

Understanding Key Environmental Management Practices Associated with the
Environmental and Financial Performance in Selected Manufacturing Firms

Gonzalo Thienel

A dissertation
submitted in partial fulfillment of the
requirements for the degree of

Doctor of Philosophy

University of Washington
2014

Reading Committee:

David Briggs, Chair

Stanley Asah

Eric Turnblom

Program Authorized to Offer Degree:
School of Environmental and Forest Sciences

University of Washington

Abstract

Understanding key environmental management practices associated with the environmental and financial performance in selected manufacturing firms

Gonzalo Thienel

Chairs of Supervisory Committee

Prof. David G. Briggs & Prof. Timothy Hargrave

School of Environmental and Forest Sciences

Because of public concern, regulatory forces, stakeholder's pressure, or simply management's belief that it is the right thing to do, implementation of environmental management practices (EMPs) can play an important role in determining the environmental and financial performance (EFPs) of a firm. Many previous studies have examined the relationship between EMPs and EFPs but differences in which EFPs and EMPs were considered, in the source and methods of data collected, in factors such as industry type, firm size, etc. that were considered in selecting sample firms, and in data analysis methods, have produced great inconsistency. Consequently, managers struggle when deciding how to implement a successful environmental management strategy.

This study developed three models to predict five EFPs (Return On Assets, Sales Growth Tobin's q, Innovation Process, and Innovation Product) from 19 EMPs (Recycling, Proactive waste reduction, Reactive waste reduction, Consume internally, Create market for waste, Water consumption, Energy consumption, Early supplier involve, Environmental standard for suppliers, Environmental audits suppliers, Environmental awards, Life cycle analysis, Design targets/goals, Environmental risk analysis, Corporate policy/procedure, Environmental mission statement, Environmental department, Surveillance of market, Strategic alliance). These EMPs and EFPs were chosen because they can be measured from corporate financial and environmental responsibility reports. Data was collected for US firms that met five criteria (1) firms with 500 or more paid employees, (2) industry sector is manufacturing, (3) Industry sector has declining contribution to GDP, (4) industry sector concentration is

moderate to low, and (5) industry sector has low market volatility. A total of 30 firms from 8 NAICS sectors that met these criteria and which had both corporate financial and environmental responsibility reports became the sample for the study.

The multivariate analysis technique, Constrained Analysis on Principal Coordinates (CAP) was used to develop three models (a) the 15 EMPs that were significant ($\alpha \leq 0.05$) predictors of at least one of the EFPs (73% of EFP variation explained), (b) the 9 EMPs that were significant predictors of at least 2 EFPs (61% of EFP variation explained), and (c) the 3 EMPs that were significant predictors of at least 3 EFPs (31% of EFP variation explained); none of the EMPs were significant for 4 or all 5 of the EFPs.

A second multivariate analysis technique, Canonical Correspondence Analysis (CCA) grouped the EMPs of the above models into three subsets according to whether they occur at the strategic, tactical, or operational management level of firms, CCA identified the relative importance of each management level for the EFPs. CCA found that, when the 15, 9 and 3 EMPs used in the CAP models were grouped into these management level subsets, 69%, 53%, and 28% respectively of EFP variation was explained. CCA analyses found that all three management levels were significant and that the operational level always explained the greatest percent of EFP variation, followed by the tactical and strategic levels. The results suggest that, for firms to be successful in improving EFPs, EMPs from all three managerial levels must be involved.

This research is a significant contribution by demonstrating that EMPs can account for a high percentage of the variation in EFPs while using data obtained from corporate financial and environmental responsibility reports that are available at little or no cost. In contrast, many previous studies relied on interview and survey methods that are time consuming and costly to conduct, and often explained a low percentage of EFP variation. This study is unique in that it is the first to use CCA to group EMPs according to management levels to understand the role that these levels play in a successful environmental management strategy. For managers of firms similar to those sampled for this study, the model with 9 EMPs is recommended. It explained a high percentage of the variability in EFPs, and 9 EMPs would be more cost effective to implement and monitor than the 19 that were examined.

TABLE OF CONTENTS

List of figures.....	iv
List of tables.....	v
Chapter 1 Introduction.....	1
Chapter 2 Literature review.....	6
2.1 Link between Environmental and Financial Performance (Win-Win).....	6
2.2 Measures of Environmental and Financial Performance (EFPs).....	9
2.2.1 Measures of Financial Performance (EFPs).....	9
2.2.2 Measures of Environmental Performance (EFPs).....	10
2.3 Environmental Management Practices (EMPs) Predictive variables.....	12
2.4 Moderators of Environmental and Financial Performance.....	14
2.5 Ability to predict EFP from EMPs.....	16
2.6 Objectives.....	19
Chapter 3 Research Methods.....	20
3.1 Selection of Sample Firms.....	20
3.1.1 Firm Size.....	20
3.1.2 Industry Type.....	21
3.1.3 Industry Growth (Munificence).....	21
3.1.4 Industry Concentration.....	22
3.1.5 Industry Dynamism.....	23
3.2 Data Collection Environmental and Financial Performance.....	25
3.2.1 ROA.....	25
3.2.2 Innovation Performance Product and Innovation Performance Process.....	26
3.2.3 Firm Sales Growth.....	26
3.2.4 Tobin's q.....	26
3.3 Data Collection Environmental Management Practices (EMPs).....	27
3.4. Data Collection EMPs.....	28
3.5 Data Analysis.....	29
3.5.1 CAP Analysis.....	31
3.5.2 CCA Analysis.....	33

Chapter 4 Results.....	34
4.1 Full Model.....	34
4.1.1 CAP of the Full Model.....	34
4.1.2 CCA of the Full Model.....	37
4.1.3 Full Model Issues.....	40
4.2 Model 1.....	40
4.2.1 CAP of the Model 1.....	40
4.2.2 CCA of the Model 1.....	43
4.2.3 Model 1 Issues.....	45
4.3 Model 2.....	46
4.3.1 CAP of the Model 2.....	46
4.3.2 CCA of the Model 2.....	49
4.4. Model 3.....	51
4.4.1 CAP of Model 3.....	52
4.4.2 CCA of the Model 3.....	54
4.5 Consistency of CAP and CCA Analyses of Models Predicting EFP from EMP...55	
Chapter 5.0 Discussion.....	58
5.1 Models Developed with CAP.....	59
5.2 Models Analyzed Using CCA.....	60
5.3 Contribution of This Research.....	62
5.4 Study Limitations.....	63
Chapter 6.0 Conclusions.....	66
Chapter 7.0 Appendix.....	76
Appendix A The North American Industry Classification System (NAICS)..76	
Appendix B Manufacturing NAICS System.....	77
Appendix C Contribution to GDP by Industry Sector. Years 2000, 2005, 2007, 2008, and 2009.....	78
Appendix D Analysis of Variance (anova) of Market Volatility Index among Manufacturing Sectors.....	79
Appendix E Environment Practices Definition Sheet for Raters. (Based on the research conducted by Montabon et al., 2007).....	80

Appendix F Environmental Practices Matrix. (Based on the research conducted by Montabon et al., 2007).....	82
Appendix G Intraclass Correlation Coefficient (ICC) for Reliability within Each Rater.....	83
Appendix H Intraclass Correlation Coefficient (ICC) for Reliability across the Five Raters.....	89
Appendix I Histograms & Shapiro-Wilk's Normality Test.....	90
Appendix J Stepwise Results.....	102
Appendix K Difference in the Constrained Proportion Explained by CAP and CCA.....	103
Appendix L Output CAP Analyses, and Monte Carlo Global Randomization Test.....	104
Appendix M Output CCA Analyses.....	118

LIST OF FIGURES

Figure 1 Positive link between environmental and financial performance (Ambec and Lanoie, 2008).....	7
Figure 2 Green payback curve (Schroeder and Robinson, 2010), cumulative net returns versus cumulative investment associated with environmental actions.....	8
Figure 3 Illustration of the results of a CAP analysis via a traditional triplot.....	31
Figure 4 Triplot of the Constrained Analysis of Principal Components (CAP) of the Full Model.....	37
Figure 5 Canonical Correspondence Analysis (CCA) Venn diagram of the Full Model.....	38
Figure 6 Triplot of the Constrained Analysis of Principal Components (CAP) of the Model 1.....	43
Figure 7 Canonical Correspondence Analysis (CCA) Venn diagram of the Model 1.....	44
Figure 8 Triplot of the Constrained Analysis of Principal Components (CAP) of the Model 2.....	49
Figure 9 Canonical Correspondence Analysis (CCA) Venn diagram of the Model 2.....	50
Figure 10 Triplot of the Constrained Analysis of Principal Components (CAP) of the Model 3.....	53
Figure 11 Canonical Correspondence Analysis (CCA) Venn diagram of the Model 3.....	54
Figure 12 Difference in the constrained proportion explained by CAP and CCA.....	57

LIST OF TABLES

Table 1 Environmental and financial performance variables (EFPs) compiled from the literature.....	2
Table 2 Examples of environmental management practices (EMPs) used by previous studies that can potentially improve the EFP of firms.....	3
Table 3 Example of moderators affecting the relationship between EMPs and EFPs.....	5
Table 4 Summary of previous research that has studied the link between EMPs, EFPs, and moderators.....	18
Table 5 NAICS sectors with decreasing net input toward the US GDP during years 2000, 2005, 2007, 2008, and 2009.....	22
Table 6 HHI using the 50 largest firms per manufacturing sector.....	23
Table 7 Market volatility for manufacturing sectors.....	25
Table 8 Environmental Management Practices (EMPs) quantified from Firms' Social Corporate Responsibility Reports.....	28
Table 9 Study sample: Thirty active US firms with at least 500 employees in 8 manufacturing sectors. These sectors are characterized as not being highly concentrated, having decreasing contribution to GDP, and not having high market volatility.....	28
Table 10 Constrained Analysis of Principal Components (CAP) of the Full Model. Level of statistical significance of the 19 Environmental Management Practices (EMPs) predicting the five Environmental and Financial Performances (EFPs) variables from 30 manufacturing firms.....	35

Table 11 Canonical Correspondence Analysis (CCA) of the Full Model. Percentage of Environmental Financial Performance (EFP) explained by the Operational, Tactical and Strategic Environmental Management Practices (EMPs) subsets for 30 manufacturing firms.....	39
Table 12 Constrained Analysis of Principal Components (CAP) of Model 1. Level of statistical significance of the 15 Environmental Management Practices (EMPs) predicting the five Environmental and Financial Performances (EFPs) variables from 30 manufacturing firms.....	41
Table 13 Canonical Correspondence Analysis (CCA) of Model 1 Percentage of Environmental Financial Performance (EFP) explained by the Operational, Tactical and Strategic Environmental Management Practices (EMPs) subsets for 30 manufacturing firms.....	45
Table 14 Constrained Analysis of Principal Components (CAP) of Model 2. Level of statistical significance of the 9 Environmental Management Practices (EMPs) predicting the five Environmental and Financial Performances (EFPs) variables from 30 manufacturing firms.....	47
Table 15 Canonical Correspondence Analysis (CCA) of Model 2. Percentage of Environmental Financial Performance (EFP) explained by the three Environmental Management Practices (EMPs) subsets from 30 manufacturing	51
Table 16 Constrained Analysis of Principal Components (CAP) of Model 3. Level of statistical significance of the 3 Environmental Management Practices (EMPs) predicting the five Environmental and Financial Performances (EFPs) variables from 30 manufacturing firms.....	52
Table 17 Canonical Correspondence Analysis (CCA) of Model 3. Percentage of Environmental Financial Performance (EFP) explained by the three Environmental Management Practices (EMPs) subsets from 30 manufacturing firms.....	55
Table 18 Constrained value of the CAP analyses expressed in % for the 4 models predicting 5 EFPs.....	56

Table 19 Constrained value of the CCA expressed in % for the 4 models predicting 5 EFPs
from operational, tactical, and strategic groupings of EMPs.....56

Table 20 Comparison CAP & CCA analyses.....57

ACKNOWLEDGEMENT

I thank my advisors, Professor David Briggs and Timothy Hargrave. Without their guidance and expertise it would have been very difficult for me to finish this dissertation. I would like to extend my gratitude to Professors Eric Turnblom, Dorothy Paun, Stanley Asah and Ann Schlosser for all their support and valuable insights to improve this work. I would also like to thank Dr. Ben Stewart-Koster, and Dr. Paul D. Sampson for their help improving this research. Especial thanks to the research team that helped me collecting the data used in this research; Nick Wegley, Jenny Ginn, Megan Varner, Chia-Pei Lin, Amanda Goffard, and Travis Fuller.

