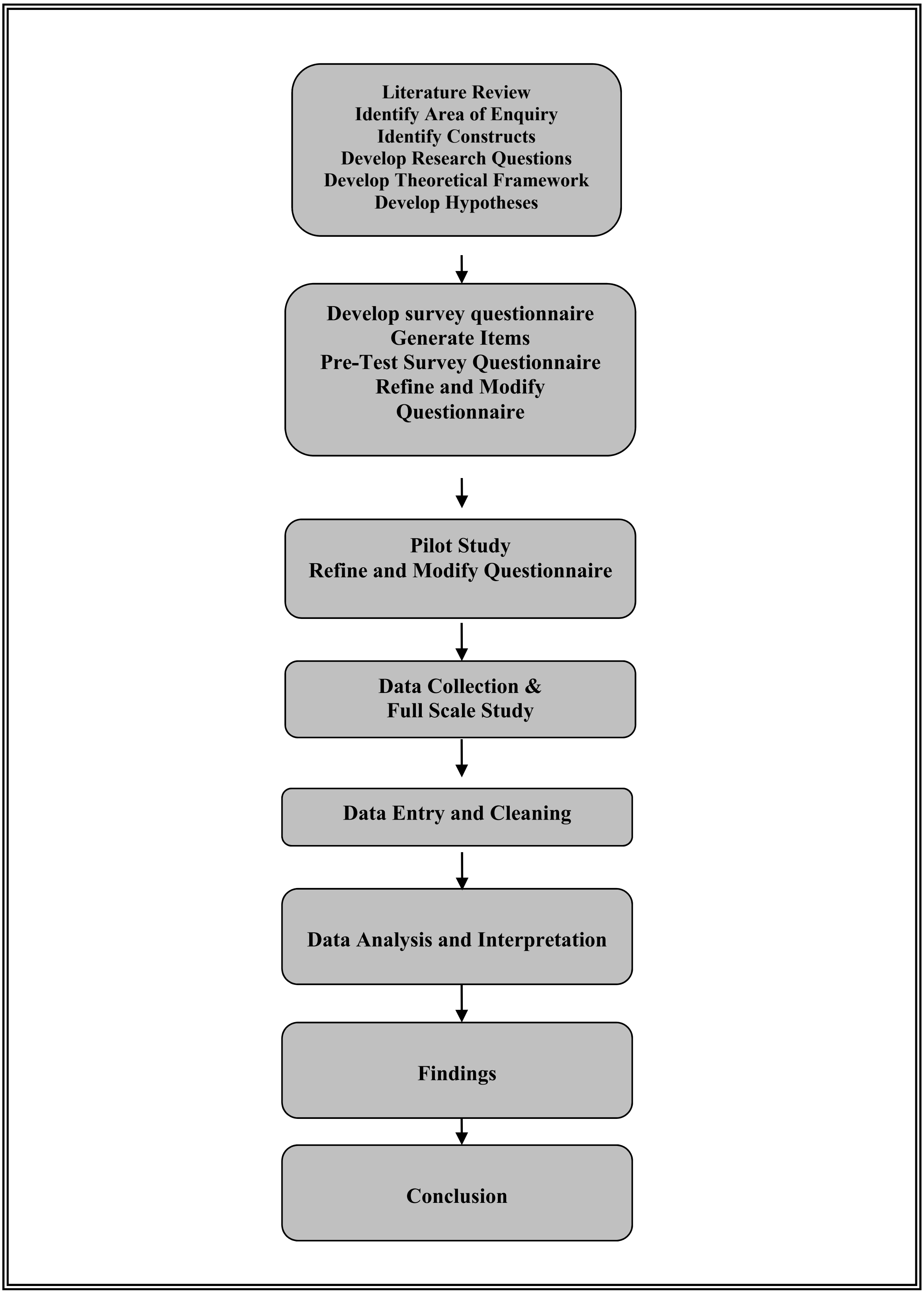
Since this study is concerned with gathering data in order to understand the relationship between the environmental orientation in procurement and its relationship to performance, a questionnaire-based survey was the most appropriate method to use. Structural equation model is the method used to analyse the data. The advantages of using the SEM are outlined below:

- It is able to simultaneously assess relationships between constructs and indicators and to test theoretical relationships. Thus, relationships among variables can be modelled in SEM to provide a better understanding of the theory under study (Holmes-Smith, 2007);
- It can be used to conduct simple, multiple, multivariate regression, analysis of variances by using confirmatory factor analysis (CFA) rather than the exploratory approach (Brown, 2006);
- When the relationships among variables are determined, SEM is a useful tool for inferential purposes (Vilares et al., 2005). In most cases, multivariate analysis can be cumbersome and difficult for hypothesising. SEM makes the testing of hypotheses much easier.

4.3.1 Methodology

The study employs quantitative approach using SEM for data analysis. Figure 4.1 illustrates the framework of the research process that guides all the steps undertaken in this study from conducting an extensive literature review to data collection and analysis to be undertaken. The research begins with the literature review on procurement. The literature has identified a number of factors that are considered to have an influence on environmentally-oriented procurement which led to conceptual propositions. They are categorised into six constructs, four of which are independent and two are dependent. These constructs are considered to be the determinants which formulate environmentally-oriented government procurement. These constructs are then operationalised by constructing a survey questionnaire. The survey questionnaire was constructed using a number of items supported by literature and was designed to elicit responses related to environmentally-oriented government procurement. The survey questionnaire was tested for its readability during the pre-test stage by a panel of experts whose subsequent recommendations led to refinements of the questionnaire. A pilot study was conducted and further refinements were made of the survey questionnaire before the full scale study was conducted. The data was evaluated for completeness of response and entered into SPSS 18 for data analysis. Data was collected in Singapore from late August to early November 2010.

Figure 4.1: Research Process



4.3.2 Unit of Analysis

A unit of analysis is defined as the case to which variables under study and the research problem refer, and for which data is collected and analysed (Hussey & Hussey, 1997). Specification of the unit of analysis is critical during the early stages of the research as it directly influences the conceptual framework, sampling frame and the data collection techniques (Zikmund, 2000b).

The unit of analysis in this study is government institutions. In line with the research questions, it was necessary to collect data from various government institutions including ministries, government departments, statutory boards and government-related agencies. The sampling unit for this study were government ministries, departments, statutory boards and government-related agencies which are involved directly and indirectly in the process of procuring products and services. The questionnaires were distributed to various key decision-makers in the ministries, statutory boards and government-owned companies. These decision-makers were identified through personal contact and recommendations from relevant authorities. They were advised to select the respondents within their organisations with respect to the completion of questionnaires. Government officers whom the investigator contacted directly requesting them to complete the questionnaire at their convenience, participated on a purely voluntary basis. The investigator personally collected the completed survey questionnaires from key participants.

4.3.3 Respondents Selection

The use of samples can be a fairly accurate and efficient means of obtaining information about a population (Churchill, 1979). Convenient sampling tends to be associated with a higher response rate, while mail surveys appear to be the least effective (Yu & Cooper, 1983).

The research is aimed at a sample of public sector organisations in Singapore. The questionnaire-based survey was administered to government officers who are involved in the areas of procurement, logistics and operations of government ministries, departments and statutory bodies. In Singapore, statutory bodies are entities that are established by an Act of Parliament. The main objective in setting up statutory bodies is to efficiently manage and deliver services such as airport and port management, broadcasting, provision of utilities and other strategic services. There are 15 ministries and more than 60 statutory bodies set up to manage public services (Public Service Division, 2012; SGDi, 2008).

A potential difficulty in research of this nature is getting access to the respondents and getting their cooperation to identify the relevant people in the organisations to assist and participate in the survey. The investigator identified influential respondents through his personal contacts. The influential respondents had access to various ministries, departments, statutory bodies and other government related agencies. The investigator conveyed to the influential respondents that they would be the contact persons for the survey questionnaires to be distributed and collected. The investigator was also informed them that their participation was confidential, as they were concerned of breaching the Official Secret Act, which public officers have to adhere to. The investigator assured the respondents that their names and which government institutions they were from would not be disclosed to protect their confidentiality.

The voluntary nature of participation means that the respondents had the right not to participate in the survey at any point in time during the data collection. There were cases where survey questionnaires were returned unanswered. However, due to the personal contact the investigator had with the respondents and in some cases the respondents had been assigned to assist the investigator in his study, ensured a relatively high participation rate and an efficient data collection.

Table 4 shows the distribution and collection of survey questionnaires. The respondents are drawn from government ministries and statutory bodies. The officers from the following ministries and statutory bodies participated in the study. 570 survey questionnaires were distributed and 370 were collected representing a response rate of 64.9%. In terms of procured products and services, although there are differences in items purchased, there are also common items procured such as audio visual equipment, electronic and electrical appliances, food and beverage, fire-fighting equipment, grease, oil and lubricants, IT hardware and software supplies, office furniture, office equipment, printing services and vehicle maintenance. The items are procured through procurement policies of demand aggregation, eProcurement system, best sourcing initiative, centre for shared services, public private partnership arrangements and other related MOF budgetary and procurement policies initiatives. Procurement activities follow an 8-step process: 1. Establishing needs 2. Determining Procurement Approach 3. Specifying requirements 4. Sourcing 5. Evaluating 6. Seeking Approval 7. Contracting and 8. Managing contract (Civil Service College, 2010).

TABLE 4: DISTRIBUTION & COLLECTION OF SURVEY QUESTIONNAIRES		
Ministries	**Distributed**	**Collected**
National Development	60	58
Home Affairs	70	53
Health	55	30
Environment & Water Resources	60	39
Community Development	80	45
Education	75	40
Information,Communication & Arts	80	50
Manpower	20	15
Others	70	50
Total	570	370
Percentage		64.9%

4.4 Questionnaire Design and Development

Questionnaires are the most frequently used method of data collection in quantitative field research (Hinkin, 1995). According to Hinkin (1995), they are relatively easy to use when correctly constructed, not too expensive and relatively easy to administer. Questionnaires are used to measure unobservable constructs such as values, perceptions and motivations (Moorman & Podsakoff, 1992). The questionnaires, intended to measure constructs, are designed to accurately and reliably operationalise, conforming to content and criterion-related validity, construct validity and consistency (Hinkin, 1995; Schriesheim & Eisenbach, 1995; Schriesheim, et al., 1995). As a guide, a well-designed questionnaire should meet the research objectives, facilitate data collection and processing, and achieve and maintain the involvement of respondents (Miller, 1991).

There are two basic types of scale development: deductive and inductive (Hinkin, 1995). A deductive scale development requires an understanding of the phenomenon to be investigated and a thorough review of the literature to develop a theoretical definition of the construct under investigation. The definition is then used as a guide for the development of the items. With the inductive approach, researchers ask respondents to state their feelings about a phenomenon when developing scales. In this study, a deductive approach was used for scale development. Items used in the previous studies for measuring a construct were used as a basis for item generation.

4.4.1 Questionnaire design

There are a number of studies that used the 5-point Likert scale. Murphy, Coover & Owen (1989) used the 5-point Likert scale in a study to develop and validate the computer efficacy scale. In the area of organizational commitment, Testa (2001) in a study on job commitment and satisfaction also employed the 5-point Likert scale. Walker & Brammer (2007) used the 5-point Likert scale to investigate sustainable procurement in the UK public sector. Salam (2008) in a study on the adoption of green procurement in electronic sector in Thailand also utilized the 5-point Likert scale. Based on the use of the 5-point Likert scale in a number of studies and more so in the areas of sustainable procurement, it is appropriate for this study to use a 5-point Likert scale.

The survey questionnaire was constructed using a five-point Likert scale for responses and a nominal scale for information classification (e.g. demographic profile) about the participants who voluntarily agreed to participate in the survey. The survey was designed to meet the following objectives:

- The survey clearly indicates to participants that involvement in the survey is voluntary. The statement of the voluntary nature of participation is placed on the first page of the questionnaire. Neither material nor financial inducement is to be given to participants to complete the survey questionnaire. Participants are to sign to show their consent to participate.

- The confidentiality aspect of information and data gathered from the survey is visibly and clearly highlighted. The statement of confidentiality is also placed on the first page of the survey questionnaire.
- The survey questionnaire is designed to be user-friendly. Explanations of how to complete the questionnaires are written in clear and plain English to ensure that the participants do not misinterpret items or need to ask the researcher to clarify any issues.
- The survey questionnaire is designed to be completed within 40 minutes.

4.4.2 Layout of the Questionnaire

The survey questionnaire is divided into seven parts. Part 1 to Part 6 contains items of survey questionnaires measuring constructs. Altogether, there are six constructs of which four are independent constructs consisting of 15 factors and two dependent constructs comprising of seven factors. Part 7 of the survey questionnaire focuses on the demographic profile of the respondents. Respondents are asked to indicate their responses by placing crosses or ticks in the boxes provided.

The five-point Likert scale was chosen for the development of most of the questions in this study as it is easy to construct and administer. The five-point Likert scale measures items generated from the unobservable constructs. Item generation is important in developing sound measures which simultaneously fulfil the requirement of content validity (Hinkin, 1995). Furthermore, the use of response categories offers a more effective framework for information transmission and respondents can more accurately communicate internal states such as attitudes, feelings or beliefs. Thus, information obtained using more response categories ensures greater reliability of measurement (Churchill, 1979).

In the literature, negatively worded items are acceptable. However, researchers favour positively-worded items rather than negatively-worded ones. Respondents are instructed to indicate their level of agreement with items based on a five-point Likert scale. The five–point Likert scale consisted of numerical values indicating the following:

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Neither Agree nor Disagree
- 4 = Agree
- 5 = Strongly Agree

The respondents are instructed to circle their responses along the statement indicated with their numerical values. Apart from responses to the Likert scale items, the survey questionnaire is also designed to elicit demographic responses from the respondents.

4.5 Administration of Questionnaire and Data Collection

The purpose of collecting data is to gain more breadth and depth of information, but also to control the amount of unpredictable data that is produced (Creswell, 2009; Cresswell & Garrett, 2008; Fidel, 2008). The study is conducted in three phases: pre-test, pilot study and a full scale study. There are specific objectives to be achieved at specific phases of the study. The purpose of the pre-test, which is exploratory in nature, is to enable the researcher to look for patterns of inconsistency in sentence construction, clarity of thought and, more importantly, to provide an insight into the appropriateness of items in measuring the constructs. The survey questionnaire in the pilot study phase is the result of inputs generated from the pre-test. Ten respondents were involved in the pilot study. The next section discusses the various purposes and changes made to the survey questionnaire at each phase.

4.5.1 Pre-Test Survey Questionnaire

Once the questionnaire has been developed, each question is rigorously tested before the pilot and full-scale study administration. The pre-test stage in the research process is to check on the survey questionnaire to ensure that the response categories to the questions are correct, that there is no ambiguous and unclear or misleading question, and correct sentence construction (Babbier, 2007; Sarantakos, 2005). It is recommended that expert opinion be sought when reviewing the survey questions. The questionnaire reviewers should have expert knowledge in the researcher's area of enquiry in order to provide feedback. In this study, five experts on procurement processes, working in the government institutions, were contacted to get their feedback on the survey questionnaire draft. Contacts with the potential experts were established through personal network and recommendations. Initial communication was established through emails to obtain their agreement to participate. Five experts were invited and agreed to provide feedback on items used for the survey questionnaire.

A number of meetings were organised in Singapore with the experts. The investigator briefed the panel of experts on the purpose of the study and the areas of research, and requested that they check on the appropriateness and relevance of questions. This panel of experts was reassured that their participation would be kept confidential and that the study had been given approval by the University Ethics Committee. A copy of the survey questionnaire was given to each of the experts who agreed to provide their feedback within a time frame of one week. The investigator met the panel members to discuss their feedback before collecting the survey questionnaires. One of the difficulties faced in the collection of the survey questionnaire was the busy schedule of the experts. Overall, the survey questionnaire was collected within a one to two-week period. During the pre-test stage, items for the survey questionnaire were tested for their relevance, accuracy and comprehensibility. The panel of experts recommended that carbon emission which is a factor for a construct of Integrated Product Attributes (IPA) be dropped. The panel of experts also recommended that landfill which is a factor for a construct of Waste Management (WM) be dropped. The recommendation was made by the panel of experts to avoid duplication of measurement. The panel of experts also recommended that the sentences of some of the items be re-worded for clarity. The panel of experts also advised the investigator about the time required to complete the survey questionnaire to ensure that the completion is not too time consuming.

The feedback and input from the experts were used to refine the construction of items used in the survey questionnaires. The pre-test also gave the researcher a sense of familiarity with the area of enquiry for rigorous investigation at a later stage. According to Sarantakos (2005), instruments for a pre-test and pilot study are used to guide researchers before the full scale data collection begins. The purpose of checking instruments used is to ensure that the planning for the full scale study and its tools are correct, clear, suitable, reliable and valid. In addition, the pre-test phase is an important milestone in alerting the researcher to any inadequacy or inconsistency of items generation, thus guiding the researcher to redesign the questionnaires for the pilot study. The pre-test stage also gives the researcher an idea of the amount of time needed to complete the questionnaires.

Following the advice given by the panel of experts, some of the items measuring the factors were re-worded such as items that measure energy efficiency, energy conservation, packaging and entrepreneurship were reworded. Two factors were dropped from the survey questionnaire. They are carbon emission which is a factor that measures a construct of IPA and landfills which is a factor that measures WM.

4.5.2 Pilot Test Survey Questionnaire

A pilot test was administered to 10 respondents who were involved in procurement functions with the objective of establishing inter-item consistency and reliability as well as examining the comprehensiveness, comprehensibility, degree of difficulty, clarity and reasonable time allocation for respondents to answer the questionnaire. Survey packets containing a cover letter explaining the research objectives, the consent form and the questionnaire and a stamped, return addressed envelope, were distributed to procurement operations staff in the government sector. They were selected following the investigator's personal contact and contact established with officers from selected government departments, ministries and statutory bodies. Results from the pilot study would improve the strength of the research model. Data collated were screened and cleaned by checking for errors in the data file. This was done by checking each variable for any out-of-range scores, identifying these in the data file, checking the variable parameters, and referring back to the hard copy questionnaires to ensure that the correct values were then added. A preliminary analysis of the data was conducted to assess the variables for normality and check for outliers. The respondents were asked to complete the questionnaire and provide comments on the wording, ease of understanding and clarity of the items, and the overall appearance and content of the instrument. The panel suggested that all statements be retained and minor cosmetic changes be made. The time taken to complete the survey questionnaire was approximately forty minutes.

4.5.3 Full Scale Study and Sample Size

During the full-scale stage, survey questionnaires were distributed to 570 government officers who were involved in the areas of procurement, logistics and operational functions. They were asked to respond to scaled items in order to ascertain the influence of identified critical factors on environment-oriented government procurement. The sample size (n) is important in statistical analysis where it has a bearing on the sampling error (Kline, 2005). As a guideline, a small sample size (n) is one with fewer than 100 respondents, a medium sample size is between 100 – 200 respondents, and a large sample size is above 200 respondents (Kline, 2005). In SEM, a much larger sample size is required to maintain power, stable parameter estimates and standard errors (Schumacker & Lomax, 2010). The issue to address is determining the right sample size for SEM because SEM requires a sufficient number of cases to provide a higher probability to get a good response rate and also to ensure that the sample is a representation of the population under study (Short et al., 2002).

Literature on sample size for SEM does not specifically indicate an absolute number for a good sample size. Boomsma (1982) recommended 400 as adequate in SEM. Hu et al., (1992) argued that, in some cases, more than 5000 cases are required. Anderson & Gerbing (1988) recommended a minimum of 150 - 200 respondents to ensure the credibility of SEM findings (Hair et al., 2010). Chou & Bentler (1995) seemed to be in agreement although they considered that a sample of 200 respondents is relatively small although quite reasonable and practical. Hoyle & Kenny (1999) argued that a sample of

150 is a reasonable size to ensure credibility. The literature suggests that a sample size for SEM of 150 to 200 is a reasonable number of respondents (Hair et al., 2006). Bentler & Chou (1987) suggested that a ratio of five subjects per variable would be sufficient depending on the normal and elliptical distribution, while a ratio of 10 subjects per variable is suggested for other distributions.

Hair et al., (2010) proposed a rule of thumb of five observations per variable and the minimum absolute sample size should be 50 observations. Based on the arguments presented above and supported by the literature, the sample size for this study is 295 observations that would fulfil the requirement for using SEM as a methodology for statistical analysis. The study on environment-oriented government procurement has 22 variables where, at a ratio of 10 subjects per variable, the required sample size is 220. In interpreting the results of factor loading and sample size, a sample of 100 respondents with a factor loading of 0.55 and above indicates significance; a sample of 50 requires a factor loading of 0.75 for significance and factor loading of 0.30 requires a sample size of 350 in order to have practical significance (Hair et al., 2010). This study used a sample size of 295 respondents which meets the requirements for multivariate statistical analysis generally and SEM specifically.

4.5.4 Data Collection Procedure

A survey questionnaire was considered the most appropriate means of primary data collection for this study. The key advantage of a survey is that it is cost-effective for large samples and can reach a geographically dispersed sample simultaneously. It ensures confidentiality and anonymity of the respondents. According to Zikmund (2000a), respondents are more likely to provide sensitive organisational information when they can remain anonymous.

The survey questionnaire emphasised the importance of completing the questionnaire by an organisational member who was the most knowledgeable in matters of procurement operations. The selection of these individuals is considered appropriate because these government officers were involved in procurement-related activities of the organisation, either directly or indirectly. This resulted in the speedy completion of the questionnaire by the head of the organisation, senior and middle level functional managers, and executive officers. This supports the position that the responses were received from the persons most knowledgeable about procurement and operational activities of the organisation.

4.6 Response Rate

A low response rate is often associated with survey questionnaires (Dillman et al., 2009, Malhotra & Grover, 1998). To increase the survey response rate, various methods as suggested by Dillman (1978) were adopted. In a study of survey response behaviour, Cavusgil & Elvey-Kirk (1998) found that the type of appeal utilized by a researcher can significantly increase the likelihood of a respondent returning the questionnaire. The questionnaire package consisted of a covering letter and an assurance of anonymity. The covering letter emphasized the significance of the research and stressed the importance of the respondents' participation. Respondents were also assured that the study was purely academic in nature.

The invitation to complete the survey was signed by the investigator certifying that the study had been granted the ethics approval from the University. The names and complete contact details of Senior Supervisor, Supervisor and contact details of the Chair of Human Research Ethics Sub-Committee were included to emphasize the authenticity and confidentiality of this research. Additionally, to increase the response rate, the following basic principles were also followed in the design of the questionnaire:

- Each question was made as clear as possible;
- A legible typeface and adequate spacing were used;
- The instructions were made crystal clear; and
- The instructions on how to answer the questions were also illustrated.

In addition to the above, the investigator used his personal relationship with relevant government officers in order to increase the response rate. To create an appeal, and establish trust and rapport with the responding government organisations, every attempt was made to make the questionnaire respondent-friendly, and designed professionally to minimise respondent burden and the effort required to respond was minimised.

4.7 Ethical and Confidentiality Considerations

Ethical consideration is an important factor in research, study or project to be undertaken. It signifies that the interests of participants in the project, research or study are not compromised or taken for granted. Observance of ethical matters is not to be taken lightly in the process of collecting qualitative and quantitative data or a combination of both. Therefore, every effort should be made to ensure that the process of data collection, apart from being technically correct and efficient, is ethically sound (Bryman & Bell, 2007). Since this research involves the participation of individuals, the principles of ethics such as honesty, integrity and respecting individual rights, although universally understood and accepted, were restated and reaffirmed to mitigate and allay any unwarranted fear and suspicion. This research, therefore, has fulfilled all ethical considerations governing the conduct and operation of this research. Further, this research sought and was granted approval by the Ethics Committee of the RMIT University.

Researchers have seven legal and ethical responsibilities to meet when conducting data collection with voluntary participation, where no coercion is employed. Respondents were assured of informed consent, no harm, confidentiality, anonymity and privacy, respect and abidance by the conditions as stipulated in the terms of agreement (Bogdan & Biklen, 2003; Bryman & Bell, 2007). Voluntary participation implies that would-be participants can exercise their rights to be involved in the survey. Participation is optional. In this self-administered research, survey questionnaires were distributed and the voluntary nature of participation was emphasized. Would-be participants had the opportunity to examine the questionnaire before making their decision. Participation in this research was entirely voluntary and anonymous; the participants could withdraw themselves and any unprocessed data concerning them at any time, without prejudice. Participants who were involved in this research were able to withdraw partially or completely at any time or refuse to answer any question. Administratively, the participants had to provide signed consent which also related to the use of information provided. In the ethics of data collection by survey questionnaires, the signing of the document indicates implied consent. Implied consent means that when the would-be participants return their completed questionnaires, they have given consent to participate (American Psychological Association, 2002). The privacy of participants, the confidentiality of data provided by them, and their anonymity are protected and maintained. On the researcher's part, efforts are made to ensure that objectivity in data analysis is maintained and also to ensure that the data collected is not misrepresented. All information collected is strictly confidential and can be accessed by the researcher and his supervisors. Participants are assured that there is no perceived risk outside their normal day-to-day activities. All data will be kept securely at RMIT University for a period of five years before being destroyed.

4.8 Summary

This chapter describes the methodology to be used to investigate research questions and test the hypotheses constructed for this study. The chapter first sets out the research paradigm and framework. It also provides justification for the methodology selected for the research and gives an overview of the three phases of data collection: the pre-test, pilot study and full-scale study. The parameter of the sampling characteristics is also discussed. The definitions of government and government-related institutions are presented and discussed. This chapter also discusses the questionnaire design and layout. The ethical considerations of this research in ensuring that the research is conducted in an ethical manner are also discussed, where guidelines as stipulated by the Ethics Committee of RMIT University are observed.

CHAPTER FIVE

DATA CLEANING AND DATA ANALYSIS

5.1 Introduction

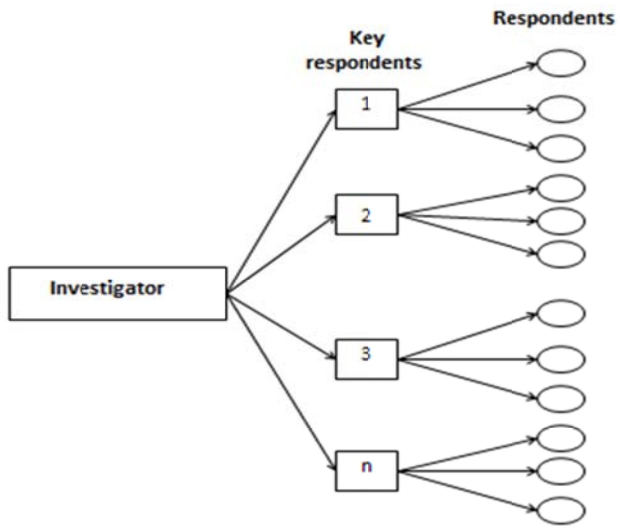
Chapter 4 focuses on the methodology, research design, stages of study, data collection and ethical consideration. This chapter looks at data preparation and cleaning before embarking on the multivariate analysis with SEM. A multivariate analysis allows deeper insight into the data compared to univariate and bivariate analysis. By cleaning and preparing the data, potential measurement error is minimised. In addition to minimising measurement errors, the data is also subjected to other statistical requirements of normality, multi-colinearity, reliability and validity.

Chapter 5 consists of six sections. Section 5.2 provides an overview of data collection, followed by data screening and cleaning in Section 5.3 which discusses in detail the testing of data normality, linearity and outliers which measure skewness and kurtosis as an indication of normal distribution, and finally, multi-colinearity that examines the inter-correlations of constructs and factors. Other than analysing the importance of multi-colinearity and normality of distribution, this chapter also addresses in detail the non-response bias by subjecting the data to the Independent Sample t-test in Section 5.4. The purpose of the test was to conform to the null hypothesis which would enable the possibility of sample generalisation to the population. Section 5.5 then discusses the procedure for data analysis followed by Section 5.6 which focuses on the descriptive analysis of respondents. This is followed by a chapter summary.

5.2 Overview of Data Collection

Survey questionnaires were distributed to 570 government officers from various ministries, departments and statutory boards inviting them to participate in this study. There were also cases where respondents expressed fear of breaching Singapore's Official Secrets Act and the inability to obtain approval from their superiors as reasons for declining to participate. The fear of being interviewed, therefore, makes survey questionnaires an appropriate method for this study because it provides anonymity.

The survey questionnaires were distributed personally to the respondents who held key positions in the public sectors. The respondents were selected based on personal contact. The investigator knew the respondents personally. This is because the investigator was an active volunteer in community activities which enabled the investigator to establish personal contact with the key respondents from various ministries, government departments and statutory bodies. Key respondents from different ministries, government department and statutory bodies address issue of bias in the response data. Initial discussion was held with the key respondents to gauge their willingness to assist the investigator in the data collection. Personal phone calls were made, emails were sent to the respondents to establish convenient meeting schedules. The key respondents became the link persons to contact suitable respondents to participate in the survey. This method to collect data is widely used in management research. With this approach, data was collected from suitable respondents who were qualified to provide information pertaining to the organisation (John & Reve, 1982; Van Bruggen et al., 2002). The mode of operation is illustrated below:



Once the schedules were confirmed, meetings were held with the respondents on the objectives of the study, types of respondents required to participate in the study. A time frame was given to the respondents which was normally two weeks. In addition, the respondents would recommend other individuals in the public sector that could assist the investigator. The investigator would call on the prospective respondents to check on the progress. Additional time was given if they require time to complete the questionnaire. The investigator would call the respondents and collect the survey questionnaire personally. The personal contact method used by the investigator enabled the survey questionnaires to be distributed and collected efficiently. This has impact on the response rate.

A total of 370 survey questionnaires were returned to the investigator. 348 survey questionnaires were found to be complete and usable for data entry and analysis. The 348 survey questionnaires represent 61% of total survey questionnaires distributed. These questionnaires were returned in two batches. In less than one month, 244 were returned and 104 survey questionnaires were returned to the investigator after one month. The data was tested for differences of opinion between the earlier and later respondents. The t-test showed that there was no difference between them. The value of t-test for equality of means is 0.116 which is above 0.05, indicating that there is no significant difference between the two groups (Pallant, 2001). The reasonably high response rate was due to the investigator having approached the right respondents.

5.3 Preparation for Data Analysis

Data screening and cleaning were conducted in several stages. The returned survey questionnaires were separated into two categories of earlier and later respondents with an identifier as mentioned in Section 5.2. The survey questionnaires were then checked for incomplete questionnaires such as those missing responses. The completed questionnaires were reviewed with the objective of increasing accuracy and precision when running the statistical analysis. This consists of screening questionnaires to identify illegible, incomplete, inconsistent or ambiguous responses (Malhotra, 2004). At this stage of the research process, all questionnaires received from the responding organisations were checked for omission, accuracy, consistency, completeness, and information quality. Respondents who had omitted an entire section, a couple of sections or a large number of questions were categorised as having incomplete questionnaires and these were discarded. As stated earlier, the items in the questionnaire consisted of close-ended 5 point scale Likert responses in which numbers of 1 to 5 were used as the response categories. Therefore, numbers were already on the questionnaire, so there was no need to use codes for the questions.

The uncompleted questionnaires were set aside. Survey questionnaires with completed responses were numbered to ensure easy detection when there are cases of missing data due to non-entry error and wrong data entry. Of the 370 survey questionnaires collected, 348 survey questionnaires were used for statistical analysis. During data cleaning, the missing value "99" was replaced with the modal value of the responses to a particular item. Extreme values have not been found in any of the completed questionnaires. Each completed questionnaire was allocated a consecutive identification number. Then the data was entered into an SPSS version 18 for Windows. After transcribing all the data to the spreadsheet, each variable was checked for consistency to identify out-of-range and extreme values due to data entry error. Data entered into the SPSS was then copied onto an Excel file to check for missing data due to non-recording and wrong data entry. The data was further screened for normality, linearity, outliers and multi-colinearity, the results of which are shown in Section 5.3.1, 5.3.2 and 5.3.3. Table 5.1 below summarises the steps taken to clean the data prior to analysis.

Table 5.1: Steps Followed for Data Preparation

No	Problems	Solutions	Results
1	Slow data collected from respondents	Check with key respondents and continuously contacting them	Respondents normally requested further extension citing working commitments. Extension given and survey questionnaires were collected
2	Data with invalid responses	The survey questionnaires are dropped.	This would affect the number of questionnaire collected and reduce the number of useable sample for data analysis.
3	Missing data	The survey questionnaires are dropped.	This affected the number of useable sample for data analysis.
4	Outliers	The respondents' survey questionnaires are dropped	The deletion of the questionnaires reduced the number of useable sample for data analysis.
5	Multi-colinearity	Correlations analysis was conducted	Results showed no evidence of multi-colinearity.
6	Non-response bias	Independent T-Test was conducted	Results showed that the null hypothesis is not violated and generalisation to population is possible.

5.3.1 Normality for Constructs and Factors

Estimation methods used in SEM assumed multivariate normality (Kline, 2005). The test for normality is used to indicate whether the data is normally distributed. Normality is used to describe a symmetrical bell-shaped curve. Normality can also be assessed by obtaining skewness and kurtosis value of +1 to -1 (Pallant, 2001). Table 5.2 indicates that all values for constructs and factors are within the requirement for skewness of +1 and -1. Hair et al., (2010) considered -3 to +3 as within range for kurtosis. However, other literature suggests that as a rule of thumb, an absolute value of kurtosis index of 10.0 may suggest a problem and a kurtosis index of 20.0 indicates a more serious problem (Kline, 2005). The data also met the requirement for kurtosis of +2 and -2. Based on the normality of the distribution of scores of Kolmogorov-Smirnov statistic, the data showed results of more than 0.05 which indicates normality (Pallant, 2001).

Table 5.2: Results for Normality of Distribution			
Constructs		**Skewness**	**Kurtosis**
IPA		.078	.047
WM		-.127	-.162
OSPP		-.172	-.158
OVALUES		-.073	-.236
ENVORIENT		-.153	-.396
OPERF		-.147	-.157
Constructs	**Factors**	**Skewness**	**Kurtosis**
IPA	ENFT	.044	-.237
	ENCONT	.042	-.182
	BIODEGT	.076	.122
	HAZARDT	-.008	-.055
WM	RLOGT	-.252	-.051
	PACKGT	-.107	-.082
	RCYCLT	-.160	-.227
OSPP	ISOT	-.181	-.022
	ECOLABLT	-.278	.110
	PRDGNT	-.335	.031
	LCYCLT	-.156	-.112
OVALUES	ENTRPNT	.092	-.164
	COMMITT	-.226	-.086
	ORGLT	-.184	.095
	INNOVNT	-.148	.066
ENVORIENT	INTELGT	-.316	-.114
	INTELDISST	-.367	.076
	RESPONST	-.220	-.153
OPERF	ENVIRONMT	-.208	-.071
	OPERNT	-.186	-.051
	FINANCLT	.000	.142
	SOCIALT	-.266	.302
n = 295			

5.3.2 Linearity and Outliers for Constructs and Factors

Linearity occurs when the value of variable X increases simultaneously with the value of Y. The rate of increase is uniform across X (Kline, 2005). The relationship between the two variables (X and Y) should be linear which means that roughly a straight line not a curve is detected (Pallant, 2001). In this study, all the constructs and factors met the requirement of linearity using the Q-Plot analysis. As for the outliers, the data was checked for outliers using the SPSS Boxplot. 348 usable survey questionnaires were further cleaned for outliers (Pallant, 2001). Finally, 295 survey questionnaires were used for analysis. There are 20 outliers in the 295 survey questionnaires. The retention of 20 outliers does not affect the normality of distribution. In fact, the data is well within the threshold level of +1 to -1 (Pallant, 2001).

5.3.3 Multi-colinearity

Multi-colinearity occurs when inter-correlations among constructs are very high. This may also indicate that the variables are measuring the same thing (Kline, 2005). A value of above 0.90 between constructs is considered as high multi-colinearity which can impact on statistical analysis (Kline, 2005; Tabachnik & Fidell, 2007). Correlation analysis was conducted to assess for multi-colinearity. Table 5.3 and Table 5.4 show the result of correlations for the constructs and sub-constructs. Values of correlations for sub-constructs are below 0.90. For the constructs, the correlation value is also below .90. Therefore, no multi-colinearity is detected for constructs and factors as identified by this study.