A special thanks goes to Professor Robert Harrison for trusting in my work as one of his ESRM 100 TA's. Without his support, I would have not written these words.

I am grateful to the staff of the Stand Management Cooperative, Megan, Randy, Bob and Bert. Thank you for being awesome to me. I am grateful to all my friends and colleagues at SEFS, without their help and support I would have never finished this work "on time". Special thanks to Amanda and Michelle, you both rock!

My deepest appreciation goes to my parents Mercedes Carrasco and Carlos Thienel, and to all my family and friends back in Chile. I would like to extend a special thanks to my sister Kahrin, and my brother Rodrigo, without their love I would be lost. I would like to thank my wonderful wife Kelly, and her lovely family for all their support and patience.

DEDICATION

To my mother Mercedes, and my wife Kelly

Chapter 1.0 Introduction

Any successful environmental management strategy needs to analyze a firms' internal and external environment. (Valentine, 2009; Aragon-Correa and Sharma, 2003; Hitt et al., 2005; Makhija, 2003). Examples of variables commonly used by previous studies to assess EFPs are presented in Table 1. They include metrics such as Return on Assets, Sales Growth, Environmental accounting, Environmental training programs, etc.

The theory that explains why a firms' EFP mainly depends upon the external environment is based on industrial organizational economics. Industrial organization is the field of economics that studies the structure and boundaries between firms and markets (Tirole, 1988). This theory is commonly known as the market-based view of the firm (Chamberlain, 1932; Caves and Porter, 1977, 1978; Tallman, 1991). In contrast, the theory that focuses on the internal resources and capabilities as sources of competitive advantages, and thus, higher performance, is commonly known as resource-based view of the firm (Barney, 1986a, 1991a, 1991b; Grant, 1991; Wernerfelt, 1984). Ultimately, every environmental management strategy aims to produce sustainability and the improvement of the financial, environmental, and social performance. This is commonly known as the "triple bottom line" approach. Nevertheless, due to a perceived lack of evidence that the benefits will exceed the costs, many firms hesitate to fully implement a more aggressive environmental management strategy (Montabon et al., 2007). However, most of the literature shows evidence supporting a positive link between implementation of environmental management practices and environmental - financial performance. This link is commonly known as the win-win argument, meaning practices that can lead to both, improved environmental and financial performance (Porter, 1991; Dahlmann and Brammer, 2011; Schroeder and Robinson, 2010; Montabon et al., 2007; Aragon-Correa and Sharma, 2003; Orlitzky et al., 2003; Berry and Rondinelli, 1998; Russo and Fouts, 1997; Sanchez, 1997; Hanna and Newman, 1995; Bonifant, 1994).

Despite the win-win argument, it is difficult for business managers to understand which business practices are related to a firms' EFP. Scholars have proposed that almost every environmental management practice (EMP) that firms may undertake is, in one way or another,

related to EFP. Examples of the many EMPs used by previous studies to potentially improve EFP of firms are presented in Table 2.

Table 1: Environmental and financial performance variables (EFPs) compiled from the literature

Environmental Financial Performance (EFP)	Author
Relationship between firm's strategic proactivity, and firm's natural environmental posture	Aragon-Correa (1998)
Description of what it takes to implement a successful and proactive environmental management strategy. Four main forces drive this outcome: Regulatory demands, Costs, Stakeholders, and Competitive requirements	Berry & Rondinelli (1998)
9 Proactive environmental practices: Environmental policy, Benchmarked environmental performance, Environmental accounting, Public environmental report, Environmental performance indicators/goals, External environmental audits, Internal environmental audits, Environmental training programs, and Use of environmental criteria in the evaluation and/or compensation of employees	Darnall et al. (2010)
Level of effort and strategies used to achieve industrial and environmental performance	Florida (1996)
Creation of competitive advantages that leads to corporate performance	Hart (1995)
Return on Investment, Sales Growth, Innovation performance products, Innovation performance process	Montabon et al. (2007)
Emergence of competitive valuable organizational capabilities	Sharma & Vredenburg (1998)
Environmental performance: Reduced raw material use, Reduced solid waste, Reduced liquid waste, Reduced energy use, Increased recycling	Simpson & Samson (2010)

Table 2: Examples of environmental management practices (EMPs) used by previous studies that can potentially improve the EFP of firms

Environmental Management Practices (EMP)	Author
14 Natural Environmental Practices: Sponsorship of natural environmental events, Use of natural environmental arguments in marketing, Natural environmental aspects in administrative work, Periodic natural environmental audits, Residue recycling, Purchasing manual with ecological guidelines, Natural environmental seminars for executives, Natural environmental training for firm's employees, Total quality program with natural environmental aspects, Pollution damage insurance, Natural environmental management manual for internal use, Filters and controls on emissions and discharges, Natural environmental analysis of product life cycle, Participation in government-subsidize natural environmental programs	Aragon-Correa (1998)
10 environmental principles: Environmental policy, Effectiveness of environmental programs, Compare environmental performance within industry context, Promulgate a company view that environmental performance is the responsibility of all employees, Analyze the impact of environmental issues on the future demand for products and the competitive economics of the industry, Frequent discussions of environmental issues at board meetings, Manage a formal system for monitoring proposed regulatory changes and for complying with changing regulations, Environmental due diligence on potential acquisitions, Develop an environmental expenditure budget, and Identify and quantify environmental liabilities from past operations and develop plans for minimizing those liabilities.	Berry & Rondinelli (1998)
10 Environmental Manufacturing Practices: Pollution prevention, Green process technology, Source reduction, Recycling, Total Quality Environmental Management, Worker involvement, Supply chain integration, Productivity and technology role in environmental strategy, Pollution prevention expenditure, and Emission reduction	Florida (1996)
3 concepts from the Natural resource-based view of the firm: Pollution prevention, Product stewardship, and Sustainable development	Hart (1995)
33 EMPs (13 Operational, 13 Tactical, and 7 Strategic): Recycling, Proactive waste reduction, Reactive waste reduction, Remanufacturing, Consume internally, Packaging, Spreading risk, Creating market for waste products, Money spent on environmental initiatives, Environmental information, Rewards as incentive for environmental project, Supply chain management, Early supply involvement, Environmental standard for suppliers, Environmental audits for suppliers, Environmental awards, Environmental participation, Use of LCA, Product development and innovation, Design, Specific design targets, Environmental risk analysis, Environmental management systems, Communication, Integration with long-term business strategy, Corporate policies and procedures, Environmental mission statement, Employee programs, Environmental department/teams, Surveillance of the market for environmental issues, and Strategic alliance	Montabon et al. (2007)
Interactions between Corporate environmental strategy, Environmental expertise, Employee empowerment, and Quality and data management	Simpson & Samson (2010)

The problem for managers is the many EMPs that can be considered to improve performance, and the inconsistency among past studies as to which EMPs were used and which were found to be important predictors of the EFP of firms. In some cases, one particular EMP

has been statistically significant in explaining a firms' EFP, while in other cases, the same EMP has been found to be not significant. For example, Darnall et al. (2010) found that the use of "environmental criteria in the evaluation/compensation of employees" was one of the main EMPs linked with improving the EFP of firms. In contrast, Montabon et al. (2007) did not find this EMP to be significantly related to EFP. Another example is the EMP of "communication/integration with stakeholders" that was found to be significant by Sharma and Vredenburg (1998), but not significant by Montabon et al. (2007).

The large number of EMPs, together with a lack of consensus as to which EMPs can help managers improve EFP, causes uncertainty among managers in deciding which EMPs should be their focus for improving EFP. Lack of homogeneity in the research sampling is another issue that may be important for improving relationships between EMPs and EFPs. For example, Darnall et al. (2010) studied firms from 6 different countries. Differences in law and public attitude toward the environment make it unlikely that a set of EMPs would work as well for firms in one country as in another. Another example is Montabon et al. (2007), who selected firms from different industries, products, processes, and size. Even within a country it is unlikely that dissimilar firms, i.e. large vs small, manufacturing vs service, etc., would employ similar EMPs in reacting to environmental regulations and public perceptions that would affect their environmental performance. One way to improve the ability of EMPs as predictors of EFPs, is to incorporate moderators to examine firms that have relatively similar characteristics. A moderator, also referred as covariate, is any qualitative or quantitative variable that affects the direction and/or strength of the relationship between response (EFP) and predictor (EMP) variables (Baron and Kenny, 1986). Table 3 lists moderators used by previous studies in examining the relationship between EFPs and EMPs.

Table 3: Examples of moderators affecting the relationship between EMPs and EFPs

Moderators	Authors
Firm size	Darnall et al. (2010); Simpson and Samson (2010); Sharma and Vredenburg (1998); Russo and Fouts (1997).
Industry type	Dahlmann and Brammer (2011); Richard et al. (2007); Aragon-Correa (1998); Klassen and McLaughlin (1996).
Industry Growth (Munificence)	Richard et al. (2007); Aragon-Correa and Sharma (2003); Ferrier (2001); Russo and Fouts (1997).
Industry dynamics	Snyder and Glueck (1982).
Industry concentration	Richard et al. (2007); Ferrier (2001); Russo and Fouts (1997).
Firm Growth	Montabon et al. (2007); Russo and Fouts (1997).
Barriers to entry	Ferrier (2001).
Uncertainty	Aragon-Correa and Sharma (2003).
Complementary assets	Christmann (2000).
Complexity	Aragon-Correa and Sharma (2003).
Market dynamics	Eisenhardt and Martin (2000)

One of the limitations of directly incorporating moderators in EFP/EMP analyses is that it is impossible to develop a “one size fits all” model. For example, it is highly unlikely that firms in the service sectors (e.g., banks, computer software, etc.) and manufactory sectors (e.g., plastic and rubber products, wood products, etc.) share much in common as to which EMPs best help improve their EFP. Better results are likely when analyses are focused on firms within similar economic sectors. One would expect that the EMPs that best explain EFP of firms in the service sector would be different than the EMPs that best explain EFP in the manufacturing sector. Moderators may be very useful in selecting a stratified sample composed of firms that are relatively similar. In other words, moderators can help in answering the question “which EMPs can explain the most variation in EFP of firms in the chosen stratum?” Extension to other strata would reveal the extent to which the different strata utilize common EMPs.

Six additional chapters compose this thesis. Chapter 2 reviews the literature concerning environmental management concepts, EMPs, Moderators, and the measuring of EFPs. Chapter 3 explains the process utilized to select the sample of firms studied in this research, the method used to collect data on the sample firms, and the methods used to analyze the data for developing relationships. Chapter 4 presents results of the analyses. Chapter 5 contains a discussion of the results, Chapter 6 presents the conclusions, and Chapter 7 presents the Appendix.

Chapter 2.0 Literature Review

2.1 Link between Environmental and Financial Performance (Win-Win)

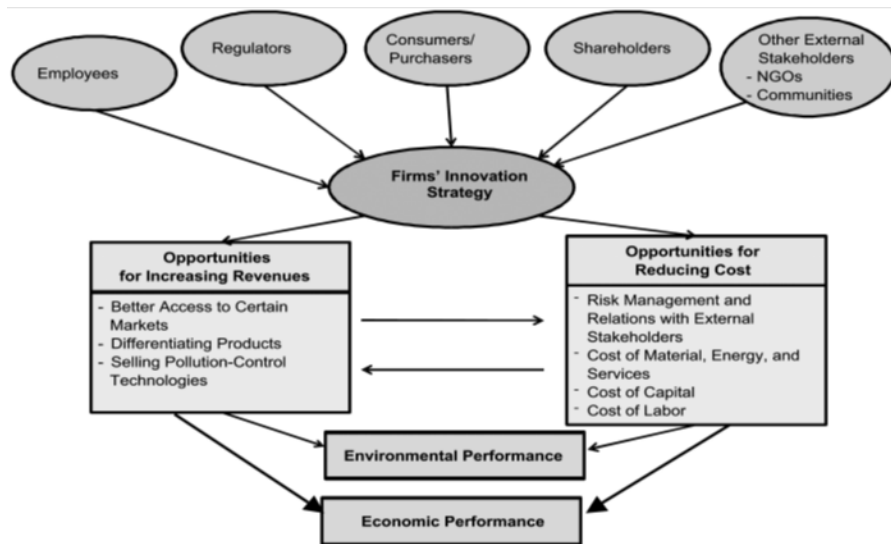
Since the publication of the Brundtland Report in 1987 (United Nations General Assembly, 1987), the “old” paradigm stating that sustainable business comes at an additional cost imposed by the government, has been challenged. Scholars such as Schroeder and Robinson (2010), Porter (1991), Porter and van der Linde (1995b), Klassen and McLaughlin (1996), have analytically and empirically shown that firms can gain competitive advantages while at the same time being responsible with the natural environment.

In the research entitled “Does it pay to be green? A systematic overview” Ambec and Lanoie (2008), presented a systematic review of empirical evidence supporting the win-win argument that a firm can improve both environmental and financial performance. The objective of the paper was not to show that a reduction of pollution is always accompanied by better financial performance, but rather to show that, in many cases, the expenses incurred to reduce pollution can partially or completely be offset by gains elsewhere (Ambec and Lanoie, 2008).

The analytical framework presented by Ambec and Lanoie (2008), states that firms can try to reduce their environmental impact without hurting their economic performance. Firms can accomplish this goal by implementing an environmental approach composed of several strategies. This approach must include one or more of seven strategies that could result in increased revenue or reduced costs.

The research suggests that better environmental performance can lead to an increase in revenue by: (a) better access to certain markets, (b) differentiating products, and (c) selling pollution-control technology. Alternatively, it can reduce costs in four categories: (a) risk management and relations with external stakeholders, (b) cost of material, energy, and services, (c) cost of capital, and (d) cost of labor. This analytical framework is summarized in Figure 1.

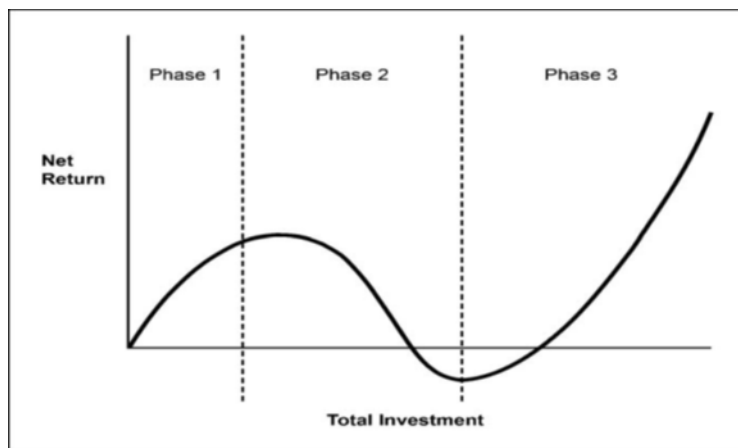
Figure 1: Positive link between environmental and financial performance (Ambec and Lanoie, 2008)



Perhaps the main dispute against the win-win argument is the belief that reducing a firms’ environmental impact drives up costs. Schroeder and Robinson (2010) found that this argument is not necessarily true. In 2007, Schroeder and Robinson conducted a study in Subaru Indiana Automotive (SIA). SIA is considered to be one of the most environmentally friendly companies in the US. SIA started their “green initiatives” more than 20 years ago. Four of their most relevant achievements are described here: First, SIA became the first U.S. auto plant to receive ISO 14001 certification (1998). ISO 14000 is a family of voluntary environmental standards developed by the International Organization for Standardization (ISO), a coalition of the world’s national standards institute (Morhardt, 2002). Second, SIA became the first auto plant to have its grounds certified as a “Backyard Wildlife Habitat” by the National Wildlife Federation (2003). Backyard Wildlife Habitat is a program of the National Wildlife Federation that encourages homeowners and organizations in the United States to manage their gardens, yards, and property for wildlife, with the goal of maintaining healthy and diverse animal habitats and ecosystems (National wildlife federation). Third, SIA became the first automobile plant in the world to achieve zero-landfill (2004). Fourth, since 2000, SIA reduced the waste discharged per vehicle by 99.9 percent.

Schroeder and Robinson documented the steps taken by SIA to achieve its outstanding environmental performance. They also addressed the issue of financial performance; more specifically, the costs and returns of environmentally friendly investments. When evaluating the financial performance of SIA's environmental investment, the authors noticed the pattern called the "Green Payback Curve" illustrated in Figure 2.

Figure 2: Green payback curve (Schroeder and Robinson, 2010), cumulative net returns versus cumulative investment associated with environmental actions



As Schroeder and Robinson summarized, the Green Payback Curve may explain why so many organizations have failed to embrace serious green improvements. While they are quick to take advantage of Phase 1 improvements with rapid paybacks, as they next approach Phase 2, where the paybacks diminish and the uncertainty increases. At this point they pull back since their institutional decision-making mechanisms, which rely heavily on cost-benefit analysis, make it difficult for them to get through to the Phase 3 upside.

Schroeder and Robinson (2010) highlighted the limitations of using simple cost-benefits analysis when making complex decisions. They state "Cost benefits analyses are effective for simple, one dimensional decisions, but it is a poor tool for more complex ones". Most of the decisions regarding environmental business have multiple dimensions, thus, are very complex. For example, managers need to consider costs, productivity, quality, sales, supply chain logistics, stakeholder integration, etc. when deciding an environmental initiative.

2.2 Measures of Environmental and Financial Performance (EFPs)

EFPs are measured to assess if they have responded positively or not to the EMPs firms have implemented. Table 1 presents many EFPs used by previous studies and illustrates their variety, ranging from those that can be quantified from financial and environmental reports, such as ROA and Sales Growth, to non-quantitative EFPs, such as descriptions of how different firms have implemented a successful and proactive environmental management strategy that led to improved environmental and financial performance. This section discusses quantitative EFPs that can be obtained from the financial and environmental reports of firms.

2.2.1 Measures of Financial Performance (EFPs)

Returns on Assets There are many possible ways to measure a firms' financial performance. A common and straightforward way is by calculating metrics such as Return on Equity (ROE), which is the amount of net income returned as a percentage of shareholders equity and calculated by dividing a firms' net income by its shareholder's equity. Another metric is Return on Investment (ROI), which is a performance measure used to evaluate the efficiency of an investment, and is calculated by obtaining the difference between the gains of an investment from the cost of the investment, divided by the cost of the investment. A third metric is Return on Assets (ROA), which is an indicator of how profitable a company is relative to its total assets, and is calculated by dividing a firms' net income over its total assets.

All of these ratios capture different performance aspects, thus, each has weaknesses and strengths. For example, ROE focuses on return to the shareholders of a firm, but it can "hide" many potential problems. As explained by Hagel III et al. (2010) "Companies can resort to financial strategies to artificially maintain a healthy ROE for a while, and hide deteriorating performance in business fundamentals. Growing debt leverage and stock buybacks funded through accumulated cash can help to maintain a company's ROE even though operational profitability is eroding. Mounting competitive pressure combined with artificially low interest rates, characteristics of the last couple decades, creates a potential incentive to engage in these strategies to keep investors happy".

These issues with ROE lead Hagel III et al. (2010) to recommend using ROA instead. “ROA avoids the potential distortions created by financial strategies like those mentioned above”. At the same time, they acknowledged the capacity of ROA as metric of financial performance. “ROA explicitly takes into account the assets used to support business activities. It determines whether the company is able to generate an adequate return on these assets rather than simply showing robust return on sales”.

Sales Growth Another way to assess firms’ profitability is by determining Sales Growth, usually measured as the percentage increase or decrease in sales from previous years (Russo and Fouts, 1997; Montabon et al., 2007).

Tobin’s q Tobin’s q is a commonly used measure of long-term profitability. It is designed to reflect the market’s perception of current and potential profitability (Carpenter, 2002; Huselid, 1995). Tobin’s q is defined as the ratio of the market value of a firm to the replacement value of its assets (Richard et al., 2007).

2.2.2 Measures of Environmental Performance (EFPs)

Measuring and publishing environmental performance is important for firms because if a firm performs well in this area, or if it is better than its competitors, it can be a source of competitive advantage. On the other hand, if a firm does not comply with regulatory market and public concerns, it could “harm” its financial bottom line (Montabon et al., 2007; Morhardt, 2002).

As in the case of financial performance, there are many possible ways to report and evaluate firms’ environmental performance. For example, corporate environmental reports, surveys, interviews, voluntary environmental initiatives, international standards, etc. However, the main difference between environmental and financial performance is the lack of consensus, and standardization, on how to define and measure a firms’ environmental performance.

Some of the reasons why measuring environmental performance is so challenging have been summarized by a research group called the “Measuring the Environmental Performance of Industry project”. This research group is coordinated by the Science and Technology Policy Research at the University of Sussex, UK. The list below has been quoted from their website, <http://www.sussex.ac.uk/Units/spru/mepi/approach/index.php>

- Environmental issues are complex and often difficult to quantify.
- Comparing the environmental impacts of firms with different economic activities is problematic.
- There is no universally accepted approach to weighing different environmental impacts against each other, and any overall assessment will produce highly contested results.
- There is no standard approach to environmental reporting and measurement, although a range of guidelines has now been developed.
- The availability and quality of environmental data is often poor.