Table 5.3: Correlation for ALL Factors

	ENFT	ENCONT	BIODEGT	HAZARDT	RLOGT	PACKGT	RECYCLT	ISOT	ECOLABLT	PRDGNT	LCYCT	ENTRPNT	COMMITT	ORGLT	INNOVNT	INTELGT	INTELLDISST	RESPONST	ENVIRONMT	OPERNT	FINANCLT	SOCIALT
1	1																					
2	.746**	1																				
3	.625**	.728**	1																			
4	.680*	.688**	.702**	1																		
5	.649**	.710**	.713**	.724**	1																	
6	.586**	.672**	.742**	.641**	.777**	1																
7	.685**	.699**	.738**	.740**	.780**	.757**	1															
8	.630**	.670**	.667**	.694**	.705**	.722**	.712**	1														
9	.661**	.715**	.689**	.694**	.741**	.751**	.761**	.845**	1													
10	.653**	.679**	.634**	.714**	.711**	.689**	.712**	.764**	.768**	1												
11	.527**	.618**	.629**	.583**	.644**	.672**	.674**	.668**	.691**	.680**	1											
12	.593**	.680**	.682**	.661**	.710**	.722**	.718**	.706**	.739**	.787**	.692**	1										
13	.619**	.616**	.645**	.666**	.659**	.719**	.685**	.683**	.649**	.764**	.602**	.798**	1									
14	.610**	.645**	.702**	.664**	.671**	.736**	.732**	.694**	.713**	.706**	.681**	.799**	.806**	1								
15	.522**	.609**	.652**	.565**	.628**	.713**	.663**	.639**	.644**	.668**	.659**	.773**	.780**	.802**	1							
16	.447**	.550**	.578**	.486**	.574**	.599**	.612**	.580**	.591**	.557**	.686**	.634**	.581**	.711**	.705**	1						
17	.427**	.540**	.540**	.430**	.526**	.561**	.519**	.520**	.523**	.512**	.687**	.600**	.552**	.636**	.665**	.826**	1					
18	.534**	.656**	.637**	.560**	.633**	.671**	.653**	.626**	.657**	.670**	.691**	.765**	.708**	.740**	.712**	.709**	.728**	1				
19	.581**	.630**	.634**	.623**	.664**	.656**	.676**	.639**	.657**	.680**	.605**	.717**	.696**	.643**	.655**	.563**	.569**	.742**	1			
20	.549**	.662**	.670**	.583**	.691**	.730**	.697**	.677**	.684**	.664**	.682**	.742**	.673**	.754**	.678**	.635**	.637**	.781**	.735**	1		
21	.514**	.581**	.584**	.550**	.626**	.666**	.598**	.638**	.684**	.685**	.653**	.728**	.681**	.683**	.684**	.540**	.559**	.703**	.759**	.752**	1	
22	.614**	.584**	.531**	.632**	.604**	.562**	.617**	.592**	.610**	.648**	.527**	.641**	.646**	.592**	.575**	.486**	.468**	.627**	.716**	.631**	.652**	1

Pearson Correlation

**. Correlation is significant at the 0.01 level.

Table 5.4: Correlation for ALL Constructs						
	IPA	**WM**	**OSPP**	**OVALUES**	**ENVORIENT**	**OPERF**
IPA	1					
WM	.857**	1				
OSPP	.832**	.859**	1			
OVALUES	.784**	.823**	.836**	1		
ENVORIENT	.656**	.702**	.737**	.786**	1	
OPERF	.769**	.800**	.817**	.831**	.752**	1

** Significant at 0.01

5.4 Non-Response Bias

The objective of knowing the extent of non-response bias is to ensure generalisation from the sample to the population. Non-response occurs when selected respondents or organisations do not respond to the survey questions (Dillman, 1991). One of the most significant problems that arise with mail surveys is that of non-response error. This occurs when a large proportion of the sample does not respond to the survey, causing a low response rate (Malhotra, 2004). The general assumption is that the higher the response rate, the lower is the potential of non-response error and, therefore, the better the survey. A low response rate, however, does not necessarily mean a non-response error, i.e. a discrepancy between the frequency of a population characteristic and that estimated by the survey that arises because some people do not respond (Moorman & Podsakoff, 1992).

The extrapolation procedure suggested by Armstrong & Overton (1977) was used to assess non-response bias. In the first stage, 244 respondents were classified as "early"; that is, they returned survey questionnaires in less than a month and the next 104 respondents as "late"; that is, they returned the survey questionnaires after one month.

At this stage, the data is not cleaned in terms of outliers. An initial run SPSS version 18 for independent-sample t-Test was conducted for the 348 survey questionnaires. It showed that no significant difference was found between the scores of earlier respondents (n = 244) and later respondents (n = 104) on the study constructs. A score of 0.116 was recorded, which is above the minimum of 0.05 and the value of Eta(η) squared is 0.009 which is in accordance with Cohen's specification on the effect of the two groups (Pallant, 2001). The result showed that there was no significant difference in scores between the earlier and later respondents as the Eta(η) of 0.009 is considered to have a very small effect (Pallant, 2001).

During the second stage of data preparation, the data is further subjected to a check for normality of distribution using Q-Plot and Boxplots for outliers before proceeding to the Exploratory Factor Analysis (EFA). An independent-sample t-test was again conducted for the valid 295 respondents. The result for the t-test was 0.68 (which is above the recommended value of 0.05) and the Eta (η) was 0.001 (Pallant, 2001). Therefore, the non-response bias is not a problem in this study. An independent t-test was also conducted on the four constructs. An independent sample t-test for non-response bias was also conducted for the earlier and later respondents for each construct. The results, as shown in Table 5.5, are based on the t-test of above 0.05, indicating that the non-response bias was not violated (Pallant, 2001).

Table 5.5: Independent Sample t-test for Non-Response Bias				
Construct	**t**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**
IPA	0.324	0.75	0.5563	1.715
WM	1.90	0.06	2.282	1.199
OSPP	0.521	0.60	0.8140	1.562
OVALUES	1.123	0.26	2.0778	1.849
ENVORIENT	0.971	0.013	3.0363	1.210
OPERF	1.409	0.160	1.9556	1.388

5.5 Data Analysis Procedures

There are a number of objectives to achieve during the process of data analysis. Apart from obtaining an initial feel and understanding of the nature of the data, the process of data analysis allows for the possibility of data reduction, testing the goodness of the data and transforming the data into meaningful and understandable information (Cavana et al., 2001). Table 5.6 shows the steps and the statistical technique used to prepare the data for SEM. The data analysis procedure ranged from simple descriptive analysis, frequency and normality of distribution, correlations, reliability and factor analysis to more sophisticated and advanced SEM. All items measuring the constructs were subjected to both exploratory (EFA) and confirmatory factor analysis (CFA) (Blunch, 2008; Hair et al., 2010; Kline, 2005). A detailed discussion of EFA and CFA is presented in Chapter 6.

Table 5.6: Statistical techniques used in the study	
Objectives	**Statistical techniques used**
To test non-response bias	Independent Sample t-test
To test normality of distribution	Skewness, Kurtosis and Boxplot
To describe characteristics of respondents	Descriptive Analysis
To measure internal consistency of items	Reliability test
To measure internal consistency of constructs and factors	Reliability test
To examine the multi-colinearity between all constructs	Pearson Correlations
To examine components of factors	Exploratory Factor Analysis
To validate the measurement model constructs and factors	Confirmatory Factor Analysis, Goodness of Fit and Average Value Extracted
To validate the environment-oriented government procurement model	Structural Equation Analysis

5.6 Demography of Respondents

This section outlines some of the characteristics of the government officials who participated in the study. The data is derived from government institutions. The names of the participating officials and the ministries, department and statutory bodies are not mentioned due to the confidentiality agreement to protect their identities. Table 5.7 to 5.9 summarises the characteristics of the respondents. Table 5.10 shows the size of the public organisations in relation to their number of employees.

In terms of position, 15 % of the respondents were in senior positions in the government sector, 25% of the respondents came from the mid-level management such as Divisional Managers, Senior Managers and Managers and 60% held the rank of executive officers such as Assistant Managers, Senior/Higher Executive Officers and Executive Officers shown in Table 5.7. Table 5.8 shows that 46.8% of the respondents were university graduates with basic degrees or post-graduate qualifications. Nearly 40% of the respondents had diplomas or higher diplomas while 15.3% had completed secondary and post-secondary education. Table 5.9 summarises gender distribution where 67.8% are males and 32.2% are female.

Table 5.10 summarises the size of the respondents' organisations. 33.9% of the respondents came from organisations that had more than 1000 employees, 7.1% of the respondents were from organisations with 500 - 999 employees, 24.7% came from organisations that had 200 - 499 employees and 34.3% came from organisations with 199 or fewer employees. The number of employees in the government sector varies depending on the types of ministries, statutory boards and government departments.

Table 5.7: Positions of Respondents (n=295)		
Respondents' Position	**Number of Respondents**	**% of Respondents**
Senior Level Government Officers (Directors, Deputy Directors, Head of Department and Deputy Heads)	44	15
Managerial Level Government Officers (Divisional Managers, Senior Managers and Managers)	74	25
Executive Level Government Officers (Assistant Managers, Senior/Higher Executive Officers and Executive Officers)	177	60
Total	295	100%

Table 5.8: Distribution of level of education of respondents (n=295)		
Respondents' Education	**Number of Respondents**	**% of Respondents**
Bachelor Degree/Postgraduate	138	46.8
Diploma/Higher Diploma	112	37.9
Secondary/Post-Secondary	45	15.3
Total	295	100%

Table 5.9: Distribution of Respondents by Gender		
Gender	**Number of respondents**	**Per cent**
Male	200	67.8
Female	95	32.2
Total	295	100%

Table 5.10: Distribution of number of employees in organisations		
No. of employees in organisations	**No of respondents**	**Per cent**
More than 1000 employees	100	33.9
500-999 employees	21	7.1
200 – 499 employees	73	24.7
199 employees and less	101	34.3
Total	295	100%

5.7 Descriptive Data Analysis

SPSS version 18 was used to provide the statistical analysis of mean and standard deviation of responses collected from the respondents. Table 5.11 shows the mean and standard deviation of responses. A five-point Likert scale was used to measure the degree of agreement on items constructed to measure environmental orientation. The scale ranges are: 1 - Strongly Disagree, 2 – Disagree, 3 - Neither Disagree nor Agree, 4 – Agree and 5 - Strongly Agree.

The mean values of factors used to measure the construct of Integrated Product Attributes (IPA) ranged a Mean ($\bar{x}$) from 4.096 for Biodegradability (BIODEGT) to 4.932 for Non-Hazardous Material (HAZARDT) and standard deviation (s) range between 0.7348 for Energy Conservation (ENCONT) and 0.8608 for Non-Hazardous Material (HAZARDT). This could be interpreted as the respondents agreeing that products are energy efficient and energy conserving, biodegradable and non-hazardous are those with the preferred attributes to be incorporated into the procurement process.

On Waste Management, the descriptive analysis indicated a preference for sustainable products which have the following attributes: the ability to be returned to the suppliers/manufacture (reverse logistics), packaging materials to packaged products are reusable and recyclability such as paper. Responses for Waste Management (WM) showed that the mean ($\bar{x}$) value ranges between 3.369 for Packaging (PACKGT) and 4.487 for Recycling (RECYCLT). The standard deviation (s) for Waste Management (WM) ranges between 0.5774 for Reverse logistics (RLOGT) and 0.8449 for Recycling (RECYCLT).

Organisational Systems, Processes and Policies (OSPP) shows a mean value (x̄) ranges between 3.336 for Life Cycle Analysis (LCYCT) and 4.091 for Product Design (PRDGNT). While the standard deviation (s) for OSPP ranges between 0.6570 for Life Cycle Analysis (LCYCT) and 0.7160 for Product Design (PRDGNT). This indicates that respondents agreed on the importance of eco-labelling, ISO 14001, labelling, product design and life cycle analysis as practices of sustainable procurement in public organisations.

Responses on Organisational Values (OVALUES) also reveal the value that respondents placed on the key ingredients of entrepreneurship, commitment, organisational learning and innovation that could influence public organisations to adopt sustainable practices in their procurement process. The mean value for Organisational Values (OVALUES) ranges between 4.1553 for Organisational Learning (ORGLT) and Innovation (INNOVNT) and 4.932 for Commitment (COMMITT). The standard deviation ranges between 0.7448 for Entrepreneurship (ENTRPNT) and 0.8618 for Commitment (COMMITT).

Descriptive statistical analysis reveals that the combination of these elements has an effect on the level of environmental orientation of public organisations. Intelligence gathering, intelligence dissemination and responsiveness are used to measure the Environmental Orientation (ENVORIENT). The results showed a mean values from 3.263 for Intelligence gathering (INTELGT) to 3.429 for Responsiveness (RESPONST). The standard deviation (s) ranges between 0.6557 for Responsiveness (RESPONST) and 0.7468 for Intelligence dissemination (INTELDISS). The responses, apart from indicating preference for sustainable product, also suggested that procurement officers are also required to have the necessary skills to acquire information of sustainable products which is disseminated to other government institutions. Turning to Organisational Performance (OPERF), the results also showed that the respondents agreed that the environment, operational, financial and social indicators could be used as acceptable indicators to measure performance. The mean value ($\overline{x}$) for OPERF ranges between 3.496 for Financial (FINANCLT) and 4.272 for Social (SOCIALT). The standard deviation (s) for OPERF ranges between 0.5687 for Financial (FINANCLT) and 0.7255 for Operational (OPERNT).

In analysing the data based on Mean ($\overline{x}$) for factors, it was found that HAZARDT has the highest ($\overline{x}$) value of 4.9 and the lowest ($\overline{x}$) is INTELGT with a value of 3.321. In terms of the value global ($\overline{x}$), there is a preference for IPA with a ($\overline{x}$) value of 4.325 followed by Waste Management (WM), Organisations Systems, Processes and Policies (OSPP) and Organisational Values (OVALUES). Turning the analysis to standard deviation (s), there is a preference for ENFT, ENCONT and BIODEGT with (s) within the range of 0.73 to 0.76 compared to HAZARDT –with a value of 0.8608. For WM, RECYCLT showed a value of 0.845 implying that it is not as preferred as other factors: RLOGT and RPACK with a value ranging from 0.58 to 0.66. The standard deviation (s) for factors for OSPP shows that ISOT, ECOLABLT, PRDGNT and LCYCT recorded a value of 0.70, 0.68, 0.72 and 0.66 respectively. For OVALUES, COMMITT is least preferred with (s) at 0.86 compared ENTRPNT, ORGLT and INNOVNT with values of 0.74, 0.76 and 0.77 respectively.

Table 5.11: Mean and Standard Deviation (n=295)			
Constructs	**Factors**	**Mean ($\overline{x}$)**	**Standard Deviation (s)**
IPA	ENFT	4.138	0.7673
	ENCONT	4.132	0.7348
	BIODEGT	4.096	0.7408
	HAZARDT	4.932	0.8608
	Global Mean	4.325	
WM	RLOGT	3.412	0.5774
	PACKGT	3.369	0.6585
	RECYCLT	4.847	0.8449
	Global Mean	3.876	
OSPP	ISOT	3.377	0.6964
	ECOLABLT	3.359	0.7013
	PRDGNT	4.091	0.7159
	LCYCT	3.336	0.6570
	Global Mean	3.540	
OVALUES	ENTRPNT	4.163	0.7448
	COMMITT	4.932	0.8618
	ORGLT	4.155	0.7555
	INNOVNT	4.155	0.7673
	Global Mean	4.351	
ENVORIENT	INTELGT	3.263	0.7194
	INTELLDISST	3.2700	0.7468
	RESPONST	3.429	0.6557
	Global Mean	3.321	
OPERF	ENVIRONMNT	3.567	0.5798
	OPERNT	4.135	0.7255
	FINANCLT	3.496	0.5688
	SOCIALT	4.272	0.6320
	Global Mean	3.867	

5.8 Summary

Chapter 5 focuses on the examination of data derived from survey questionnaires collected from government officers who agreed to participate in the survey. A number of steps were taken to ensure that the data was prepared in accordance with statistical requirements supported by the literature. Table 5.1 shows the various steps undertaken to ensure that the data collected are useable and reliable for further analysis. The data was subjected to statistical tests to ensure conformity with normality of distribution, non-response bias and multi-colinearity of constructs and factors. The statistical test was performed in accordance with the literature on quantitative analysis.

CHAPTER SIX

INSTRUMENT VALIDATION AND MEASUREMENT MODEL

6.1 Introduction

This chapter presents the instrument development process that satisfies the requirements of reliability, validity and uni-dimensionality. Churchill (1979) recommended several measures to achieve good reliability and reduce measurement errors in instruments that include the specification of constructs, generation of survey items, purifying the measures and reassessing the validity and reliability of the items used. This chapter is divided into seven sections. Section 6.2 focuses on the reliability analysis of items measurement as shown by Cronbach alpha (α). Section 6.3 describes the sampling adequacy of the items scales used in the questionnaire which are well-grounded in the literature review. Section 6.4 provides an overview of the content, construct, convergent validity and uni-dimensionality as recommended by literature (Fornell & Larker; 1981; Hair et al., 2010). It also presents a detailed discussion of the reliability and validity of the constructs. Section 6.5 provides detailed discussion on the reliability of constructs and factors through explanatory factor analysis (EFA) I and II. EFA I was conducted to look for a way that the data may be reduced using a smaller set of factors (Pallant, 2001). EFA II was conducted to group the factor as recommended by the EFA I where some items which are cross-loaded and have the values of lower than 0.5 were to be deleted (Pallant, 2001). The reliability analysis conducted for EFA II is critical because the results of this analysis formed the basis for confirmatory factor (CFA) analysis before conducting the structural equation modelling (SEM). Section 6.6 discusses the preparation for SEM and goodness-of-fit measurements as recommended by the literature followed by chapter summary.

Table 6.1: Reliability of Items Measurement				
Items	**No of Items**	**Factors**	**Cronbach alpha (α)**	**Standardised Cronbach alpha(α)**
A1-A6	6	ENFT	0.874	0.874
B1-B6	6	ENCONT	0.871	0.872
C1-C6	6	BIODEGT	0.871	0.872
D1-D7	7	HAZARDT	0.912	0.913
E1-E5	5	RLOGT	0.845	0.847
F1-F5	5	PACKGT	0.888	0.888
G1-G7	7	RECYCLT	0.889	0.888
H1-H5	5	ISOT	0.899	0.901
I1-I5	5	ECOLABLT	0.899	0.900
J1-J6	6	PRDGNT	0.876	0.876
K1-K5	5	LCYCT	0.895	0.895
L1-L6	6	ENTRPNT	0.861	0.863
M1-M8	8	COMMITT	0.888	0.889
N1-N6	6	ORGLT	0.870	0.874
O1-O6	6	INNOVNT	0.873	0.873
P1 – P5	5	INTELGT	0.894	0.894
Q1- Q5	5	INTELDISST	0.900	0.900
R1-R5	5	RESPONST	0.879	0.880
S1-S5	5	ENVIRONMT	0.815	0.815
T1-T6	6	OPERNT	0.888	0.888
U1-U5	5	FINANCLT	0.799	0.800
V1-V6	6	SOCIALT	0.833	0.833
n= 295				

6.2 Reliability Analysis of Items Measurement

A reliability test was conducted to evaluate the reliability of factors. Tables 6.1 and 6.2 show the results of reliability analysis for item measurement and factors respectively. The instrument measurement of validity and reliability of this study is based on Anderson and Gerbing (1988)'s guidelines on content and construct validity. Steps are also taken in the research design to ensure the validity of the quantitative research. Reliability, on the other hand, deals with how consistent similar measures will produce similar results

(Neuman, 2003). Zhu et al., (2008b) argued that the correlations of all factors with the performance measures are all significant. This implies that the test results provide evidence of criteria validity. The results showed that all factors range between 0.799 and 0.912 for Cronbach alpha. For standardised Cronbach alpha, the value ranged between 0.800 and 0.913. These values are above the accepted value of 0.70 (Pallant, 2001). Based on the value of standardised Cronbach alpha of above 0.800, the reliability measurement showed a high degree of internal consistency (Pallant, 2001).

Table 6.2: Reliability Analysis for factors (n=295)

Construct	Factors	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach alpha (α) if Item Deleted	Composite Reliability (CR)
IPA	ENFT	0.762	0.609	0.875	0.793
	ENCONT	0.814	0.678	0.857	0.642
	BIODEGT	0.765	0.608	0.874	0.760
	HAZARDT	0.772	0.600	0.874	0.897
WM	RLOGT	0.830	0.690	0.846	0.614
	PACKGT	0.809	0.661	0.842	0.765
	RECYCLT	0.814	0.666	0.870	0.864
OSPP	ISOT	0.845	0.750	0.882	0.763
	ECOLABLT	0.858	0.762	0.877	0.730
	PRDGNT	0.813	0.663	0.893	0.759
	LCYCT	0.732	0.539	0.919	0.779
OVALUES	ENTRPNT	0.851	0.724	0.916	0.745
	COMMITT	0.856	0.734	0.919	0.892
	ORGLT	0.867	0.752	0.910	0.759
	INNOVNT	0.842	0.712	0.917	0.774
ENVORIENT	INTELGT	0.830	0.708	0.838	0.763
	INTELLDISST	0.843	0.723	0.828	0.763
	RESPONST	0.752	0.566	0.905	0.763
OPERF	ENVIRONMT	0.830	0.692	0.857	0.635
	OPERNT	0.784	0.635	0.878	0.826
	FINANCLT	0.809	0.667	0.866	0.643
	SOCIALT	0.727	0.549	0.892	0.759

Five-point Likert scale

Table 6.2 shows the results of reliability analysis when items are deleted. The Cronbach alpha (α) is above 0.8 which indicated good internal consistency. The sum of squared multiple correlation is above 0.5 (Hair et al., 2010). The composite reliability (CR) was calculated and the values of CR for most factors are above 0.7 except for ENCONT, RLOGT, ENVIRONMNT and FINANCLT which are close to 0.7 (Hair et al., 2006).

6.3 Sampling Adequacy of Item Scale for Questionnaire

Sampling adequacy is one of several important considerations to ensure that the data that is prepared meets the requirements for a statistical test. It provides a basis for the estimation of sampling error. Table 6.3 shows the sampling adequacy based on the Kaiser-Meyer-Olkin (KMO) index for item measurement and constructs. A KMO value of 0.80 and above is considered good, 0.70 as average, 0.60 as mediocre, 0.50 as poor and below 0.50 as unacceptable (Pallant, 2001).

The KMO values ranged between 0.90 and 0.957 and are well above the accepted values. The values of the KMO index range from 0 to 1, with 0.80 or above being considered good, 0.70 as average, 0.60 to 0.69 as mediocre, 0.50 to 0.59 as poor and below 0.50 as unacceptable (Pallant, 2001). Based on the values of KMO index, constructs of this study have met the conditions for test of factors analysis with scores of above 0.90 (Pallant, 2001).

Table 6.3: Sampling Adequacy of Constructs (KMO), n=295		
Factors	**Constructs**	**KMO**
ENFT	IPA	0.948
ENCONT		
BIODEGT		
HAZARDT		
RLOGT	WM	0.900
PACKGT		
RECYCLT		
ISOT	OSPP	0.953
ECOLABLT		
PRDGNT		
LCYCT		
ENTRPNT	OVALUES	0.957
COMMITT		
ORGLT		
INNOVNT		
INTELGT	ENVORIENT	0.951
INTELLDISST		
RESPONST		
ENVIRONMT	OPERF	0.946
OPERNT		
FINANCLT		
SOCIALT		

6.4 Validity and Reliability of Constructs

A construct is a theoretical concept used to define a variable. Constructs are intended to investigate the relationship between critical factors that influence environment-oriented government procurement. After reviewing the literature and conducting the pre-test with industry experts and academics, the initial constructs to be investigated were determined. As discussed in Chapter 3, Section 3.5. The constructs to be investigated that are postulated to have relationships with environmentally-oriented government procurement are:

- Integrated Product Attributes (IPA)
- Waste Management (WM)
- Organisational Systems, Processes and Policies (OSPP)
- Organisational Values (OVALUES)

6.4.1 Content Validity

There is constant debate about the issue of content validity. Research in social sciences, especially in the areas of business and management, argues that measurement instruments used must be content-valid. Content validity refers to the extent to which an empirical measurement reflects a specific domain of the content (Churchill, 1979; Hair et al., 2010). Sireci (1998) argued that the content validity refers to the credibility, the soundness of the assessment instrument in measuring the construct. Content validity, which may be subjective and judgemental, encourages the investigator to ensure that the instruments used are representative and that appropriate methods are used in the construction of the scale. Lennon (1956), on the other hand, argued that content validity should be meaningful and definable responses matched to the sample whereby a conclusion can be drawn in a useful and meaningful manner.

In this study, prior to data collection, the content validity of the instrument was established by strongly grounding it in existing literature. The measurement instrument was pre-tested by a panel of experts involved in the areas of procurement, logistics and operations from public organisations. Dillman (1978) suggested that experts be asked to review the questionnaire for structure, readability, ambiguity and completeness. The final survey instrument incorporated minor changes to remove a few ambiguities as discussed in Section 4.4 to Section 4.5.3. These tests indicated that the final measurement instrument before the full scale study represented the content of validity of environment-oriented procurement factors.

6.4.2 Construct Validity

Construct validity is a measure whereby the items in a scale measure the construct and the measurement is meaningful (Churchill, 1979; Litwin, 1995). Construct validity comprises convergent validity and discriminant validity. Construct validity refers to three related issues: uni-dimensionality, convergent validity, and discriminant validity (Hair et al., 2006). Uni-dimensionality is the degree to which a set of items that form an instrument measure an underlying construct (Hair et al., 2006). Each critical factor of the research constructs is evaluated by factor-analysing the measurement instruments using Cronbach alpha (α) reliability tests. According to Churchill (1979), the coefficient or Cronbach alpha (α) should be the first measure used to assess the quality of an instrument. A cut-off point of $\alpha = 0.7$, as suggested by Nunnally & Bernstein (1994), was used as a reasonable indicator of fit.

The focus of testing construct validity ensures that item loads significantly on the factor it measures, also known as convergent validity, but also discriminant validity. Convergent validity means that theoretically similar or overlapping constructs are strongly interrelated. Discriminant validity, on the other hand, shows that theoretically distinct constructs are not highly inter-correlated (Brown, 2006). Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) are used to assess convergent and discriminant validity (Blunch, 2008; Chen & Paulraj, 2004). Brown (2006) argued that CFA provides a stronger analytical framework because of measurement error in determining the convergent and discriminant validity of a construct.

6.4.3 Convergent and Discriminant Validity

Convergent validity refers to the extent to which multiple attempts to measure the same concept with different methods are in agreement, whereas discriminant validity is the degree to which a concept differs from other concepts (Hair et al., 2006). To establish convergent and discriminant validity, multi-factor analyses were conducted. Convergent and discriminant validity are discussed in Chapter 7.

6.4.4 Uni-dimensionality of Constructs

Uni-dimensionality refers to the existence of a construct underlying a set of measures (Hattie, 1985). Joreskog (1971) refers to it as a congeneric measurement. An assessment of uni-dimensionality would determine whether or not a set of indicators reflect one, as opposed to more than one, underlying factor (Gerbing & Anderson, 1988). Uni-dimensionality is established when an empirical item is significantly associated with the empirical representation of a construct and which is associated with one construct (Anderson & Gerbing; Hair et al., 2010). A measure must satisfy both of these conditions in order to be considered uni-dimensional. The lack of uni-dimensionality, a form of measurement error, attenuates correlation and standard error (Garson, 2012). Cronbach alpha is used to test uni-dimensionality. In this study, uni-dimensionality was initially established using the value of 0.7 as recommended by literature (Hair et al., 2006; Garson, 2012)

6.4.5 Reliability of Items Measurements

Reliability was operationalised using the internal consistency method that is estimated using Cronbach alpha (α), which considers a reliability coefficient of 0.7 or higher as adequate (Cronbach, 1951; Nunnally, 1978). The reliability of item measurement was drawn heavily from literature. This is to ensure that items generation and construction for the survey questionnaires are well-grounded. A step-by-step process of instrument validation is undertaken in order to develop new multi-item scales with good reliability and validity. The instrument development process usually includes three overall steps: item creation, scale development and instrument testing (Moore & Benbasat, 1991). Instrument validation is conducted in the following stages: pre-testing the instruments thus ensuring its construct validity and also to validate for reliability. This is to be followed by pilot test of reliability and construct validity and finally conducting the full-scale study.

The theoretical framework in Chapter 3 shows six constructs where four are independent and two are dependent constructs. These constructs are operationalised using multi-item measurement scales. These scales have been used in previous studies where they obtained Cronbach alpha (α) values of above 0.7 to ensure a high degree of internal consistency (Cronbach, 1951; Nunnally, 1978). Results of the initial run using SPSS Version 18 as shown in Table 6.1 indicated the overall reliability coefficient for item measurements for each item. Cronbach alpha (α) is regarded as a lower bound estimate of internal reliability. The coefficient appeared to satisfy suggested minimum criterion of $\alpha = 0.70$ (Nunnally, 1978). At this stage, there is no necessity to delete any item in order to improve the Cronbach alpha (α).

6.5 Determining Reliability Through Exploratory Factor Analysis (EFA)

Reliability analysis indicates the internal consistency of a measurement instrument. A Cronbach alpha (α) is computed for each of the factors to determine the extent of reliability. An alpha value of 0.5 to 0.6 is sufficient for exploratory research, but 0.7 or higher is obviously more desirable (Nunnally, 1978). During a statistical run to evaluate reliability, if a factor does not exhibit acceptable reliability, then items are dropped from the factor based on the magnitude of the item loadings to improve reliability. The process is repeated to achieve an acceptable alpha value of each factor observed.

6.5.1 Overview of Exploratory Factor Analysis

Two types of FA are conducted – exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The major goal of EFA is to identify a minimum number of common factors required to reproduce the initial correlation or covariance matrix (Ferguson & Cox, 1993). In this analysis, the relationships are represented by factor loadings.

Exploratory Factor Analysis (EFA) is a tool to assess factors that underlie a set of variables by allowing all the loadings to freely vary. The goal of exploratory factor analysis (EFA) is to describe and summarise data by grouping together variables that are correlated. EFA is also frequently used to assess which items should be grouped together or deleted to form a scale. It is also used to examine and identify the minimal number of factors among the observed variables (Bryne, 2001). The identified factors from the exploratory factor analysis are the starting point for the confirmatory analysis (CFA) which is discussed in Section 6.6.

6.5.2 Exploratory Factor Analysis I: Initial Results

EFA was performed using principal component extraction and varimax rotation. The varimax criterion does not simplify the column for the factor matrix; it also maximizes the sum of variances of required loadings of the factor matrix that is possible and gives a clearer separation of factors (Hair et al., 2010). This suggests that the loadings indicate a simple structure which is in accordance with the factor structure that has been proposed. The investigator used SPSS version 18, with principal component extraction technique and setting criteria of varimax rotation, eigen-values greater than 1 and factor loading greater than 0.5 (Hair et al., 2010) to identify factor loadings for factors of Integrated Product Attributes (IPA), Waste Management (WM), Organisational Systems, Processes and Policies (OSPP), Organisational Values (OVALUES), Environmental Orientation (ENVORIENT) and Organisational Performance (OPERF). Table 6.4 to Table 6.9 tabulate the initial exploratory factor analysis for all constructs and factors.

Integrated Product Attributes (IPA) which initially was considered to have four factors – Energy Efficiency (ENFT), Energy Conservation (ENCONT), Biodegradability (BIODEGT) and Non-Hazardous Materials (HAZARDT) were shown to have three factors (Table 6.4). The factor analysis also showed cross loaded items B1, B2, C3 and C6. Table 6.5, Waste Management (WM) was originally constructed to have three factors: Reverse Logistics (RLOGT), Packaging (PACKGT) and Recycling (RECYCLT). Factor analysis shows that WM has two factors (Table 6.5). Results for Organisational Systems, Processes and Policies (OSPP) showed a factor reduction from four to two where ISO 14001, Eco-Label and Product Design are revealed to be one factor and the other is Life Cycle Analysis (LCYCT). There are no cross-loaded items for OSPP (Table 6.6). The factor analysis for Organisational Values (OVALUES) which originally had four factors:

Entrepreneurship (ENTRPNT), Commitment (COMMIT), Organisational Learning (ORGLT) and Innovation (INNOVT) showed two factors. There are two cross-loaded items: M8 and N2 (Table 6.7). On Environmental Orientation (ENVORIENT) which initially has three factors, factor analysis showed two factors where Intelligence Gathering (INTELGT) and Intelligence Dissemination (INTELLDISST) were indicated to form one factor. The other factor is Responsiveness (RESPONST). There is no cross-loaded item for ENVORIENT (Table 6.8). Organisational Performance (OPERF) is operationalised with four factors: Environment, Operational, Financial and Social. After conducting the factor analysis, the results showed that Organisational Performance (OPERF) is comprised of three factors. There is one cross loaded item V5 (Table 6.9).