Generally speaking, the environmental management field has considered corporate environmental reports as the best way to communicate environmental performance (Jones et al., 1999; Montabon et al., 2007; Morhardt 2002). However, other authors such as Ullmann (1985) have noticed that self-reporting of environmental performance is not consistently associated with unbiased measures of environmental performance (Klassen and McLaughlin, 1996).

In the field of Environmental management, Porter’s (1991) win-win argument is one of the most common ways to assess environmental and financial performance. Porter (1991), Porter and van der Linde (1995a), Ambec and Lanoie (2008), among others, have argued that the benefits of environmental management are larger than the cost of implementing such a strategy. These authors argued that environmental management will lead to financial benefits, either in the form of minimizing cost, and/or improving productivity. Specifically, Porter and van der Linde (1995a) argued that the medium by which environmental management will improve firms’ performance, is by creating “innovation offsets”.

The environmental performance variables measured in this research are extracted from firms' corporate environmental report, and they are a subset of those proposed by Montabon et al. (2007). Montabon et al. (2007) used Porter and van der Linde's (1995a) innovation offset argument as one of their response variables to assess firms' performance. Using firms' corporate sustainability reports, they quantified two innovation constructs; Product innovation and Process innovation. These were measured independently by answering the following questions: "Overall, how well has this firm done in introducing product/process innovations, and are they constantly looking for product/process innovations?" Are there specific mentions of product/process innovation?

Product Innovation This measure is obtained when answering the question in terms of the product context.

Process Innovation This measure is obtained when answering the question in terms of the process context.

2.3 Environmental Management Practices (EMPs) Predictive variables

Environmental management consists of all the actions taken by a firm with the objective of minimizing its impact on the natural environment throughout the firms' life cycle (Klassen and McLaughlin, 1996). EMPs are all the techniques, policies, and procedures used by a firm that are specifically designed to monitor and control a firms' environmental impact on the environment (Montabon et al., 2007).

Montabon et al. (2007) noted that "EMPs can be implemented at different organizational levels throughout a firm. The scope of an EMP can be operational, tactical, or strategic. Operational level EMPs are usually internally focused and generally pertain to shop floor operations. Examples are programs to reduce water and energy consumption. Tactical level EMPs fall somewhere between operational and strategic practices, and can be viewed as representing both internal and external foci. The use of Life Cycle Analysis and involvement of suppliers are two examples of tactical EMPs. Strategic level EMPs are usually externally focused,

and are typically a set of objectives, plans, and policies established by top managers reflecting the firms' environmental posture to external constituencies and stakeholders”

EMPs can also be grouped into two broad categories, (a) to increase revenue, and/or (b) to reduce costs. More specifically, according to Banerjee, Iyer, and Kashyap (2003), public concern, regulatory forces, competitive advantage, and top management commitment, are the main reasons to adopt EMPs. Rondinelli and Vastag (1996) proposed that firms may be reacting to regulatory environment, or responding to market pressure. Regardless of these reasons, all these actions will have a financial impact on a firm (Montabon et al., 2007). Generally speaking, due to the imminent impact on profitability, and the belief that the costs of implementing an aggressive environmental strategy will be greater than its financial benefits, many firms hesitate to implement a proactive environmental strategy (Montabon et al., 2007).

As shown in Table 2, many EMPs have been examined by previous studies as potential predictors of improved EFP. Most of the literature dealing with EMPs has supported Porter's (1991) win-win argument (Porter and van der Linde, 1995b; Berry and Rondinelli, 1998; Hanna and Newman, 1995; Bonifant, 1994; Christmann, 2000; Florida, 1996; Orlitzky et al., 2003). However, results from many studies may not be generalizable because they (a) focus on descriptive statistics rather than rigorous hypothesis testing, (b) utilize a small set of EMPs (Montabon et al., 2007), or (c) examined a heterogeneous group of firms, and did not consider enough moderators (e.g. industry sector, firm size, country of origin, etc.) that may account for differences in how firms of diverse background use EMPs to improve EFP.

In order to further develop the topic of EMPs and their relation to firms' EFP, Montabon et al. (2007) studied the EMP vs. EFP relationship using a broader range of EMPs than other studies. They found that some of these EMPs were positively associated with firm's EFP. A subset of the EMPs proposed by Montabon et al. (2007) can be extracted from the corporate environmental report of firms. Measures of these EMPs, which can be obtained from corporate environmental reports, will be used in this research. Their definitions and method for measuring them are explained in Chapter 3 section 3.

2.4 Moderators of Environmental and Financial Performance

Table 3 lists examples of moderators that may affect the relationship between EMPs and EFPs. It was previously mentioned that due to a broad numbers of EMPs, together with an apparent lack of consensus about which EMPs yield higher EFP, managers have had problems deciding how to create a successful environmental management strategy. Evidence of this problem has been presented by Valentine (2009), and Porter and Kramer (2006). These authors argued that the current knowledge of corporate social responsibility is very fragmented, thus, it is complicated for managers to develop an environmental management strategy that can be easily implemented.

To help ease this problem, moderators must be incorporated when creating such a strategy. A moderator is “a qualitative (e.g., sex, race, class) or quantitative (e.g., level of reward) variable that affects the direction and/or strength of the relation between an independent or predictor variable and a dependent or response variable” (Baron and Kenny, 1986).

There are two general types of moderators: 1) moderators based on the market structure (external moderators), and 2) moderators based on the firms’ internal structure (internal moderators). Even though there is a vast body of research that has incorporated moderators (e.g. Darnall et al., 2010; Florida, 1996; Montabon et al., 2007; Snyder and Glueck, 1982), most have considered only one or just a few moderators and these are not consistent among them.

Table 3 lists examples of moderators that may affect the relationship between EMPs and EFPs. The following is a list of some of the moderators that have been linked to the EFP of firms.

Firm size Arguably, the most intuitive moderator that may affect the relationship between EMPs and EFP is the size of a firm. Many scholars have considered this moderator in their research (Darnall et al., 2010; Florida, 1996; Richard et al., 2007; Simpson and Samson, 2010; Aragon-Correa, 1998; Sharma and Vredenburg, 1998; Russo and Fouts, 1997), as it can affect a firms’ organizational power, financial performance, strategic proactivity, training requirements, etc.

Industry type The second moderator included by many studies is industry type. The North American Industry Classification System (NAICS) is a classification system composed of 24 different primary industry sectors. Many scholars have also considered this moderator in their research (Darnall et al., 2010; Dahmann and Brammer, 2011; Aragon-Correa, 1998; Sharma and Vredenburg, 1998; Russo and Fouts, 1997).

A common industrial context facilitates control for external influences such as the degree of environmental regulation, and the degree of scrutiny by media and special interest groups (Sharma and Vredenburg, 1998).

Munificence /Industry Growth Munificence is the degree to which the general business environment can support a sustained rate of organizational growth or sales growth (Starbuck, 1976; Dess and Beard, 1984).

Russo and Fouts (1997) tested the idea that enhanced environmental performance resulted in a competitive advantage, which was reflected in economic benefits. Their results support the win-win argument, and this relationship is strengthened with the existence of industry growth. Other authors such as Aragon-Correa and Sharma (2003), Richard et al. (2007), and Ferrier (2001) have also explored the relationship between munificence and EFP. Given that industry growth is positively correlated with performance, this moderator helps with the objective of selecting a homogeneous group of firms.

Industry concentration Industrial concentration refers to a structural characteristic of the business sector. It is the degree to which production in an industry, or in the economy as a whole, is dominated by a few large firms. Industry concentration is broadly defined both in terms of the product it produces, and the extent of the geographic area it serves (Shughart, 2008). For example, a specific industry will be highly concentrated if most of their firms are located in one geographic area and their products are relatively similar.

Industry concentration moderates the relation between EMPs and EFP because it considers general market conditions that will influence managers in their decision regarding

EMPs. Overall the incorporation of this moderator also helps with the objective of selecting a homogenous group of manufacturing firms.

The Herfindahl index (HHI) for industry concentration has been extensively used by researchers to assess industry concentration (Ferrier, 2001; Coate et al., 1990; Stigler, 1964). In general, the fewer the firms and the more unequal the distribution of market shares among firms, the larger the HHI.

Industry dynamism/Environmental volatility Environmental volatility is related to managing the unexpected. It has been widely studied in management research, and it tries to capture the degree, frequency, and unpredictability of environmental change. There is an abundant body of research that has explored the relationship between environmental volatility and a firms' performance (Dill, 1958; Kast and Rosenzweig, 1978; Snyder and Glueck, 1982; Richard et al., 2007, Dess and Beard, 1984; Starbuck, 1976, Farjoun and Levin, 2011). A firms' response to environmental volatility has significant effects on its performance. Thus, determining the extent of volatility faced by a firm and its sources is crucial if managers are concerned about performance (Aldrich, 1969; Child, 1972).

2.5 Ability to Predict EFP from EMPs

There have been several attempts to predict firms' EFP from either an individual EMP, or a group of EMPs. Table 4 summarizes the main aspects, methods, response variables (EFPs), and predictive variables (EMPs) used by previous studies. These studies have tried to answer a similar question: "What can firms do to perform well environmentally and financially?" Some focused solely on theory while others have empirically analyzed variables that have an impact on the EFP of a firm. These studies used different sample sizes, analytical tools, data collection methods, numbers of firms, number of EMPs, etc. The response variables or EFPs range from the study of the relationship between firms' strategic proactivity and firms' natural environmental posture (Aragon-Correa, 1998), to more traditional financial report metrics such as ROI, and Sales Growth (Montabon et al., 2007). Similarly, there is great range in the number and type of EMPs used to predict EFPs. Some researchers report the percent of variation in EFP

accounted by the EMPs, while others show which EMPs were statistically significant predictor of EFP. These differences make comparisons very difficult, and highlight the difficulties managers face when attempting to use past research in deciding which of the many possible EMPs should be chosen to improve EFP. This is an important problem as managers want to minimize the cost of implementing, monitoring, and managing EFPs while selecting EMPs that are effective improvers of EFP.

Table 4: Summary of previous research that has studied the link between EMPs, EFPs, and moderators

	Authors							
	Aragon-Correa (1998)	Berry & Rondinelli (1998)	Darnall et al. (2010)	Florida (1996)	Hart (1995)	Montabon et al. (2007)	Sharma & Vredenburg (1998)	Simpson & Samson (2010)
Research Type	Empirical	Theoretical	Empirical	Empirical	Theoretical	Empirical	Empirical	Empirical
Response variable(s)	Relationship between firm's strategic proactivity, and firm's natural environmental posture	Successful environmental Management Strategy	9 Proactive Environmental Practices	Perception of corporate performance	Competitive advantage	ROI, Sales Growth, Product Innovation, Process Innovation	Emergence of organizational capabilities	Environmental performance
Explanatory variable(s)	14 Natural Environmental Practices, and 18 measurements of business strategy	10 Environmental Principles	Stakeholder pressure, firm size	10 EMPs and 11 Factors associated with adoption of green design.	Natural Resource-Based view (Pollution prevention, Product stewardship, Sustainable development)	20 EMPs, 6 of which were statistically significant (Recycling, Proactive waste reduction, Remanufacturing, Environmental design, Specific design targets, Surveillance of markets)	Proactive environmental strategy	Interaction between corporate environmental strategy and environmentally beneficial operations (Environmental expertise & Information-intensive practices)
Moderator(s)	Country, Firm size, Industry type, Annual turnover	NA	Age of plant, Industry type, Ownership, Export orientation	Firms size, Industry type	NA	Firms considered "proactive" with regards to environmental issues	Country, Firm size, Industry type	Country, Firm size, Industry type, Age of plant
Sample size	105	NA	2687	256	NA	45	7	55
Variability explained or Significance level	60%	NA	$\alpha \leq 0.01$	NA	NA	.308 Stewart-Love canonical redundancy index	20%	$\alpha \leq 0.01$

2.6 Objectives

This research has two main objectives.