Table 6.4: Results of EFA I-IPA						
Construct		Items	Item Descriptions	Factors		
				1	2	3
IPA	ENFT	A1	Our organisation buys products and equipment from suppliers that declared products are energy efficient.		0.708	
		A2	Our organisation buys only products that have energy efficiency labels.		0.764	
		A3	Our organisation provides guidelines on energy efficiency for suppliers to tender for electronic and electrical equipment.		0.701	
		A4	Our organisation buys products that are energy efficient.		0.697	
		A5	Our organisation buys from suppliers who are at least Green Mark certified which is the minimum level of energy efficiency.		0.627	
		A6	Our organisation sets minimum energy performance standards for various types of equipment purchased.		0.573	
	ENCONT	B1	Our organisation buys from suppliers who have a policy blueprint for energy conservation.		0.495	0.499
		B2	Our organisation procures products manufactured using renewable energy.		0.516	0.599
		B3	Our organisation buys from suppliers who implement energy conservation programmes.			0.524
		B4	Our organisation purchases from suppliers who provide training on eco-office practices to conserve energy.			0.564
		B5	Our organisation buys from suppliers that implement energy conservation initiatives.		0.542	
		B6	Our organisation buys equipment that conserves energy.	0.390		
	BIODEGT	C1	Our organisation has set minimum biodegradability standard for products purchased.			0.690
		C2	Our organisation buys products that are biodegradable.			0.587
		C3	Our organisation buys from suppliers whose products adhere to international biodegradability standards.	0.484		0.614
		C4	Our organisation buys from suppliers who use biodegradable packaging materials.			0.730
		C5	Our organisation buys from suppliers who have policy that products sold are biodegradable.			0.694
		C6	Our organisation buys products that do not harm the environment.	0.514		0.486
	HAZARDT	D1	Our organisation buys from suppliers who have a policy to systematically separate dangerous wastes.	0.695		
		D2	Our organisation buys from suppliers who understand the impact of hazardous materials on the environment.	0.768		
		D3	Our organisation buys from suppliers who implement adequate policy to manage hazardous waste.	0.673		
		D4	Our organisation has a policy to reject products from suppliers if they contain hazardous elements.	0.671		
		D5	Our organisation buys from suppliers who implement stringent control for the disposal of hazardous materials.	0.701		
		D6	Our organisation buys from suppliers who dispose of hazardous waste through environmentally safe methods.	0.774		
		D7	Our organisation buys products that are properly labelled and packed when they contain hazardous materials.	0.662		
n =295						

Table 6.5: Results of EFA I-WM						
Construct		**Items**	**Item Descriptions**	**Factors**		
				1	**2**	**3**
WM	RLOGT	E1	Our organisation considers reverse logistics that comply with environmental regulations.	0.512	0.494	
		E2	Our organisation prefers to award tenders to suppliers who have a return management policy.	0.569		
		E3	Our organisation views suppliers favourably when they implement reverse logistics.	0.514	0.529	
		E4	Our organisation generates less waste when buying products from suppliers who implement reverse logistics.	0.658		
		E5	Our organisation has a policy to buy from suppliers that implement reverse logistics.	0.558	0.496	
	PACKGT	F1	Our organisation has a policy that the packaging of products purchased should be manufactured from reusable materials.	0.710		
		F2	Our organisation has policy to buy products from suppliers who take back packaging materials.	0.865		
		F3	Our organisation prefers to buy from suppliers who signed the Singapore Packaging Agreement.	0.650		
		F4	Our organisation purchases products that use minimum packaging.	0.794		
		F5	Our organisation buys from suppliers that provide green packaging.	0.634		
	RECYCLT	G1	Our organisation buys from suppliers who have a blueprint to increase their recycling rate.		0.711	
		G2	Our organisation buys from suppliers who have a policy on buy- back programmes.	0.553	0.499	
		G2	Our organisation promotes programmes of reduce, re-use and recycle at all levels in the organisation.		0.611	
		G4	Our organisation buys from suppliers who have guidelines to systematically separate different types of recyclable wastes.		0.754	
		G5	Our organisation buys from suppliers who provide labelled containers for different types of recyclable wastes.		0.740	
		G6	Our organisation buys from suppliers who have a long-term objective to promote recycling as a policy, thereby reducing the use of landfill and incinerators.		0.756	
		G7	Our organisation buys from suppliers with an appropriate policy that recycled products are to be used.		0.649	
n = 295						

Table 6.6: Results of EFA I-OSPP						
Construct		**Items**	**Item Descriptions**	**Factors**		
				1	**2**	**3**
OSPP	ISOT	H1	Our organisation prefers to purchase products from suppliers who are certified with ISO 14001.	0.703		
		H2	Our organisation considers suppliers who have ISO 14001 as adhering to environmental regulations.	0.800		
		H3	Our organisation considers suppliers who use of ISO 14001 as committed to environment.	0.757		
		H4	Our organisation uses ISO 14001 to conduct suppliers' selection criteria at every stage of procurement process.	0.703		
		H5	Our organisation requires suppliers to be certified with ISO 14001 to pre-qualify them.	0.721		
	ECOLABLT	I1	Our organisation procures products that are clearly labelled according to their environmental performance standards.	0.712		
		I2	Our organisation procures products that are environmentally labelled.	0.742		
		I3	Our organisation ensures eco-labels of products purchased are certified by country of origin.	0.744		
		I4	Our organisation purchases products that are independently certified on their environmental performance.	0.640		
		I5	Our organisation considers that products with eco-labels have achieved the required environmental standards.	.752		
	PRDGNT	JI	Our organisation buys products that are designed either for re-use, recyclable, or recovery of materials and components.	0.619		
		J2	Our organisation participates in the design of products for recycling and re-use.	0.538		
		J3	Our organisation constantly sources products that are made from sustainable and renewable resources.	0.609		
		J4	Our organisation considers buying products that are designed to reduce resource consumption and waste generation.	0.688		
		J5	Our organisation considers buying products that are designed to avoid or reduce the use of hazardous materials in the manufacturing process.	0.591		
		J6	Our organisation has appropriate guidelines for purchasing products that are designed to eliminate any potential environmental problems.	0.668		
	LCYCT	K1	Our organisation buys products from suppliers that use life cycle analysis.		0.752	
		K2	Our organisation buys products from suppliers who consider the use of LCA as not incurring additional costs.		0.817	
		K3	Our organisation buys from suppliers who provide LCA Report.		0.813	
		K4	Our organisation performs environmental performance evaluation of suppliers.		0.732	
		K5	Our organisation buys from suppliers who use life cycle analysis to evaluate their products' environmental friendliness.		0.744	
n = 295						

Table 6.7: Results of EFA I-OVALUES						
Constructs		Items	Item Descriptions	Factors		
				1	2	3
OVALUES	ENTRPNT	L1	Our organisation has a high level of environmental-friendly products used.		0.584	
		L2	Our organisation is the first to purchase environmentally friendly products.	0.690		
		L3	Our organisation believes there is sufficient availability of environmentally friendly product alternatives in the market.	0.540		
		L4	Our organisation uses environmental criteria in selecting suppliers.	0.596		
		L5	Our organisation uses environmental criteria in awarding procurement contract.	0.659		
		L6	Our organisation encourages employees to contribute innovative environmental ideas that could be transformed into environmental policies.	0.676		
	COMMITT	M1	Our organisation is highly committed to environmental goals.		0.806	
		M2	Our organisation considers environmental issues to be very relevant to the organisation.		0.820	
		M3	Our organisation integrates environmental issues into our strategic planning process.		0.699	
		M4	Our organisation has provided experienced and capable people to manage environmental issues in our procurement activities.		0.577	
		M5	Our organisation has a clear policy statement urging environmental awareness in our operations.		0.634	
		M6	Our organisation rejects material from suppliers who lack environmental awareness.	0.694		
		M7	Our organisation has full-time employees devoted to environmental procurement.	0.699		
		M8	Our organisation has appropriate reward system that recognises environmental achievements.	0.526	0.489	
	ORGLT	N1	Our organisation views learning new approaches in environmental buying policy as important.		0.616	
		N2	The culture of our organisation put top priority on learning on environmental matters.	0.546	0.549	
		N3	Our organisation implements programs to foster awareness on the importance of environmental benefits.		0.625	
		N4	Our employees are trained on the importance and relevance of environmental products and services.	0.592		
		N5	Our organisation sends staff to countries that are more advanced in environmental oriented procurement practices for training.	0.772		
		N6	Our organisation organises in-house environmental procurement training.	0.728		
	INNOVNT	O1	Senior management in our organisation actively seeks innovative ideas on environmental matters.		0.583	
		O2	Our organisation provides rewards for innovative suggestions on environmental procurement.		0.607	
		O3	Employees in our organisation are encouraged to perceive risk-taking as a part of corporate culture.	0.612		
		O4	Our organisation environmental procurement practices are constantly reviewed and updated.	0.600		
		O5	Our organisation identifies sufficient possibilities of environmentally friendly products and services within the procurement market.	0.704		
		O6	Our organisation has developed environmental procurement manual and documentation.	0.769		
n =295						

Table 6.8: Results of EFA I-ENVORIENT						
Construct		**Items**	**Item Descriptions**	**Factors**		
				1	**2**	**3**
ENVORIENT	INTELGT	P1	Our organisation does a lot of in-house environmental research.	0.707		
		P2	Our organisation collects information on environmentally-oriented procurement by informal methods.	0.709		
		P3	Our organisation collects information on suppliers that comply to environmental regulations.	0.732		
		P4	In this organisation, we meet with our suppliers to inform them of our environmental procurement requirements	0.766		
		P5	Our organisation conducts survey on environmental compliance on our suppliers.	0.784		
	INTELLDISST	Q1	Our organisation has interdepartmental meetings on procurement at least once a month to discuss market trends and developments on environmental products.	0.752		
		Q2	Our organisation is quick to alert other departments when one department finds out something important about the environmental regulatory climate impacting on procurement.	0.756		
		Q3	Our organisation disseminates information on environmental procurement to all departments on a regular basis.	0.703		
		Q4	In our organisation, there is extensive communication on matters of environmentally-oriented procurement.	0.703		
		Q5	Our organisation shares information on development of environmentally friendly products in the market.	0.699		
	RESPONST	R1	Our organisation effectively co-ordinate all environmental activities of different departments.		0.740	
		R2	Our organisation ensures environmental criteria in the procurement procedures are implemented in timely manner.		0.694	
		R3	Our organisation immediately responds to changes in environmental standards/pressures.		0.786	
		R4	Our organisation is quick to respond to changes in the environmental climate for one reason or another.		0.780	
		R5	Our organisation takes the lead in implementing environmental procurement programmes.		0.735	
n = 295						

Table 6.9: Results of EFA I-OPERF						
Constructs		**Items**	**Item Descriptions**	**Factors**		
				1	**2**	**3**
OPERF	ENVIRONMNT	S1	There is a noticeable decrease in the volume of internal waste generated.	0.450		
		S2	There is a decrease in the volume of harmful products purchased from suppliers.	0.550		
		S3	There is an increase in the number of products purchased from suppliers who conform to environmental requirements.	0.601		
		S4	There is an overall improvement in energy efficiency in our organisation.		0.686	
		S5	There is an increasing level of recycling in the organisation.		0.632	
	OPERNT	T1	There is an increase of suppliers taking back packaging materials.	0.744		
		T2	The number of environmental products in our database has increased.	0.726		
		T3	There are an increasing number of suppliers who are pre-qualified based on environmental criteria.	0.770		
		T4	There is an increase in the number of environmentally certified suppliers in our database.	0.694		
		T5	There is an increasing number of environmentally certified suppliers being awarded procurement contracts.	0.781		
		T6	There is a steady increase in the number of environmentally friendly products purchased.	0.557		
	FINANCLT	U1	There is a decrease in the cost of energy consumption in our organisation.		0.734	
		U2	There is an increase of budget allocation for environmental activities.	0.455		
		U3	There is an increase in operational cost in our organisation because of monitoring and enforcement activities on suppliers.	0.655		
		U4	There is a decrease in fines due to our organisation's compliance with environmental regulations.	0.543		
		U5	The purchase of environmentally friendly products, although more expensive, is cost efficient in the long run.		0.590	
	SOCIALT	V1	There is an increasing measures implemented to ensure employees' health and safety are well taken care.			0.616
		V2	There is an increasing level of participation from employees in providing feedback on social issues confronting the organisation.			0.668
		V3	There is an increasing involvement of stakeholders and senior management in developing corporate social policies in the organisation.			0.594
		V4	There are periodic reviews and evaluations of performance of the organisation's social activities			0.741
		V5	There is an improved awareness among suppliers of how best to conserve resources and to integrate social factors into their operations.	0.483		0.575
		V6	There is an improved awareness within the organisation of government's social initiatives.			0.638
n = 295						

6.5.3 Exploratory Factor Analysis II: Items Deletion

The EFA I analysis also showed cross-loaded items with a factor loading of a minimum of lower than 0.5. Items that are cross-loaded and below 0.5 have been deleted (Hair et al., 2006). This is to prepare the data for confirmatory factor analysis (CFA). The process of deleting items is justified in the factor analysis step due to loadings below the established threshold or because an item loads on multiple factors. The deletion process would improve instrument reliability. The deletion of items needs to take into account the issue of uni-dimensionality and content analysis (Blunch, 2008; Sireci, 1998). Uni-dimensionality measures scaled loadings where the often-recommended value of 0.40 meets the uni-dimensionality rule (Blunch, 2008). Items that achieved factor loading of 0.5 and above are retained and items that are cross-loaded are dropped. The use of factor loading that exceeds 0.70 is recommended because the value is indicative of a well-defined structure (Hair et al., 2010). The results of exploratory factor analysis II are shown in Table 6.10 to Table 6.15.

Table 6.10 shows the content analysis as designed in the measurement instrument, Energy Conservation (ENCONT) and Energy Efficiency (ENFT) when combined to become ENFCON. The previous Cronbach alpha (α) for ENFT and ENCONT are 0.874 and 0.871 respectively. Item B5 was included into the factor of ENFCON as recommended by EFA I. After combining ENFT and ENCONT, a reliability test was conducted and it registered a new value for α which is 0.884.Cronbach alpha (α) for BIODEGT is now 0.812 instead of 0.871. This is an improvement on the reliability test for internal consistency. Taking Hair et al., (2010)'s proposal into consideration for significant and well-defined structures, items that have a factor loading of less than 0.6 and cross-loaded items were deleted from the analysis thus resulting in three factors: ENFCON, BIODEGT and HAZARDT.

Table 6.10: Results of EFA II-IPA						
Construct		Item	Item Descriptions	Factors		
				1	2	3
IPA α =. 0.949	ENFCONT	A1	Our organisation buys products and equipment from suppliers that declare products are energy efficient.		0.708	
		A2	Our organisation buys only products that have energy efficiency labels.		0.764	
		A3	Our organisation provides guidelines on energy efficiency for suppliers to tender for electronic and electrical equipment.		0.701	
		A4	Our organisation buys products that are energy efficient.		0.697	
		A5	Our organisation buys from suppliers who have at least Green Mark certification which is the minimum level of energy efficiency.		0.627	
		A6	Our organisation sets minimum energy performance standards for various types of equipment purchased.		0.573	
		B5	Our organisation buys from suppliers that implement energy conservation initiatives.		0.542	
	BIODEGT	C1	Our organisation sets a minimum biodegradability standard for products purchased.			0.690
		C2	Our organisation buys from suppliers whose products adhere to international biodegradability standards.			0.587
		C4	Our organisation buys from suppliers who use biodegradable packaging materials.			0.730
		C5	Our organisation buys from suppliers who have a policy that products sold are biodegradable.			0.694
	HAZARDT	D1	Our organisation buys from suppliers who have a policy to systematically separate dangerous wastes.	0.695		
		D2	Our organisation buys from suppliers who understand the impact of hazardous materials on the environment.	0.768		
		D3	Our organisation buys from suppliers who implement an adequate policy to manage hazardous waste.	0.673		
		D4	Our organisation has a policy to reject products from suppliers if they contain hazardous elements.	0.671		
		D5	Our organisation buys from suppliers who implement stringent control over the disposal of hazardous materials.	0.701		
		D6	Our organisation buys from suppliers who dispose of hazardous waste by environmentally safe methods.	0.774		
		D7	Our organisation buys products that are properly labelled and packed when they contain hazardous materials.	0.662		
n= 295						

Table 6.11: Results of EFA II-WM					
Construct		Item	Item Descriptions	Factors	
				1	2
WM α = 0.946	RPACK	E2	Our organisation prefers to award tenders to suppliers who have a return management policy.	0.569	
		E4	Our organisation generates less waste when buying products from suppliers who implement reverse logistics.	0.658	
		F1	Our organisation has a policy that the packaging of products purchased should be manufactured from reusable materials.	0.710	
		F2	Our organisation has a policy to buy products from suppliers who take back packaging materials.	0.865	
		F3	Our organisation prefers to buy from suppliers who signed the Singapore Packaging Agreement.	0.650	
		F4	Our organisation purchases products that use minimum packaging.	0.794	
		F5	Our organisation buys from suppliers that provide green packaging.	0.634	
	RECYCLT	G1	Our organisation buys from suppliers who have a blueprint to increase recycling rate.		0.711
		G2	Our organisation buys from suppliers who have a policy on buy-back programmes.		0.611
		G4	Our organisation buys from suppliers who have guidelines to systematically separate different types of recyclable wastes.		0.754
		G5	Our organisation buys from suppliers who provide labelled containers for different types of recyclable wastes.		0.740
		G6	Our organisation buys from suppliers who have a long-term objective to promote recycling as a policy, thus reducing the use of landfill and incinerators.		0.756
		G7	Our organisation buys from suppliers that have an appropriate policy that recycled products are to be used.		0.649
n= 295					

The factors for WM are reverse logistics (RLOGT), packaging (PACKGT) and recycling (RECYCLT). These factors are important in determining the level of environment-oriented procurement. Initial reliability analysis for factor of WM indicated α = 0.845 for RLOGT, α = 0.888 for PACKGT and α = 0.889 for RECYCLT. During the EFA I, WM has three factors which have been reduced to two factors. RLOGT and PACKGT are now combined to RPACK (Table 6.11). Table 6.11 shows the results of EFA II for WM. Cross-loaded items E1, E5 and G2 with values of below 0.5 are dropped so that a new factor can be formed. Item E3 which refers to government preference to procure from organisations that implement reverse logistics (RLOGT) is cross-loaded into the factor of recycling (RECYCLT) with values of 0.514 and 0.529. In terms of weight, the value weighs more on RECYCLT with 0.529 compared to 0.514 on RLOGT. E3 is constructed to measure reverse logistics. It is more appropriate to put E3 as item measurement for RLOGT because of content validity. Content validity is achieved through literature review. Content validity which is sometimes considered as face validity exists if the item looks 'right' and the sample is appropriate (Churchill, 1979). This is further supported when a re-run of reliability analysis is executed where RLOGT and PACKGT are combined to form RPACK. The new α for RPACK and RECYCLT are 0.920 and 0.889 respectively. Table 6.12 shows OSPP which refers to organisational systems, processes and policies. OSPP constitutes factors such as ISO 14001 (ISOT), eco-label (ECOLABLT), product design (PRDGNT) and life cycle analysis (LCYCT). The implementation and use of these systems, processes and policies by suppliers influence the environment-oriented government procurement process. Using principal component for factor analysis, OSPP which initially has four factors, is reduced to two factors. The results suggest that ISOT, ECOLABLT and PRDGNT are considered as one factor. The other factor is LCYCT. The result also shows that there is no problem of cross-loading. ISO 14001, eco-label and product design are considered as one factor ISOECO and the other factor is life cycle analysis – LCYCLT. Initial reliability analysis showed Cronbach alpha (α) for ISOT = 0.899, ECOLABLT = 0.899, PRDGNT = 0.876 and LCYCT = 0.895. Taking results of exploratory analysis I and II into consideration, ISOT, ECOLABLT and PRDGNT are combined to form PISOECO. The reliability analysis for PISOECO showed the Cronbach alpha (α) of 0.952 and Cronbach alpha (α) for LCYCT remained unchanged at 0.895 which is above the requirement of 0.7 for internal consistency (Pallant, 2001).

Table 6.12: Results of EFA II-OSPP					
Constructs		**Items**	**Item Descriptions**	**Factors**	
				1	**2**
OSPP α = 0.959	**PISOECO**	H1	Our organisation prefers to purchase products from suppliers who are certified with ISO 14001.	0.703	
		H2	Our organisation considers suppliers who have ISO 14001 as adhering to environmental regulations.	0.800	
		H3	Our organisation considers suppliers who use ISO 14001 as committed to environment.	0.757	
		H4	Our organisation uses ISO 14001 to apply suppliers' selection criteria at every stage of the procurement process.	0.703	
		H5	Our organisation requires suppliers to be certified with ISO 14001 to pre-qualify them.	0.721	
		I1	Our organisation procures products that are clearly labelled according to their environmental performance standards.	0.712	
		I2	Our organisation procures products that are environmentally labelled.	0.742	
		I3	Our organisation ensures eco-labels of products purchased are certified by country of origin.	0.744	
		I4	Our organisation purchases products that are independently certified on their environmental performance.	0.640	
		I5	Our organisation considers that products with eco-labels have achieved the required environmental standards.	0.752	
		JI	Our organisation buys products that are designed either for re-use, recyclable, or recovery of materials and components.	0.619	
		J2	Our organisation participates in the design of products for recycling and re-use.	0.538	
		J3	Our organisation constantly sources products that are made from sustainable and renewable resources.	0.609	
		J4	Our organisation considers buying products that are designed to reduce resource consumption and waste generation.	0.688	
		J5	Our organisation considers buying products that are designed to avoid or reduce the use of hazardous materials in the manufacturing process.	0.591	
		J6	Our organisation has appropriate guidelines to purchase products that are designed to eliminate any potential environmental problems.	0.668	
	LCYCT	K1	Our organisation buys products from suppliers that use life cycle analysis.		0.752
		K2	Our organisation buys products from suppliers who consider the use of LCA as not incurring additional costs.		0.817
		K3	Our organisation buys from suppliers who provide LCA Report.		0.813
		K4	Our organisation performs environmental performance evaluation on suppliers.		0.732
		K5	Our organisation buys from suppliers who use life cycle analysis in evaluating their products' environmental friendliness.		0.744
n = 295					

Table 6.13: Results of EFA II-OVALUES					
Constructs		Items	Item Descriptions	Factors	
				1	2
OVALUES α = 0.936	COMMITT	M1	Our organisation is highly committed to environmental goals.		0.806
OVALUES α = 0.936	COMMITT	M2	Our organisation considers environmental issues to be very relevant to the organisation.		0.820
OVALUES α = 0.936	COMMITT	M3	Our organisation integrates environmental issues into our strategic planning process.		0.699
OVALUES α = 0.936	COMMITT	M4	Our organisation has provided experienced and capable people to manage environmental issues in our procurement activities.		0.577
OVALUES α = 0.936	COMMITT	M5	Our organisation has a clear policy statement urging environmental awareness in our operations.		0.634
OVALUES α = 0.936	ENTORGINNOV	L2	Our organisation is the first to purchase environmentally friendly products.	0.690	
OVALUES α = 0.936	ENTORGINNOV	L3	Our organisation believes there is sufficient availability of environmentally friendly product alternatives in the market.	0.540	
OVALUES α = 0.936	ENTORGINNOV	L4	Our organisation uses environmental criteria in selecting suppliers.	0.596	
OVALUES α = 0.936	ENTORGINNOV	L5	Our organisation uses environmental criteria when awarding procurement contract.	0.659	
OVALUES α = 0.936	ENTORGINNOV	L6	Our organisation encourages employees to contribute innovative environmental ideas that could be transformed into environmental policies	0.676	
OVALUES α = 0.936	ENTORGINNOV	N4	Our employees are trained on the importance and relevance of environmental products and services.	0.592	
OVALUES α = 0.936	ENTORGINNOV	N5	Our organisation sends staff to countries that are more advanced in environmentally-oriented procurement practices for training.	0.772	
OVALUES α = 0.936	ENTORGINNOV	N6	Our organisation organises in-house environmental procurement training.	0.728	
OVALUES α = 0.936	ENTORGINNOV	O3	Our organisation integrates environmental issues into our strategic planning process.	0.612	
OVALUES α = 0.936	ENTORGINNOV	O4	Our organisation has provided experienced and capable people to manage environmental issues in our procurement activities.	0.600	
OVALUES α = 0.936	ENTORGINNOV	O5	Our organisation has a clear policy statement urging environmental awareness in our operations.	0.704	
OVALUES α = 0.936	ENTORGINNOV	O6	Our organisation rejects material from suppliers who lack environmental awareness.	0.769	
n = 295					

Table 6.13 refers to the Organisational Values (OVALUES) construct which is the fourth independent construct that impacts on environment-oriented government procurement. OVALUES focuses on critical values of entrepreneurship (ENTRPNT), commitment (COMMITT), organisational learning (ORGLT) and innovation (INNOVNT). These values are hypothesised to have a positive relationship with environment-oriented government procurement. Initial reliability analysis for factors of OVALUES showed the Cronbach alpha (α) for ENTRPNT = 0.861, COMMITT = 0.888, ORGLT = 0.870 and INNOVNT = 0.873. Using the principal component extraction technique and setting criteria of varimax rotation, the EFA showed two factors instead of four. It also showed that M8 is cross-loaded with loadings of 0.526 and 0.489. Cross-loadings and loadings below 0.5 are deleted. N2 is also cross-loaded with loadings of 0.546 and 0.549. ENTRPNT, ORGLT and INNOVNT are combined to form a new sub-construct (ENTORGINNOV) with a Cronbach alpha (α) of 0.915. The other sub-factor is Commitment (COMMITT) with a Cronbach alpha (α) of 0.843. The measurement for Organisational Values (OVALUES) was re-tested for reliability. The Cronbach alpha (α) for Organisational Values (OVALUES) was 0.936.

Table 6.14 presents the Environmental Orientation (ENVORIENT) construct. It is the dependent variable of the proposed conceptual framework with three factors – Intelligent Gathering (INTELGT), Intelligence Dissemination (INTELLDISST) and Responsiveness (RESPONST). Based on factor analysis, ENVORIENT has two factors instead of three initially where INTELG and INTELDISST are merged into INTELGDISS. The construct for ENVORIENT achieved a Cronbach alpha of 0.949.

Table 6.14: Results of EFA II-ENVORIENT					
Constructs		**Items**	**Item Descriptions**	**Factors**	
				1	**2**
ENVORIENT $\alpha = 0.949$	INTELGDISS	P1	Our organisation does a lot of in-house environmental research.	0.707	
		P2	Our organisation collects information on environmentally-oriented procurement by informal methods.	0.709	
		P3	Our organisation collects information on suppliers that comply with environmental regulations.	0.732	
		P4	In this organisation, we meet with our suppliers to inform them of our environmental procurement requirements	0.766	
		P5	Our organisation conducts survey on environmental compliance on our suppliers.	0.784	
		Q1	Our organisation has interdepartmental meetings on procurement at least once a month to discuss market trends and developments of environmental products.	0.752	
		Q2	Our organisation is quick to alert other departments when one department finds out something important about the environmental regulatory climate impacting on procurement.	0.756	
		Q3	Our organisation disseminates information on environmental procurement to all departments on a regular basis.	0.703	
		Q4	In our organisation, there is extensive communication on matters of environmentally-oriented procurement.	0.703	
		Q5	Our organisation shares information on the development of environmentally-friendly products in the market.	0.699	
	RESPONST	R1	Our organisation effectively co-ordinate all environmental activities of different departments.		0.740
		R2	Our organisation ensures environmental criteria in the procurement procedures are implemented in timely manner.		0.694
		R3	Our organisation immediately responds to changes in environmental standards/pressures.		0.786
		R4	Our organisation is quick to response to changes in the environmental climate for one reason or another.		0.780
		R5	Our organisation takes the lead in implementing environmental procurement programmes.		0.735
n = 295					

Table 6.15: Results of EFA II-OPERF						
Constructs		**Items**	**Item Descriptions**	**Factors**		
				1	**2**	**3**
OPERF α =0.922	**ENVFIN**	S4	There is an overall improvement in energy efficiency in our organisation.		0.686	
		S5	There is an increasing level of recycling in the organisation.		0.632	
	OPERNT	T1	There is an increase of suppliers taking back packaging materials.	0.744		
		T2	The number of environmental products in our database has increased.	0.726		
		T3	There are an increasing number of suppliers who are pre-qualified based on environmental criteria.	0.770		
		T4	There is an increase in the number of environmentally certified suppliers in our database.	0.694		
		T5	There is an increasing number of environmentally certified suppliers awarded procurement contract.	0.781		
		T6	There is a steady increase in the number of environmentally friendly products purchased.	0.557		
		U3	There is an increase in operational cost in our organisation because of monitoring and enforcement activities on suppliers.	0.655		
		U4	There is a decrease in fines due to our organisation's compliance with environmental regulations.	0.543		
	SOCIALT	V1	There is an increasing measures implemented to ensure employees' health and safety are well taken care.			0.616
		V2	There is an increasing level of participation from employees in providing feedback on social issues confronting the organisation.			0.668
		V3	There is an increasing involvement of stakeholder and senior management in developing corporate social policies in the organisation.			0.594
		V4	There are periodic reviews and evaluations of performance of organisation's social activities.			0.741
		V6	There is an improved awareness within the organisation of government's social initiatives.			0.638
n= 295						

Table 6.15 is the Organisational Performance (OPERF) construct. It is the dependent variable of the proposed conceptual model. The EFA II for OPERF has three factors compared to four initially. A new factor that emerged is OPERNT. The other two factors are ENVFIN and SOCIALT. A new reliability analysis for OPERF was conducted. The Cronbach alpha is 0.922 which is above the recommended level of 0.7 (Pallant, 2001).

6.6 Developing Measurement Model in SEM

SEM is a powerful multivariate analysis technique. It has become one of the preferred methods in social science research. The model fit in SEM, although it is crucial in determining the fit between model and data, has caused intense debate among researchers on the appropriate model fit to be used and reported. Intense debate was inevitable due to the abundance of fit indices that can be used. To ensure reliability and validity of measures such as internal consistency, convergent and discriminant validity respectively, as suggested by Gerbing & Anderson (1988) and Churchill (1979), the data was subjected to a confirmatory factor analysis (CFA). The objective of Confirmatory Factor Analysis (CFA) is to empirically validate the hypothesised model and to confirm or otherwise a prior theory. The process of conducting the CFA is also to determine the closeness between actual and estimated covariance matrix to the sample and hypothesised model. The closer the two, the better is the fit between the sample and the hypothesised model. The stages of SEM applications are model specification, identifications, estimation, testing fit and finally re-specification (Bollen & Long, 1993).

6.6.1 Data Screening for SEM

The most widely-used estimation methods in SEM assume normality of distribution. The EFA for items and constructs and factors generated from SPSS Version 18 were subjected to Amos 18 for Confirmatory Factor Analysis (CFA). Since the SEM technique is very sensitive to the soundness of the dataset, the dataset was screened for missing data, outliers, linearity and normality, as suggested by SEM literature (Kline, 2005; Schumacker& Lomax, 2010). In conducting the CFA, the Maximum Likelihood Estimation (MLE) is used as it is very popular and available in statistical packages such as Amos and LISREL (Kelloway, 1998). MLE analysis requires a sample size of at least 100

(Hair et al., 2006). general rule considers a sample size of 100 to 200 as a 'good sample size' (Bentler & Bonnet, 1980; Bentler & Chou, 1987). Therefore, this study has a good sample size of 295 respondents.

6.6.2 Construct Validity and Confirmatory Factor Analysis (CFA)

One of the major tasks of data analysis is to reduce measurement errors. Measurement error is the degree to which observed values are not representative of the true value. Causes of measurement errors are data entry error and imprecision of measurement. These errors can be minimised by assessing the validity of the measurement model. The availability of many different fit indices presents problems of selection to researchers. There is no agreement among researchers and the literature is divided on the amount of fit indices that should be reported (Kline, 2005). In general, literature on fit indices seems to concur on the statistics of model Normed Chi-Square, root mean square of approximation (RMSEA) with its 90% confidence interval, comparative fit index – CFI, Incremental Fit Indices that provided measurement of normed-Fit-Index (NFI) and standardised root mean square residual – SRMR (Hair et al., 2006; Kline, 2005). The construct would be tested for discriminant and convergent validity with a value of above 0.5 and 0.7 respectively (Hair et al., 2010).

6.6.3 Statistical Criteria to Assess the Measurement Model

Table 6.22 represents statistical measurement of goodness-of-fit to assess model validity. The values of goodness-of-fit indicate the mathematical values of two matrices – estimated covariance and observed covariance. The closer the value of these two matrices, the better is the fit of the model. There are two types of GFI (Goodness-of-Fit Index). The model fit is evaluated in terms of Absolute Fit Index and Incremental Fit Index (Hair et al., 2010). The literature is divided over the value and number of fit indices to be applied. This study to a large extent follows GFI as suggested by the accepted literature such as Hair et al., (2010); Hu & Bentler (1998); Meyer, Gamst & Guarino (2006). Within these indices, there are acceptable or threshold values that are to be observed to achieve a good model fit.

Absolute Fit Index The test for absolute fit is concerned with the ability to reproduce the correlations/covariance matrix. The absolute fit indices are Chi-Square (X^2) and normed Chi-Square (x^2/df), Root Mean Square Error of Approximation (RMSEA), Goodness-of-Fit Index and Root Mean Square Residual (RMR).

Chi-Square (X^2) is used to evaluate the appropriateness of a model. When the value of X^2 is high in relation to the number of degrees of freedom (df), this suggests that the sample covariance matrix and the model-implied covariance matrix differ from each other significantly (Schermelleh-Engel et al., 2003). On the other hand, a smaller Chi-Square value shows a better fit. Ideally, the Chi-Square would be non-significant indicating no significant discrepancy between the model and data. Statistically, Chi-Square will increase with larger samples and non-normally distributed data. Both of these issues have nothing to do with the appropriateness of the proposed model. Also, a slight discrepancy between the model and the data could also result in a statistically significant chi square. CMIN is a normed Chi-Square statistic comparing the tested model and the independence model with the saturated model. CMIN/DF, the relative Chi-Square, is an index of the extent of the fit of data to the model.

Goodness-of-Fit Index (GFI) and the ***Adjusted Goodness-Of-Fit Index*** (AGFI). GFI indicates the proportion of the variance in the sample variance-covariance matrix accounted for by the model. A good-fit model should exceed 0.90l and 1 for a perfect model. AGFI (adjusted GFI) is used to compensate the GFI index in which the value of the index is adjusted for the number of parameters in the model. The fewer the number of parameters in the model relative to the number of variances and covariances in the sample variance-covariance matrix, the closer is the value of AGFI to GFI.

Root Mean Square Residual (RMR) and ***Standardised Root Mean Square Residual*** (SRMR). The root mean square residual is the square root of the mean of the squared residuals – an average of the residuals between observed and estimated measures. Typically, a value for each factor of below 0.08 is desired (Kelloway, 1998).

The Root Mean Square Error of Approximation (RMSEA) estimates the lack of fit to the saturated model. RMSEA of 0.05 or less indicates a good fit, and 0.08 or less an adequate fit. LO 90 and HI 90 are the lower and upper ends of a 90% confidence interval for the population value of RMSEA. It is also a measure of exact fit but not necessary in the determination of fit indices. PCLOSE is the p value testing the null that RMSEA is no greater than 0.05. The rule of thumb suggests <0.05 is good and <0.08 is acceptable (Hair et al., 2010; Kelloway, 1998).

<u>**Incremental Fit Indices**</u> – ***Normed-Fit Index*** (NFI) and the ***Comparative Fit Index*** (CFI): The goodness-of-fit indices compare the hypothesised model to the independence model rather than to the saturated model. The normed Fit Index (NFI) is simply the difference between the two models' Chi-Squares divided by the Chi-Square for the independence model. Values of 0.9 or higher indicate good fit. The Comparative Fit Index (CFI) uses a similar approach (with a non-central Chi-Square) and is said to be a

good index for use even with small samples. The value of CFI ranges from 0.00 to1.00. Similar to the NFI, CFI considers the value of 0 .90 or higher indicates a good model fit. The rule of thumb suggests > 0.90 is good; > 0.95 is very good. The RMSEA should be in the range of < 0.05 which is a good fit and <0.08 which is an acceptable fit, with a CFI value of 0.90 (Hair et al., 2010; Meyer, Gamst & Guarino, 2006).

Table 6.16: Summary for Goodness of Fit Indices

Category	Indicator	Purpose	Acceptance Level
Absolute fit indices is a measure of fit between a priori model and sample data	Chi-Square (x^2)	Evaluates overll model fit and assesses the magnitude of discrepancy between sample and fitted covariance matrices	P ≥ 0.05 p < 0.05 Bryne (2010)
	normed-Chi Square x^2/df		1.0 – 3.0 Tabachnick and Fidell (2007); Kline (2005)
	Goodness of Fit Index (GFI)	Evaluates the proportion of variance that is accounted for by the estimated population covariance	≥ 0.90
	Adjusted Goodness of Fit Index (AGFI)		≥ 0.90
	Root Mean Square Error of Approximation (RMSEA)	Estimates how well the model fits	< 0.05 – good fit < 0.08 acceptable fit with CFI of 0.92 or higher (Hair et al., 2010)
	Root Mean Square Residual (RMR)		< 0.10
Incremental Fit Indices	Normed Fit Index (NFI)	Estimates how well the model fits	≥ 0.90
	Comparative Fit Index (CFI)		≥ 0.90

Source: (Hair et al., (2010); Hooper et al., (2008); Joreskog & Sorbom, (1993); Meyer, Gamst & Guarino (2006).

Table 6.17 to Table 6.34 and Figure 6.1 to Figure 6.12 show the results of model fit for the all constructs. The following is a discussion of the initial and final model fit indices for all constructs.

Fit Indices for IPA

Tables 6.17 and 7.18 show the results of model fit for Integrated Product Attributes for the initial and final results respectively. Figure 6.1 and 6.2 show the initial and final models. Items B3, B4 and C6 in Figure 6.1 are the results of factor analysis generated by SPSS vesion 18. Therefore, they are adequately represented (Pallant, 2001). The initial model revealed that x^2 with 206 degrees of freedom is 2.878 which achieved the acceptable level as recommended by Kline (2005) (see Table 6.16). However, the initial fit model for Integrated Product Attributes (IPA) is mis-specified although fit measurements for GFI, NFI, RFI and CFI are near to the acceptable level of 0.90 and the RMSEA is 0.080. But, the value for PCLOSE is 0.000 which is lower than the recommended value of > 0.05 (Hair et al., 2010). The unstandardised and standardised regression weights (factor loadings) revealed that they are statistically significant (Table 6.17). The initial model for IPA is rejected based on Hair et al., (2010) who considered CFI should be 0.95 for sample size of above 250 and with more than 30 variables in the study. Further modifications were made to achieve goodness-of-fit. Table 6.18 shows the results of further modifications. The normed Chi-Square of 2.149 is below the acceptable level recommended by Kline (2005). The goodness-of-fit indices are good where GFI, NFI, RFI, IFI, TLI and CFI are above the acceptable level of 0.90. The value of RMR is also <0.08. The final model for IPA has an RMSEA value of 0.063 which is below the recommended level of 0.08. The PCLOSE is 0.028 which is above the recommended value of 0.005. The construct is tested for internal consistency (Table 6.19) which also shows the retained items. The Cronbach alpha (α) shows a good internal consistency or reliability of 0.939, which is above the acceptable level of 0.70 (Pallant, 2001). The values for factor loadings are also significant, being near to 0.5 (Chin, 1998).

Figure 6.1: Initial Measurement for IPA

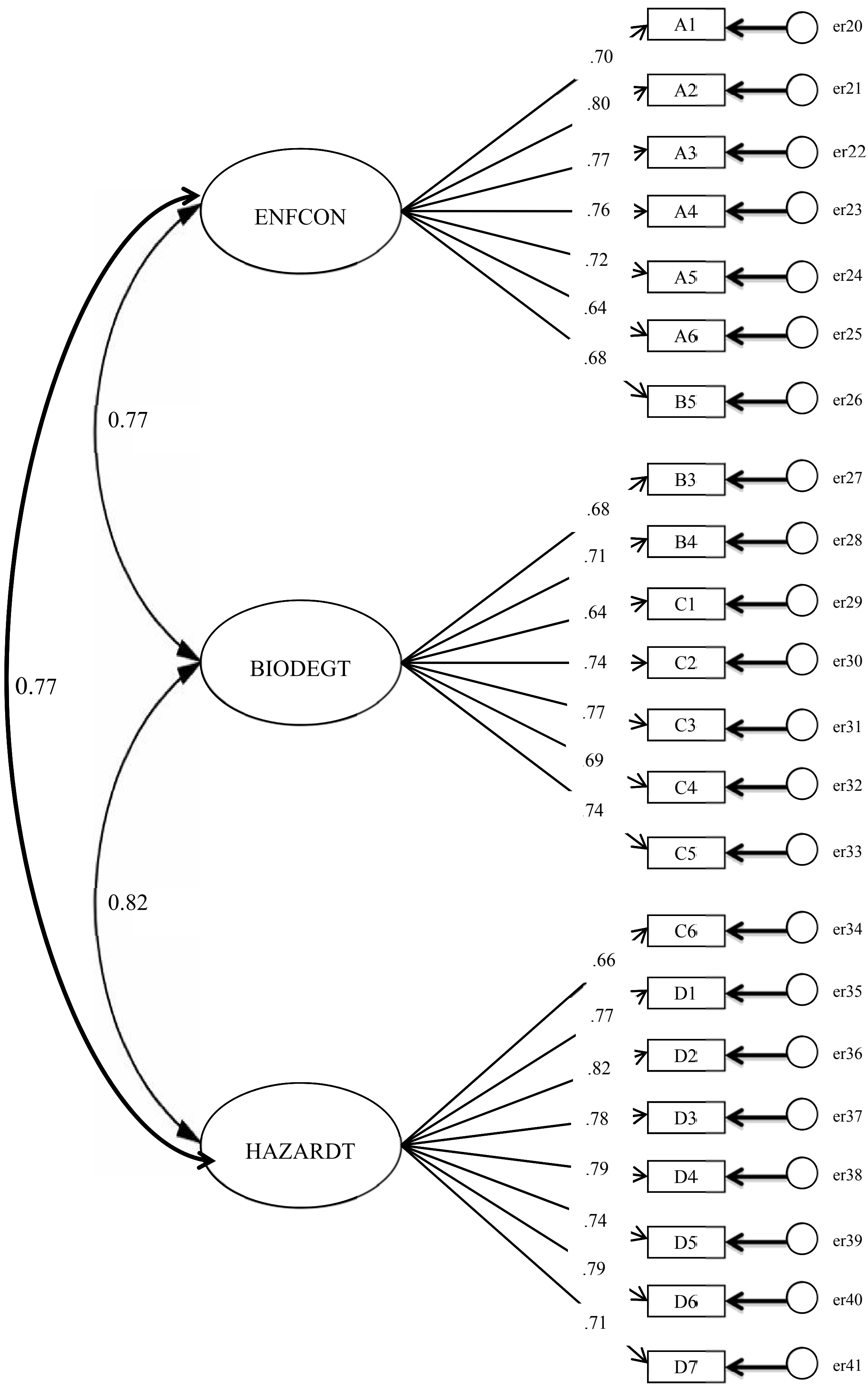


Table 6.17: Initial Fit Indices for IPA								
Items/Factors		Estimate Unstd	S.E	C.R	p	Label	Estimate Std	SMC
A1←	ENFCON	1.000					.704	.496
A2←	ENFCON	1.112	.085	13.033	***	par_1	.797	.635
A3←	ENFCON	.958	.078	12.260	***	par_2	.767	.588
A4←	ENFCON	.974	.081	12.061	***	par_3	.763	.582
A5←	ENFCON	.950	.083	11.381	***	par_4	.718	.515
A6←	ENFCON	.843	.083	10.153	***	par_5	.637	.405
B5←	ENFCON	.864	0.80	10.843	***	par_6	.682	.465
B3←	BIODEGT	1.000					.680	.462
B4←	BIODEGT	1.091	.097	11.276	***	par_7	.714	.510
C1←	BIODEGT	.977	.099	9.838	***	par_8	.637	.406
C2←	BIODEGT	1.029	0.91	11.322	***	par_9	.744	.554
C3←	BIODEGT	1.185	.102	11.646	***	par_10	.768	.589
C4←	BIODEGT	1.022	.097	10.489	***	par_11	.685	.470
C5←	BIODEGT	1.086	.096	11.274	***	par_11	.738	.544
C6←	HAZARDT	1.000					.657	.431
D1←	HAZARDT	1.052	.091	11.507	***	par_13	.775	.601
D2←	HAZARDT	1.130	.093	12.092	***	par_14	.823	.677
D3←	HAZARDT	1.034	.089	11.570	***	par_15	.776	.603
D4←	HAZARDT	1.148	.097	11.813	***	par_16	.787	.619
D5←	HAZARDT	1.117	.099	11.242	***	par_17	.743	.552
D6←	HAZARDT	1.140	.096	11.906	***	par_18	.795	.631
D7←	HAZARDT	1.035	.095	10.882	***	par_19	.712	.507
Absolute Fit		x^2/df =2.878		P = 0.000		RMSEA= 0.080		
		RMR = 0.034		GFI= 0.847		AGFI = 0.812		
Incremental Fit		NFI = 0.857	RFI = 0.839	IFI = 0.901		TLI = 0.889	CFI = 0.901	

***Significant at 0.001
SMC = Squared Multiple Correlations
Unstd = Unstandardised
Std = Standardised

Figure 6.2: Final Measurement for IPA

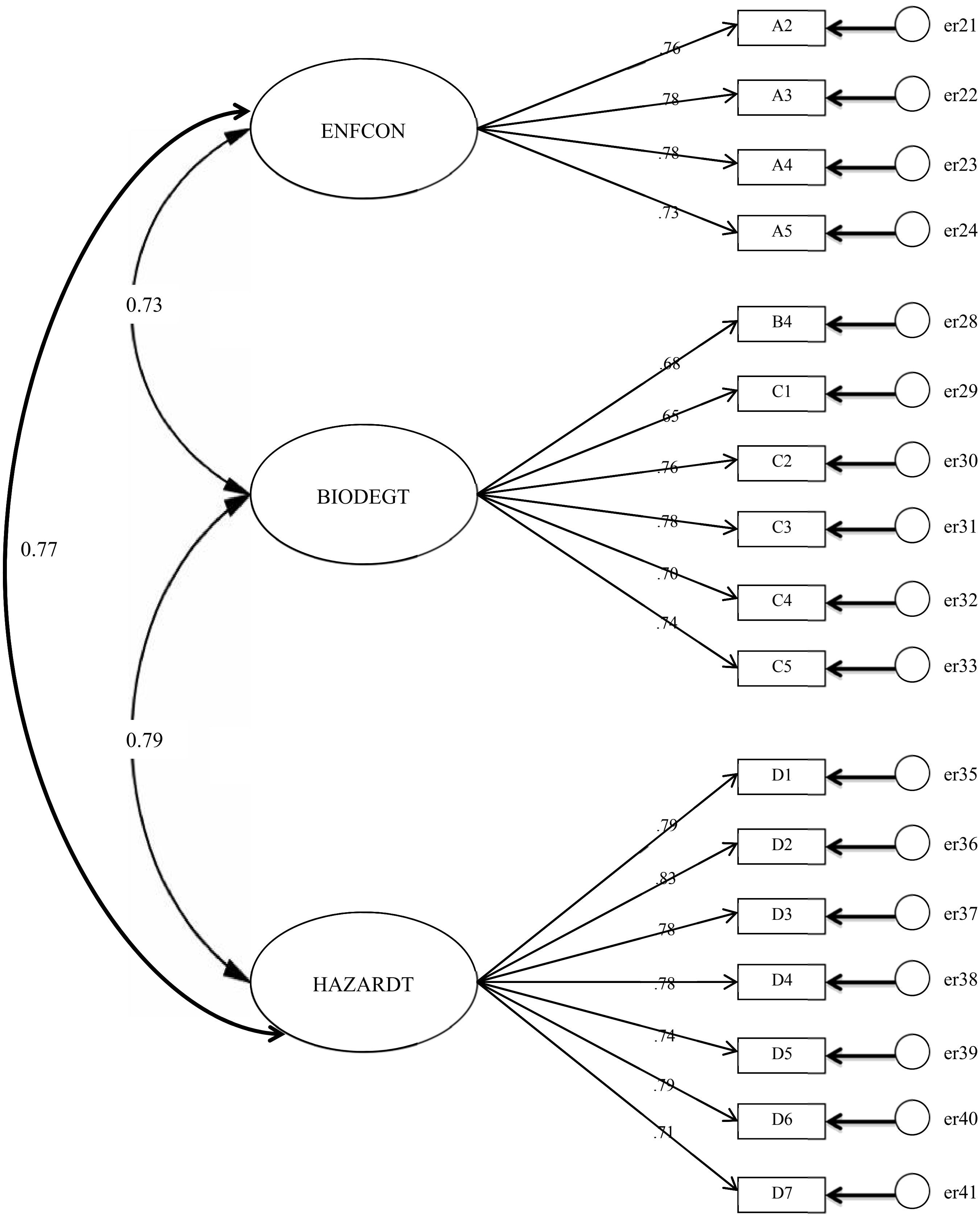


Table 6.18: Final Fit Indices for IPA								
Items/Factors		**Estimate Unstd**	**S.E.**	**C.R**	**p**	**Label**	**Estimate Std**	**SMC**
A2←	ENFCON	1.000			***		.761	.579
A3←	ENFCON	.915	.069	13.348	***	par_1	.778	.605
A4←	ENFCON	.940	.073	12.896	***	par_2	.782	.611
A5←	ENFCON	.909	.075	12.142	***	par_3	.730	.533
B4←	BIODEGT	1.000			***		.678	.459
C1←	BIODEGT	.968	.097	9.947	***	par_4	.653	.427
C2←	BIODEGT	1.010	.089	11.390	***	par_5	.757	.573
C3←	BIODEGT	1.162	.101	11.548	***	par_6	.779	.606
C4←	BIODEGT	1.005	.095	10.583	***	par_7	.698	.484
C5←	BIODEGT	1.056	.093	11.340	***	par_8	.742	.551
D1←	HAZARDT	1.000					.787	.620
D2←	HAZARDT	1.072	.067	16.098	***	par_9	.787	.696
D3←	HAZARDT	.975	.066	14.701	***	par_10	.834	.614
D4←	HAZARDT	1.069	.074	14.423	***	par_11	.783	.614
D5←	HAZARDT	1.040	.077	13.526	***	par_12	.740	.547
D6←	HAZARDT	1.062	.072	14.662	***	par_13	.791	.626
D7←	HAZARDT	.961	.075	12.842	***	par_14	.708	.501

Absolute Fit	x^2/df = 2.149		p = 0.000		RMSEA= 0.063
	RMR = 0 .024		GFI= 0.912		AGFI = 0.885
Incremental Fit	NFI = 0.918	RFI = 0.903	IFI =0.954	TLI = 0.946	CFI = 0 .954

***Significant at 0.001
SMC = Squared Multiple Correlations
Unstd = Unstandardised
Std = Standardised

Table 6.19: Items Retained and Reliability Analysis for IPA	
Items	**Reliability α = 0.939**
A2	Our organisation buys only products that have energy efficiency labels.
A3	Our organisation provides guidelines on energy efficiency for suppliers to tender for electronic and electrical equipment.
A4	Our organisation buys products that are energy efficient
A5	Our organisation buys from suppliers who are at least Green Mark certified which is the minimum level of energy efficiency.
B4	Our organisation purchases from suppliers who provide training on eco-office practices to conserve energy
C1	Our organisation set a minimum biodegradability standard for product purchased.
C2	Our organisation buys products that are biodegradable.
C3	Our organisation buys from suppliers whose products adhere to international biodegradability standards.
C4	Our organisation buys from suppliers who use biodegradable packaging materials.
C5	Our organisation buys from suppliers who have policy that products sold are biodegradable.
D1	Our organisation buys from suppliers who have policy to systematically separate dangerous wastes.
D2	Our organisation buys from suppliers who understand the impact of hazardous materials on the environment.
D3	Our organisation buys from suppliers who implement adequate policy to manage hazardous waste.
D4	Our organisation has a policy to reject products from suppliers if they contain hazardous elements.
D5	Our organisation buys from suppliers who implement stringent control for the disposal of hazardous materials.
D6	Our organisation buys from suppliers who dispose of hazardous wastes by environmentally safe methods.
D7	Our organisation buys products that are properly labelled and packed when they contain hazardous materials.

Figure 6.3: Initial Measurement for WM

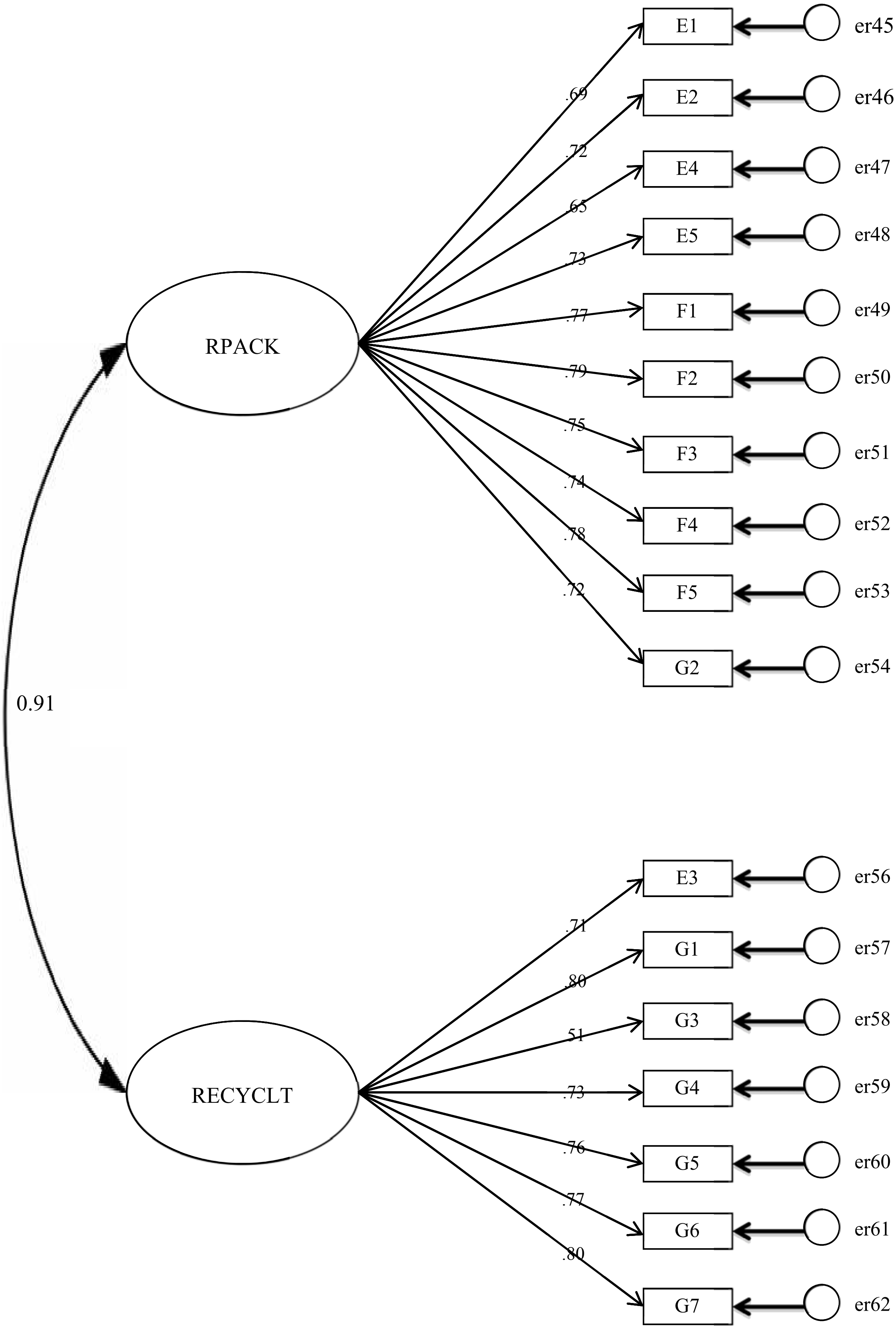


Table 6.20: Initial Fit Indices for WM								
Items/Factors		**Estimate (Unstd)**	**S.E**	**C.R**	**p**	**Label**	**Estimat e Std**	**SMC**
E1←	RPACK	1.000					.690	.475
E2←	RPACK	.959	.092	11.657	***	par_1	717	.515
E4←	RPACK	.998	.096	10.399	***	par_2	.645	.416
E5←	RPACK1	1.124	.096	11.709	***	par_3	.728	.530
E3←	RECYCLT	1.000					.707	.500
G1←	RECYCLT	1.214	.093	13.054	***	par_4	.803	.645
G3←	RECYCLT	.739	.088	8.434	***	par_5	.514	.264
G4←	RECYCLT	1.041	.087	11.903	***	par_6	.732	.536
G5←	RECYCLT	1.078	.088	12.272	***	par_7	.759	.576
G6←	RECYCLT	1.157	.093	12.447	***	par_8	.770	.592
G7←	RECYCLT	1.133	.088	12.944	***	par_9	.799	.638
F1←	RPACK	1.210	.098	12.386	***	par_11	.772	.596
F2←	RPACK	1.288	.104	12.407	***	par_12	.786	.617
F3←	RPACK	1.184	.099	11.910	***	par_13	.747	.557
F4←	RPACK	1.173	.100	11.744	***	par_14	.738	.544
F5←	RPACK	1.269	.102	12.415	***	par_15	.778	.605
G2←	RPACK	1.074	.094	11.482	***	par_16	.716	.513
Absolute Fit		x^2/df =3.079		p = 0.000			RMSEA = 0.084	
		RMR = 0.027		GFI= 0.876			AGFI = 0.839	
Incremental Fit		NFI = 0.886	RFI = 0.869	IFI = 0.920	TLI = 0.908		CFI = 0.920	

***Significant at 0.001
SMC = Squared Multiple Correlations
Unstd = Unstandardised
Std = Standardised

Fit Indices for WM

Tables 6.20 and 6.21 show the results of the initial and final measurements for WM respectively. While Figures 6.3 and 6.4 showed the initial and final model for WM. Initial measurement for WM showed that the model is mis-specified. The normed Chi-Square is above the recommended level of 3 with degree of freedom 118. Although the RMR which is 0.027 well below the value of 0.08, the initial model GFI indices showed that some of the values are below the recommended level of 0.9. The model achieved GFI = 0.876, AGFI = 0.839, NFI = 0.886, RFI = 0.869, IFI = 0.920, TLI = 0.908 and CFI 0.920. On the RMSEA, the initial model for WM showed a value of 0.084. Although this value can be acceptable as Meyer, Gamst and Guarino (2006) considered 0.084 as moderate fit, the model did not achieve the threshold value of above 0.05 as recommended. The initial model for WM achieved a PCLOSE value of 0.000 which is below 0.05.

The initial model in Table 6.20 was re-specified by analysing the modification indices and factor loadings. A total of 6 items with a lower loading were deleted. The final model for WM has 11 retained items. The GFI indices for WM measurement model achieved reasonable values as recommended by the literature. Table 6.21 and Figure 6.4 showed results of the final model. The normed Chi-Square was 2.04 below the recommended value of 3. The goodness-of-fit indices are well above the recommended value of 0.9. The final model RMR was 0.019 which is lower than 0.080. Taking the RMSEA into consideration, the value of 0.60 which is well below the value of 0.08 is considered a good model fit. The PCLOSE of 0.178 also showed that the final WM model is a good model fit. The final WM model factor loadings analysed from the value of SMC showed that the values are above 0.5 which are significant and the items reflect the construct very well (Hair et al., 2006) except for item E4 which is close to 0.4 and item G3 which is close to 0.3 to one decimal point. The value of factor loadings for items E4 and G3, although are below 0.5 as recommended by Hair et al., (2006), is considered to be an acceptable and adequate measure of construct (Holmes-Smith, 2007).

Table 6.22 shows the results for the final WM measurement model. The model showed that 11 items were retained and a further reliability analysis was conducted. The results for reliability showed that the WM construct achieved a Cronbach alpha of 0.915 which is well above the threshold value of 0.7 (Pallant, 2001).

Figure 6.4: Final Measurement for WM

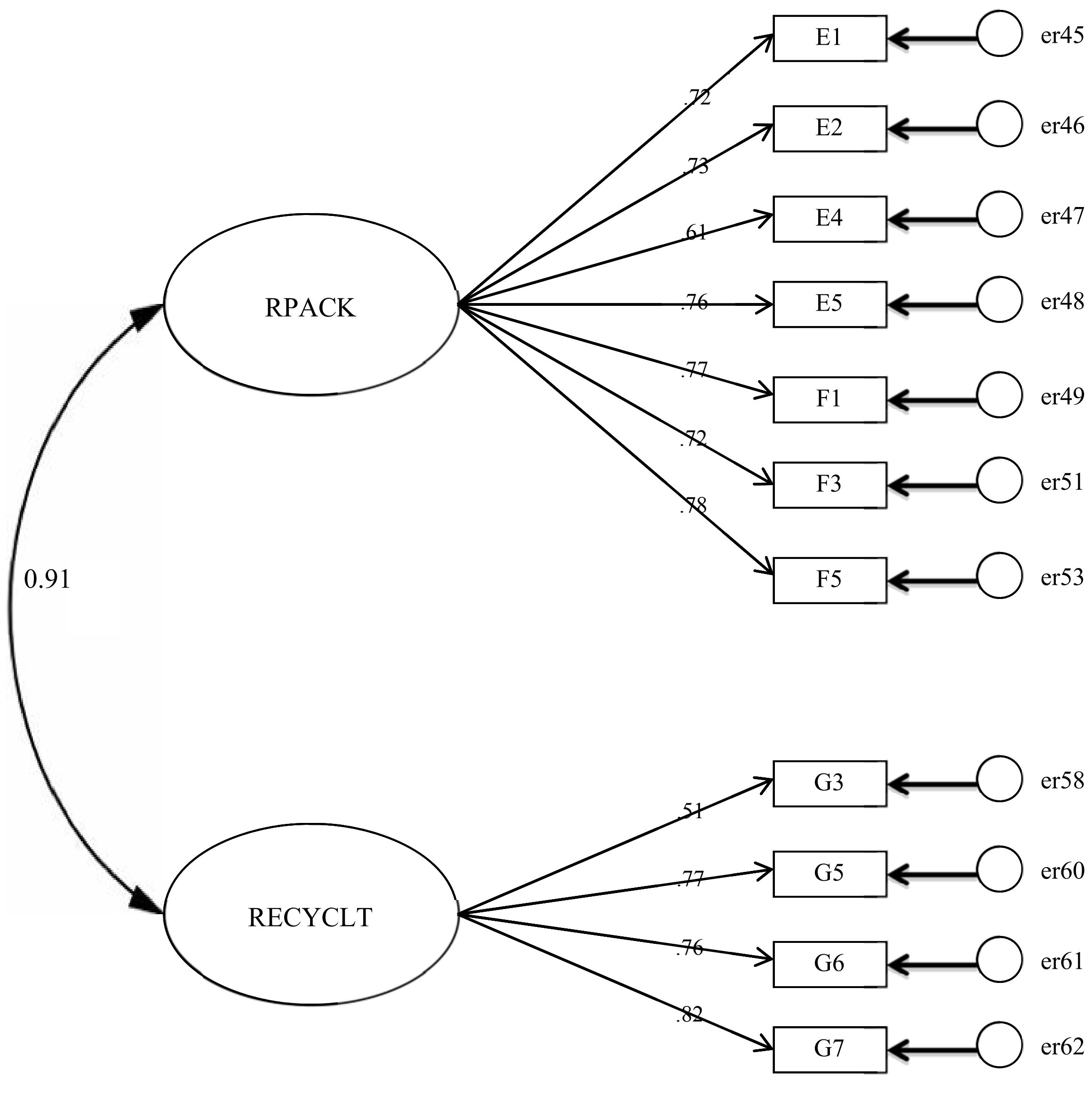


Table 6.21: Final Fit Indices for WM								
Items/Factors		**Estimate Unstd**	**S.E**	**C.R**	**p**	**Label**	**Std Estimate**	**SMC**
E1←	RPACK	1.000					.717	.514
E2←	RPACK	.936	.077	15.99	***	par_1	.728	.530
E4←	RPACK	.911	.091	13.34	***	par_2	.612	.374
E5←	RPACK	1.123	.091	13.38	***	par_3	.756	.572
G3←	RECYCLT	1.000					.510	.261
G5←	RECYCLT	1.498	.175	8.564	***	par_4	.774	.599
G6←	RECYCLT	1.5516	.183	8.473	***	par_5	.757	.573
G7←	RECYCLT	1.580	.182	8.694	***	par_6	.818	.668
F1←	RPACK	1.162	.092	12.694	***	par_8	.771	.594
F3←	RPACK	1.097	.094	11.709	***	par_9	.719	.517
F5←	RPACK	1.219	.096	12.659	***	par_10	.777	.604
Absolute Fit		x^2/df = 2.043		p = 0.000		RMSEA = 0.060		
		RMR = 0.019		GFI= 0.951		AGFI = 0.925		
Incremental Fit		NFI = 0.948	RFI = 0.933	IFI = 0.973	TLI = 0.965	CFI = 0.973		

***Significant at 0.001
SMC = Squared Multiple Correlations
Unstd = Unstandardised
Std = Standardised

Table 6.22: Items Retained and Reliability Analysis for WM	
Items	**α = 0.915**
E1	Our organisation believes that reverse logistics complies with environmental regulations
E2	Our organisation has a policy to buy products from suppliers who take back packaging materials.
E4	Our organisation prefers to award tenders to suppliers who have a return management policy.
E5	Our organisation has a policy to buy from suppliers that implement reverse logistics.
F1	Our organisation has a policy that the packaging of products purchased should be manufactured from reusable materials.
F3	Our organisation prefers to buy from suppliers who signed the Singapore Packaging Agreement.
F5	Our organisation prefers to buy from suppliers who signed the Singapore Packing Agreement.
G3	Our organisation promotes programmes of reduce, re-use and recycle at all levels in the organisation.
G5	Our organisation buys from suppliers who provide labelled containers for different types of recyclable wastes.
G6	Our organisation buys from suppliers who have a long-term objective to promote recycling as a policy, thus reducing the use of landfill and incinerators.
G7	Our organisation buys from suppliers who have an appropriate policy that recycled products are to be used.

Figure 6.5: Initial Measurement for OSPP

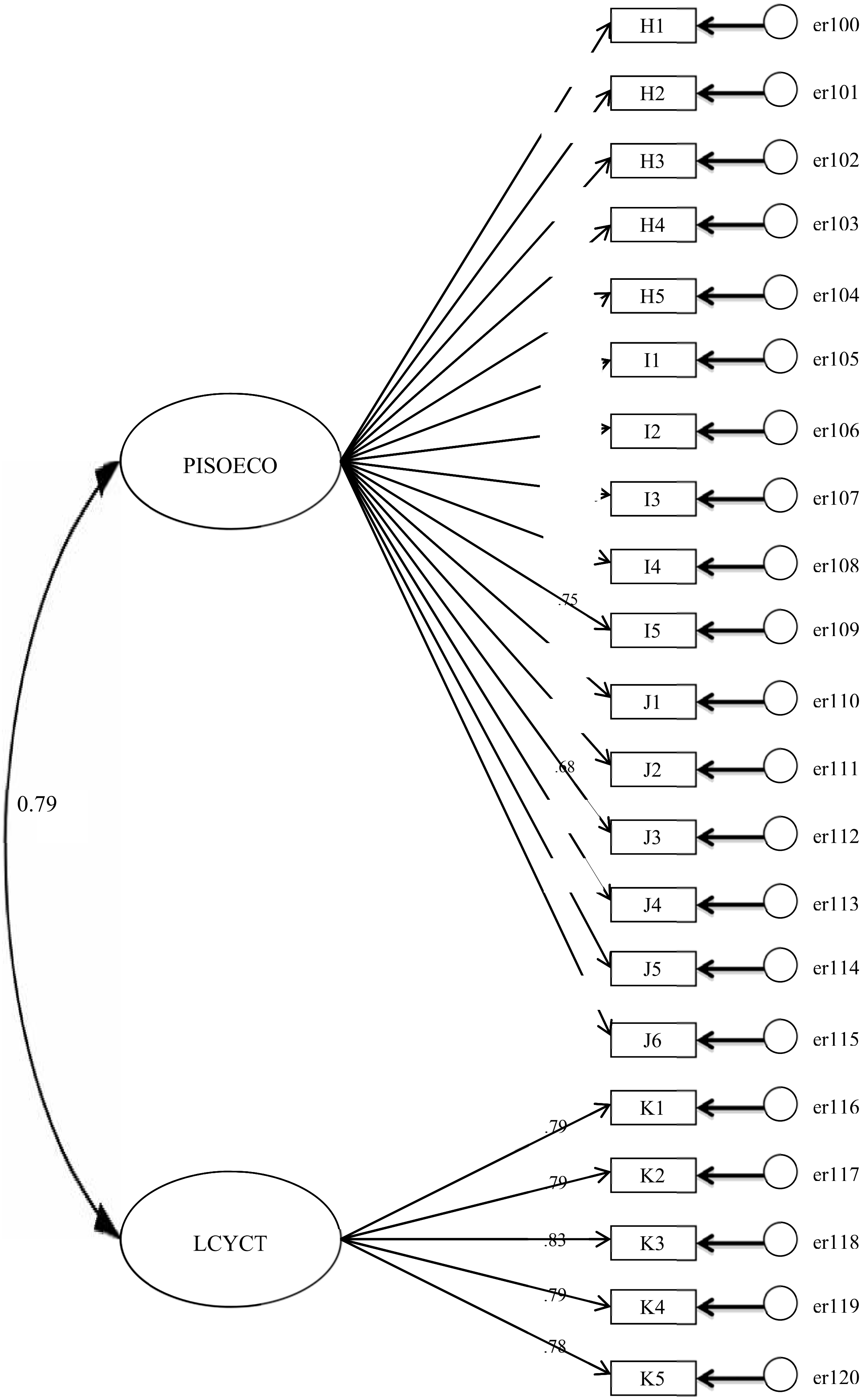


Table 6.23: Initial Fit Indices for OSPP								
Items/Factors		Estimate Unstd	S.E	C.R	p	Label	Estimate Std	SMC
H1←	PISOECO	1.000					.794	.630
H2←	PISOECO	1.047	.064	15.197	***	par_1	.824	.679
H3←	PISOECO	.941	.066	15.730	***	par_2	.742	.551
H4←	PISOECO	1.058	.073	14.656	***	par_3	.758	.574
K1←	LCYCT	1.000					.786	.617
K2←	LCYCT	1.004	.069	14.586	***	par_4	.787	.620
K3←	LCYCT	1.176	.077	15.303	***	par_5	.832	.692
K4←	LCYCT	1.034	.072	14.426	***	par_6	.789	.623
K5←	LCYCT	1.055	.075	14.052	***	par_7	.777	.604
H5←	PISOECO	1.126	.074	15.183	***	par_9	.785	.616
I1←	PISOECO	1.025	.066	15.606	***	par_10	.800	.640
I2←	PISOECO	1.006	.066	15.197	***	par_11	.785	.616
I3←	PISOECO	1.124	.071	15.730	***	par_12	.807	.652
I4←	PISOECO	1.039	.071	14.656	***	par_13	.766	.586
I5←	PISOECO	1.030	.072	14.288	***	par_14	.751	.564
J1←	PISOECO	.816	.064	12.841	***	par_15	.690	.476
J2←	PISOECO	.819	.067	12.225	***	par_16	.662	.438
J3←	PISOECO	.809	.064	12.613	***	par_17	.680	.463
J4←	PISOECO	.853	.067	12.715	***	par_18	.685	.469
J5←	PISOECO	.841	.068	12.297	***	par_19	.666	.444
J6←	PISOECO	.871	.065	13.401	***	par_20	.713	.508
Absolute Fit		x^2/df =3.657		p = 0.000		RMSEA= 0.095		
		RMR = 0.030		GFI= 0.809		AGFI = 0.765		
Incremental Fit		NFI = 0.854	RFI = 0.837	IFI = 0.889	TLI = 0.876	CFI = 0.889		

***Significant at 0.001
SMC = Squared Multiple Correlations
Unstd = Unstandardised
Std = Standardised

Figure 6.6: Final Measurement for OSPP

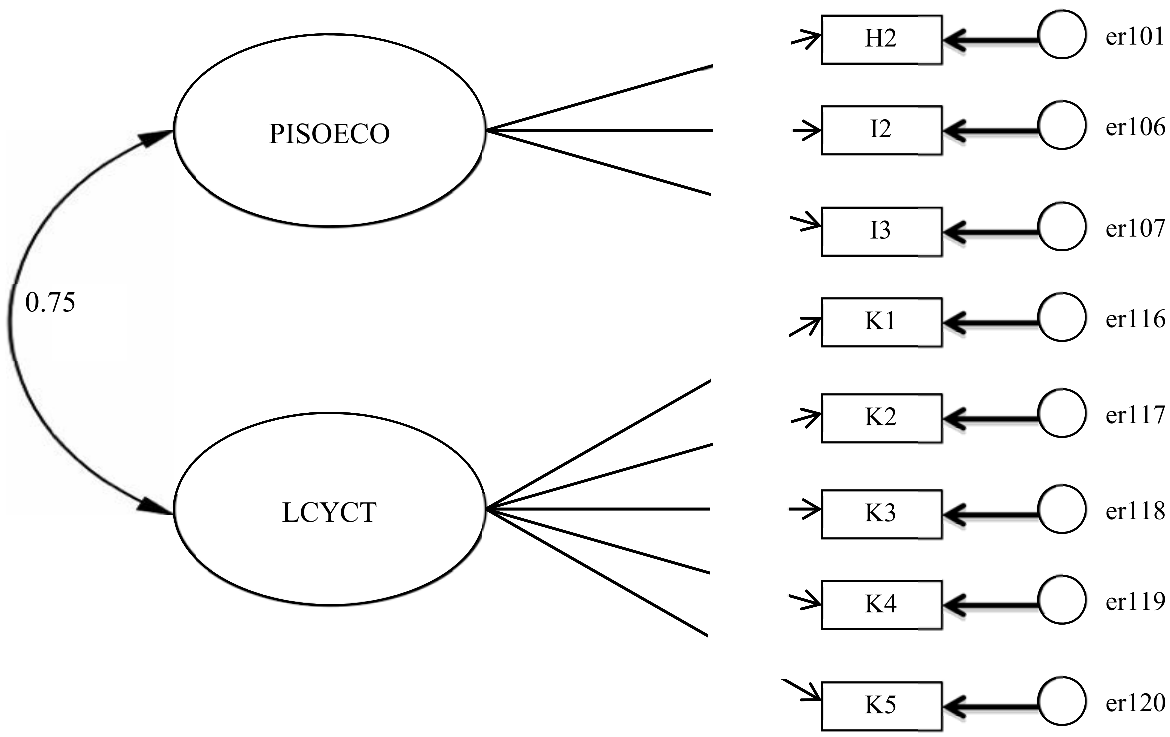


Table 6.24: Final Fit Indices for OSPP

Items	Factors	Unstd Estimate	SE	CR	p	Label	Std Estimate	SMC
K3←	LCYCT	1.163	.077	15.142	***	par_1	.826	.682
I2←	ISOECO	0.985	.066	14.757	***	par_3	.799	.638
I3←	ISOECO	1.106	.072	15.272	***	par_4	.832	.692
H2←	ISOECO	1.000					.824	.678
K4←	LCYCT	1.034	.072	14.437	***	par_5	.792	.627
K5←	LCYCT	1.060	.075	14.123	***	par_6	.784	.615
K1←	LCYCT	1.000					.789	.622
K2←	LCYCT	0.993	.069	14.458	***	par_7	.782	.611
Absolute Fit		x^2/df = 2.745		p = 0.020		RMSEA = 0.077		
		RMR = 0.019		GFI=0.957		AGFI = 0.918		
Incremental Fit		NFI = 0.963	RFI = 0.946	IFI = 0.976	TLI = 0.965	CFI = 0.976		

***Significant at 0.001
SMC = Squared Multiple Correlations, Unstd = Unstandardised, Std = Standardised

Fit Indices for OSPP

Table 6.23 and Table 6.24 present the results of initial and final measurement models for OSPP respectively. In the initial measurement model for OSPP, the model did not achieve the desired model fit. With a degree of freedom of 188, the initial measurement model normed Chi-Square was above the recommended value of 3. The normed Chi-Square for OSPP initial measurement was 3.657. The model fit is mis-specified although all goodness-of-fit indices such as GFI = 0.809, AGFI = 0.765, NFI = 0.854, RFI = 0.837, IFI = 0.889, TLI = 0.876 and CFI = 0.889 were near to 0.9. This is because the initial measurement model for OSPP is not supported by the recommended value of RMSEA of 0.08. The RMSEA is 0.095 indicating a poor fit. The factor loadings: SMC and standardised regression weights showed values of above 0.6 and above 0.7 respectively which are significant.

Table 6.25: Items Retained and Reliability Analysis for OSPP

Items	α = 0.910
H2	Our organisation considers suppliers who have ISO 14001 as adhering to environmental regulations.
I2	Our organisation procures products that are environmentally labelled.
I3	Our organisation ensures eco-labels of products purchased are certified by country of origin.
K1	Our organisation buys products from suppliers that use life cycle analysis.
K2	Our organisation buys products from suppliers who consider the use of LCA as not incurring additional costs.
K3	Our organisation buys from suppliers who provide a LCA Report.
K4	Our organisation undertakes environmental performance evaluation of suppliers.
K5	Our organisation buys from suppliers who use life cycle analysis to evaluate their products' environmental friendliness.

In the OSPP final measurement model as shown in Table 6.24, the normed Chi-Square is 2.745 below the acceptable value of 3. The RMR value is 0.019, well below the recommended value of 0.080. All measure of goodness-of fit indices showed values of above 0.9. The RMSEA is 0.077 close to 0.08 which is acceptable (Meyer, Gamst & Guarino, 2006). Table 6.25 shows that 8 items were retained for the construct of OSPP construct where the reliability test for the construct showed a Cronbach alpha of 0.91. This is above the recommended value of 0.70 (Pallant, 2001).