The first objective is to examine the empirical relationship between EMPs and EFPs using EFPs that can be measured from corporate financial and environmental reports, and a subset of the EMPs developed by Montabon et al. (2007) that can be measured from corporate environmental reports. The reason for the focus on these reports is that they are routinely published and provide a relatively inexpensive and simple basis for data collection compared with expensive, time consuming interview and survey methods. This study will also incorporate a set of moderators to produce a sample of relatively similar firms. By developing a more homogeneous sample of firms than previous studies it is believed that predictions of EFPs from EMPs will be improved. It is also anticipated that a mix of strategic, tactical, and operational EMPs is needed to obtain the greatest improvement in EFPs. This is based on the belief that all three levels of management must be involved to maximize the improvement in EFPs.

The second objective is to be able to generalize results from which recommendations can be made to managers of firms similar to the sampled firms, as to which EMPs they should consider to improve the EFP of their firms.

Chapter 3.0 Research Methods

3.1 Selection of Sample Firms

This research uses the five moderators explained in section 2.4. These moderators were: firm size, industry type, industry growth (munificence), industry dynamism, and industry concentration.

In addition, the firms selected also met the following criteria:

- Being a currently active firm
- Country of operations: USA

3.1.1 Firm Size

To conduct a firms' financial analysis, it is necessary to access its financial reports. The only type of firms that are legally required to disclose financial information are publicly traded companies. For this reason, it was decided to use publicly available data to define firm size.

The U.S. Census Bureau does not define small or large business, but it provides statistics that allow users to define business categories in any of the following ways: (a) employers and nonemployers, (b) employment size of firms, (c) employment size of establishment, and (d) receipts size of firms.

In 2008, the US Census Bureau published information that summarized the number of companies according to their number of paid employees (e.g. firms with 1 to 4 paid employees, firms with 5 to 9 paid employees, ..., firms with 10,000 or more paid employees). After reviewing the statistics provided by the U.S. Census Bureau regarding firm size, it was decided that the size criteria used in this research would be firms with 500 or more paid employees (U.S. Census Bureau, <http://www.census.gov/econ/smallbus.html>, accessed on May 14,2013).

After applying this moderator (firm size), the total number of active firms with operations in the US with 500 or more paid employees was 18,469 firms.

3.1.2 Industry Type

As the second moderator, this research focused on the manufacturing industry because it produces more air, land, and water pollution than the service sector (Stead and Stead, 1992). However, the manufacturing industry can be divided into several groups.

The North American Industry Classification System (NAICS) is the standard used by federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. Appendix A summarizes the industry types proposed by the primary NAICS, and Appendix B summarizes the manufacturing NAICS system.

3.1.3 Industry Growth (Munificence)

To standardize this diverse group of manufacturing sectors, the next moderator used in this research was industry growth. Industry Growth has been used as a tool to estimate industry munificence (Richard et al., 2007; Russo and Fouts, 1997). To homogenize the diverse group of manufacturing sectors, it was decided to choose only sectors with “similar” growth patterns. Industry Growth was considered to be the relative contribution of a sector into the overall national economy.

The industry growth extent considered for each NAICS group was its net input toward the Gross Domestic Product (GDP) during the years 2000, 2005, 2007, 2008, and 2009.

With the objective of selecting a homogenous group of firms, only sectors with a decreasing trend (negative slopes) were chosen. This information was extracted from the US Census Bureau, Statistical Abstract of the United States: 2012 (US Census Bureau, http://www.census.gov/prod/www/abs/statab2011_2015.html, accessed on April 17, 2013).

These years were selected because they were the most current data available in the US Census Bureau website.

The US Census Bureau grouped some of the individual NAICS sectors into more homogenous groups, thus, the sectors shown in Table 5 are those with negative trend in their contribution to the GDP during the years 2000, 2005, 2007, 2008, and 2009.

Table 5: NAICS sectors with decreasing net input toward the US GDP during years 2000, 2005, 2007, 2008, and 2009

Sector (NAICS code)	Slopes
Wood products (321)	-2.27
Nonmetallic mineral products (327)	-1.33
Motor vehicles, bodies, and trailers, and parts (3361–3363)	-11.05
Furniture and related products (337)	-2.47
Textile mills and textile products mills (313, 314)	-2.17
Apparel and leather and allied products (315, 316)	-2.19
Paper products (322)	-1.12
Printing and related support activities (323)	-1.55
Plastics and rubber products (326)	-2.2

3.1.4 Industry Concentration

The fourth moderator, industrial concentration, refers to a structural characteristic of the business sector. It is the degree to which production in an industry, or in the economy as a whole, is dominated by a few large firms (Shughart, 2008).

The Herfindahl-Hirschman Index (HHI) has become the standard measurement of industrial concentration. “The HHI is calculated by summing the squared market shares of all the firms in an industry. In general, the fewer the firms and the more unequal the distribution of market shares among them, the larger the HHI. An industry controlled by a single firm has an HHI of $100^2 = 10,000$, while the HHI for an industry populated by a very large number of very small firms would approach the index’s theoretical minimum value of zero” (Shughart, 2008). According to the U.S. Department of Justice’s merger guidelines, an industry is considered concentrated if the HHI exceeds 1,800, and it is unconcentrated if the HHI is below 1,000. Since

1982, HHI has been calculated based on the shipment value of the fifty largest companies, and it has been reported in the manufacturing series of the Economic Census (Shughart, 2008).

Table 6: HHI using the 50 largest firms per manufacturing sector

Manufacturing sector	NAICS	Year	HHI
Wood products	321	2007	38.3
Nonmetallic mineral products	327	2007	89.6
Motor vehicles, bodies and trailers, and parts	3361	2007	1,744.2
	3362	2007	167.9
	3363	2007	144
Furniture and related products	337	2007	61.5
Textile mills and textile product mills	313	2007	160.2
	314	2007	418.6
Apparel and leather and allied products	315	2007	44
	316	2007	174.8
Paper products	322	2007	227.8
Printing and related support activities	323	2007	77.9
Plastics and rubber products	326	2007	31.3

Source: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ECN_2007_US_31SR12&prodType=table, accessed on April 24, 2013

Of these nine manufacturing sectors, NAICS 3361 Component of motor vehicles, bodies and trailers, and parts; was considered too concentrated compared to the others for inclusion in this research, therefore, only NAICS 3362 and 3363 were included under “Motor vehicles, bodies and trailers, and parts”.

3.1.5 Industry Dynamism

The fifth moderator, industry dynamism, refers to the volatility of the market. One of the most common and accepted ways to assess environmental volatility (uncertainty), is through an Industry Volatility Index (Tosi et al., 1973; Snyder and Glueck, 1982; Richard et al., 2007). Environmental volatility refers to the rate of unpredictable change in environmental factors that are considered to be relevant (Carpenter and Westphal, 2001; Duncan, 1972; Richard et al., 2007).

Market volatility was calculated using the coefficients of variation of sales over a 5 year period (2007 – 2011). Tosi et al.’s definition of market volatility is the average of the coefficients of variation of sales divided by average sales revenue for individual firms in the industry.

The formula used to calculate market volatility is:

$$\frac{\sqrt{\frac{\sum_{i=1}^x \frac{(y_i - \bar{y})^2}{x}}{y}}}{z} + \dots + \frac{\sqrt{\frac{\sum_{i=1}^x \frac{(y'_i - \bar{y}')^2}{x}}{y'}}}{z}$$

Where:

x is the number of years being considered (5)

y is sales for firm y in each of the x years

\bar{y} is average sales for firm y over x years

y' is sales for firm y' in each of the x years

\bar{y}' is average of sales for firm y' over x years

z is the number of firms from the industry used to calculate the volatility measure. In this study, 20% of the total amount of firms in a particular NAICS sector was used to calculate market volatility.

After calculating market volatility for the 9 NAICS sectors (Table 7), only sectors 3362 & 3363 were significantly different ($\alpha \leq 0.01$) from the other NAICS sectors.

Table 7: Market volatility for manufacturing sectors

NAICS	Market volatility	Total number of firms
323	0.099	23
322	0.111	46
326	0.121	24
313 & 314	0.143	27
315 & 316	0.161	87
321	0.172	14
337	0.182	36
327	0.185	47
3362 & 3363	0.404	76

For more information about Market volatility calculation, see Appendix D.

Mergent Online was used as a database to apply the five moderators to select the appropriate firms included in this research. Mergent Online is an online database provider that allows access to a vast archive of corporate and industry related documents such as: business description, history, properties, subsidiaries, officers, directors, long-term debt, capital stock, income statement, balance sheet, statements of cash flow, exchange and ticker symbol, number of employees, address, telephone number, annual stock price ranges, etc. After applying the five moderators, 304 firms emerged as the potential sample population for this study.

3.2 Data Collection Environmental and Financial Performance

The EFPs used in this research were: Return on Assets (ROA), Innovation performance (products), Innovation performance (process), Sales Growth, and a measure of Tobin's q proposed by Lee and Tompinks (1999). The EFP information was obtained from the firms' 2011 publicly available financial reports, and from the 2011 corporate environmental reports.

3.2.1 ROA

ROA was calculated by dividing a firms' net income by its total assets.

3.2.2 Innovation Performance Product and Innovation Performance Process

Innovation performance product and Innovation performance process were measured by answering the following questions for each variable: “Overall, how well has this firm done in introducing innovations, and are they constantly looking for innovations?” Are there specific mentions of innovation? Corporate environmental reports published in 2011 were analyzed to answer these questions regarding innovation product and innovation process. A Likert scale ranging from 1 to 5 was utilized to quantify these two EFPs.

3.2.3 Firm Sales Growth

Firm Sales Growth was calculated as the average rate of change of sales between the years 2007 through 2011. The average rate of change was set equal to the slope coefficient in a linear regression of annual sales for those years. The rate of change of each firm was sorted from highest to lowest, and then converted into a scale with values from 0 to 1. The relative scaling was accomplished by first applying a translation to make all values positive, then forming the quotient between the absolute slope value and the range of the translated values.

3.2.4 Tobin’s q

Tobin’s q was defined as:

$$Q = (\text{MKTVAL} + \text{PSVAL} + \text{DEBT}) / \text{TA}$$

where:

MKTVAL the market value is obtained by multiplying the number of shares outstanding by share price.

PSVAL is the liquidating value of the outstanding preferred stock.

DEBT is the long-term debt plus the difference between the value of the firms’ short-term liabilities and its short-term assets.

TA is the book value of the total assets of the firm.

Tobin's q can be viewed as the sum of all funds invested by external sources, stockholders and lenders, divided by the book value of the firm's assets.

This measure of Tobin's q was calculated from COMPUSTAT, a business and financial dataset that provides annual and quarterly income statement and balance sheet data on over 10,000 firms dating back to the 1950s.