Figure 6.7: Initial Measurement for OVALUES

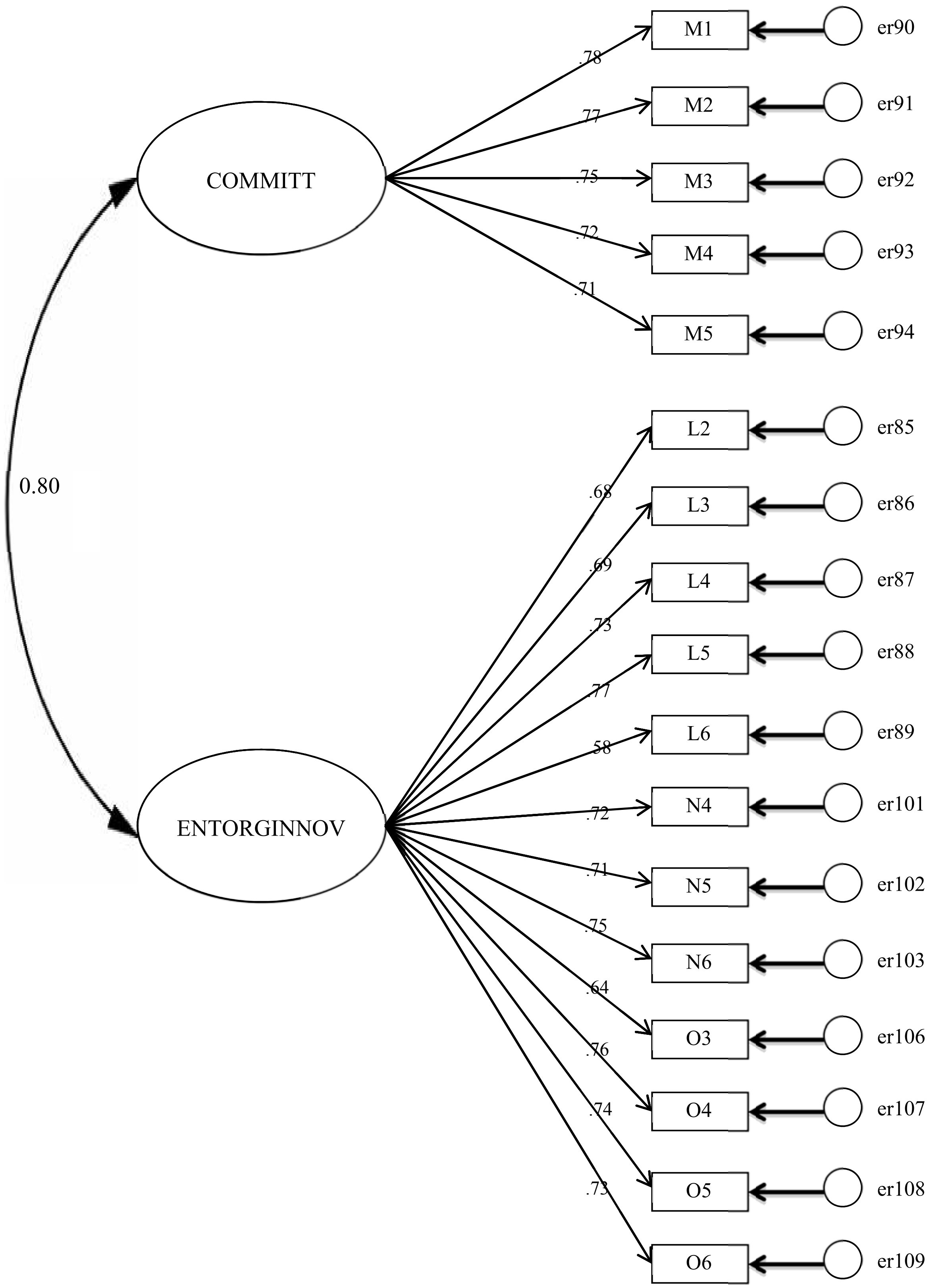


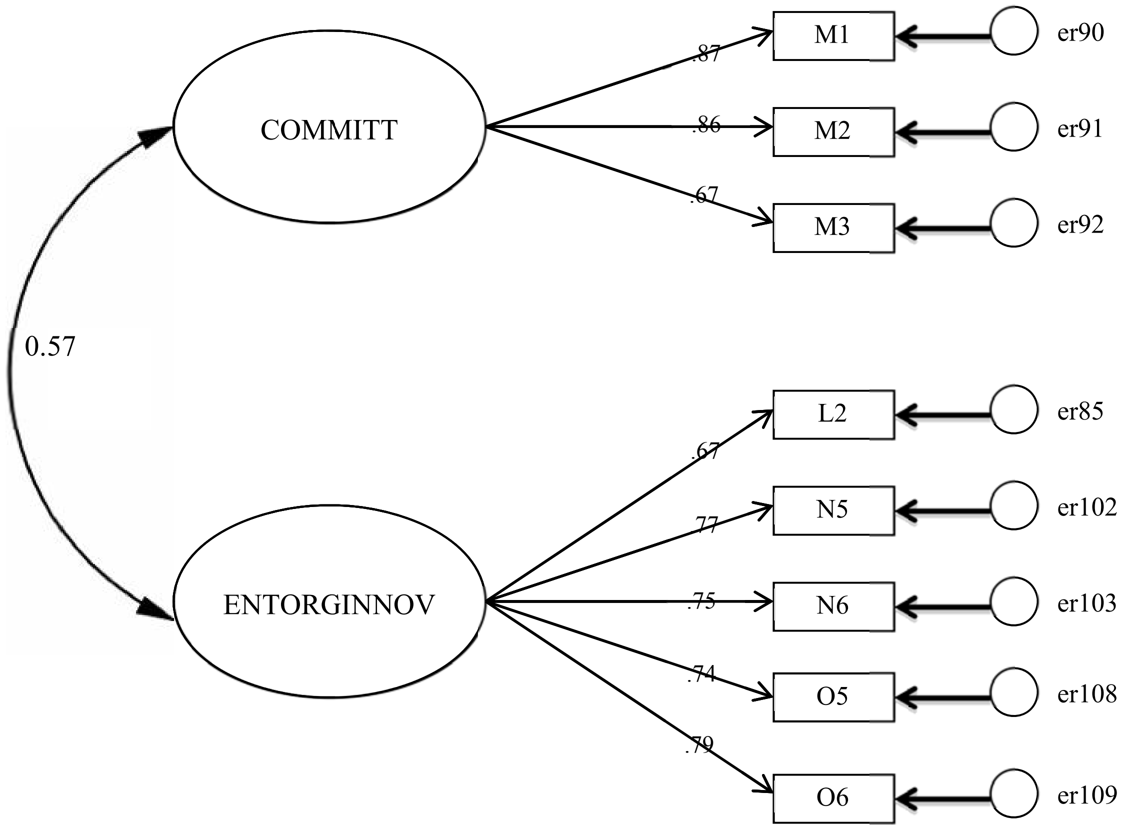
Table 6.26: Initial Fit Indices for OVALUES								
Items/Factors		Estimate Unstd	S.E.	C.R.	p	Label	Estimate Std	SMC
M1←	COMMITT	1.000					.780	.608
M2←	COMMITT	.933	.066	14.134	***	par_1	.780	.590
M3←	COMMITT	.860	.068	12.690	***	par_2	.768	.559
M4←	COMMITT	.965	.083	11.664	***	par_3	.748	.522
M5←	COMMITT	.867	.074	11.764	***	par_4	.722	.497
N4←	ENTORGINNOV	.931	.082	11.292	***	par_5	.705	.521
N5←	ENTORGINNOV	1.083	.097	11.173	***	par_6	.722	.501
N6←	ENTORGINNOV	1.043	.089	11.688	***	par_7	.708	.559
O3←	ENTORGINNOV	.855	.084	10.199	***	par_8	.747	.408
O4←	ENTORGINNOV	.965	.082	11.804	***	par_9	.639	.572
O5←	ENTORGINNOV	.997	.085	11.695	***	par_10	.75.6	.554
O6←	ENTORGINNOV	1.039	.090	11.535	***	par_11	.744	.536
L2←	ENTORGINNOV	1.000					.732	.459
L5←	ENTORGINNOV	.990	.082	12.018	***	par_13	.677	.591
L4←	ENTORGINNOV	.940	.081	11.551	***	par_14	.734	.539
L3←	ENTORGINNOV	.878	.080	10.929	***	par_15	.687	.472
L6←	ENTORGINNOV	.754	.083	9.130	***	par_16	.576	.331
Absolute Fit		x^2/df =3.248		p = 0.000			RMSEA= 0.087	
		RMR = 0.039		GFI= 0.860			AGFI = 0.819	
Incremental Fit		NFI = 0.870	RFI = 0.850	IFI = 0.906	TLI =0.891		CFI = 0.905	

***Significant at 0.001
SMC = Squared Multiple Correlations
Unstd = Unstandardised
Std = Standardised

Fit Indices for OVALUES

Table 6.26 showed the initial measurement model for OVALUES. The normed Chi-Square with 118 degree of freedom is 3.248. This is above the acceptable Chi-Square value of 2 for this study. The RMR of 0.039 is lower than the acceptable value of 0.08. Although measurement for the goodness-of-fit showed that they are nearly 0.9 and in cases such as IFI and CFI which are above 0.9, the model is poorly fit as the RMSEA is above the recommended value of 0.08. The RMSEA for the OVALUES initial model fit measurement is 0.087.

Figure 6.8: Final Measurement for OVALUES



<table>
<tr><th colspan="9">Table 6.27: Final Fit Indices for OVALUES</th></tr>
<tr><th colspan="2">Items/Factors</th><th>EstimateUnstd</th><th>S.E.</th><th>C.R.</th><th>p</th><th>Label</th><th>Estimate Std</th><th>SMC</th></tr>
<tr><td>N6←</td><td>ENTORGINNOV</td><td>1.059</td><td>.096</td><td>11.016</td><td>***</td><td>par_7</td><td>.753</td><td>.567</td></tr>
<tr><td>M1←</td><td>COMMITT</td><td>1.000</td><td></td><td></td><td></td><td></td><td>.865</td><td>.748</td></tr>
<tr><td>M2←</td><td>COMMITT</td><td>.943</td><td>.059</td><td>16.091</td><td>***</td><td>par_1</td><td>.861</td><td>.742</td></tr>
<tr><td>M3←</td><td>COMMITT</td><td>.697</td><td>.058</td><td>12.016</td><td>***</td><td>par_2</td><td>.672</td><td>.452</td></tr>
<tr><td>O5←</td><td>ENTORGINNOV</td><td>1.005</td><td>.091</td><td>11.053</td><td>***</td><td>par_10</td><td>.745</td><td>.555</td></tr>
<tr><td>O6←</td><td>ENTORGINNOV</td><td>1.135</td><td>..098</td><td>11.559</td><td>***</td><td>par_11</td><td>.794</td><td>.630</td></tr>
<tr><td>L2←</td><td>ENTORGINNOV</td><td>1.00</td><td></td><td></td><td></td><td></td><td>.672</td><td>.451</td></tr>
<tr><td>N5←</td><td>ENTORGINNOV</td><td>1.183</td><td>.106</td><td>11.165</td><td>***</td><td>par_6</td><td>.767</td><td>.558</td></tr>
<tr><td colspan="2" rowspan="2">Absolute Fit</td><td colspan="2">x^2/df = 2.065</td><td colspan="3">p = 0.004</td><td colspan="2">RMSEA= 0.060</td></tr>
<tr><td colspan="2">RMR = 0.029</td><td colspan="3">GFI= 0.968</td><td colspan="2">AGFI = 0.939</td></tr>
<tr><td colspan="2">Incremental Fit</td><td>NFI = 0.965</td><td>RFI = 0.949</td><td>IFI = 0.982</td><td colspan="2">TLI = 0.973</td><td colspan="2">CFI = 0.982</td></tr>
</table>

***Significant at 0.001
SMC = Squared Multiple Correlations
Unstd = Unstandardised
Std = Standardised

Table 6.27 showed the final measurement model for OVALUES. The normed Chi-Square is 2.065 which is acceptable as it is below the acceptable value for this study. The RMR is 0.029 which is below the recommended value of 0.08. Goodness-of-fit indices showed values of above 0.9. The RMSEA is 0.06 indicates a good model fit. The recommended value of a good model fit is 0.08 or lower (Hair et al., 2010; Meyer, Gamst & Guarino, 2006). All factor loadings are significant and with acceptable value as they are above 0.5, except items L2 and M3 where the SMC are close to 0.5. This model is accepted based on the recommended value of a good model fit (Hair et al., 2010; Meyer, Gamst & Guarino, 2006).

Table 6.28: Items Retained and Reliability Analysis for OVALUES	
Items	**α = 0.871**
M1	Our organisation is highly committed to environmental goals.
M2	Our organisation considers environmental issues to be very relevant to the organisation.
M3	Our organisation integrates environmental issues into our strategic planning process.
L2	Our organisation is the first to purchase environmentally friendly products.
N5	Our organisation sends staff to countries that are more advanced in environmentally-oriented procurement practices for training.
N6	Our organisation organises in-house environmental procurement training.
O5	Our organisation identifies sufficient possibilities of environmentally friendly products and services within the procurement market.
O6	Our organisation has developed an environmental procurement manual and documentation.

While Table 6.27 provides an analysis of the model fit for OVALUES, Table 6.28 shows that a total of 8 items were retained for OVALUES. A reliability test was conducted for internal consistency on items retained. The reliability achieved was Cronbach alpha 0.871 which is above the recommended value of 0.7 (Pallant, 2001). Fit Indices for analysing the goodness-of-fit indices for all constructs to measure OVALUES, it can be concluded the all the four constructs have achieved the threshold value of goodness-of-fit indices as recommended by the literature (Hair et al., 2010).

Figure 6.9: Initial Measurement for ENVORIENT

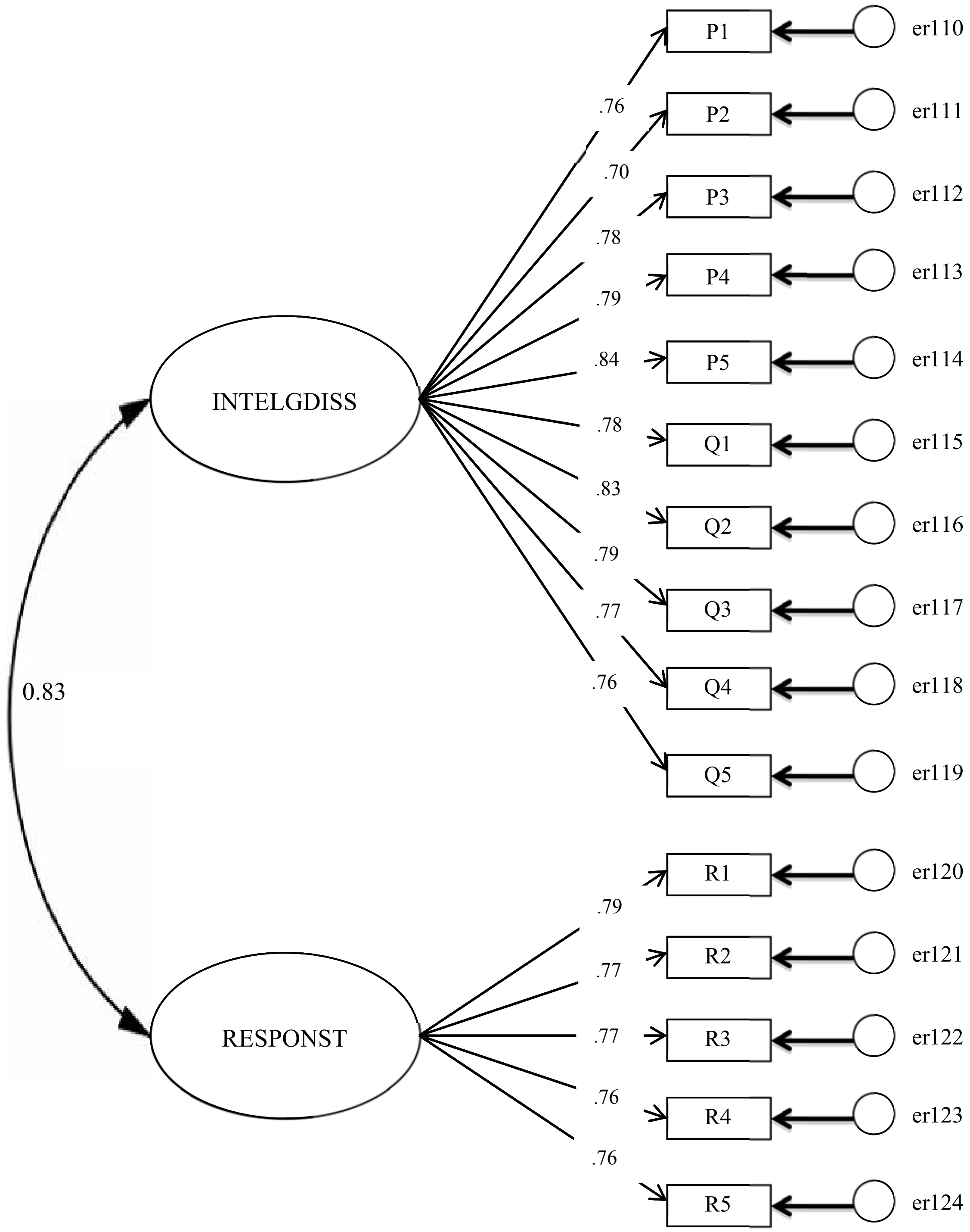


Table 6.29: Initial Fit Indices for ENVORIENT								
Items/Factors		**Estimate Unstd**	**S.E.**	**C.R.**	**p**	**Label**	**Estimate Std**	**SMC**
P1←	INTELGDISS	1.000					.756	.571
P2←	INTELGDISS	.839	.067	12.514	***	par_1	.698	.488
P3←	INTELGDISS	1.030	.073	14.024	***	par_2	.775	.601
P4←	INTELGDISS	1.042	.073	14.303	***	par_3	.794	.631
P5←	INTELGDISS	1.086	.071	15.241	***	par_4	.835	.697
Q1←	INTELGDISS	1.045	.074	14.056	***	par_5	.782	.611
Q2←	INTELGDISS	1.093	.072	15.109	***	par_6	.830	.689
Q3←	INTELGDISS	1.112	.079	14.107	***	par_7	.790	.624
Q4←	INTELGDISS	1.022	.074	13.801	***	par_8	.773	.598
Q5←	INTELGDISS	.969	.072	13.518	***	par_9	.759	.576
R1←	RESPONST	1.000					.786	.618
R2←	RESPONST	1.020	.072	14.159	***	par_10	.771	.594
R3←	RESPONST	1.060	.077	13.746	***	par_11	.773	.597
R4←	RESPONST	1.011	.074	13.601	***	par_12	.760	.488
R5←	RESPONST	1.023	.075	13.595	***	par_13	.762	.577
Absolute Fit		x^2/df =2.882		p = 0.000		RMSEA= 0.080		
		RMR = 0.026		GFI= 0.896		AGFI = 0.816		
Incremental Fit		NFI = 0.919	RFI = 0.904	IFI = 0.945		TLI = 0.935		CFI = 0.945

***Significant at 0.001
SMC = Squared Multiple Correlations
Unstd = Unstandardised
Std = Standardised

Fit Indices for ENVORIENT

Figure 6.9 and Table 6.29 show the results of initial measurement for ENVORIENT. The construct of ENVORIENT has two factors: INTELGDISS and RESPONST. In the initial measurement ENVORIENT has 15 items. Analysing the model fit, the initial measurement normed Chi-Square was acceptable because the value of 2.882 was still below the threshold value of this study which is 3. Although the value of goodness-of-fit indices for ENVORIENT were above the threshold value of 0.90 as indicated by GFI = 0.896, AGFI

= 0.816, NFI = 0.919, RFI = 0.904, IFI = 0.945, TLI = 0.935 and CFI = 0.945, the value 0f RMSEA of 0.08 can be considered as acceptable fit (Hair et al., 2010).

Figure 6.10: Final Measurement for ENVORIENT

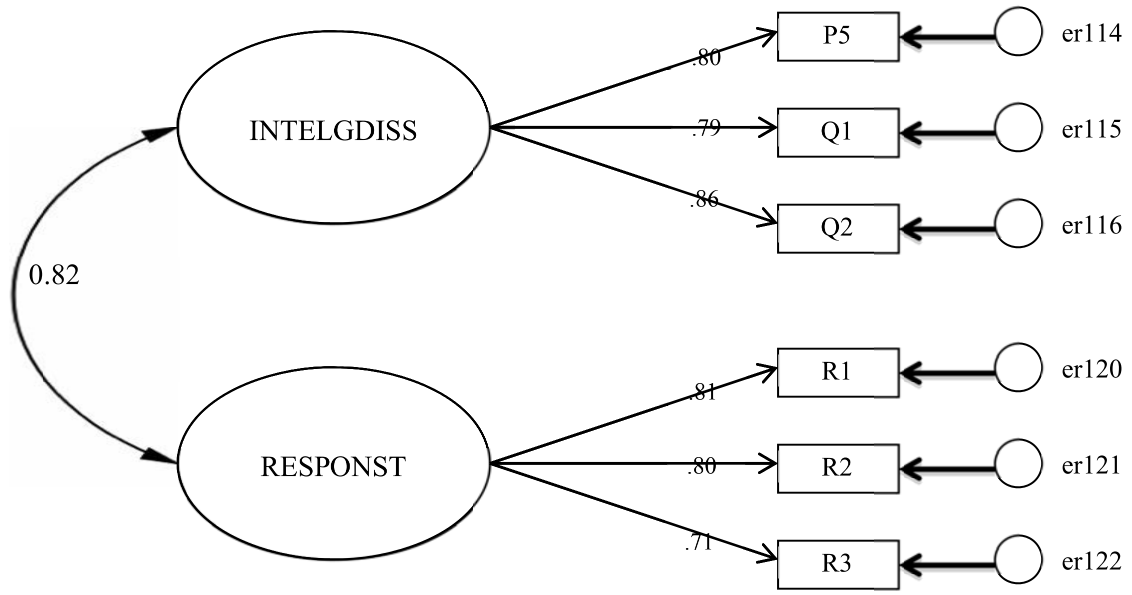


Table 6.30: Final Fit Indices for ENVORIENT								
Items/Factors		**Estimate Unstd**	**S.E.**	**C.R.**	**p**	**Label**	**Estimate Std**	**SMC**
P5 ←	INTELGDISS	1.000					.806	.640
Q1 ←	INTELGDISS	1.021	.071	14.376	***	par_1	.794	.631
Q2 ←	INTELGDISS	1.090	.070	15.464	***	par_2	.857	.742
R1 ←	RESPONST	1.000					.767	.664
R2 ←	RESPONST	1.020	.072	14.155	***	par_3	.783	.638
R3 ←	RESPONST	.942	.077	12.240	***	par_4	.769	.507

Absolute Fit	x^2/df = 1.697		p = 0.094		RMSEA = 0.049
	RMR = 0.015		GFI = 0.985		AGFI = 0.961
Incremental Fit	NFI = 0.985	RFI = 0.972	IFI= 0.994	TLI =0.988	CFI=0.994

***Significant at 0.001
SMC = Squared Multiple Correlations
Unstd = Unstandardised
Std = Standardised

Figure 6.10 and Table 6.30 show the final measurement model for ENVORIENT indicating that all goodness-of-fit indices achieved the threshold value of this study. The normed Chi-Square was 1.697. RMR was 0.015, GFI = 0.985, AGFI = 0.961, NFI = 0.985, RFI = 0.972, IFI = 0.988 and CFI = 0.994. The RMSEA for the ENVORIENT was 0.049 which was below the threshold value of 0.08 (Hair et al., 2010). The final measurement indicated that the model achieved a good model fit.

Table 6.31: Items Retained and Reliability Analysis for ENVORIENT	
Items	**α = 0.871**
P5	Our organisation conducts surveys on environmental compliance by our suppliers.
Q1	Our organisation has interdepartmental meetings on procurement at least once a month to discuss market trends and developments of environmental products.
Q2	Our organisation is quick to alert other departments when one department finds out something important about the environmental regulatory climate impacting on procurement.
R1	Our organisation effectively co-ordinates all environmental activities of different departments.
R2	Our organisation ensures that environmental criteria in the procurement procedures are implemented in timely manner.
R3	Our organisation immediately responds to changes in environmental pressures.

Table 6.31 shows the retained items and reliability analysis for ENVORIENT. The final measurement model for ENVORIENT shows that six items were retained as a measure for ENVORIENT. The reliability analysis for the construct is Cronbach alpha 0.87 which was above the recommended value of 0.7 (Pallant, 2001).

Figure 6.11: Initial Measurement for OPERF

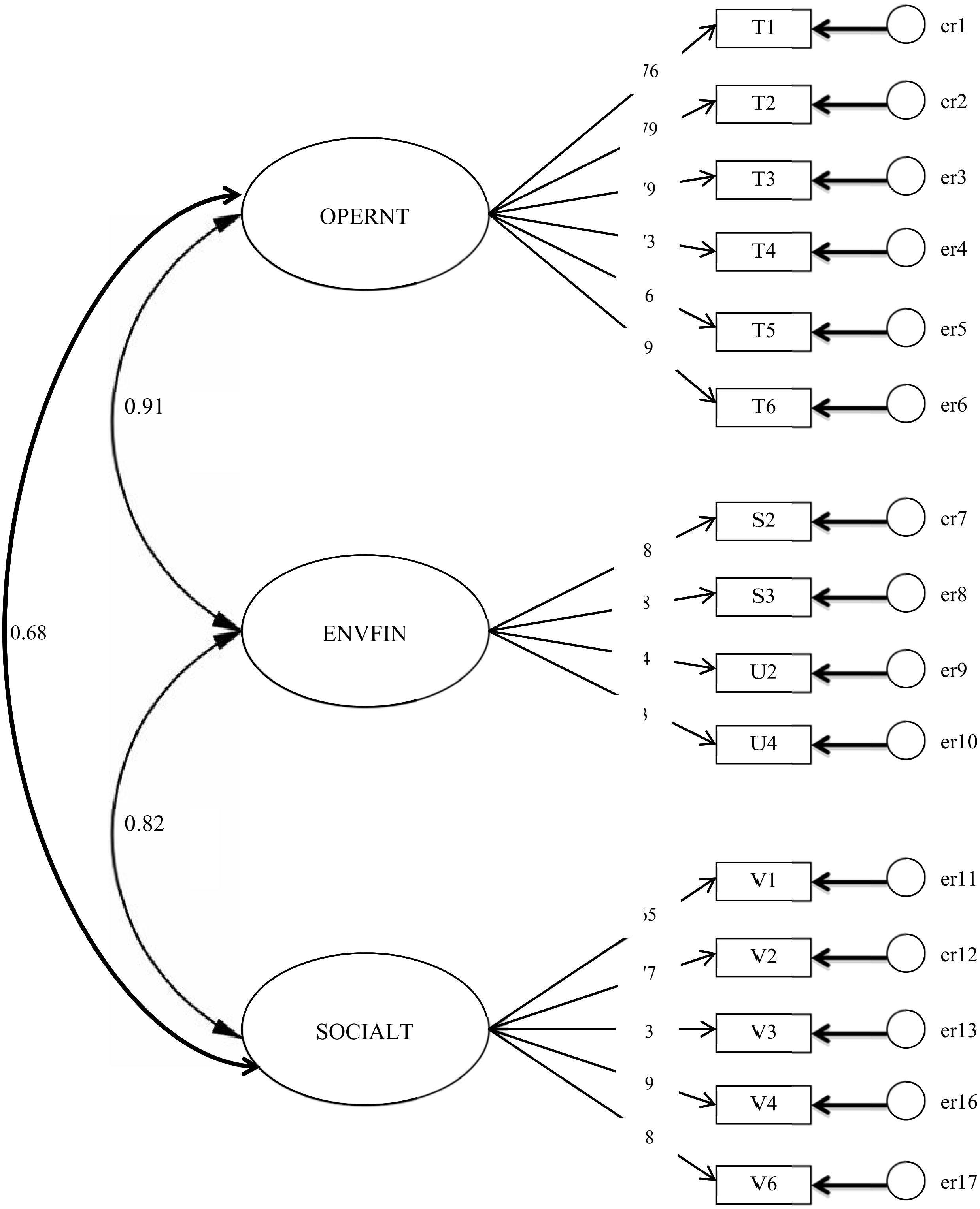


Table 6.32: Initial Fit Indices for OPERF								
Items/Factors		Estimate Unstd	S.E.	C.R.	p	Label	Estimate Std	SMC
T1←	OPERNT	1.000					.758	.574
T2←	OPERNT	.985	.072	13.895	***	par_1	.794	.631
T3←	OPERNT	1.080	.078	13.809	***	par_2	.790	.624
T4←	OPERNT	.959	.076	12.658	***	par_3	.731	.534
T5←	OPERNT	.983	.074	13.324	***	par_4	.762	.580
T6←	OPERNT	.894	.075	11.883	***	par_5	.692	.480
S2←	ENVFIN	1.000					.776	.602
S3←	ENVFIN	.813	.069	11.756	***	par_6	.682	.465
U2←	ENVFIN	.786	.072	12.957	***	par_7	.636	.405
U4←	ENVFIN	.934	.078	12.926	***	par_8	.731	.534
V1←	SOCIALT	1.000					.654	.427
V2←	SOCIALT	1.134	.104	10.888	***	par_9	.765	.586
V3←	SOCIALT	.885	.098	9.079	***	par_10	.630	.397
V4←	SOCIALT	1.059	.111	9.562	***	par_11	.685	.469
V6←	SOCIALT	1.114	.116	9.598	***	par_12	.675	.456
Absolute Fit		x^2/df = 2.566		p = 0.000		RMSEA = 0.073		
		RMR = 0.025		GFI = 0.909		AGFI = 0.874		
Incremental Fit		NFI = 0.903	RFI = 0.883	IFI = 0.938	TLI = 0.925	CFI = 0.938		

*** Significant at 0.001
SMC = Squared Multiple Correlations
Unstd = Unstandardised
Std = Standardised

Fit Indices for OPERF

Figure 6.11 and Table 6.32 show the results of initial measurement for OPERF. The initial measurement for OPERF has sixteen items. The normed Chi-Square for OPERF was acceptable. The value was below 3 for this study. All goodness-of fit indices showed that the values were above 0.9 except for RFI which was 0.883. The value for RFI of 0.883 could be considered as acceptable for this study. The value of 0.073 for RMSEA was just below the threshold value of 0.08. The model was re-specified to achieve a better model fit (Hair et al., 2010).

Figure 6.12: Final Measurement for OPERF

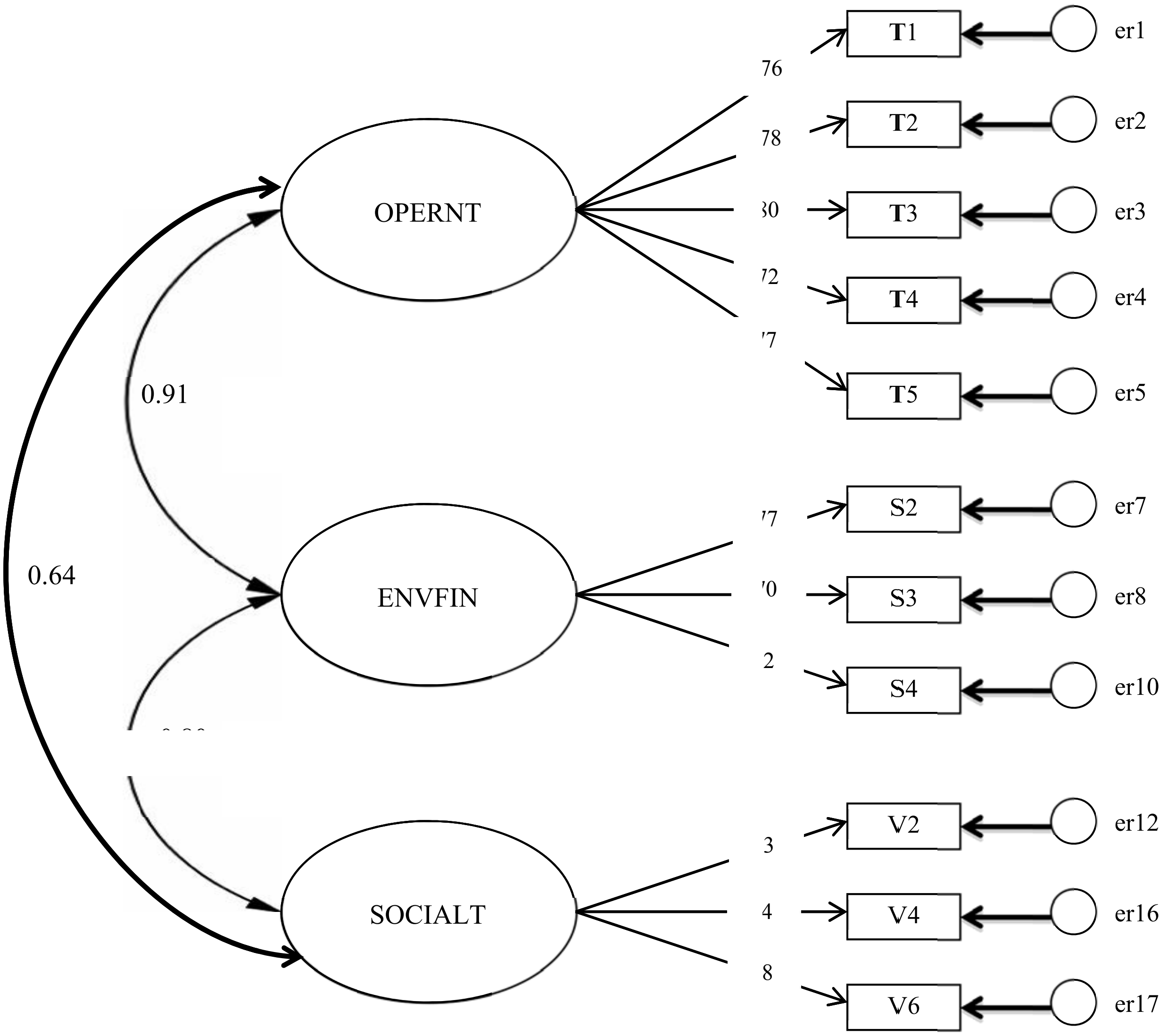


Table 6.33: Final Fit Indices for OPERF								
Items/Factors		Estimate	S.E.	C.R.	p	Label	Estimate Std	SMC
T1←	OPERNT	1.000					.764	.584
T2←	OPERNT	.967	.071	13.559	***	par_1	.775	.601
T3←	OPERNT	1.087	.078	13.950	***	par_2	.802	.643
T4←	OPERNT	.943	.075	12.531	***	par_3	.725	.526
T5←	OPERNT	.988	.073	13.488	***	par_4	.773	.597
S2←	ENVFIN	1.000					.772	.596
S3←	ENVFIN	.837	.071	11.796	***	par_5	.698	.487
U4←	ENVFIN	.931	.074	12.608	***	par_6	.725	.525
V2←	SOCIALT	1.000					.732	.536
V4←	SOCIALT	1.052	.103	10.235	***	par_7	.739	.546
V6←	SOCIALT	1.036	.109	9.481	***	par_8	.681	.464
Absolute Fit			x^2/df = 2.400	p = 0.000			RMSEA= 0.069	
			RMR = 0.022	GFI= 0.942			AGFI = 0.907	
Incremental Fit			NFI = 0.940	RFI=0.920	IFI=0.964		TLI=0.951	CFI = 0.964

***Significant at 0.001
SMC = Squared Multiple Correlations
Unstd = Unstandardised
Std = Standardised

Figure 6.12 and Table 6.33 show the results of final measurement for OPERF. The factor loadings for OPERF ranged between 0.681 and 0.802 (Table 6.33). The normed Chi-Square for OPERF was 2.4 below the value of 3 for this study. The goodness-of fit indices for OPERF were well above 0.9 and the RMSEA was 0.69. Analysing factor loadings and path coefficients, the values are significant and acceptable as they are close to 0.5. Table 6.34 shows that a total of ten items were retained for OPERF. Reliability analysis showed the items measurement achieved a Cronbach alpha of 0.876 above the required value of 0.7 for internal consistency (Pallant, 2001).

Table 6.34: Items Retained and Reliability Analysis for OPERF	
Items	**α = 0.876**
S2	There is a decrease in the volume of harmful products purchased from suppliers.
S3	There is an increase in the number of products purchased from suppliers who conform to environmental requirements.
T1	There is an increase of suppliers taking back packaging materials.
T2	The number of environmental products in our database has increased.
T3	There is increasing number of suppliers who are pre-qualified based on environmental criteria.
T4	There is an increase in the number of environmentally certified suppliers in our database.
T5	There is an increasing number of environmentally certified suppliers awarded procurement contracts.
V1	There is an increasing in measures implemented to ensure that employees' health and safety are well taken care.
V2	There is an increasing level of participation from employees in providing feedback on social issues confronting the organisation.
V4	There are periodic reviews and evaluations on performance of organisation's social activities.
V6	There is an improved awareness within the organisation of government's social initiatives.
U4	There is a decrease in fines due to our organisation's compliance with environmental regulations.

6.6.4 Evaluating Discriminant and Convergent Validity

Factors that met the requirements of face, content and construct validity are further evaluated for convergent and discriminant validity. If items that are indicators of a specific construct have a high proportion of variance in common, this is known as convergent validity (Hair et al., 2010, p. 709). It also evaluates how well multiple measures of the same construct agree with each other (Kerlinger, 1986). Convergent validity was assessed by measuring the extent to which items correlated with other items in the same factor. High correlations among items within each factor are considered to indicate convergent validity. The measurement for convergent validity is used to assess the value of composite reliability. Convergent validity is also shown in the value of statistically significant loadings giving an indication that an observed variable is able to measure a latent construct. It also provides a reasonable benchmark value of substantial magnitude of the parameter estimate indicating convergent validity is 0.70. To assess the convergent validity, the measurement model established by Bagozzi and Baumgartner (1994) was used. The formula is:

$$\gamma = \Lambda y \eta + \varepsilon$$

Discriminant validity is the extent to which a construct is distinct from other constructs (Hair et al., 2010). An additional facet of discriminant validity is construct validity (Fiske, 1982). Kline (1998) also suggested that discriminant validity can be supported when estimated correlations between factors are significantly less than one. Discriminant validity is achieved when the square root of the Average Variance Extracted (AVE) exceeds the inter-correlations of the construct with the other constructs in the model (Chin, 1998; Fornell & Larcker, 1981). Average Variance Extracted (AVE) was proposed by Fornell and Larcker (1981) as a measure for discriminant validity where the average variance explained (AVE) should be above 0.5. After the constructs achieved the required model fit as recommended by the literature, the convergent and discriminant validity were calculated.

Discriminant validity was calculated to investigate whether the variables measured different things. All constructs developed in order to measure environmental orientation conform to the measurement for convergent and discriminant validity. Table 6.35 and Table 6.36 showed the results of all the factors and constructs that conformed to discriminant validity with average variance extracted (AVE) of above 0.5. The composite reliability to assess convergent validity achieved for all constructs was above 0.7 (Fornell & Larcker, 1981). Other studies accepted the value of average variance extracted below 0.5 for discriminant validity (Bagozzi & Yi, 1998; Bagozzi & Baumgartner, 1994). During the CFA, results showed that all constructs achieved the recommended threshold values for the goodness-of-fit index (GFI) and conformed to validity requirements. The value of Average Variance Extracted (AVE) is used to determine discriminant validity. The formula is:

$$\rho_{vc\,(\eta)} = \frac{\Sigma\,\lambda^2 i}{\Sigma\,\lambda^2 + \Sigma\varepsilon i}$$

Table 6.35: Convergent and Discriminant Validity for Factors After CFA

Factors	Validity	
	Discriminant Average Variance Extracted (AVE) (≥0.5)	**Convergent Composite Reliability (CR) (≥0.7)**
ENFCONT	0.776	0.848
BIODEGT	0.622	0.815
HAZARDT	0.599	0.912
RPACK	0.534	0.889
RECYCLT	0.526	0.812
PISOECO	0.667	0.857
LCYCT	0.631	0.895
COMMITT	0.648	0.845
ENTORGINNOV	0.555	0.862
INTELLDISST	0.668	0.858
RESPONST	0.600	0.818
ENVFIN	0.534	0.667
OPERNT	0.587	0.850
SOCIALT	0.514	0.760
n = 295		

Table 6.36: Convergent and Discriminant Validity for Constructs After CFA

Constructs	Validity

	Discriminant Average Variance Extracted (AVE) (≥ 0.5)	Convergent Composite Reliability (CR) (≥ 0.7)
IPA	0.568	0.957
WM	0.527	0.924
OSPP	0.644	0.876
OVALUES	0.590	0.856
ENVORIENT	0.650	0.767
OPERF	0.511	0.912
n = 295		

Convergent validity can also be assessed using regression weights, standardized regression weights and squared multiple correlations (SMC). Standardised regression weights should be above 0.5 with values of above 0.7 as optimal (Hair et al., 2006). On using SMC, there is no agreement among researchers on the acceptance level. Values of SMC between 0.4 and 0.5 indicate adequate measure of construct (Hair et al., 2006; Holmes-Smith, 2007). Analysing the value of SMC using AMOS version 18, all factors showed values of above 0.4 (Hair et al., 2006).

6.7 Summary

This chapter provided the basis for the structural equation to be discussed in Chapter 7. The proposed conceptual model of this study postulated that a link exists between the critical determinants that could influence environmental orientation. In answering the postulated relationship, critical determinants were identified and supported by the literature. A detailed questionnaire was designed to evaluate the extent of the determinants' influence on the orientation of government officers and their preference for environmental products.

Based on a review of the literature on scale developments, and measures used from studies on the logistics and supply chain as well as from other disciplines, multi-item scales were constructed for research constructs. Multi-item scales from previous studies were used. These scales have established a level of validity and reliability in measuring research constructs. These multi-items scales were modified and adapted for use in this study. Much effort and strategies were used to develop items for the survey instruments. A pre-test was conducted to ensure that the items used were clear and relevant. Recommendations by the panel of experts during the pre-test stage were adopted. A pilot study was conducted to ensure that the items used conform to content validity and the survey could be completed by respondents within the stipulated allotted time frame.

SPSS version 18 was utilised for data analysis. Rigorous data analysis was conducted to ensure the robustness of the measurement model. Factor analysis, exploratory factor analysis 1 and 2 were conducted where some items were deleted to conform to rigorous threshold level for internal consistency of Cronbach alpha (α) of above 0.7 and factor loadings of above 0.5. Using Amos version 18, confirmatory factor analysis (CFA) was conducted on constructs. The measurement of CFA for all constructs conformed to a rigorous threshold level of goodness-of-fit as recommended by the literature. A good goodness-of-fit for all constructs ensures that the measurement model is operating well. This would have implications for the assessment of the hypothesised structural model. Discriminant and convergent validity were also performed to assess the constructs. All constructs conformed to the measurement of discriminant and convergent validity of above 0.5 and 0.7 respectively.

CHAPTER SEVEN

ANALYSIS & FINDINGS

7.1 Introduction

Chapter 7 presents and discusses the key findings of this study. The main thrust of this section is to answer the thesis research questions stated in Section 1.4. This study postulates that the determinants of environment-oriented government procurement, that is, 'Integrated Product Attributes', 'Waste Management', 'Organisational Systems, Processes and Policies' and 'Organisational Values' have significant impact on organisational performance. To explore this proposition, a conceptual framework was developed and discussed in the earlier chapters. The survey instruments to measure these constructs were developed, validated and refined to test the hypotheses constructed for this study. The rest of the chapter is organised as follows:

Section 7.2 provides a description of the analysis of the research constructs with regard to various goodness-of-fit indices supported by the literature. This section specifically discusses the results of the Initial Structural Model. In Section 7.3, the model is re-specified to achieve the desired model fit where the hypothesised model fits with the data. The final structural relationships within the theoretical framework are assessed and the results of hypothesis tests are determined. The results are discussed in Section 7.4 by revisiting the hypotheses. Section 7.6 provides a summary of Chapter 7.

7.2 Structural Model and Hypotheses Testing

In the SEM analysis, goodness-of-fit tests are used to evaluate how well the model fits the data. There is no complete agreement among researchers on the best type of goodness-of-fit test. This is because each type of test produces its own unique insight into different aspects of model fit. Consequently, it is good practice to use a number of these different types of tests concurrently to provide a holistic assessment of the model fit, rather than use a single test by itself. This allows the overall model fit process to take into account sample size and model complexity (Gallagher et al., 2008).

The range of goodness-of-fit tests is discussed in detail in Chapter 6 with their threshold levels. In general, for this study, GFIs were used to obtain a final fitting model (Bryne, 2001). The threshold values of the normed Chi-Square should be below 2.0, the Comparative Fit Index (CFI) should be above 0.90 with a model of over 30 items, and above 0.95 with a model of over 12 items conforming to a minimum acceptable cut-off point of .90 (Bentler & Bonnet, 1980). Finally, the RMSEA should be below 0.08 and PCLOSE above 0.05. Meyers, Gamst & Guarino (2006) indicated that for RMSEA 0.08 reflect good fit, 0.08 to 0.1 reflects moderate fit and value of > 0.1 reflects poor fit.

Figure 7.1 represents the theoretical framework of this study showing the ten hypotheses that have been constructed for this study. Figure 7.2 and Table 7.1 show the results of the model fit evaluation for the Initial Model. Table 7.5 and Figure 7.3 show the results of the Final Model.

Figure 7.1: Research Model for Environmental Orientation

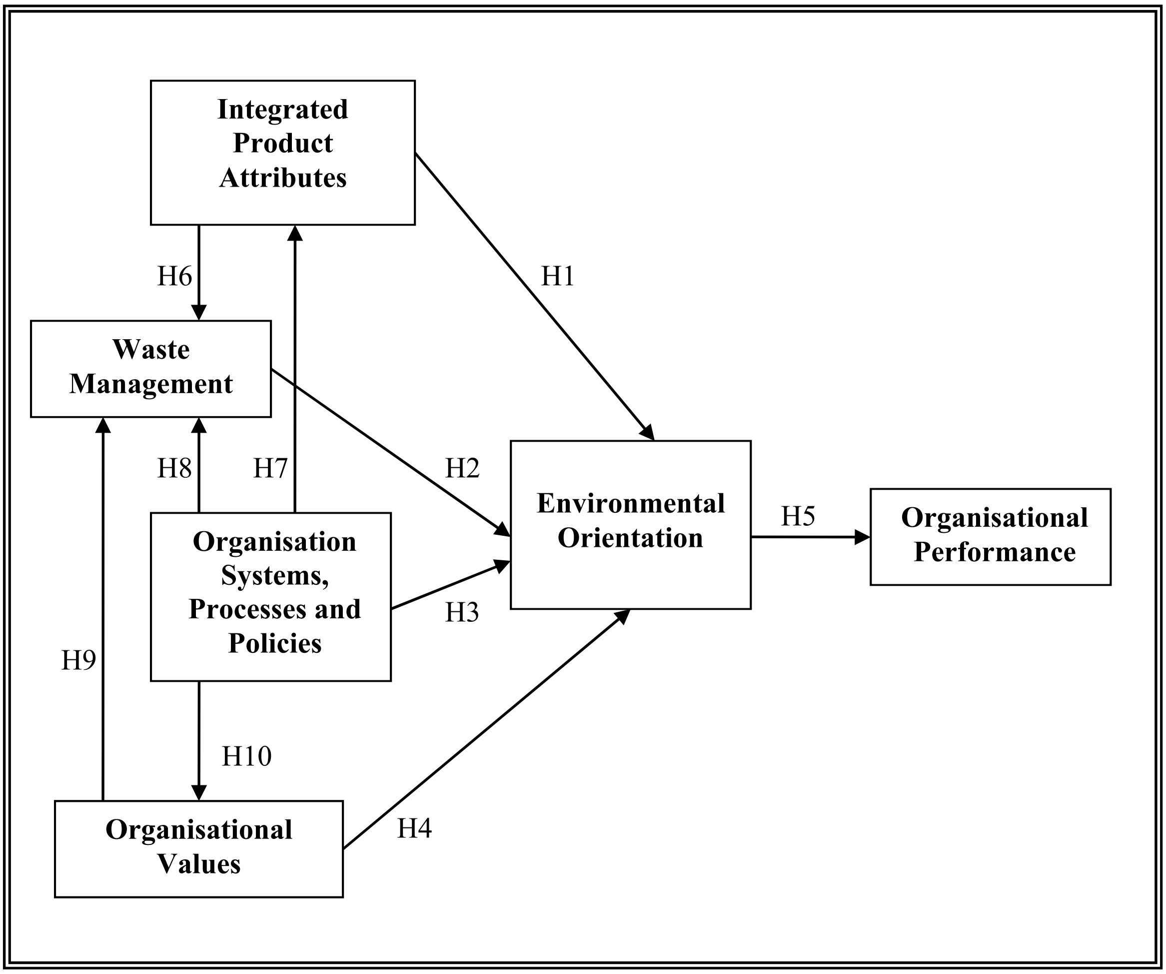


Figure 7.2: The Initial Model

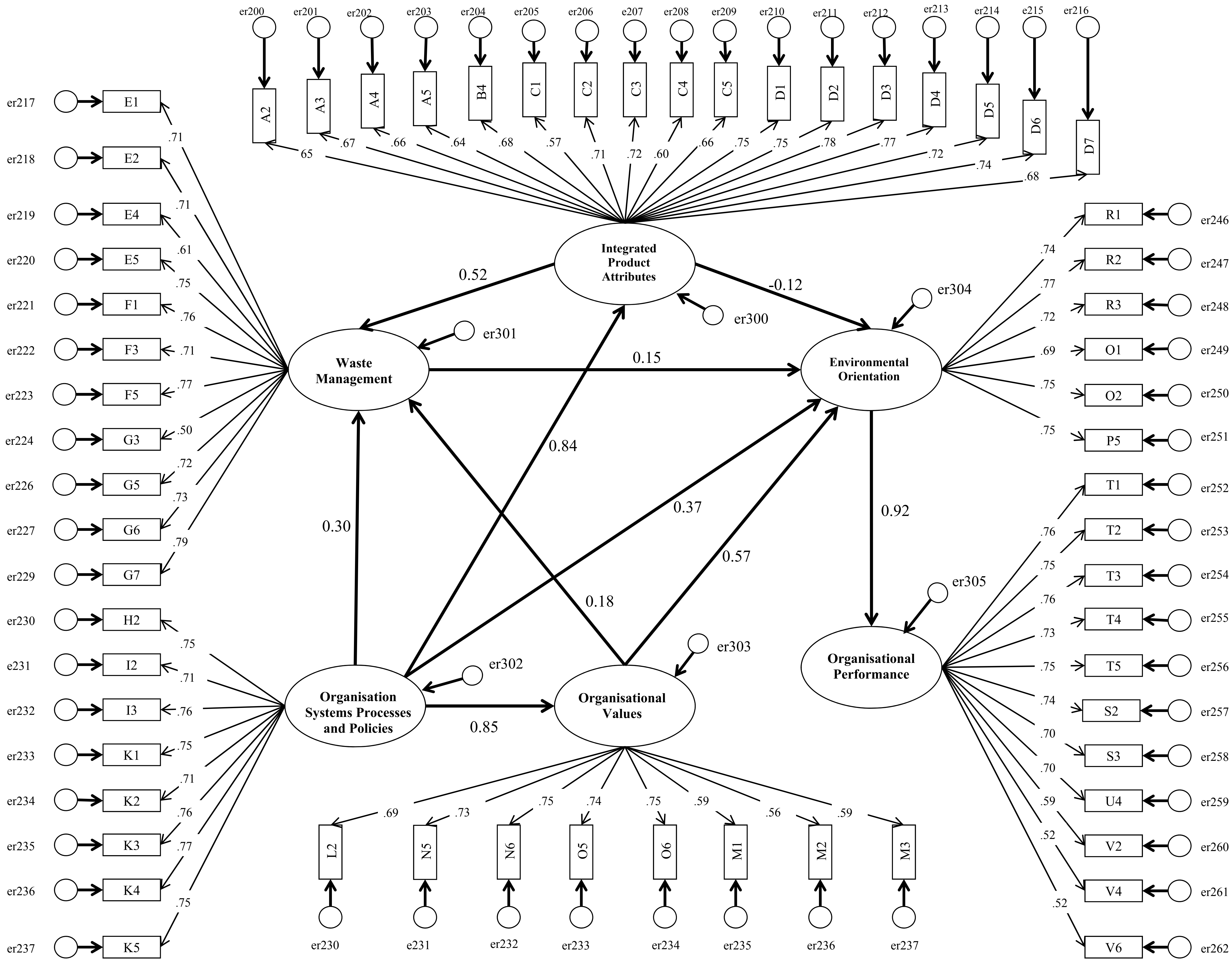


Table 7.1: Results of Initial Structural Model

Paths	EstimateUnstd	S.E.	C.R.	P	Label	s/ns
OVALUES←OSPP	.584	.062	9.347	***	par_59	s
IPA ←OSPP	.738	.068	10.785	***	par_64	s
WM←OSPP	.299	.099	3.022	.003	par_60	s
WM←IPA	.587	.084	6.959	***	par_61	s
WM←OVALUES	.265	.109	2.434	.015	par_63	ns
ENVORIENT←IPA	-.128	.097	-1.323	.186	par_55	ns
ENVORIENT←WM	.145	.111	1.313	.189	par_56	ns
ENVORIENT←OSPP	.347	.104	3.330	***	par_57	s
ENVORIENT←OVALUES	.777	.133	5.858	***	par_62	s
OPERF←ENVORIENT	.948	.076	12.500	***	par_58	s

Absolute Fit	DF 1759		x^2/df = 2.385		p = 0.000	
	RMR = 0.0040		GFI= 0.638	AGFI = 0.611	RMSEA= 0.069	
Incremental Fit	NFI = 0.706	RFI= 0.694	IFI=0.805	TLI= 0.796	CFI= 0.804	PCLOSE = 0.000

***Significant at 0.001
s = Supported
ns = Not Supported

Results of the initial Structural Equation Modelling are shown in Table 7.1 and Table 7.1.1. Table 7.1 shows the results of the initial structural model. While Table 7.1.1 showed the values of factor loading for all items for the initial structural model. The results indicate that the value of x^2 with 1759 degrees of freedom is 4194.786, providing little guidance in ascertaining the model fit. The Chi-Square of showing the p value of 0.000 is below the threshold value of 0.05. However, the Chi-Square is too sensitive to sample size and is no longer relied upon as a basis for acceptance or rejection (Schermelleh-Engel et al., 2003; Vandenberg, 2006). Other goodness-of-fit measures such as GFI, NFI, RFI, IFI, TLI and CFI showed that the Initial Structural Model is not a good fit to the data as all the indices of goodness of fit are below the value of 0.9 (Hair et al., 2006).The RMSEA value of 0.069, although within the acceptable range of 0.05 to 0.08, still does not indicate a good model fit, a conclusion reinforced by the PCLOSE value which is far below the required 0.005. The normed Chi-Square of 2.798 is within the acceptable range between 2 and 3 as suggested by Joreskog & Sorbom (1993) and Wheaton et al., (1977). Analysis of absolute and incremental fit indices reveals that the model fit is not acceptable as the fit indices are below the 0.9 threshold value (Hair et al., 2010; Singh, 2010). It is thus reasonable to conclude that the initial model does not fit well and it is therefore rejected. The model needs to be re-specified to achieve a good model fit.

Table 7.1.1: Factor Loadings for the Initial Structural Model

Items	Standardised Regression Weights	Squared Multiple Correlations (SMC)
D7	0.682	0.465
D6	0.741	0.549
D5	0.715	0.512
D4	0.769	0.592
D3	0.756	0.572
D2	0.778	0.606
D1	0.748	0.559
C5	0.656	0.430
C4	0.596	0.355
C3	0.715	0.511
C2	0.707	0.500
C1	0.574	0.329
B4	0.675	0.456
A5	0.642	0.412
A4	0.660	0.436
A3	0.669	0.447
A2	0.648	0.420
G7	0.787	0.620
G6	0.728	0.530
G5	0.721	0.519
G3	0.497	0.247
F5	0.765	0.585
F3	0.714	0.510
F1	0.757	0.573
E5	0.750	0.562
E4	0.608	0.370
E2	0.705	0.496
E1	0.713	0.509

Continued:

Table 7.1.1: Factor Loadings for the Initial Structural Model		
Items	**Standardised Regression Weights**	**Squared Multiple Correlations (SMC)**
K5	0.754	0.568
K4	0.773	0.597
K3	0.763	0.582
K2	0.710	0.505
K1	0.746	0.557
I3	0.757	0.573
I2	0.712	0.508
H2	0.748	0.560
M3	0.587	0.345
M2	0.556	0.309
M1	0.589	0.346
O6	0.749	0.561
O5	0.736	0.542
N6	0.749	0.561
N5	0.733	0.537
L2	0.688	0.474
R1	0.740	0.548
R2	0.773	0.597
R3	0.721	0.520
Q1	0.691	0.478
Q2	0.751	0.563
P5	0.751	0.564
T1	0.763	0.583
T2	0.753	0.567
T3	0.755	0.569
T4	0.727	0.529
T5	0.751	0.564
S2	0.742	0.551
S3	0.695	0.484
U4	0.695	0.483
V2	0.593	0.351
V4	0.516	0.267
V6	0.524	0.274

The model is re-specified by analysing the value of factor loadings derived from square multiple correlations (SMC) (Table 7.1.1) by deleting non-significant items from the model. The rule on factor loading considered values that are below 0.3 indicate that the item is a poor measure of the construct and should be dropped (Hair et al., 2006; Holmes-

Smith, 2007). Therefore, items that have a factor loading below 0.3 would be deleted as the values are considered to be insignificant and a poor measure of construct (Hair et al., 2010). The process is repeated until an acceptable model fit is achieved.

7.3 Model Re-specifications

The goal of model re-specification is to improve the fit of the model (MacCallum, 1986). There are two methods for re-specifying the model –deleting non-significant items from the model or adding paths to the model based on empirical data. In order to ascertain that the model is correctly specified, there should be consistency between hypothesised models with the real world where a correctly specified model produces a good analysis of covariance among a set of variables (Holmes-Smith, 2007; Kline, 1998). The opposite occurs when a model is poorly specified. Therefore, to address a mis-specified model, existing variables can be deleted or new variables added, guided by analysis of the modification indices and examination of the critical ratios and standardised residuals (Jöreskog, 1984; MacCallum, 1986). The process of addressing the mis-specified model is also guided by the hypotheses so that the re-specified models are substantively meaningful (McCoach et al., 2007).

Table 7.2 shows modifications made to achieve model fit. Re-specifications have been made by analysing modification indices and square multiple correlations (SMC). Variables with low SMC and high covariances within items have been removed. To arrive at Model 1 (Table 7.2), a total of 39 items were removed from the data set. A total of 22 items were retained and the new dataset then re-analysed. Finally, 21 items were retained with one covariance to achieve the model fit as recommended in the literature (Hair et al., 2006). The goodness-of-fit results of Model 1 as shown in Table 7.2 have improved slightly. An x^2 of 3352 with df of 179 was achieved. As mentioned earlier, the Chi-Square (x^2) is not the only litmus test to determine goodness-of-fit. The normed Chi-Square (x^2/df) has improved further from 2.383 to 1.969, well below the threshold value of 3. The absolute and incremental fit of the new model have registered better results than the initial model. All but one of the GFI for Model 1 is 0.90 or more but the GFI is 0.89, which is slightly below the threshold value of 0.9. The RMSEA test shows a value of 0.057. This is below the recommended value of 0.08. The RMR value of 0.028 which is below the threshold value of 0.08 is good. The PCLOSE value is also good at 0.08 which is above the threshold value of 0.05. It can be concluded that Model 1 is a good model fit with no covariance.

The same processes were repeated for Models 2 to 5 with the objective of achieving better model fit and improved structural paths. As the models have been re-specified and items dropped, the new datasets were re-run using Amos 18 to re-evaluate the goodness-of-fit tests. Items have been carefully deleted and reinserted to enable the analysis of modification indices indicating covariances and the value of squared multiple correlation (SMC) generated from Amos 18 output. The normed Chi-Square (x^2/df) for Models 3 to 5 are below 2.0. All models show a reasonably good model fit where the RMSEA values are 0.053, 0.056, 0.051 and 0.056 respectively for Models 2 to 5. The GFI tests all have values above 0.9, except for AGFI which is within the acceptable range of 0.871 to 0.881. The RMR values for Models 2 to 5 are well below the 0.08 threshold and the PCLOSE value is above 0.05. There are covariances in Models 2 to 5 to achieve a good model fit. Model 5 is the Final Model based on overall goodness-of-fit indices which are acceptable and above the required threshold values, but also based on the results of the estimates of the structural paths. The critical ratio (C.R) on six paths shows a significant relationship at

0.001. Overall, the ratio of (x^2/df) is good at 1.908 which is less than the acceptable level of 3 (Joreskog & Sorborm, 1993). The goodness-of-fit indices achieved the threshold value of 0.90 (Hair et al., 2006). Model 5 showed the values for GFI = 0.90, NFI = 0.92, RFI = 0.90, IFI = 0.96 and CFI = 0.96. The Root Mean Square Error of Approximation (RMSEA), an informative criterion in covariance structural modelling, achieved a value of 0.056 which is less than 0.08, indicating a good model fit (Hair et al., 2010). The low standardised root mean square residual (RMR) of 0.029 is within the range of 0.08 or less (Hair et al., 2010).The RMR is good at 0.029 which is lower than the recommended level of 0.08. The PCLOSE is 0.150, well above the recommended value of 0.05.

Model 5 has achieved the threshold of model fit, as indicated by the indices of fit. It also conforms to acceptable values for sample size (i.e. more than 250 respondents, with observed variables of more than 30 (Hair et al., 2010),one covariance and 21items retained. Table 7.3 provides a summary of the structural paths. An examination of all structural paths shows that 7 paths are significant, one partially significant and two paths are insignificant. In other words, 7 hypotheses have been shown to be supported, one is partially supported and two hypotheses are not supported. Based on the combined goodness-of-fit tests, Models 2, 3, 4 and 5 are the better model fit with normed Chi-Square values of 1.827, 1.915 and 1.908 respectively. On the RMSEA test, models 2, 3, 4 and 5 have values of 0.053, 0.056, 0.051 and 0.056 respectively.

Based on the results provided by Amos, Model 5 is the preferred model over Model 4 because of the value of normed Chi-Square. Model 5 is also the preferred model because organisational values are critical in guiding the direction and effecting changes in organisations (Mack, Green & Vedlitz, 2008). Although the measurement of the goodness-of-fit is important, it should not override the importance of organisational reality.

In addition to using the goodness-of-fit tests, the values of factor loadings are also used to indicate the predictiveness of the model. Table 7.4 shows the values of standardised regression weights and squared multiple correlations. The standardised path should be at least 0.2 and ideally 0.3 in order to be considered meaningful (Chin, 1998). The value of the standardised path in the Final Model ranges from 0.7 to nearly 0.9. The squared multiple correlations in the final model indicate values ranging from nearly 0.6 to nearly 0.8. It can be concluded that all factor loadings are substantively high and statistically significant with regard to the constructs (Hair et al., 2010; Chin, 1998). Chin (1998) argued that all loadings should be at least 0.6 and ideally 0.7 or above indicating that each measure is accounting for 50 per cent or more of the variance of the underlying latent variable.

Table 7.2: Summary of Structural Model Re-specifications							
Goodness-of-Fit Test	**Threshold Values**	**Initial Model**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Chi Square	-	4194.786	352.250	325.170	339.026	312.254	339.554
df	-	1759	179	178	177	177	178
p value	≥ 0.005	0.000	0.000	0.000	0.000	0.000	0.000
normed Chi Square	1-3	2.383	1.969	1.827	1.915	1.764	1.908
RMR	< 0.08	0.040	0.028	0.026	0.029	0.027	0.029
GFI	0.9	0.638	0.896	0.904	0.901	0.909	0.901
AGFI	0.9	0.611	0.866	0.875	0.871	0.881	0.872
RMSEA	< 0.08	0.069	0.057	0.053	0.056	0.051	0.056
NFI	0.9	0.706	0.915	0.922	0.918	0.925	0.918
RFI	0.9	0.694	0.900	0.908	0.903	0.911	0.904
IFI	0.9	0.805	0.956	0.963	0.959	0.966	0.959
TLI	0.9	0.796	0.948	0.956	0.951	0.959	0.952
CLI	0.9	0.804	0.956	0.963	0.959	0.966	0.959
PCLOSE	> 0.05	0.000	0.083	0.284	0.141	0.420	0.150
Remarks	Covariance	-	No covariance	1 covariance Q2 & P5	2 covariance D4, D6 and R2,Q2	2 covariance D4 & D6, Q2 & P5	1 covariance D4 & D6

Table 7.3: Summary of Structural Paths					
Paths	p value				
	Model 1	Model 2	Model 3	Model 4	Model 5
OVALUES←OSPP	***	***	***	***	***
IPA←OSPP	***	***	***	***	***
WM←OSPP	0.108	0.107	0.111	0.110	0.111
WM←OVALUES	***	***	***	***	***
WM←IPA	***	***	***	***	***
ENVORIENT←WM	0.003**	***	0.002**	***	0.002**
ENVORIENT←OSPP	***	***	***	***	***
ENVORIENT←OVALUES	***	0.002**	***	0.002**	***
ENVORIENT←IPA	0.285	0.258	0.231	0.220	0.241
OPERF←ENVORIENT	***	***	***	***	***

***Significant at 0.001, **Significant at 0.005

Table 7.4: Factor Loadings for the Final Structural Model (Model 5)		
Items	Estimate Standardised	Squared Multiple Correlation (SMC)
D6	0.751	0.615
D4	0.749	0.630
D3	0.776	0.595
D2	0.860	0.593
D1	0.820	0.571
G7	0.784	0.569
F5	0.757	0.558
F1	0.764	0.594
K5	0.814	0.626
K4	0.814	0.602
K3	0.786	0.617
O6	0.776	0.663
N6	0.791	0.663
N5	0.771	0.583
R2	0.747	0.573
Q2	0.754	0.614
P5	0.756	0.673
T1	0.770	0.739
T2	0.772	0.603
T3	0.794	0.561
T5	0.784	0.564

Figure7.3: Model 5 - The Final Structural Model

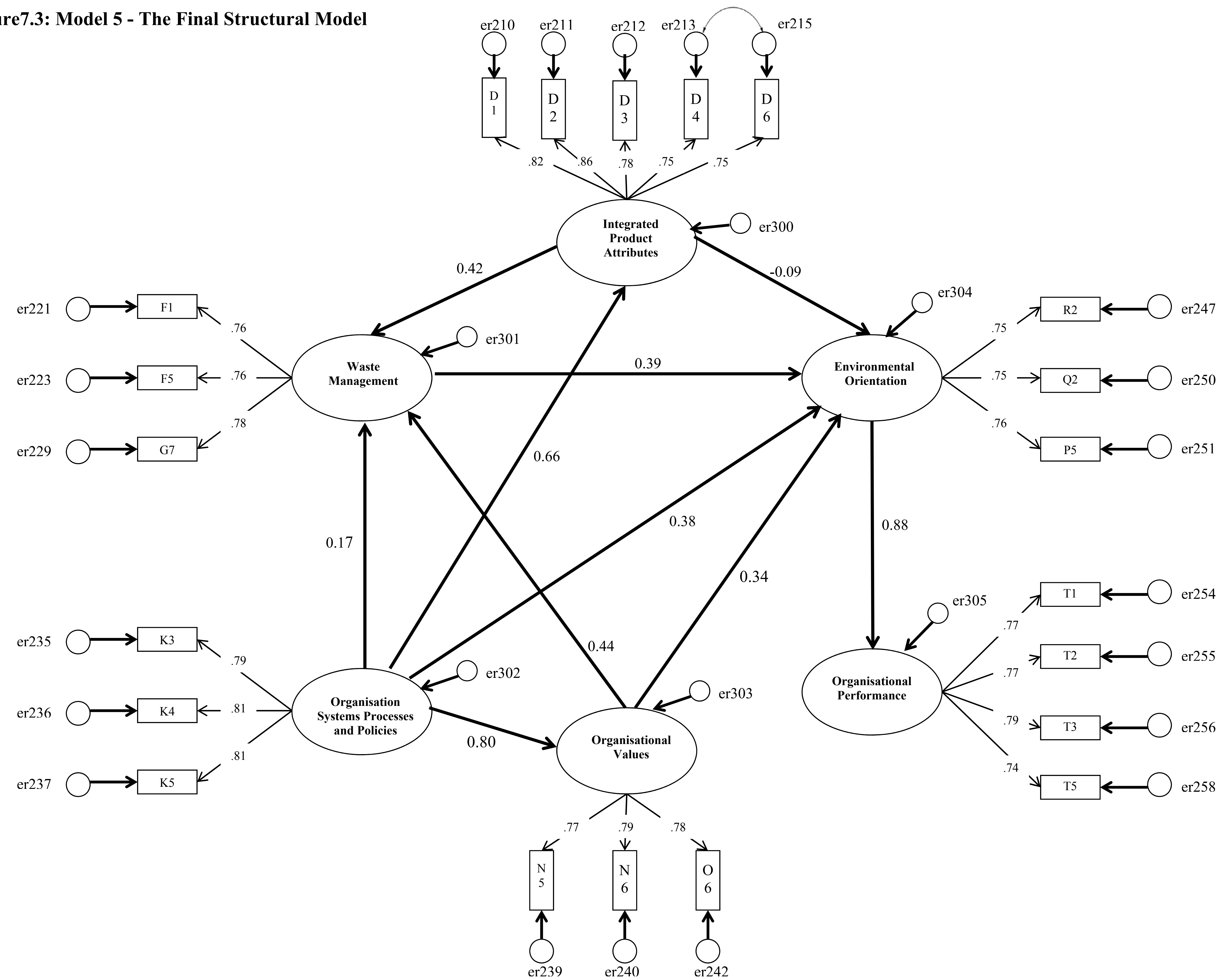


Table 7.5: Results of Final Structural Model (Model 5)						
Paths	**Estimate Unstd**	**S.E.**	**C.R.**	**p**	**Label**	**s/ns**
OVALUES←OSPP	.883	.078	11.316	***	par_19	s
IPA←OSPP	.585	.061	9.556	***	par_24	s
WM←OSPP	.159	.100	1.592	0.111	par_20	ns
WM←OVALUES	.362	.082	4.434	***	par_22	s
WM←IPA	.440	.071	6.196	***	par_23	s
ENVORIENT←WM	.387	.128	3.036	.002**	par_16	s
ENVORIENT←OSPP	.346	.084	4.144	***	par_17	s
ENVORIENT←OVALUES	.277	.083	3.324	***	par_21	s
ENVORIENT←IPA	-.092	.079	-1.172	0.241	par_25	ns
OPERF←ENVORIENT	.868	.071	12.192	***	par_18	s

Absolute Fit	df = 178		x^2/df = 1.908		P = 0.000	
	RMR = 0.029		GFI = 0.901	AGFI = 0.872	RMSEA = 0.056	
Incremental Fit	NFI = 0.918	RFI = 0.904	IFI = 0.959	TLI = 0.952	CFI = 0.959	PCLOSE = 0.150

***Significant at 0.001, **significant at 0.005
s = Supported
ns = Not Supported

7.4 Revisiting the Hypotheses

The results are evaluated based on statistical measures of standardised coefficient path and parameter estimates by Amos version 18 output. During the analysis of the final structural model (Model 5) in Table 7.2, Section 7.3, 8 out of the 10 hypotheses were supported to have positive relationships at p<0.01. The results of the hypotheses testing are presented below. The hypotheses are referred to as H1 to H10. The results of hypotheses testing are discussed below.

H1: Integrated product attributes are positively associated with environmental orientation of government procurement.

Hypothesis 1is not supported. A significant relationship between the construct Integrated Product Attributes (comprising factors of Energy Efficiency and Energy Conservation, Biodegradability and Non-Hazardous Materials) and the construct Environmental

Orientation of government procurement is not supported. The H1 path coefficient of -.092 is low and the critical ratio (C.R) value is -.1.172 and the p value is 0.241 as shown in Table 7.5.

What might account for the lack of a significant relationship between Integrated Product Attributes and Environmental Orientation? Although Singapore is a developed country in terms of per capita income, this achievement has been attained relatively recently in the last decade. Singapore might still have a long way to achieve the sustainable development values which are embedded in the Western democratic public institutions. This is evident that although public organisations in Singapore are making good progress in developing a number of environmental initiatives, there is still no specific legislation, policy directives and regulations that would direct public institutions to buy products that are environmentally-friendly. Singapore's public organisations procurement process is a case in point. The procurement process does not specially embed environmental requirements in the procurement policy (Ministry of Finance, 2012). The government procurement portal - GeBiz does not specify any environmental criteria in the calling for quotes, tenders and selection process in the awarding of tenders (GeBiz, 2009).

This is in direct contrast to the practices in the European Union and Scandinavian countries. The European and Scandinavian countries sustainable procurement practices are embedded into their Integrated Product Policies (IPP). The environmental criteria are central to the procurement process (Parikka-Alhola, 2008; Preuss, 2007; Rehfeld et al., 2007). With government green procurement, China enacted legislation in 2002 known as the Clean Production Promotion Law of the People's Republic of China requiring that government institutions to acquire environmentally friendly products (Qiao & Wang, 2011). Therefore, it is high time that Singapore introduces legislation with regard to environmental government procurement in line with her status as a developed country.

H2: Waste management is positively associated with environmental orientation of government procurement.

Hypothesis 2 is supported. There is a significant relationship between the construct of Waste Management comprising of factors: Reverse Logistics (RLOGT), Packaging (PACKGT) and Recycling (RECYCLT) and the construct of Environmental Orientation (ENVORIENT). The results show that the relationship is supported at p value < 0.005. The H2 path coefficient is 0.387, the C.R. value is 3.036 and the p value is 0.002. A detailed discussion is presented in Chapter 8, Section 8.2.1.1.