3.3 Data Collection Environmental Management Practices (EMPs)

Corporate environmental reports published in 2011 were used to collect information regarding the predictive variables (EMP) for the sample firms. This research used a modified EMP set list developed by Montabon et al. (2007). The 19 items set list was developed with the intent of capturing the majority of techniques, options, and policies regarding environmental management. Table 8 summarize the 19 EMPs grouped into 3 managerial levels (operational, tactic, and strategic), while Appendix E displays the definition sheet for the EMPs given to a data collection and rater team.

Following the method utilized by Montabon et al. (2007), The EMP set list was converted into a matrix (Appendix F) for use in further analysis. The EMPs in the matrix were grouped into operational, tactical, and strategic management levels. Each EMP has a column for objective measures of the attribute and intensity of use of the attribute. An additional field was used to highlight if the sample firm noted any measurements of the EMP (e.g., tons of paper recycled), how involved the firm was with the EMP, and where in the environmental report the EMP could be found.

Although 304 US firms were in the original list of potential firms to study, applying the five moderators: Manufacturing firms with at least 500 paid employees, firms with negative trend in contribution to GDP, in a relatively un-concentrated and non-volatile sectors, only 30 (10%) firms published a corporate social responsibility report in 2011. These 30 firms shown in Table 9 became the sample basis for this study.

Table 8: Environmental Management Practices (EMPs) quantified from Firms' Social Corporate Responsibility Reports.

EMP		
Operational	Tactical	Strategic
Recycling	Early supplier involvement	Corporate policy procedure
Waste reduction (proactive)	Environmental standard for suppliers	Environmental mission statement
Waste reduction (reactive)	Environmental audits suppliers	Environmental department
Consume internally	Environmental awards	Surveillance of market
Create market for waste	Life cycle analysis	Strategic alliance
Water consumption	Design targets	
Energy consumption	Environmental risk analysis	

Table 9: Study sample. Thirty active US firms with at least 500 employees in 8 manufacturing sectors. These sectors are characterized as not being highly concentrated, having decreasing contribution to GDP, and not having high market volatility

Manufacturing sector	NAICS	Number of firms
Wood products	321	3
Nonmetallic mineral products	327	2
Furniture and related products	337	2
Textile mills and textile product mills	313 & 314	2
Apparel and leather and allied products	315 & 316	4
Paper products	322	13
Printing and related support activities	323	3
Plastics and rubber products	326	1
Total		30

3.4 Data Collection EMPs

This research explores the relationship between the 19 EMPs (predictive variables) and 5 firms' EFPs (response variables) defined in Appendix E. The data for these variables were

obtained from corporate environmental reports of the sample of 30 firms selected as described in the preceding section.

Grading of the level of involvement of each firm with the EMPs followed the method used by Montabon et al. (2007). Six undergraduate students were trained to grade the corporate environmental reports according to the definitions in Appendix E. These documents were provided to the raters to assist in their evaluation of each firms' involvement with the EMPs. Data for each variable was taken on a five point Likert scale, with 1 representing very low intensity of involvement with the practice, and 5 representing very high intensity of involvement. Each rater completed a coding sheet for each firms' corporate environmental report (See Appendix F).

To ensure rater's reliability, each rater re-rated three randomly selected reports a second time, after they had analyzed all of the reports. Intraclass correlation coefficient (ICC) was calculated on each rater based on guidelines from Shrout and Fleiss (1979). These analyses indicated that five of the six raters should be considered reliable. Nunnally (1978) recommends that ICC values of 0.8 or above should be considered reliable (See Appendix G).

To ensure rater's consistency, ICC was calculated among the five reliable raters. The reliability measure across these five raters was 0.855, which is considered reliable according to Nunnally (1978) (See Appendix H).

3.5 Data Analysis

Given the multidimensional nature of this research, multivariate analysis techniques are necessary to analyze the data. Two complementary statistical methods were used in this study; (1) Constrained Analysis on Principal Coordinates (CAP) and (2) Canonical Correspondence Analysis (CCA). The use of these two methods is desirable because they complement each other, and permit a more holistic view/interpretation of the results. CAP analysis provides an explanation of the variation within the response variables (EFPs) than can be explained by

individual EMPs; while CCA allows the creation of subgroups of similar EMPs, thus, providing a more generic view of the results.

To use these methods it is important to determine whether a linear or unimodal response model is appropriate for the data. CAP was used because it can handle any dissimilarity measure, and performs linear mapping. CCA however, obtains linear combinations of the predictive variables (EMPs) that best explain an object's (firms) position in the ordination space. CCA is based on chi-squared distances and performs weighted linear mapping. CCA is appropriate when response variables are unimodal, and predictive variables are linear. The response variables collected in this research are not entirely unimodal. A normality test (Shapiro-Wilk test), and visual examination of histograms, indicated that only one of the five response variables can be considered approximately normally distributed (See Appendix I); therefore, CCA is not a recommended analysis for this particular dataset. However, given that there is no other method that can identify the proportion of the variance in the response variables (EFPs) that can be separately explained by subsets of the predictors (EMPs), it was decided that, despite the statistical limitations, CCA would still provide useful information.

CAP was the first statistical analysis performed. CAP tests how well a set of predictive variables (EMPs) can explain the variation in a set of response variables (EFPs) among objects (firms) (Anderson and Willis, 2003; Legendre & Anderson, 1999; Hair et al., 1998). Constrained, also called canonical methods, are used to determine the common structure, or correspondence, between two sets of variables. This permits the direct testing of a priori hypotheses by examining all of the variance in a matrix "Y" (EFPs) that is directly related to a matrix "X" (EMPs).

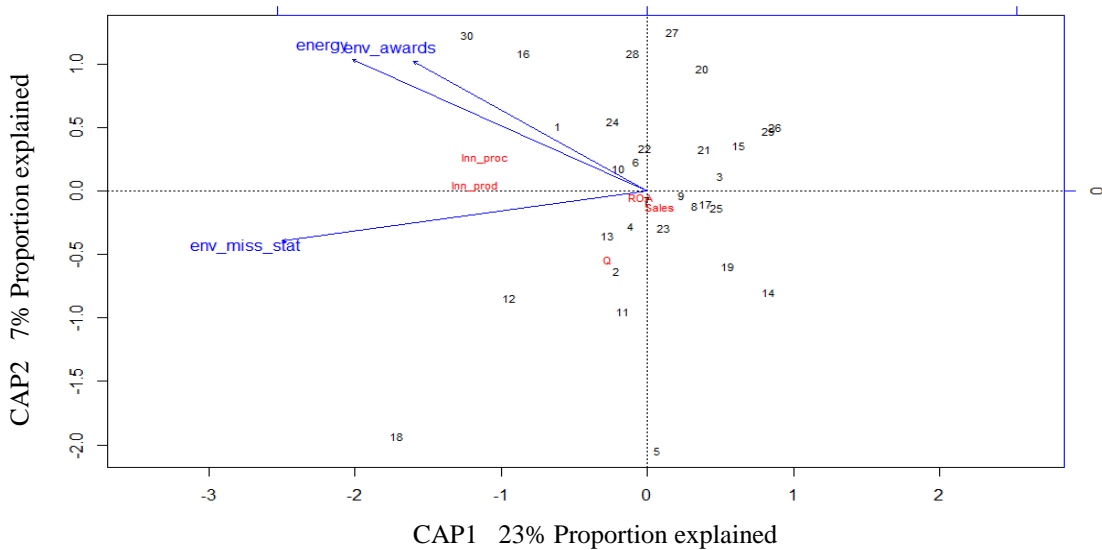
The main results of a CAP analysis are: 1) the percentage of variance in the matrix Y (EFPs) explained by a matrix X (EMPs), this is computed as eigenvalue divided by the total inertia (reported as a cumulative percentage), and 2) The eigenvalues and/or eigenvectors that form the canonical axes that can be used to plot an indirect ordination of the data. A triplot is commonly used to plot the results of a CAP analysis. A triplot (Figure 3) simultaneously displays the objects (firms), response variables (EFPs), and predictor variables (EMPs). It also shows the major patterns in the EFP data with respect to the EMPs. A triplot is not a traditional Cartesian

graph, the axes of a triplot are represented by the two most dominant canonical axes of the CAP analysis; CAP1 and CAP2 (Anderson and Willis, 2003).

In the triplots, each number represents an object (firm). A firm’s location in the ordination space indicates its similarity to other firms; the closer they are, the more similar they are. Likewise, the location of the EFPs in the ordination space also indicates their resemblance to each other.

The loading of individual EMPs is illustrated by vectors (arrows), where an arrow’s length and direction corresponds to the magnitude and gradient of each EMP. The angle between any two arrows indicates their correlation (positive, negative, or non-existing) between EMPs. Acute angles indicate positive correlation, obtuse angles indicate negative correlation, and right angles indicate no correlation.

Figure 3: Illustration of the results of a CAP analysis via a traditional triplot



3.5.1 CAP Analysis

There is no rule that dictates the number of observations (objects) needed relative to the number of predictive variables (EMPs) in a CAP analysis. However, it is necessary that the

number of predictive variables (EMPs) must be small relative to the number of objects (firms) (Ter Braak, 1986). To reduce the number of predictive variables and to ensure that the results are not sample-specific, a stepwise backwards elimination procedure was used as follows:

- 1) Separately conduct a regression analysis with each of the five response variables (EFPs) against **all 19** predictive variables (EMPs) and run the CAP analysis (This step created the Full Model).
- 2) From each of the preceding five regression analyses, identify those EMPs that were significant predictors ($\alpha \leq 0.05$) of **at least one** of the EFPs, and rerun the CAP analysis (This step created Model 1).
- 3) From each of the five step 2 regression analyses, identify those EMPs that were significant predictors ($\alpha \leq 0.05$) of **at least two** of the EFPs, and rerun the CAP analysis (This step created Model 2).
- 4) From each of the five step 3 regression analyses, identify those EMPs that were significant predictors ($\alpha \leq 0.05$) of **at least three** of the EFPs, and rerun the CAP analysis (This step created Model 3).

Appendix J summarizes the stepwise regression process used to systematically drop predictive variables that were not significant predicting EFPs.

Significance of CAP was tested using Monte Carlo global randomization to test whether the amount of variation in the response matrix (EFPs), explained by variation in the predictive matrix (EMPs), is greater than what would be expected by chance at alpha level of 0.05. Significance of CAP axes was also tested using a randomization approach at an alpha level of 0.05.

3.5.2 CCA Analysis

Following the CAP analyses, CCA was conducted. CCA subdivides the set of predictive variables (EMPs) into logical subsets, and determines how much of the variance of the response variables (EFPs) can be explained independently by each subset of predictive variables (EMPs), or by any combination of two or more subsets.

The predictive variables (EMPs) from each of the final CAP analyses were grouped into three matrices. (a) Operational, (b) Tactical, and (c) Strategic. (see Stewart-Koster et al. 2007). These lead to an analysis that includes the three subset main effects (pure Operational (O); pure Tactical (T); pure Strategic (S)); four interactions (Tactical and Operational (TO); Strategic and Operational (SO); Strategic and Tactical (TS); Tactical and Strategic and Operational (TSO)); and the Unexplained component (U).

RStudio, Microsoft Excel, and IBM SPSS were used to compute all the analyses in this study.