H3: Organisational systems, processes and policies are positively associated with environmental orientation government procurement.

Hypothesis 3 is supported. The H3 path coefficient is 0.79 and the CR value 3.437. The value of $p < 0.01$ indicated significant relationship. Organisational Systems, Processes and Policies consisting of factors such as Eco-Labelling (ECOLABLT), ISO 14001 (ISOT), Product Design (PRDGNT) and Life Cycle Analysis (LCYCT). A detailed discussion is presented in Chapter 8, Section 8.2.1.2.

H4: Organisational values are positively associated with environmental orientation of government procurement.

Hypothesis 4 is supported. The H4 path coefficient is 0.44 and the CR value is 4.606. The $p < 0.01$ indicates a significant relationship.

Organisational Values (OVALUES) measured by Entrepreneurship (ENTRPNT), Commitment (COMMITT), Organisational Learning (ORGLT) and Innovation INNOVNT) are shown to positively influence the environmental orientation of government procurement. In the literature on organisational culture, these values create an effective organisation that has a clear focus on results, clarity of goals and a decentralised decision-making structure (Moynihan and Pandey, 2004). This is discussed in detail in Chapter 8, Section 8. 2.1.3.

H5: Environmental orientation of government procurement is positively associated with organisational performance.

Hypothesis 5 is supported. The path coefficient is .91 and the CR value is 12.192. The value of $p < 0.001$ showed significant relationship. The construct environmental orientation of government procurement is measured by three factors: Intelligence Gathering (INTELGT), Intelligence Dissemination (INTELDISST) and Responsiveness (RESPONST have a significant relationship with the construct of Organisational Performance measured by four factors: Environmental (ENVRNMT), Financial (FINANCLT), Operational (OPERNT) and Social (SOCIALT). A more detailed discussion on the influence of environmental orientation on the performance of public organisations in Singapore is presented in Chapter 8, Section 8.2.2. This is because H5 is one of the research questions for this study as mentioned in Chapter 1, Section 1.4.

H6: Integrated product attributes are positively associated with waste management.

Hypothesis 6 is supported. The path coefficient is 0.42 and the CR value is 6.196. The value of $p < 0.001$ showed significant relationship**.** This hypothesis is constructed to measure the relationship between constructs. The construct of Integrated Product Attributes (IPA) are measured by four factors: Energy Efficiency (ENFT), Energy

Conservation (ENCONT), Biodegradability (BIODEGT) and Non-Hazardous Material (HAZARDT). In Singapore, the town councils which manage the day-to-day running of housing estates have plans to install LED lights in the common areas of 2,000 Housing Board blocks island-wide. This would help town councils save $5 million a year. The 10 town councils involved in the project have identified some 340,000 fluorescent lights in corridors and staircases to be replaced. LED, or light-emitting diode, lights use 60 per cent less energy, are just as bright, and generate far less heat than their less efficient counterparts. It costs about $60 to $80 to install an LED light, compared with $20 to $25 for a fluorescent one. However, an LED light lasts for 12 years, while a fluorescent light lasts for two years as such energy is conserved (Green Business Times, 2012). The National Environment Agency (NEA) in June 2007 signed a voluntary Singapore Packaging Agreement that managed to reduce packaging material by more than 800 tonnes per annum (NEA, 2012). The importation of fluorescent lamps containing mercury that exceed the stipulated limits of 5mg and 10 mg for compact and linear lamps respectively are not allowed for use and distribution. Fluorescent lamps are normally disposed of together with municipal waste at incineration facilities. Therefore controlling the amount of mercury present in our fluorescent lamps would help to minimize any release of mercury which is hazardous into the environment (NEA, 2013).

H7: Organisational systems, processes and policies are positively associated with integrated product attributes.

Hypothesis 7 is supported. There is a positive association of Organisational Systems, Processes (OSPP) comprising of factors: Eco-labelling (ECOLABLT), ISO 14001 (ISOT), Product Design (PRDGNT) and Life Cycle Analysis (LCYCT) and Policies on Integrated Product Attributes comprising of factor: Energy Efficiency (ENFT), Energy Conservation (ENCONT), Biodegradability (BIODEGT) and Non-Hazardous Material (HAZARDT).

The path coefficient is 0.66 and the CR value is 9.556. The value of $p < 0.001$ indicates a significant relationship. The results of SEM indicate that Organisational Systems, Processes and Policies have a positive and significant relationship with Integrated Product Attributes. Successful implementation of sustainable procurement requires much more up-to-date information, resources and database to promote green procurement activities across government institutions. The up-to-date information of green criteria supported by an established framework of systems, processes and policy reflect, as a measure of government commitment, could be embedded into procurement software as a default option which facilitates the tracking of greener purchases from government institutions (Lagault, 2000). Systems of incentives and disincentives have to be included in the architecture of government institutions that the operating culture of government is a culture of sustainability which currently does not exist. There would be an increasing supply of environmental products to meet government institutions requirement for sustainable products because businesses are responding with activities designed to meet the growing demand for environmentally friendly products (Pujari & Wright, 1996).

H8: Organisational systems, processes and policies are positively associated with waste management.

Hypothesis 8 is not supported. The path coefficient is 0.17 and the CR value is 1.592 and the p value is 0.111. Although the relationship between the construct of Organisation Systems, Processes and Policies (OSPP) comprising of factors: Eco-labelling (ECOLABLT), ISO 14001 (ISOT), Product Design (PRDGNT) and Life Cycle Analysis (LCYCT) and Waste Management (WM) consisting of factors: Reverse Logistics (RLOGT), Packaging (PACKGT) and Recycling (RECYCLT) is not supported, the results of the findings should be evaluated from an integrated and holistic perspective. There is a possibility that the construct of Waste Management (WM) is possibly addressed by the constructs of Integrated Product Attributes (IPA) and Organisational Values (OVALUES).

H9: Organisational values are positively associated with waste management.

Hypothesis 9 is supported. The path coefficient is 0.44 and the CR value is 4.434. The relationship between Organisational Values (OVALUES) measured by Entrepreneurship (ENTRPNT), Commitment (COMMITT), Organisational Learning (ORGLT) and Innovation (INNOVNT) and Waste Management (WM) measured by Reverse Logistics (RLOGT), Packaging (PACKGT) and Recycling (RECYCLT) showed that it is significant. Earlier discussion has shown that organisational values are critical in determining environmental orientation. The spirit of innovation can also be nurtured and supported. The Singapore's National Environmental Agency, a government institution, provided S$ 15 million funding under the Environment Research Technology Programme (ETRP). Initially, a grant of $4.8 million were given to five projects to develop waste management solutions (Neo, 2010). For example, one of the projects is to eliminate the problem caused by plastic waste so that there is less reliance on landfill. The other project is to develop a chemical catalyst to replace precious metal catalyst so that harmless gases are produced. This project also cut the cost of removing pollutants and other cancer-causing dioxins (Neo, 2010). The provision of research grants in the long term influences the development of environmental products and services, which consequently increases the availability of environmental products.

H10: Organisational systems, processes and policies are positively associated with organisational values.

Hypothesis 10 is supported. The path coefficient is 0.80 and the CR value is 11.316. The value of $p < 0.001$ shows a significant relationship. The application of Organisational

Systems, Processes and Policies (OSPP) which refer to ISO 14001 (ISOT), eco-labels (ECOLABLT), product design (PRDGNT) and life cycle analysis (LCYCT) show a positive and significant relationship with Organisational Values comprising of Entrepreneurship (ENTRPNT), Commitment (COMMITT), Organisational Learning (ORGLT) and Innovation (INNOVNT). From the results of the hypothesised relationship, it could be inferred that the application of organisational systems, processes and policies (OSPP) provided a degree of certainty for government officers to integrate environmental considerations in their procurement policies. Organisational systems, processes and policies (OSPP) provided operational manuals that are consistent with and support procurement requirements. Government officers were well aware that within the established framework of ISO 14001, eco-labelling, product design and life cycle analysis, the values of entrepreneurship, commitment, learning capability and innovativeness could be further enhanced.

Lynch (2010) conducted a study of 18 Australian state government departments which were responsible for environmentally-sensitive areas covering 2000-1 to 2007-8. He found that during the research period, environmental disclosures increased from 336 in 2000-2001 to 449 in 2007-2008. Based on the findings of this study, similar systems of environmental disclosures could be developed for government institutions in Singapore which reflect the principles of transparency and accountability. The adoption of an established framework of systems, processes and policies enabled government officials to learn quickly. ISO 14001 and similar tools have been used with considerable success in businesses to strengthen organisational values and facilitate change.

Table 7.6: Summary of Results of Hypotheses Testing				
Hypotheses	**S.E.**	**C.R.**	**p**	**Results**
H1: Integrated product attributes are positively associated with environmental orientation of government procurement.	-.092	.079	0.241	Not Supported
H2: Waste management is positively associated with environmental orientation of government procurement.	.128	3.036	0.002**	Supported
H3: Organisation systems, processes and policies are positively associated with environmental orientation of government procurement.	.084	4.144	***	Supported
H4: Organisational values are positively associated with environmental orientation of government procurement.	.089	3.325	***	Supported
H5: Environmental orientation of government procurement is positively associated with organisational performance.	.073	11.989	***	Supported
H6: Integrated product attributes are positively associated with waste management.	.071	6.196	***	Supported
H7: Organisation sysrems, processes and policies are positively associated with integrated product attributes.	.061	9.556	***	Supported
H8: Organisation systems, processes and policies are positively associated with waste management.	.100	1.592	0.111	Not Supported
H9: Organisational values are positively associated with waste management.	.087	4.437	***	Supported
H10: Organisation systems, processes and policies are positively associated with organisational values.	.072	11.386	***	Supported

*** p< 0.001, **p<0.005

Table 7.7 shows the results of correlation analysis. Correlation analysis showed that the relationships between constructs are significant based on the minimum value of 0.492 and maximum value of 0.712 for Pearson and Spearman correlations measuring bi-variate relationship. None of the correlational values is above 0.7 which implies that there are no multi-colinearity issues between constructs. The correlation analysis as shown in Table 7.8 results indicates that all six correlations among four determinants are positive and statistically significant (*p = 0.01*).

Table 7.7: Correlations Analysis							
	Constructs	IPA	WM	OSPP	OVALUES	ENVORIENT	OPERF
Pearson Correlations 1-tailed	IPA	1					
	WM	.659**	1				
	OSPP	.585**	.631**	1			
	OVALUES	.520**	.646**	.619**	1		
	ENVORIENT	.540**	.636**	.721**	.685**	1	
	OPERF	.547**	.697**	.637**	.651**	.691**	1
Spearman's rho 1-tailed	IPA	1.00					
	WM	.698**	1.00				
	OSPP	.603**	.661**	1.00			
	OVALUES	.539**	.659**	.619**	1.00		
	ENVORIENT	.540**	.647**	.730**	.685**	1.00	
	OPERF	.548**	.689**	.638**	.632**	.685**	1.00

**Correlation is significant at the 0.01 level
n= 295, 5-point Likert scale

7.5 Summary

This chapter focuses on the analysis of a structural equation model. It specifically looks at the assessment of the relationship of the independent constructs, and examines the size and significance of the path coefficient. The research hypotheses have been tested by examining the direction, strength and level of significance of the path coefficient calculated by Amos version 18. Correlation analyses have been performed to evaluate the presence of a multi-colinearity relationship between the constructs. A test of discriminant and convergence validity has also been conducted using the methods recommended by the literature. The use of SEM-Amos as a methodology is suitable for this study because SEM as a multivariate technique uses analysis of covariance to explore relationships among a set of variables. SEM also allows the testing of hypothesised models with sample data (Breckler, 1990; Kline, 1998). As a multivariate technique, SEM provides a number of advantages: flexibility and versatility in research design and data analysis (Hoyle, 1995), accounts for measurement errors (Raykov & Marcoulides, 2000), separates 'true variance' from 'error variance' and corrects unreliability within constructs which provides more accurate estimates of the relationship between latent variables (McCoach et al., 2007).

During the early stages of SEM, it was found that the initial conceptual model as suggested by the research literature was not consistent with the variances and covariances in the dataset. Adjustments were then made by removing items as suggested by SEM modification indices whereby a reasonable and significant model was finally achieved, with 21 items retained and one covariance as shown in Figure 7.3 Model 5 in Table 7.2. The final model conforms to the threshold values of model fit statistics of normed Chi-Square, goodness-of-fit indices (comparative and incremental), RMR, RMSEA and PCLOSE. Results of Amos 18 output shows the final model fits well in terms of the statistical tests mentioned earlier. The final model shows a normed Chi-Square of 1.908, RMR = 0.029, GFI = 0.901, AGFI = 0.872, NFI = 0.918, RFI = 0.904, IFI = 0.959, TLI =0.952, CFI =0.959 and RMSEA = 0.056 and PCLOSE of 0.150. In general, the data is consistent with the hypothesised model.

CHAPTER EIGHT

DISCUSSION, IMPLICATIONS AND CONCLUSION

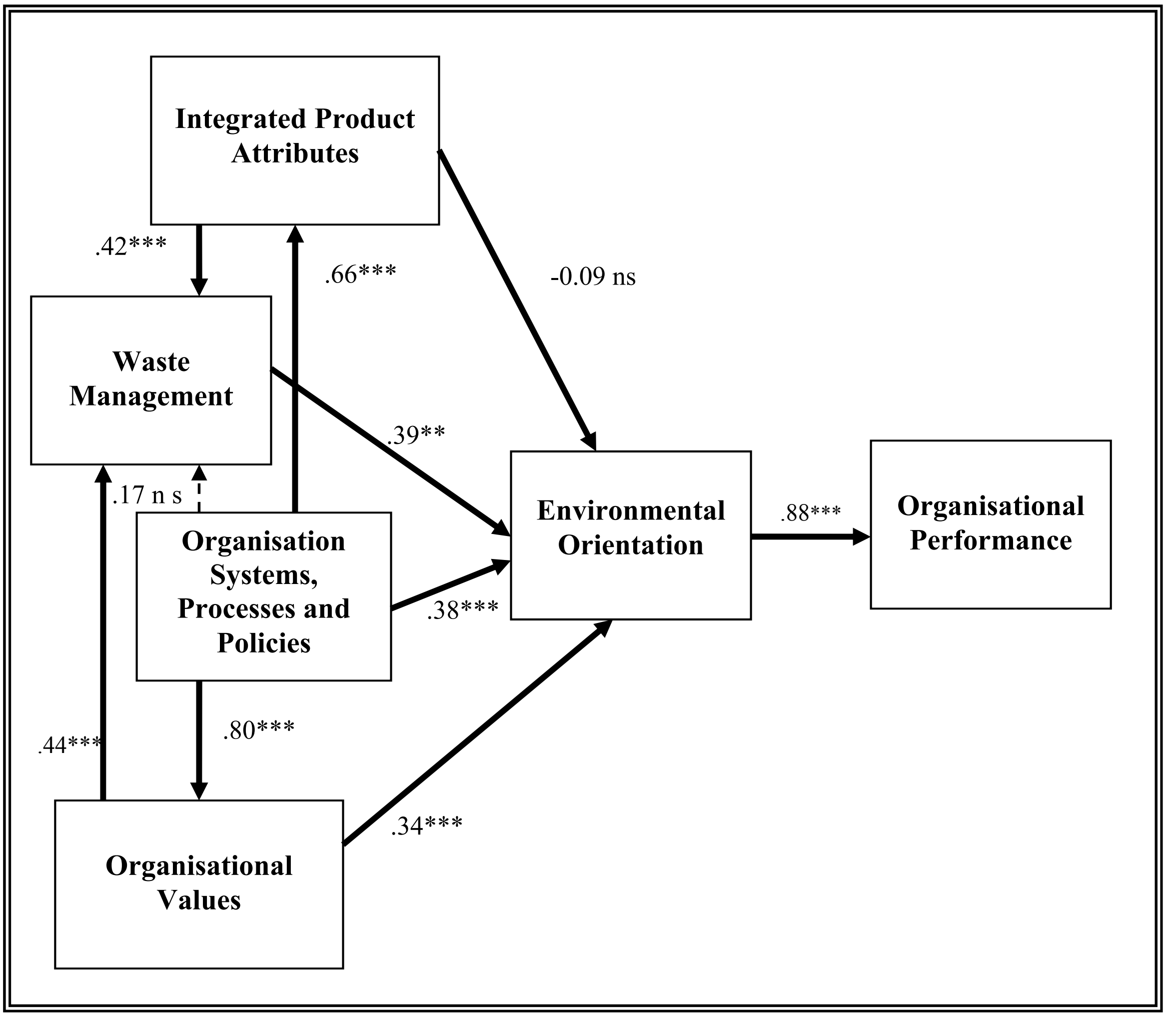
8.1 Introduction

This chapter addresses the two research questions presented in Chapter 1. Apart from acknowledging the limitations of this study, it also suggests possible areas of research to be undertaken in the future. This chapter is a culmination of this study which began by outlining the aims, rationale, developing research questions and proposing a research model for this study as discussed from Chapters 1, 2, 3 and 4 which are supported by literature. The research model for this study was discussed in detail and empirically tested and discussed in Chapters 5 and 6. Findings of this study are discussed in Chapter 7 where the constructed hypotheses are revisited. The chapter then discusses the research questions, the potential contribution of this study, both theoretically and practically as well as its limitations, and it also provides suggestions for future research before concluding.

8.2 Revisiting the Research Questions

This study began with the premise that while there has been much research in the area of sustainable procurement, which encapsulates economic, environmental, social and ethical issues (Steurer et al., 2007) much has concentrated on business organisations (Carter & Carter, 1998; Handfield et al., 2002). Academic research on procurement with specific reference to government procurement has been under-represented and not extensive. Drawing from the objectives and rationale of this study, a research model was developed and SEM was used to investigate three research questions. Figure 8.1 shows the final structural model where eight out of ten hypotheses were supported.

Figure 8.1:The Structural Paths of Final Model (Model 5)



*** significant p < 0.001,** significant at p < 0.005, ns = not supported

The following section addresses the research questions. Recently, environmental issues have been a major concern for business organisations from the strategic and business standpoint, but also for governments in addressing problems of managing waste, pollution and the impact on the environment due to climate change. Against this backdrop, this study has been designed to provide practical implications for practitioners in the areas of logistics and supply chains in general, but more specifically for practitioners in the area of procurement. The first research question below seeks to answer several questions with regard to the environmental orientation of government procurement. The research questions for this study are:

1. What are the determinants that influence the environmental orientation of government procurement in Singapore?
2. Do the determinants influence organisational performance of public organisations?

The following section addresses the two research questions and also provides an insight into to the extent to which these determinants influence sustainable procurement practices in Singapore.

8.2.1 What are the determinants influencing the environmental orientation of government procurement in Singapore?

In addressing the research questions, four latent constructs with 15 factors have been identified which are supported by literature. These factors are classified to form four constructs measuring environmental orientation. To operationalize these constructs, items have been developed that measure environmental orientation. The items of measurement were designed to measure the constructs and factors. The literature was referred to for the design of the survey questionnaire regarding item construction and the development of a scale to provide internal consistency. In Figure 8.1, three constructs: waste management, organisational systems, processes and policies; and organisational values are found to be the determinants influencing the environmental orientation of government procurement. It is thus concluded that environmental orientation is directly influenced by:

- Waste Management (WM)
- Organisation Systems, Process and Policies (OSPP)
- Organisational Values (OVALUES).

WM, OSPP and OVALUES as methodically measured and validated, are critical determinants from the perspective of public organisations in Singapore. The result of the study as validated by SEM also suggests that the determinants of environmentally-oriented government procurement practices must be implemented in combination. Thus, the degree to which each determinant is implemented is correlated with the implementation of other determinants to achieve a holistic, integrated and sustainable government procurement practice. The following is a discussion of the influence of these determinants on the environmental orientation of government procurement. Literature on the determinants of environmental orientation and examples of sustainable initiatives and practices undertaken by public institutions in other countries in general and Singapore specifically are used to support the findings of this study.

8.2.1.1 Waste management influences the environmental orientation of government procurement

Waste Management in this study is measured by factors of Reverse Logistics, Packaging and Recycling. By definition, reverse logistics is the flow of products from manufacturers to consumers and back to manufacturers to recapture their value and final disposal (Roger & Tibben-Lembke, 1998). The impact of reverse logistics is that resources recovered are used to make new products, thereby mitigating the need to extract new resources thus reducing the environmental impact (Miller & Sarder, 2011). For example, South Korea has implemented the regulations that extend to producer responsibility where manufactured products are returned to the manufacturers. A similar situation also occurs in Singapore where the take-back programme is implemented for office equipment. The National Environmental Agency (NEA) and the National Library Board (NLB) has started the take-back programme with manufacturers of printer ink and toner (GreenBusinessTimes, 2012)

The packaging of a product is also important. Although there are benefits derived from packaging such as optimising storage and distribution cost, packaging also contributes to waste (Unilever, 2012; Murphy & Wood, 2011). Therefore, research advocates the use of reusable packaging that protects the environment and has the benefit of reducing cost (Mollenkoft et al., 2005). Data from Eurostat (2010) showed that the amount of packaging waste generated annually in UK was estimated to be more than 10 million tonnes. In Singapore, domestic waste forms 58% of all waste disposed and one-third was packaging waste (National Environmental Agency, 2010).

Packaging waste has become a focus of attention by policy-makers in addressing environmental problems. In Singapore in 2007, the National Environment Agency (NEA) has signed a voluntary Singapore Packaging Agreement with product manufacturers to reduce packaging waste. This effort has managed to reduce packaging waste by more than 7,000 tonnes of packaging waste representing a saving of S$14.9 million (National Environmental Agency, 2011).

Recycling is also an important element in influencing procurement decisions. Research has identified a number of benefits derived from recycling. It can be argued that recycling impacts on the use of less energy and fewer resources in the manufacturing of products because recycled materials are used (Björklund & Finnveden, 2005). Erdmenger (2000) argued that when recycled papers were used, an annual cost reduction of 125,000 euros was achieved. A similar situation occurred in Dunkerque, France when the city procurement officials found that the use of recycled papers cost the municipality 16 per cent less (Plas & Erdmenger, 2000). Hence, recycling has become one of the primary strategies to manage waste (Mo, Wen & Chen, 2009; Ketlogetswe & Mothundi, 2005).

South Korea, for example, has intensified the use of recycling to protect the environment from an increase of electronic and electrical waste (Lee, Song & Yoo, 2005).

In Singapore, the government has targeted 65% recycling rate by 2020 from 56% in 2008, and 70 % by 2030. To date, the recycling rate has increased to 58% in 2010 compared to 2008. To achieve 70% recycling rate, the government in 2008 amended the Environmental Public Health Act to provide recycling receptacles in all housing estates (National Environmental Agency, 2012). While Singapore may lag behind other developed countries with regard to legislation to entrench environmental government procurement, she is at the fore-front in waste water management technology. Singapore now relies on the extensive use of recycled water (Tan, 2009). Singapore’s investments in the waste water management also reflect entrepreneurship, commitment, learning and innovation in the public sector.

8.2.1.2 Organisation systems, processes and policies influence environmental orientation of government procurement

Organisational Systems, Processes and Policies are found to be significantly correlated with Environmental Orientation. These are standardised environmental measures that are internationally-recognised and supported with validated and verifiable manuals that can used for training purposes; they can also be used to evaluate the environmental performance of organisations. The construct of Organisational Systems, Processes and Policies, comprising Eco-labelling, ISO 14001, Product Design and Life Cycle Analysis, are critical determinants for Environmental Orientation. This study provides an insight into the way these determinants can be adopted and integrated into sustainable government procurement process. It is consistent with earlier studies on CSR found in logistics and supply chain literature and also literature on purchasing social responsibility (Carr & Pearson, 2002; Carter, 2005; Carter et al., 2000).

The use of eco-labelling has gained acceptance world-wide. Eco-labelling can constitute to some extent an environmentally effective and economically efficient policy (Ibanez & Grolleau, 2007). Eco-labelling such as Energy Star (USA) and Blue Angel (Germany) often exceed the legislative requirements of environmentally-friendly products. Blue Angel has often been used as a basis to develop green procurement guidelines (Mulder, 1998). The 'Green Tick' eco-label which conforms to the ISO 14001 has been accepted by consumers as a gauge of sustainability. According to Harris (2007), organisations have benefited from using the eco-label for their products. Market trials of certified household products and lamb meat in Australasia have confirmed positive consumer acceptance on the eco-label (Harris, 2007).

The National Environment Agency (NEA) has also issued eco-labels. It is mandatory for registered suppliers of air-conditioners, refrigerators and clothes dryers to affix the Energy Label to their appliances. The NEA has also issued the Fuel Economy Label (FEL). It is also mandatory for registered suppliers of motor vehicles to affix the label. The FEL shows the fuel consumption of the vehicle, which indicates how much fuel is needed for travelling a certain distance. This provides a clear criterion for government procurement decisions (Tay, 2011). The NEA has also established the Design for Efficiency Scheme (DfE). The scheme provides assistance to manufacturers to improve in the areas of energy and resource efficiency at the design stage (IMCSD, 2009).

The Building and Construction Authority, a statutory board in 2005 launched the Green Mark Scheme to help Singapore's construction industry to build more environmentally-friendly buildings. Apart from promoting sustainability in the built environment and raising environmental awareness among developers, designers and builders, the BCA Green Mark is a green building rating system that evaluates a building for its environmental impact and performance (IMCSD, 2009).The BCA has also launched the Green Mark Scheme to promote the labelling of resource-efficient buildings.

Studies have shown that buildings could achieve 10% to 30% reduction in energy consumption through energy-efficient building design and the use of energy-efficient equipment (IMCSD, 2009). Public organisations in Singapore such as BCA have a zero energy building under the Green Building Master Plan. The 4500m^2 building generates its own electricity from solar panels and reduces its energy needs through the use of green building technology and design (NCCS, 2012). The Punggol Eco-Town is a test bed for new urban living solutions by creating a green living environment. The Punggol Eco-Town is a public-private partnership between Japanese electronics firm Panasonic and three government agencies: Economic Development Board (EDB), Energy Market Authority (EMA) and the Housing & Development Board (HDB). The Singapore Green Building Council (SGBC) is working with the Singapore Ministry of Education (MOE) and 20 schools to monitor and improve energy use and performance by installing smart meters in each school (ZDNet, 2012). Even buildings for worship have joined the drive to be green. As a buyer, the Majlis Ugama Islam Singapore (MUIS), a statutory board in Singapore, has been involved in the earlier stages of the building of the Al-Mawaddah mosque in Sengkang New Town. The mosque has environmentally-friendly features such as energy-saving solar tubes and design that uses natural skylight which would cut down the use of electric bulbs (Channel News Asia, 2013). The PohErn Shih Buddhist Temple, originally built in 1964, was refurbished in2003 by adopting ecologically friendly technologies. The temple took advantage of Singapore's abundant sunlight to produce electricity by installing three different types of energy cells. The electricity generated is used to heat up water and provide night lighting (asiagreen.com, 2009). In addition, the Housing and Development Board plans to operate 30 solar precincts by 2015 (Newman, 2010).

The ISO 14001 requires a proactive approach in managing the procurement process. ISO 14001, an internationally accepted standard environmental management system, has gained worldwide acceptance as one of the key measures in addressing environmental issues in public organisations and businesses. The ISO 14001 has been adopted by organisations to address the immediate and long-term impact of products, services and activities in managing environmental matters impacting on performance (Boiral & Sala, 1998; Lee, 2005; Melynk et al., 2003). Chen (2005) found that the voluntary adoption of ISO 14001 would improve the environmental and financial performance of an organisation. In Japan, the public sector succeeded in controlling the environmental impact and contributed to the overall improvement in the sustainability of the other economic sectors by applying ISO 14001 (Ito, 2005). In fact, (Chen, 2005) suggested that the ISO 14001, as a policy, should be incorporated as a framework for environmental procurement to address environmental issues.

Environmentally-designed products are those that can be disassembled, recycled and reused (Carter, Kale & Grimm, 2000; Ciliberti et al., 2008). Zsidisin & Siferd (2001) argued that environmentally-designed products, apart from being reliable and durable, also do not have a negative effect on the environment because non-hazardous materials are used during design stage and production. Sustainable procurement is a process where the economic, social and environmental objectives are balanced against organisational needs.

The life cycle cost of the product is an integral part of the buying decision, where products are repaired and recycled rather than thrown away (Kennard, 2006). As concern for the environment is gaining importance, life cycle analysis (LCA) has a role to play in the government procurement process. Studies have shown that although there is a premium in buying environmentally compliant goods and services, in the longer term it is more cost effective (GreenBusinessTimes, 2012). In Singapore, LCA has been used to evaluate the long-term benefits of having roof-top gardens (Wong et al., 2003).

From the above discussion, it can be inferred that organisational systems, processes and policies comprising of eco-labelling, ISO 14001, product design and life cycle analysis, play a significant role in influencing the paradigm of public organisations. Government employees require an established set of guidelines in their decision-making process. The availability of established systems and processes which are internationally recognised provide transparency in decision-making. In this regard, government procurement decisions could be made as they are based on life cycle analysis and the design of the product conforms to environmental requirements.

8.2.1.3 Organisational values influence the environmental orientation of government procurement

Organisational Values (measured by Entrepreneurship, Commitment, Organisational Learning and Innovation) are shown to positively influence the environmental orientation of government procurement. In the literature of organisational culture, these values create an effective organisation that has a clear focus on results, clarity of goal and a decentralised decision-making structure (Moynihan & Pandey, 2004).

Organisations that are committed to environmental issues often organised training activities. They also train their employees to take a long term perspective of the environmental and implement strategies and policies and allocate resources that support this approach (Henriques & Sadorsky, 1999; Hunt & Auster, 1990; Roome, 1992). Employees who are supportive of each other are more likely to establish strong connections and communication flows within different functional areas, thus creating a supportive organisational climate and demonstrating increased organisational commitment (Schuster et al., 1997). As a learning organisation, it is important for the organisational activities and practices to be put in place to realise the collective knowledge for the benefit of all public organisations.

Organisational learning is one of the factors that promote and enhance the skills in managing the environment procurement process. Organisational learning goes beyond the collection and dissemination of organisational knowledge. According to Senge (1990), organisational learning enables organisations to be committed and responsive in articulating organisational vision that shapes the culture of the organisations. Learning is associated with introducing better ways of implementing measures to achieve the organisation's environmental goals (Jabbour et al., 2008). Procuring environmentally conscious products requires a new learning process. The ability to acquire new knowledge and reflect critically on decisions made based on environmental considerations indicates a degree of open mindedness, and is an essential part of creating a learning organisation (Calantone et al., 2002). Accordingly, Sinkula et al., (1997) stated that learning-oriented organisations tend to be more responsive and adaptive to changing environment and unpredictable events. Public and business organisations that provide environments conducive to learning would encourage innovation (Yeo, 2007).

As an example, in Singapore the National Environmental Agency (NEA) has set up a $20 million 'Innovation for Environmental Sustainability (IES) Fund. The Fund is to be used by organisations to develop innovative environmental technologies that can contribute to environmental sustainability (Tan, 2009).Another initiative to encourage innovation is the Enterprise Challenge (TEC). This initiative by the Singapore Prime Minister's Office in 2000 is a S$29 million fund set up to support innovative proposals that have the potential to create new value or make significant improvements to public service delivery.

In the area of innovation, Singapore has established Environment and Water Institute (EWI). An initial funding of $100 million over five years has been earmarked for research and development projects (MEWR & MND, 2009). The initiative has attracted more than 120 proposals, 17 of which received funding totalling $11 million. They comprise 12 research projects from the public sector, including tertiary institutions and research institutes, as well as 5 projects from the private sector. The grants range from $100,000 to $1.9 million each, over one to three years. The projects are expected to lead to applications, marketable products or services in the environment and water industry (MEWR & MND, 2009).

Literature on environmental management has revealed seven (7) critical factors that are important in implementing environmental measures in organisation. The factors are: top management's commitment to environmental management, total involvement of employees, training, green product and process design, supplier management, measurement, and information management (Yeo & Quazi, 2005).The presentation of Singapore's Inter-Ministries Committee Sustainable Development Report in 2009 reflects the government's commitment to environmental sustainability. This runs parallel to the World Commission on Environment and Development which is also known as the

Brundtland Commission(WCED, 1987). The government also accepted recommendations made during the United Nations Conference on Environment and Development in Rio de Janeiro, commonly referred to as "The Earth Summit" (UNCED, 1992) under the Kyoto Protocol in 1997 with the objective of addressing the problems of climate change (Grubb et al., 1999).The Inter-Ministries Committee on Sustainable Development (IMCSD) Report is an affirmation of the government's commitment on the environment (MEWR & MND, 2009).

8.2.2 Do the determinants of environmental orientation influence the performance of public organisations in Singapore?

The above research question is addressed by the hypothesis which postulates that there is a significant positive relationship between environmental orientation of government procurement and organisational performance. Preuss (2007) argued that the performance of public organisations is measured in the typology of environment, economic and social aspects. This analysis typified the concept of the triple bottom line approach. The findings of this research validate and strengthen the proposition of the strategic importance of environmental orientation of procurement on performance. The argument follows that the adoption of organisational systems, processes and policies supported by organisational values are critical determinants for sustainable government procurement to affect performance. Organisational systems, processes and policies provide the government with the necessary tools that can be incorporated into different stages of procurement processes.

Government performance is not measured from the perspective of market performance or financial ratios alone, but in terms of transparency and accountability of using public funds effectively and efficiently. It has to be noted that government procurement is funded by taxpayers. The application of whole life cost analysis is akin to the principle of 'value for money' which is a pillar of the Singapore government procurement process. With a population density of 6,520 persons per km^{2}' Singapore is the most densely populated places in the world and therefore needs to effectively manage the use of its limited space. The land constraint has been a critical consideration in the government policy decisions and the development of effective waste management strategies. Public organisations in Singapore have to be pro-active and creative in their approach to developing environmental strategies.

The Housing and Development Board (HDB) houses more than 80% of the population (Housing and Development Board, 2012). Therefore, policies implemented by the HDB have far-reaching implication. Recently, the HDB has launched a pilot project under the Greenprint programme to cut energy usage in common areas by some 30 per cent. Under this programme, 38 blocks of flats would be the first existing HDB neighbourhood to try out several green initiatives. Energy-saving lights, such as intelligent LED lights and outdoor LED street lamps, would also be used. Storage tanks located at the void decks of some blocks would collect rainwater for cleaning the estate. The tanks could supply enough treated water for the monthly block cleanings as well as cutting energy and water consumption by 30 per cent. This translates to cost savings of more than S$144,000 per year for the 38 blocks (Green Business Times, 2012).

The findings of this PhD study have empirically tested the suggested link between the determinants of environmental orientation and performance. This study has conceptually and empirically examined constructs of environmental orientation. This strengthens the argument for the relationship between environmental orientation determinant and the government's sustainable procurement but is also a source for performance measures.

Firstly, this study provides researchers and practitioners with a validated framework to assess the extent of government's commitment to environmental sustainability. Firstly, the result shows the influence of organisational values in public organisations that could help promote the value of sustainability in the procurement process. Organisational values were proven to have a positive and significant relationship with environmental orientation. The greater the degree of acceptance of the importance of environmental issues, the higher the level of adoption of sustainable practices in public organisations.

Secondly, the importance of organisational values also addressed the role of top management in shaping the culture public organisations. With regard to environmental government procurement, Gunningham & Sinclair (2002) argued that managerial values are the predominant in evaluating environmental policy. As mentioned earlier, the construct of Organisational Values requires commitment from top management to implement change (D'Amato & Roome, 2009, Isabella & Waddock, 1994). Resource commitment by a management team that promotes, supports, and guides sustainable practices is perceived to enhance the impact on performance (Richey et al., 2005b). When such support is lacking, the capability of these resources would have negligible impact even when considerable investments to train and support environmental procurement process are made to develop such resources. Chen et al., (2004) suggested that strong top management support is closely linked with performance and reflects top managements' attitudes towards organisational changes that value and promote sustainability.

Thirdly, this study indicates the importance of support provided by top management which could result in a more empowered decision-making process for procurement. As decisions regarding sustainable procurement are system driven through the integration of environment management systems such as ISO 14001 and LCA, this facilitates the process of procurement where top management can influence and promote a culture of sustainability in the overall context of the organisation. Top management support and involvement can establish an organisational climate in which sustainable practices are considered worthwhile as well as strategic.

Finally, managers too are more ready to be involved in the transformation of their organisations by using the common constructs identified in this study. They could also use the constructs to benchmark their organisations against the best practices of other government institutions that have long history in the implementation of sustainable procurement practices especially in EC, UK and Scandinavian countries. A study by Bouwer et al., (2005) showed that environmental criteria were used in over 40% of calls for tender in Finland, 60% and 30% in Sweden and Denmark respectively. Therefore, this model provides a mechanism for managers to move toward developing an environmentally-focused culture in the procurement process for public organisations by incorporating environmental criteria in tender calls, technical specifications and contract clauses.

8.3 Contribution of this Study

Environmental procurement is a growing area of research. Over the past decade, much of the research was undertaken in businesses organisations. Research on government environmental procurement tended to be neglected although governments are major buyers of a wide range of goods and services. This study provides empirical evidence to augment the scant literature on the relationship between the determinants of environmental procurement in public organisations in general and specifically in Singapore.

8.3.1 Theoretical Contribution

The study provides a theoretical framework with constructs identifying the determinants of environmental factors. They are conceptualized, defined and tested in accordance with the rigorous statistical parameters of structural model. This study further adds to a growing area of research that is concerned with environmental sustainability generally and sustainable government procurement specifically. In addition, there are important theoretical and practical implications that can benefit both researchers and practitioners.

For researchers, this study provides a conceptual model of critical determinants of environmental factors to determine causal relationships with government procurement. Theories from multiple domains have been synthesized to construct the model of environment-oriented government procurement. The model could serve as a basis for further research on environmental factors that contribute to sustainable government procurement focusing on environmental determinants.

8.3.2 Managerial Contribution

This study provides strategic and policy implications for managers. The study offers policy makers guidelines for integrating determinants of environmental orientation into their procurement strategy, making it more integrated and holistic. This could be implemented across ministries, statutory boards and other related government agencies. Incorporating environmental considerations in the procurement function presents significant pressures and complications to the procurement process since government procurement process does not take these into account.

Although government procurement is subjected to continual scrutiny, either through internal audits or media coverage for any suggestions of mismanagement or impropriety

(Straits Times, 2012), this does not mean not mean that environmental concerns further complicate the procurement process. Government procurement activities must conform to established policies and procedures regarding procurement decisions due to the government's public responsibility. By incorporating ISO 14001, eco-labelling and life cycle analysis, which are readily interpreted to meet international and national requirements, government procurement is considered to proactively subscribe to the notion of environmental sustainability in terms of principles and practices. Furthermore, a good policy requires that integrated environmental management systems, processes and policies can be implemented at different levels of decision-making process. Also, the results of implementing the systems can be verified and evaluated, and steps can be taken to educate government officials on the value of environmental procurement.

From the perspective of practical considerations, this study provides a valuable insight for policy-makers, procurement, logistics and operational managers in the government to address issues or questions frequently raised on the importance of sustainable procurement. Policy-makers and managers are often faced with having to justify procurement as a critical factor determining performance that ultimately supports the government's objectives and vision of sustainable development. This study enhances the knowledge of how procurement can contribute to the overall well-being of an organisation and the country.

The results of this study confirm that procurement can contribute positively to supporting the government's concern for the environment. Procurement has an impact on the environment, operational, financial and social performance of public organisations. An effective cross-functional integration within government institutions and disclosure would further enhance the effectiveness of environmentally-oriented procurement in public organisations.

Based on the premise of value attached to environmentally-oriented procurement practices, practitioners might raise the question of how well the government procurement process adapts to new requirements of a business practice that values the environment. The research instrument developed in this study, especially the environmental orientation construct, gives practitioners the ability to measure the extent to which organisations understand the importance of adapting to a new environment. Increasing support for sustainable development has affected the decision making process so that governments have to consider more than just delivering services to their citizens. It is an acceptable dictum that governments have to understand the needs of their citizen and respond to their demands. However, in the current climate of openness and accountability, a government has to be proactive by anticipating and pre-empting demands (Boland & Fowler, 2000).

Organisationally, procurement has always been confronted with the question of how organisations can improve the capability of the procurement process to deal with the new paradigm which focuses on concern for the environment. The framework developed for this study examined the environmental factors that assist the procurement process to adapt to change. As a result, the integration of systems, processes and policies that are based on verifiable and certifiable standards are integrated with the procurement process in the organisation supported with the right organisational values. Sustainability is not a zero-sum game where the government as a stakeholder understands that by focusing on environment, this does not necessarily mean that the principle of economic value is neglected. Sustainability is a dynamic and interactive processes where economic, environment and social dimensions are considered in the decision-making process

(Lozano, 2007). Can government institutions deliver added value and provide value for money? The answer is potentially yes but government has to be actively involved in promoting environmental procurement. These determinants may assist in shaping a public procurement culture of environmentally sustainable procurement practices vis-à-vis the value for money and cost efficiency, the prime motive of public procurement, in the long run. This role is expected to have an impact on the marketplace where more innovative environmentally-oriented products would be manufactured.

The study also suggests that commitment from decision-makers and the degree of implementation within the procurement departments of various government agencies are critical. Public organisations too should ensure that they provide an open and fair process to identify and procure environmentally-oriented products from manufacturers/suppliers. The environmental consideration has to be factored in at every stage of the procurement process. The adoption of non-ad-hoc strategies that encourage the development of environmentally-oriented products is important to enable sufficient choice.

Finally, this study provides an indication of possibilities for government institutions to devise a generic model so as to provide identified parameters in developing and implementing green procurement in which government institutions, with the vast resources at their disposal, have the ability to take the lead. Practitioners, on the other hand, can use the exploratory results of this study as a benchmarking tool in the process of developing sustainable procurement in their organisations with regard to the status of their own sustainable procurement capability.

8.4 Limitations and Implications for Future Study

The proposed model is a working model of environmental orientation of government procurement and does not claim to be comprehensive. The results and implications of this study must be considered in light of the limitations of the survey method used to collect data. As an empirical study, this study has several limitations. Firstly, the use of self-reported perception by operations, logistics and procurement practitioners implies that there could be some possibility of a common bias in the results of the study. As in any linear model of the research process, the results may not reflect actual practice (McGrath et al., 1982) and there is no perfect measurement for latent construct as there would be measurement error (Kelloway, 1998).

Secondly, a possible area of limitation of this study is the selection of respondents. Arguably, research on sustainable government procurement would be more valuable if collected, for example, those in the upper echelon in the bureaucracy ranging from Deputy Secretary to Permanent Secretary of the public organisations. The participation of the policy-makers would provide strategic inputs from the perspective of policy-making mechanisms for this study. Therefore, more effort could be made to collect data from the policy-makers. The questionnaire attempted to measure a number of dimensions of environmental constructs but it could not probe deeply into the respondents' opinions and attitudes.

Thirdly, this study relied on a cross-sectional survey of respondents through structured questionnaires. The cross-sectional nature of the research design implies that true causal relationships between the research constructs cannot be inferred. In most cases, the procurement process is gradually adapting and adjusting to the integration of environmental consideration into operational activities of various government institutions.

Therefore, a longitudinal study would be more informative in terms of ascertaining the impact of the determinants on sustainable government procurement.

Despite of the limitations, the findings of this study indicated several implications for future research. Firstly, this study provides a model for future researchers to deduce and possibly develop a different operational model from the model used in this study. Based on the findings of this study, future research examining the effect of determinants on environmental orientation of government procurement should focus on the corresponding causal relationships between the observed factors and also on the impact of other related factors. Second, future research could continue in the area of improving scales developed to measure the constructs. To achieve this, more cross-organisational studies using longitudinal data collection techniques could be conducted. Longitudinal investigation may lend further support the empirical validity and generalisability of the proposed model and research instrument.

Thirdly, future research could be undertaken in the area of collaboration between public-private procurement with regards to environmental concerns. Traditionally, the public sector engages the private sector to construct facilities or supply equipment. The government institutions own and operate the facilities or equipment or engage separate maintenance and operations companies to operate the facilities. There are many possible public-private partnership (PPP) models such as joint-ventures and strategic partnerships that can make better use of public funds (Ministry of Finance, 2012). Through the PPP, the public sector seeks to bring together the expertise and resources of the public and private sectors to provide services with the best value for money. Studies could be conducted from the perspective of how the environmental procurement process could be integrated into PPP projects. Future studies on the environmental orientation of government procurement could also be conducted in terms of specific ministries and statutory boards to evaluate the extent of their awareness and participation in environmental management.

Finally, there is a limited amount of research comparing different perspectives on the importance of sustainable government procurement in the Southeast Asian region. In some countries in Southeast Asia, the governments are taking initial steps to incorporate environmental considerations in their development plan. Future study can also look into this area further from a comparative perspective.

8.5 Summary and Concluding Remarks

This study bridges a research gap regarding the environmental orientation of government procurement. The model proposed in this study provides an integrated and holistic approach for the government procurement process. The adoption of such an approach does not undermine the tenets of government procurement. In fact, it upholds the principles of value for money, transparency and accountability. Organisationally, the core competencies of government institutions in delivering quality public services are further strengthened with an emphasis on building a bureaucratic culture steeped in sustainability, galvanized by critical elements of entrepreneurship, commitment, organisational learning and innovation. The results of this study reaffirm the strategic role of environmental determinants in equipping government procurement to manage environmental issues. This study contributes to both the theoretical and practical issues underpinning sustainable government procurement by developing and validating measurement instruments to critically assess the determinants of environment-related constructs. The constructs are validated using a structural model which shows that the environmental orientation of government procurement has a positive effect on performance.

Constructs of Waste Management, Organisational Systems, Processes, Policies and Organisational Values, are methodically measured and validated, as the determinants are applicable from the perspective of government institutions in Singapore but also other government institutions in the Southeast Asian region that are taking initial steps to incorporate environmental considerations in their development plans. It is not an oversimplification to conclude that the issues of sustainable development and sustainability will continue to attract the attention of governments and will feature prominently in their action plans. This is because governments now operate in an environment which embraces sustainability as a natural path of development enshrined in a communiqué of the Durban Conference (UNFCCC, 2013). The communiqué signifies and specifies the government's commitment to address environmental issues as a critical component in Singapore's development plan. The public sector is expected to provide leadership and lead by example by using its substantial procurement spending to effect change and demonstrate the benefits of sustainable procurement (IMCSD, 2009).

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APPENDIX 1 (LETTER TO RESPONDENT)

Portfolio Business

School of Business IT and Logistics

INVITATION TO PARTICIPATE IN A RESEARCH PROJECT
PROJECT INFORMATION STATEMENT

Project Title:
Environmental Orientation of Government Procurement in Singapore

Investigator:

PhD Candidate
Sujak Bakir, RMIT University, sujak.bakir@rmit.edu.au, +61-3-9925 1672

Senior Supervisor
Prof Shams Rahman, RMIT University, shams.rahman@rmit.edu.au, +61-3-9925 5530

Second Supervisor
Dr Shahadat Khan, RMIT University, shahadat.khan@rmit.edu.au, +61-3-9925 5536

Dear Participant,

You are invited to participate in a PhD research project being conducted by RMIT University. These two pages are to provide you with an overview of the proposed research. Please read these pages carefully and be confident that you understand its contents before deciding whether to participate. If you have any questions about the project, please ask one of the investigators identified above.

I am currently a research student in the School of Business IT and Logistics at RMIT University. This project is being conducted as a part of my PhD study. My supervisors for this project are Professor Shams Rahman and Dr Shahadat Khan. The project has been approved by the RMIT Business Human Resource Research Ethics Sub Committee.

The project seeks to investigate the extent of environmentally-oriented factors that influence government purchases of products and services in Singapore. Your participation is important for us to understand the view and perception of procurement officers in the public administration pertaining to environmental issues that influence government's purchases. By answering the questionnaire, you will provide us with an invaluable insight on factors that determined government procurement process as well as the role played by government in developing effective environmental policies.

There are no perceived risks associated with participation outside the participants' normal day-to-day activities. Your responses will contribute to understanding the interplay of a number of environmental factors that are important in government procurement activities that impact on the quality of life of the population and the environment. The finding of this study will be disseminated in conferences and published in journals.

If you are unduly concerned about your responses to any of questions or if you find participation in the project distressing, you should contact my supervisors as soon as convenient. My supervisors will discuss your concerns with your confidentially and suggest appropriate follow-up, if necessary.

Your privacy and confidentiality will be strictly maintained in such a manner that you will not be identified in the thesis report or any related publication. Any information that you provide can be disclosed only if (1) it is protect you or others from harm, (2) a court order is produced, or (3) you provide the researchers with written permission. Data will be only seen by my supervisors and examiners who will also protect you from any risk.

The questionnaire should not take more than 30 minutes to complete. Once you have completed the questionnaire, please return it to me in the enclosed postage-paid envelope. As you are not being identified in any way, your views will remain anonymous. The data will only be seen by the investigator and project supervisor. As a participant of this survey, you have the right to withdraw your participation at any time, without prejudice. Further, you have the right to have any unprocessed data withdrawn and destroyed provided it can be reliably identified, and provided that so doing does not increase your risk. You also have the right to have any questions answered at any time.

The result of this study will be disseminated in the PhD thesis, paper for publication or presentation for conferences. The research data collected will be securely kept at RMIT University for a period of five years before being destroyed

To ensure that data collected is protected, the data will be retained upon completion of the project after which time paper records will be shredded and placed in a security recycle bin and electronic data will be deleted/destroyed in a secure manner. All hard data will be kept in a locked filing cabinet and soft data in a password protected computer in the office of the investigator in the School of Business, IT and Logistics RMIT University. Data will be saved on the University Network System where practicable (as the system provides a high level of manageable security and data integrity, can provide secure remote access, and is backed up on a regular basis). Only the researcher/s will have access to the data.

I am assuring you that responses will remain confidential and anonymous.

If you have any queries regarding this project please contact me at +61-3-9925 1672 or email me at sujak.bakir@rmit.edu.au or Prof Shams Rahman +61-3-99255530 or email him at or Dr Shahadat Khan at +61-3-99255536 or email him at shahadat.khan@rmit.edu.au.

Thank you very much for your contribution to this research.

Yours Sincerely,

____

Sujak Bakir
PhD Candidate
School of Business IT and Logistics
RMIT University
Level 13, 239 Bourke Street
Melbourne, VIC 3000

Any complaints about your participation in this project may be directed to the Chair, Business College Human Ethics Advisory Network, College of Business, RMIT, GPO Box 2476V, Melbourne, 3001. The telephone number is (03) 9925 5598 oremailaddressrdu@rmit.edu.au. Details of the complaints procedure are available from http://www.rmit.edu.au/browse;ID=2jqrnb7hnpyo

APPENDIX 2 (ETHICS APPROVAL)

NOTE: Consent form

A consent form is required for Persons Participating in Research Projects Involving Interviews, Questionnaires, Focus Groups or Disclosure of Personal Information. However if anonymous postal/ email surveys you do not need a consent form as return of the form constitutes consent. The Plain language Statement should include this information

RMIT HUMAN RESEARCH ETHICS COMMITTEE

Prescribed Consent Form for Persons Participating In Research Projects Involving Interviews, Questionnaires, Focus Groups or Disclosure of Personal Information

PORTFOLIO		**Business**		
SCHOOL/CENTRE OF		**School of Business IT and Logistics**		
Name of Participant:				
Project Title:		**Environmental Orientation of Government Procurement in Singapore**		
Name of Investigator:		**Sujak Bakir**	Phone:	**+61-3-9925 1672**
Supervisors	1	**Prof Shams Rahman**	Phone:	**+61-3-9925 5530**
	2	**Dr Shahadat Khan**	Phone	**+61-3-9925 5536**

1. I have received a statement explaining the interview/questionnaire involved in this project.
2. I consent to participate in the above project, the particulars of which - including details of the interviews or questionnaires - have been explained to me.
3. I authorise the investigator or his or her assistant to interview me or administer a questionnaire.
4. I give my permission to be audio taped: ☐ Yes ☐ No **N/A**
5. I give my permission for my name or identity to be used: ☐ Yes ☐ No **N/A**
6. I acknowledge that:
   - (a) Having read the Plain Language Statement, I agree to the general purpose, methods and demands of the study.
   - (b) I have been informed that I am free to withdraw from the project at any time and to withdraw any unprocessed data previously supplied.
   - (c) The project is for the purpose of research and/or teaching. It may not be of direct benefit to me.
   - (d) The privacy of the information I provide will be safeguarded. However should information of a private nature need to be disclosed for moral, clinical or legal reasons, I will be given an opportunity to negotiate the terms of this disclosure.
     If I participate in a focus group I understand that whilst all participants will be asked to keep the conversation confidential, the researcher cannot guarantee that other participants will do this.
   - (e) The security of the research data is assured during and after completion of the study. The data collected during the study may be published, and a report of the project outcomes will be provided to_____________(researcher to specify). Any information which may be used to identify me will not be used unless I have given my permission (see point 5).

i. Participant's Consent

Name: ____ Date: ____________________

(Participant)

Name: ____ Date: ____________________

(Witness to signature)

ii. Where participant is under 18 years of age:

I consent to the participation of ___________________________________ in the above project.

Signature: (1) ____________________ (2) ____________________ Date: ____________________

(Signatures of parents or guardians)

Name: ____ Date: ____________________

(Witness to signature)

Participants should be given a photocopy of this consent form after it has been signed.

Any complaints about your participation in this project may be directed to the Chair, Portfolio Human Research Ethics Sub-Committee, Business Portfolio, GPO Box 2476V, Melbourne, 3001. The telephone number is (03) 9925 5594 or email address rdu@rmit.edu.au. Details of the complaints procedure are available from: http://www.rmit.edu.au/rd/hrec_complaints

APPENDIX 3 (SURVEY QUESTIONNAIRE)

SURVEY ON ENVIRONMENTAL ORIENTATION OF GOVERNMENT PROCUREMENT

This questionnaire is a key part of a study on environmental orientation of government procurement in Singapore. We define environmental orientation as information and knowledge on environmental factors that are critical in evaluating products and services before government decides to buy. The knowledge of environmental factors is an integral part of government buying process which affects the quality of environment.

As a guide, the meaning of scales is indicated below:

1. Strongly Disagree 2. Disagree 3. Neither Agree nor Disagree 4. Agree 5. Strongly Agree

- Below is an example how to complete the questionnaire:

		Strongly Disagree				Strongly Agree
A-1	Our organisation procures equipment that consumes less energy.	1	2	3	4	5

By circling 4, your answer indicates that the organisation procures equipment that consumes less energy.

INSTRUCTIONS

- It is important that you **PLEASE ANSWER ALL QUESTIONS** to the best of your knowledge, even if some may appear to be similar. Your answers to all sections of this questionnaire are vital to the success of this study. Unfortunately partly answered surveys are not useable. Therefore, please do not leave questions unanswered.
- There is no right or wrong answers.
- If you wish to comment on any of the questions, please use the space provided at the end of the questionnaire.
- The findings of this study will be reported in aggregated form, so no organisation, department or individual respondent can be identified.
- If you have any queries or comments about the questionnaire, please do not hesitate to contact **Sujak Bakir at +61 3 99251672**, or via email: **sujak.bakir@rmit.edu.au**

We appreciate highly your time and effort in participating in this research. If you would like a copy of the findings sent to you, please fax, phone or send your business card separately from the questionnaire. The answers to the survey will be kept in strict confidence. The names of participating ministries, departments and statutory bodies, government-owned companies and individuals will not be released.

PART 1: INTEGRATED PRODUCT ATTRIBUTES

The following questions refer to integrated product attributes that relate energy conservation, energy efficiency, biodegradability and hazardous materials. Please indicate your response by circling on the following scales.

A. Energy Efficiency

		Strongly Disagree				Strongly Agree
A-1	Our organisation buys products and equipment from suppliers that declared products are energy efficient.	1	2	3	4	5
A-2	Our organisation buys only products that have energy efficiency labels.	1	2	3	4	5
A-3	Our organisation provides guidelines on energy efficiency for suppliers to tender for electronic and electrical equipment.	1	2	3	4	5
A-4	Our organisation buys products that are energy efficient.	1	2	3	4	5
A-5	Our organisation buys from suppliers who have at least Green Mark certified which is the minimum level of energy efficiency.	1	2	3	4	5
A-6	Our organisation sets minimum energy performance standards for various types of equipment purchased.	1	2	3	4	5

B. Energy Conservation

		Strongly Disagree				Strongly Agree
B-1	Our organisation buys from suppliers who have policy blueprint for energy conservation.	1	2	3	4	5
B-2	Our organisation procures products manufactured using renewable energy.	1	2	3	4	5
B-3	Our organisation buys from suppliers who implement energy conservation programmes.	1	2	3	4	5
B-4	Our organisation purchases from suppliers who provides training on eco-office practices to conserve energy.	1	2	3	4	5
B-5	Our organisation buys from suppliers that implements energy conservation initiatives.	1	2	3	4	5
B-6	Our organisation buys equipment that conserve energy.	1	2	3	4	5

C. Biodegradability

		Strongly Disagree				Strongly Agree
C-1	Our organisation set minimum biodegradability standard for products purchased.	1	2	3	4	5
C-2	Our organisation buys products that are biodegradable.	1	2	3	4	5
C-3	Our organisation buys from suppliers whose products adhere to international biodegradability standards.	1	2	3	4	5
C-4	Our organisation buys from suppliers who use biodegradable packaging materials.	1	2	3	4	5
C-5	Our organisation buys from suppliers who have policy that products sold are biodegradable.	1	2	3	4	5
C-6	Our organisation buys products that do not harm the environment.	1	2	3	4	5

D. Non-Hazardous Materials

		Strongly Disagree				Strongly Agree
D-1	Our organisation buys from suppliers who have policy to systematically separate dangerous wastes.	1	2	3	4	5
D-2	Our organisation buys from suppliers who understand the impact of hazardous materials on the environment.	1	2	3	4	5
D-3	Our organisation buys from suppliers who implements adequate policy to manage hazardous waste.	1	2	3	4	5
D-4	Our organisation has a policy to reject products from suppliers if they contain hazardous elements.	1	2	3	4	5
D-5	Our organisation buys from suppliers who implement stringent control for the disposal of hazardous materials.	1	2	3	4	5
D-6	Our organisation buys from suppliers who dispose of hazardous waste through environmentally safe methods.	1	2	3	4	5
D-7	Our organisation buys products that are properly labelled and packed when they contain hazardous materials.	1	2	3	4	5

PART 2: WASTE MANAGEMENT

The following factors refer to packaging, incineration, reverse logistics, landfill and recycling of waste management. Please indicate your responses by circling on the following statements.

E. Reverse Logistics

		Strongly Disagree				Strongly Agree
E-1	Our organisation considers reverse logistics complies with environmental regulations.	1	2	3	4	5
E-2	Our organisation prefers to award tenders to suppliers who have return management policy.	1	2	3	4	5
E-3	Our organisation views suppliers favourably when they implements reverse logistics.	1	2	3	4	5
E-4	Our organisation generates less waste when buying products from suppliers who implement reverse logistics.	1	2	3	4	5
E-5	Our organisation has a policy to buy from suppliers that implement reverse logistics.	1	2	3	4	5

F. Packaging

		Strongly Disagree				Strongly Agree
F-1	Our organisation has policy that the packaging of products purchased should be manufactured from reusable materials.	1	2	3	4	5
F-2	Our organisation has policy to buy products from suppliers who take back packaging materials.	1	2	3	4	5
F-3	Our organisation prefers to buy from suppliers who signed the Singapore Packaging Agreement.	1	2	3	4	5
F-4	Our organisation purchased products that used minimum packaging.	1	2	3	4	5
F-5	Our organisation buys from suppliers that provide green packaging.	1	2	3	4	5

G. Recycling

		Strongly Disagree				Strongly Agree
G-1	Our organisation buys from suppliers who have a blueprint to increase recycling rate.	1	2	3	4	5
G-2	Our organisation buys from suppliers who have policy on buy- back programmes.	1	2	3	4	5
G-3	Our organisation promotes programmes of reduce, re-use and recycle at all levels in the organisation.	1	2	3	4	5
G-4	Our organisation buys from suppliers who have guidelines to systematically separate different types of recyclable wastes.	1	2	3	4	5
G-5	Our organisation buys from suppliers who provide labelled containers for different types of recyclable wastes.	1	2	3	4	5
G-6	Our organisation buys from suppliers who have a long term objective to promote recycling as a policy thus reducing the use of landfill and incinerators.	1	2	3	4	5
G-7	Our organisation buys from suppliers has appropriate policy that recycled products are to be used.	1	2	3	4	5

PART 3: ORGANISATION SYSTEMS, PROCESSES & POLICIES

The following questions concern with organisational systems, processes and policies that relates to ISO 14001, eco-labels, product design and life cycle analysis**.** Please indicate by circling on the following statements.

H. ISO 14001

		Strongly Disagree				Strongly Agree
H-1	Our organisation prefers to purchase products from suppliers who are certified with ISO 14001.	1	2	3	4	5
H-2	Our organisation considers suppliers who have ISO 14001 as adhering to environmental regulations.	1	2	3	4	5
H-3	Our organisation considers suppliers who use of ISO 14001 as committed to environment.	1	2	3	4	5
H-4	Our organisation uses ISO 14001 to conduct suppliers' selection criteria at every stage of procurement process.	1	2	3	4	5
H-5	Our organisation requires suppliers to be certified with ISO 14001 to pre-qualify them.	1	2	3	4	5

I. Eco-labelling

Strongly Disagree ... Strongly Agree

I-1	Our organisation procures products that are clearly labelled according to their environmental performance standards.	1	2	3	4	5
I-2	Our organisation procures products that are environmentally labelled.	1	2	3	4	5
I-3	Our organisation ensures eco-labels of products purchased are certified by country of origin.	1	2	3	4	5
I-4	Our organisation purchases products that are independently certified on their environmental performance.	1	2	3	4	5
I-5	Our organisation considers that products with eco-labels have achieved the required environmental standards.	1	2	3	4	5

J. Product Design

Strongly Disagree ... Strongly Agree

J-1	Our organisation buys products that are designed either for re-use, recyclable, or recovery of materials and components.	1	2	3	4	5
J-2	Our organisation participates in the design of products for recycling and re-use.	1	2	3	4	5
J-3	Our organisation constantly sources for products that are made from sustainable and renewable resources.	1	2	3	4	5
J-4	Our organisation considers buying products that are designed to reduce resource consumption and waste generation.	1	2	3	4	5
J-5	Our organisation considers buying products that are designed to avoid or reduce the use of hazardous materials in the manufacturing process.	1	2	3	4	5
J-6	Our organisation has appropriate guidelines to purchase products that are designed to eliminate any potential environmental problems.	1	2	3	4	5

K. Life Cycle Analysis

Strongly Disagree ... Strongly Agree

K-1	Our organisation buys products from suppliers that use life cycle analysis.	1	2	3	4	5
K-2	Our organisation buys products from suppliers who consider the use of LCA as not incurring additional costs.	1	2	3	4	5
K-3	Our organisation buys from suppliers who provide LCA Report.	1	2	3	4	5
K-4	Our organisation performs environmental performance evaluation on suppliers.	1	2	3	4	5
K-5	Our organisation buys from suppliers who use life cycle analysis in evaluating their products' environmental friendliness.	1	2	3	4	5

PART 4: ORGANISATIONAL VALUES

The following statements refer to organisational values which refer to entrepreneurship, commitment, organisational learning, and innovation of your organisation. Please indicate by circling on the following statements.

L. Entrepreneurship

		Strongly Disagree				Strongly Agree
L-1	Our organisation has a high level of environmental-friendly products used.	1	2	3	4	5
L-2	Our organisation is the first to purchase environmentally friendly products.	1	2	3	4	5
L-3	Our organisation believes there is sufficient availability of environmentally friendly product alternatives in the market.	1	2	3	4	5
L-4	Our organisation uses environmental criteria in selecting suppliers.	1	2	3	4	5
L-5	Our organisation uses environmental criteria in awarding procurement contract.	1	2	3	4	5
L-6	Our organisation encourages employees to contribute innovative environmental ideas that could be transformed into environmental policies.	1	2	3	4	5

M. Commitment

		Strongly Disagree				Strongly Agree
M-1	Our organisation is highly committed to environmental goals.	1	2	3	4	5
M-2	Our organisation considers environmental issues to be very relevant to the organisation.	1	2	3	4	5
M-3	Our organisation integrates environmental issues into our strategic planning process.	1	2	3	4	5
M-4	Our organisation has provided experienced and capable people to manage environmental issues in our procurement activities.	1	2	3	4	5
M-5	Our organisation has a clear policy statement urging environmental awareness in our operations.	1	2	3	4	5
M-6	Our organisation rejects material from suppliers who lack environmental awareness.	1	2	3	4	5
M-7	Our organisation has full-time employees devoted to environmental procurement.	1	2	3	4	5
M-8	Our organisation has appropriate reward system that recognises environmental achievements.	1	2	3	4	5

N. Organisational Learning

		Strongly Disagree				Strongly Agree
N-1	Our organisation views learning new approaches in environmental buying policy as important.	1	2	3	4	5
N-2	The culture of our organisation put top priority on learning on environmental matters.	1	2	3	4	5
N-3	Our organisation implements programs to foster awareness on the importance of environmental benefits.	1	2	3	4	5
N-4	Our employees are trained on the importance and relevance of environmental products and services.	1	2	3	4	5
N-5	Our organisation sends staff to countries that are more advanced in environmentally-oriented procurement practices for training.	1	2	3	4	5
N-6	Our organisation organises in-house environmental procurement training.	1	2	3	4	5

O. Innovation

		Strongly Disagree				Strongly Agree
O-1	Senior management in our organisation actively seeks innovative ideas on environmental matters.	1	2	3	4	5
O-2	Our organisation provides rewards for innovative suggestions on environmental procurement.	1	2	3	4	5
O-3	Employees in our organisation are encouraged to perceive risk-taking as a part of corporate culture.	1	2	3	4	5
O-4	Our organisation environmental procurement practices are constantly reviewed and updated.	1	2	3	4	5
O-5	Our organisation identifies sufficient possibilities of environmentally friendly products and services within the procurement market.	1	2	3	4	5
O-6	Our organisation has developed environmental procurement manual and documentation.	1	2	3	4	5

PART 5: ENVIRONMENTAL ORIENTATION

The following statements on environmental orientation refer to intelligence generation, intelligence dissemination and responsiveness of your organisation. Please indicate your response by circling on the scale provided.

P. Intelligence Generation

		Strongly Disagree				Strongly Agree
P-1	Our organisation does a lot of in-house environmental research.	1	2	3	4	5
P-2	Our organisation collects information on environmentally-oriented procurement by informal methods.	1	2	3	4	5
P-3	Our organisation collects information on suppliers that comply to environmental regulations.	1	2	3	4	5
P-4	In this organisation, we meet with our suppliers to inform them of our environmental procurement requirements	1	2	3	4	5
P-5	Our organisation conducts survey on environmental compliance on our suppliers.	1	2	3	4	5

Q. Intelligence Dissemination

		Strongly Disagree				Strongly Agree
Q-1	Our organisation has interdepartmental meetings on procurement at least once a month to discuss market trends and developments on environmental products.	1	2	3	4	5
Q-2	Our organisation is quick to alert other departments when one department finds out something important about the environmental regulatory climate impacting on procurement.	1	2	3	4	5
Q-3	Our organisation disseminates information on environmental procurement to all departments on a regular basis.	1	2	3	4	5
Q-4	In our organisation, there is extensive communication on matters of environmentally-oriented procurement.	1	2	3	4	5
Q-5	Our organisation shares information on development of environmentally friendly products in the market.	1	2	3	4	5

R. Responsiveness

		Strongly Disagree				Strongly Agree
R-1	Our organisation effectively co-ordinate all environmental activities of different departments.	1	2	3	4	5
R-2	Our organisation ensures environmental criteria in the procurement procedures are implemented in timely manner.	1	2	3	4	5
R-3	Our organisation immediately responds to changes in environmental standards/pressures.	1	2	3	4	5
R-4	Our organisation is quick to response to changes in the environmental climate for one reason or the other.	1	2	3	4	5
R-5	Our organisation takes the lead in implementing environmental procurement programmes.	1	2	3	4	5

PART 6: ORGANISATIONAL PERFORMANCE

The following statements relate to performance of your organisation on environmental procurement. Please indicate by circling on scale provided.

S. Environmental

		Strongly Disagree				Strongly Agree
S-1	There is noticeable decrease in the volume of internal waste generated.	1	2	3	4	5
S-2	There is a decrease in the volume of harmful products purchased from suppliers.	1	2	3	4	5
S-3	There is an increase in the number of products purchased from suppliers who conform to environmental requirements.	1	2	3	4	5
S-4	There is an overall improvement in energy efficiency in our organisation.	1	2	3	4	5
S-5	There is increasing level of recycling in the organisation.	1	2	3	4	5

T. Operational

		Strongly Disagree				Strongly Agree
T-1	There is an increase of suppliers taking back packaging materials.	1	2	3	4	5
T-2	The number of environmental products in our database has increased.	1	2	3	4	5
T-3	There is increasing number of suppliers who are pre-qualified based on environmental criteria.	1	2	3	4	5
T-4	There is an increase in the number of environmentally certified suppliers in our database.	1	2	3	4	5
T-5	There is an increasing number of environmentally certified suppliers awarded procurement contract.	1	2	3	4	5
T-6	There is a steady increase in the number of environmentally friendly products purchased.	1	2	3	4	5

U. Financial

		Strongly Disagree				Strongly Agree
U-1	There is a decrease in cost of energy consumption in our organisation.	1	2	3	4	5
U-2	There is an increase of budget allocation for environmental activities.	1	2	3	4	5
U-3	There is an increase in operational cost in our organisation because of monitoring and enforcement activities on suppliers.	1	2	3	4	5
U-4	There is a decrease in fines due to our organisation's compliance on environmental regulations.	1	2	3	4	5
U-5	The purchase of environmentally friendly products, although more expensive, is cost efficient in the long run.	1	2	3	4	5

V. Social

		Strongly Disagree				Strongly Agree
V-1	There is an increasing measures implemented to ensure employees' health and safety are well taken care.	1	2	3	4	5
V-2	There is an increasing level of participation from employees in providing feedback on social issues confronting the organisation.	1	2	3	4	5
V-3	There is an increasing involvement of stakeholder and senior management in developing corporate social policies in the organisation.	1	2	3	4	5
V-4	There are periodic reviews and evaluations on performance of organisation's social activities	1	2	3	4	5
V-5	There is an improved awareness among suppliers on how best to conserve resources and to integrate social factors into their operations.	1	2	3	4	5
V-6	There is an improved awareness within the organisation on government's social initiatives.	1	2	3	4	5

PART 7: YOUR PROFILE

The following information requires personal details of the respondents.

Please indicate your answer by crossing X in the box ☐ provided.

W.1 Your position in the organisation:

a. Executive Officer ☐

b. Senior/Higher Executive Officer ☐

c. Assistant Manager ☐

d. Manager ☐

e. Senior Manager ☐

f. Divisional Manager ☐

g. Deputy Head of Unit ☐

h. Head of Unit ☐

i. Deputy Head of Department ☐

j. Head of Department ☐

k. Assistant Director ☐

l. Deputy Director ☐

m. Director ☐

n. Others ☐

Others, please specify:____

W.2 Your functional area in the organisation

a. Procurement ☐ c. Operations ☐

b. Logistics ☐ d. Others ☐

Others, please specify:____

W.3 Highest level of education attained:

a. Post-Graduate/Master/PhD ☐

b. Bachelor Degree ☐

c. Higher/Advanced Diploma ☐

d. Diploma ☐

e. Post-Secondary ☐

f. Secondary ☐

W.4 Gender

a. Male ☐ b. Female ☐

W.5 Years of experience you have in procurement:

a. 1 year or less ☐ d. 11 - 15 years ☐

b. 2 – 5 years ☐ e. 16 – 20 years ☐

c. 6 – 10 years ☐ f. 21 years and above ☐

W.6 Years of experience you have in the organisation:

a. 1 year or less ☐

d. 11 - 15 years ☐

b. 2 – 5 years ☐

e. 16 - 20 years ☐

c. 6 – 10 years ☐

f. 21 years and above ☐

W.7 Your age range:

a. Between 20 - 29 years ☐

d. Between 51 - 60 years ☐

b. Between 30 - 40 years ☐

e. 61 years and above ☐

c. Between 41 - 50 years ☐

W.8 Type of organisation you are working in:

a. Ministry ☐

c. Statutory Board ☐

b. Department ☐

d. Others ☐

e. Others, please specify____

W.9 Type of sector you are working in:

a. Education ☐

b. Environment & Water Resources ☐

c. National Development ☐

d. Health ☐

e. Transport ☐

f. Information, Communications and the Arts ☐

g. Manpower ☐

h. Finance ☐

i. Defence ☐

j. Home Affairs ☐

k. Community Development & Youth and Sports ☐

l. Others ☐

Others, specify:____

W.10 Number of employees in the organisation:

a. 1 – 9	☐	e. 200 – 499	☐
b. 10 – 49	☐	f. 500 – 999	☐
c. 50 – 99	☐	g. 1000 and above	☐
d. 100 – 199	☐		

W.11 Number of staff handling procurement function:

a. 1- 5	☐	d. 16 – 20	☐
b. 6 – 10	☐	e. more than 21	☐
c. 11 -15	☐		

W.12 Types of certification your organisation registered:

a. ISO 9001	☐	d. Environmental Auditing 19011	☐
b. ISO 14001	☐	e. Green Mark	☐
c. Eco-Management and Audit Scheme	☐	f. Others	☐

Others, please specify:____

Thank you very much for your assistance and co-operation in participating in this research.