Chapter 4.0 Results

This Chapter presents the CAP and CCA results of four statistical models that differ in the number of EMPs used to predict 5 EFPs. The full details of the four CAP analyses and four CCA analyses can be seen on Appendix L and Appendix M respectively.

4.1 Full Model

The Full Model used all 19 EMPs (seven operational, seven tactical, and five strategic) to predict 5 EFPs (Sales Growth, ROA, Tobin's q, Innovation product, and Innovation process).

4.1.1 CAP of the Full Model

CAP analysis estimates the constrained proportion of the total variation in the response variables that can be explained by the predictive variables (Anderson and Willis, 2003; Legendre & Anderson, 1999; Hair et al., 1998). Table 10 summarizes the CAP of the Full Model, showing which of the 19 EMPs were statistically significant predictors of the 5 EFPs. The Full Model accounted for **80%** of the variation in the EFPs.

Table 10: Constrained Analysis of Principal Components (CAP) of the Full Model. Level of statistical significance of the 19 Environmental Management Practices (EMPs) predicting the five Environmental and Financial Performances (EFPs) variables from 30 manufacturing firms

Signif. Codes: 0.001 '***' 0.01 '**' 0.05 '*'

EMPs Subset/level	Environmental Management Practices (EMP)	Environmental and Financial Performance (EFP)				
		Tobin's q	ROA	Innovation product	Innovation process	Sales
Operational	Recycling				*	
	Proactive waste reduction			**		
	Reactive waste reduction					
	Consume internally					*
	Create market for waste			***	**	
	Water consumption					
	Energy consumption	***	***	**		
Tactical	Early supplier involve				***	
	Environmental standard for suppliers				***	
	Environmental audits suppliers					
	Environmental awards	**		**		*
	Life cycle analysis		*			
	Design targets/goals	**		**		
	Environmental risk analysis	*				**
Strategic	Corporate policy/procedure		*	***		
	Environmental mission statement	***	*	***		
	Environmental department	**				***
	Surveillance of market					
	Strategic alliance	***	*			

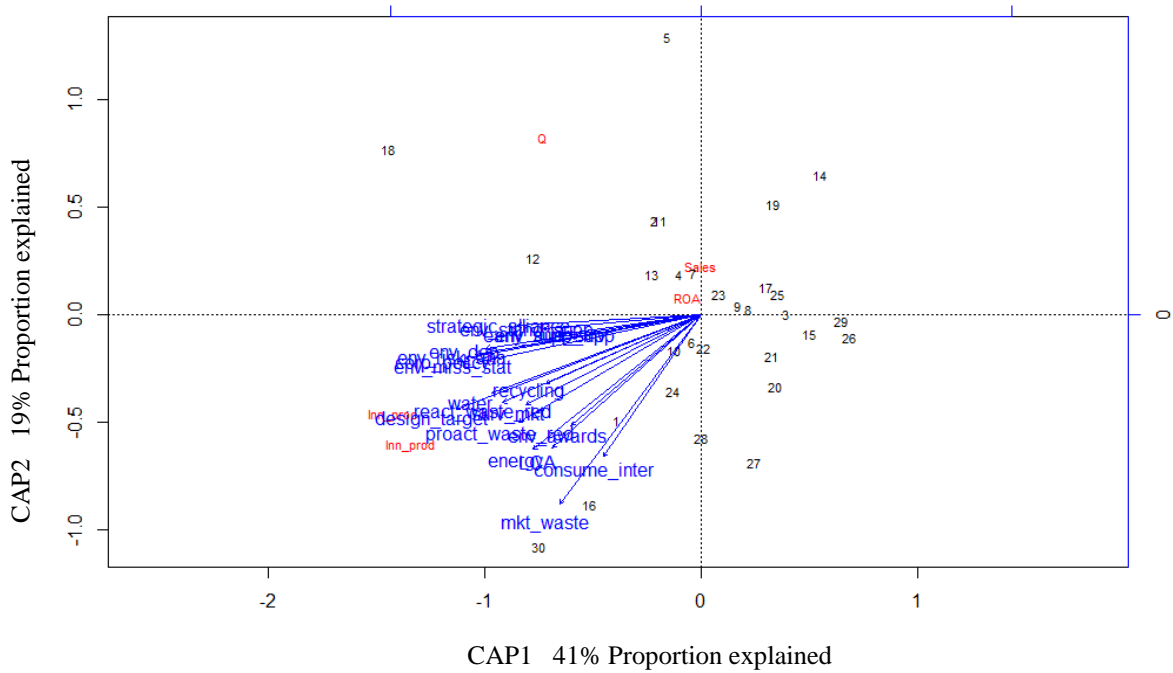
Of the 19 EMPs:

- Seven EMPs, one operational (Energy consumption), three tactical (Environmental awards, Design targets/goals, Environmental risk analysis), and three strategic (Environmental mission statement, Environmental department, Strategic alliance), were significant predictors of Tobin's q.
- Five EMPs, one operational (Energy consumption), one tactical (Life cycle analysis) and three strategic (Corporate policy/procedure, Environmental mission statement, Strategic alliance), were significant predictors of ROA.

- Seven EMPs, three operational (Proactive waste reduction, Create market for waste, Energy consumption), two tactical (Environmental awards, Design targets/goals), and two strategic (Corporate policy/procedure, Environmental mission statement), were significant predictors of Innovation product.
- Four EMPs, two operational (Recycling, Create market for waste) and two tactical (Early supplier involve, Environmental standard for suppliers), were significant predictors of Innovation process.
- Four EMPs, one operational (Consume internally), two tactical (Environmental awards, Environmental risk analysis), and one strategic (Environmental department), were significant predictors of Sales Growth.

Figure 4 shows the triplot of the Full Model. There are two pairs of EMPs that can be considered similar, because they are located relatively close to each other in the ordination space. These are (1) Innovation product and Innovation process, and (2) Sales with ROA. Two tactical EMPs (Early supplier involvement, and Environmental audit of suppliers), and one strategic EMP (Strategic alliance) were the most related to ROA and Sales. Three operational EMPs (Reactive waste reduction, Proactive waste reduction, and Water consumption), and one tactical EMP (Design targets) were the most related to Innovation product and Innovation process. Most of the firms tend to be clustered around Sales and ROA, which tend to be relatively far from Tobin's q. The EMP vectors have acute angles between them, thus, indicating positive correlations among them. Some of the most influential EMPs in this ordination space (the longer vectors) were Design targets, Market waste, Environmental mission statement, and Energy.

Figure 4: Triplot of the Constrained Analysis of Principal Components (CAP) of the Full Model



4.1.2 CCA of the Full Model

Canonical Correspondence Analysis (CCA) quantifies the percentage of the constrained proportion on the response variables (EFPs) that can be explained by logical subsets of predictive variables (EMPs). Three subsets were used in this research: operational, tactical, and strategic. Figure 5 shows the Venn-diagram of the Full Model CCA which was able to explain **74%** of the variation within the five EFPs. This information is summarized in Table 11. The most important level was the operational level which by itself explained 27% of the variation in EFPs. The tactical and strategic levels explained 19% and 16% of the variability in the EFPs respectively. Interactions between the levels explained 13% of the total variation in the EFPs.

Figure 5: Canonical Correspondence Analysis (CCA) Venn diagram of the Full Model

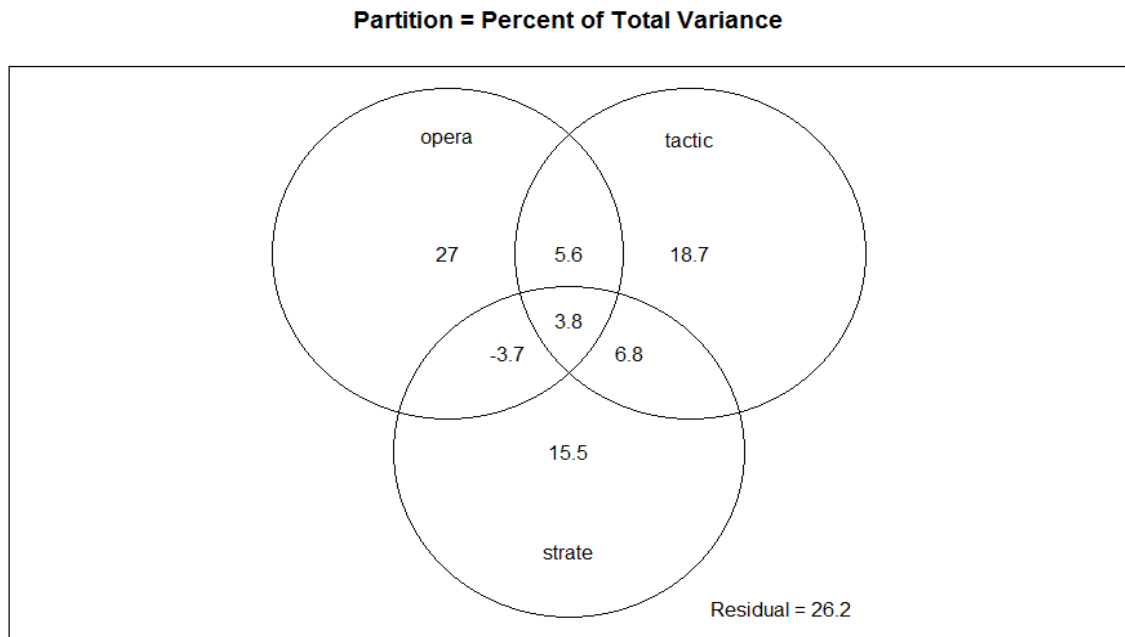


Table 11: Canonical Correspondence Analysis (CCA) of the Full Model. Percentage of Environmental Financial Performance (EFP) explained by the Operational, Tactical and Strategic Environmental Management Practices (EMPs) subsets for 30 manufacturing firms

Environmental Management Practices (EMP)	Percentage of EFP variation Explained by Subsets
Operational practices	Operational
Recycling Proactive waste reduction Reactive waste reduction Consume internally Create market for waste Water consumption Energy consumption	27
Tactical practices	Tactical
Early supplier involve Environmental standard for suppliers Environmental audits suppliers Environmental awards Life cycle analysis Design targets/goals Environmental risk analysis	19
Strategic practices	Strategic
Corporate policy/procedure Environmental mission statement Environmental department Surveillance of market Strategic alliance	16
Interactions	13
Total	74
Residual	26

4.1.3 Full Model Issues

The Full Model contains four EMPs that were not significant for predicting any of the EFPs. These EMPs were two operational variables (Reactive waste reduction and Water consumption), one tactical variable (Environmental audit supply), and one strategic variable (Surveillance of market). The CAP and CCA analyses were repeated using the remaining 15 EMPs to produce Model 1.

4.2 Model 1

Model 1 deleted the 4 non-significant EMPs of the Full Model, and used the remaining 15 EMPs (five operational, six tactical, and four strategic) to predict the 5 EFPs.

4.2.1 CAP of the Model 1

CAP analysis estimates the percentage of constrained proportion which is the percentage of the variability in the variance of the response variables that can be explained by the predictive variables (Anderson and Willis, 2003; Legendre & Anderson, 1999; Hair et al., 1998). Table 12 presents the Model 1 CAP analysis that used the 15 EMPs that were significant ($\alpha \leq 0.05$) predictors of at least one of the five EFPs in the Full Model. Model 1 CAP results accounted for **73%** of the variation in the EFPs.

Table 12: Constrained Analysis of Principal Components (CAP) of Model 1. Level of statistical significance of the 15 Environmental Management Practices (EMPs) predicting the five Environmental and Financial Performances (EFPs) variables from 30 manufacturing firms

Signif. Codes: 0.001 '***' 0.01 '**' 0.05 '*'

EMPs Subset/level	Environmental Management Practices (EMP)	Environmental and Financial Performance (EFP)				
		Tobin's q	ROA	Innovation product	Innovation process	Sales
Operational	Recycling				*	
	Proactive waste reduction			**		
	Consume internally					*
	Create market for waste			***	**	
	Energy consumption	***	***	**		
Tactical	Early supplier involve				***	
	Environmental standard for suppliers				***	
	Environmental awards	**		**		*
	Life cycle analysis		*			
	Design targets/goals	**		**		
	Environmental risk analysis	*				**
Strategic	Corporate policy/procedure		*	***		
	Environmental mission statement	***	*	***		
	Environmental department	**				***
	Strategic alliance	***	*			

Of the 15 EMPs:

- Seven EMPs, one operational (Energy consumption), three tactical (Environmental awards, Design targets/goals, Environmental risk analysis), and three strategic (Environmental mission statement, Environmental department, Strategic alliance), were significant predictors of Tobin's q.
- Five EMPs, one operational (Energy consumption), one tactical (Life cycle analysis) and three strategic (Corporate policy/procedure, Environmental mission statement, Strategic alliance), were significant predictors of ROA.
- Seven EMPs, three operational (Proactive waste reduction, Create market for waste, Energy consumption), two tactical (Environmental awards, Design targets/goals), and

two strategic (Corporate policy/procedure, Environmental mission statement), were significant predictors of Innovation product.

- Four EMPs, two operational (Recycling, Create market for waste) and two tactical (Early supplier involve, Environmental standard for suppliers), were significant predictors of Innovation process.
- Four EMPs, one operational (Consume internally), two tactical (Environmental awards, Environmental risk analysis), and one strategic (Environmental department), were significant predictors of Sales Growth.

Figure 6 shows the triplot of Model 1 (15 predictive variables). There are two pairs of EFPs that can be considered similar, because they are located relatively close to each other in the ordination space. These are (1) Innovation product and Innovation process, and (2) Sales with ROA. Two tactical EMPs (Early supplier involvement, and Environmental audit of suppliers), and one strategic EMP (Strategic alliance) were the most related to ROA and Sales. One operational EMP (Proactive waste reduction), and one tactical EMP (Design targets) were the most related to Innovation product and Innovation process. Most of the firms tend to be clustered around Sales and ROA, while they also tend to be relatively far from Tobin's q. The EMP vectors have acute angles between them, thus, indicating positive correlations among them. Some of the most influential EMPs in this ordination space (longer arrows) were Design targets, Market waste, Environmental mission statement, and Energy.

Figure 7: Canonical Correspondence Analysis (CCA) Venn diagram of the Model 1

Partition = Percent of Total Variance



Table 13: Canonical Correspondence Analysis (CCA) of Model 1. Percentage of Environmental Financial Performance (EFP) explained by the Operational, Tactical and Strategic Environmental Management Practices (EMPs) subsets for 30 manufacturing firms

Environmental Management Practices (EMP)	Percentage of EFP variation Explained by Subsets
Operational practices	Operational
Recycling Proactive waste reduction Consume internally Create market for waste Energy consumption	27
Tactical practices	Tactical
Early supplier involve Environmental standard for suppliers Environmental awards Life cycle analysis Design targets/goals Environmental risk analysis	19
Strategic practices	Strategic
Corporate policy/procedure Environmental mission statement Environmental department Strategic alliance	12
Interactions	11
Total	69
Residual	31

4.2.3 Model 1 Issues

Two issues arise with Model 1. First, from a statistical perspective, it used 15 EMPs to predict the 5 EFPs for a sample of 30 firms. Unfortunately, there is no rule that dictates the number of observations (firms) needed relative to the number of predictive variables (EMPs) in a

CAP analysis. However, it is necessary that the number of predictive variables (EMPs) must be small relative to the number of objects (firms) (Ter Braak, 1986). The second issue is a practical one for managers. It may be too costly to implement, monitor, and manage 15 different EMPs. Could the number of EMPs be reduced without great sacrifice of the ability to predict the EFPs? This would address both, the statistical, and management issues. To do this, the approach was to use EMPs that were common predictors of more than one EFP. Model 2 was developed by repeating the CAP and CCA analyses using only those EMPs that were significant in predicting at least 2 of the EFPs. There were 9 EMPs that met this criterion, which formed the basis for Model 2 (see Table 14).

4.3 Model 2

Model 2 deleted the 6 EMPs that were statistically significant predictors of only 1 EFP in Model 1, and used the remaining 9 to predict the 5 EFPs. These 9 EMPs were two operational, three tactical, and four strategic.

4.3.1 CAP of the Model 2

CAP analysis estimates the percentage of constrained proportion which is the percentage of the variability in the variance of the response variables that can be explained by the predictive variables (Anderson and Willis, 2003; Legendre & Anderson, 1999; Hair et al., 1998). Table 14 presents the Model 2 CAP analysis which used the 9 EMPs that were significant ($\alpha \leq 0.05$) predictors of at least two of the five EFPs in the Model 1. Model 2 CAP analysis results accounted for **61%** of the variation in the EFPs.

Table 14: Constrained Analysis of Principal Components (CAP) of Model 2. Level of statistical significance of the 9 Environmental Management Practices (EMPs) predicting the five Environmental and Financial Performances (EFPs) variables from 30 manufacturing firms

Signif. Codes: 0.001 '***' 0.01 '**' 0.05 '*'

EMPs Subset/level	Environmental Management Practices (EMP)	Environmental and Financial Performance (EFP)				
		Tobin's q	ROA	Innovation product	Innovation process	Sales
Operational	Create market for waste			***	**	
	Energy consumption	***	***	**		
Tactical	Environmental awards	**		**		*
	Design targets/goals	**		**		
	Environmental risk analysis	*				**
Strategic	Corporate policy/procedure		*	***		
	Environmental mission statement	***	*	***		
	Environmental department	**				***
	Strategic alliance	***	*			

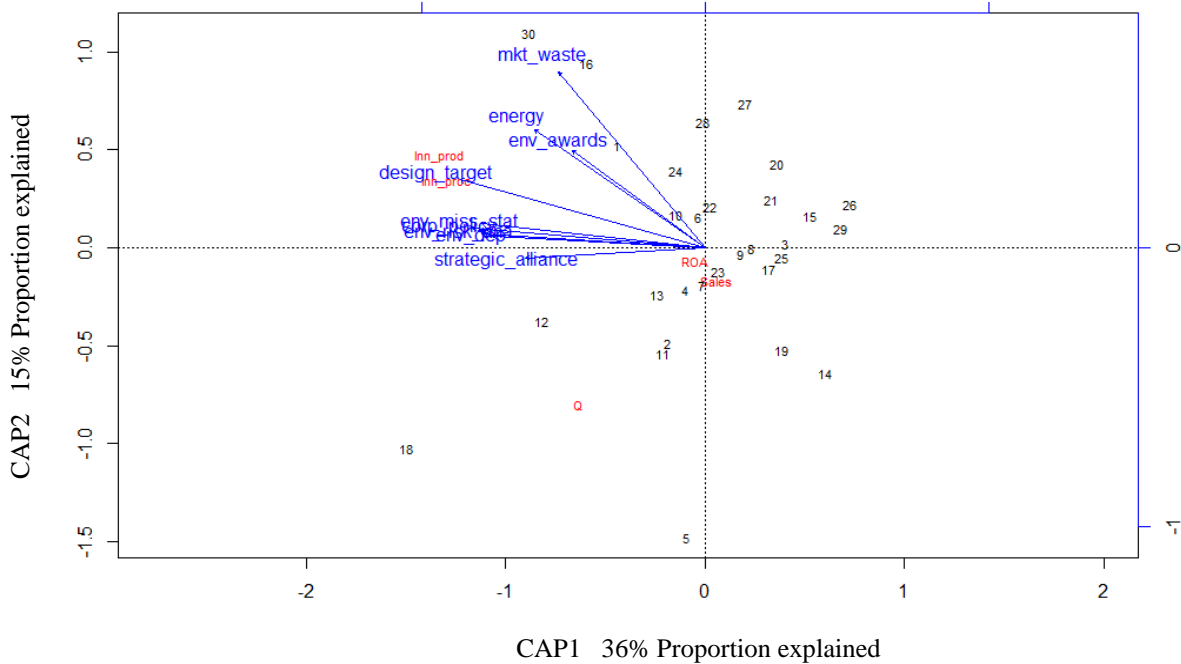
Of the 9 EMPs:

- Seven EMPs, one operational (Energy consumption), three tactical (Environmental awards, Design targets/goals, Environmental risk analysis), and three strategic (Environmental mission statement, Environmental department, Strategic alliance), were significant predictors of Tobin's q.
- Four EMPs, one operational (Energy consumption), no tactical, and three strategic (Corporate policy/procedure, Environmental mission statement, and Strategic alliance), were significant predictors of ROA.
- Six EMPs, two operational (Create market for waste, Energy consumption), two tactical (Environmental awards, Design targets/goals), and two strategic (Corporate policy/procedure, Environmental mission statement), were significant predictors of Innovation product.
- One operational EMP (Create market for waste) was significant predictors of Innovation process.

- Three EMPs, no operational, two tactical (Environmental awards, Environmental risk analysis), and one strategic (Environmental department), were significant predictors of Sales Growth.

Figure 8 shows the triplot of Model 2 (9 predictive variables). The six variables that were dropped from the previous model (Model 1) were three operational variables (Proactive waste reduction, Recycling, and Consume internally), and three strategic variables (LCA, Early supply involvement, and Environmental standard suppliers). There are two pairs of EMPs that can be considered similar, because they are located relatively close to each other in the ordination space. These are (1) Innovation product and Innovation process, and (2) Sales with ROA. One strategic EMP (Strategic alliance) was the most related to ROA and Sales. One tactical EMP (Design targets) was the most related to Innovation product and Innovation process. Most of the firms tend to be clustered around Sales and ROA, while they also tend to be relatively far from Tobin's q. The EMP vectors have acute angles between them, thus, indicating positive correlations among them. Some of the most influential EMPs (longer arrows) in this ordination space were Design targets, Market waste, Environmental mission statement, and Energy.

Figure 8: Triplot of the Constrained Analysis of Principal Components (CAP) of the Model 2



4.3.2 CCA of the Model 2

CCA quantifies the percentage of the constrained proportion on the response variables (EFPs) that can be explained by logical subsets of predictive variables (EMPs). Three subsets were used in this research: operational, tactical, and strategic. Figure 9 shows the Venn-diagram of the Model 2 CCA which was able to explain **53%** of the variation within the five EFPs. This information is summarized in Table 15. The most important level was the operational level, which explained 20% of the variation in the EFPs. The tactical and strategic levels explained 8% and 16% of the variability in the EFPs respectively. Interactions between the three levels explained 8 % of the total variation in EFP.

Figure 9: Canonical Correspondence Analysis (CCA) Venn diagram of the Model 2

Partition = Percent of Total Variance

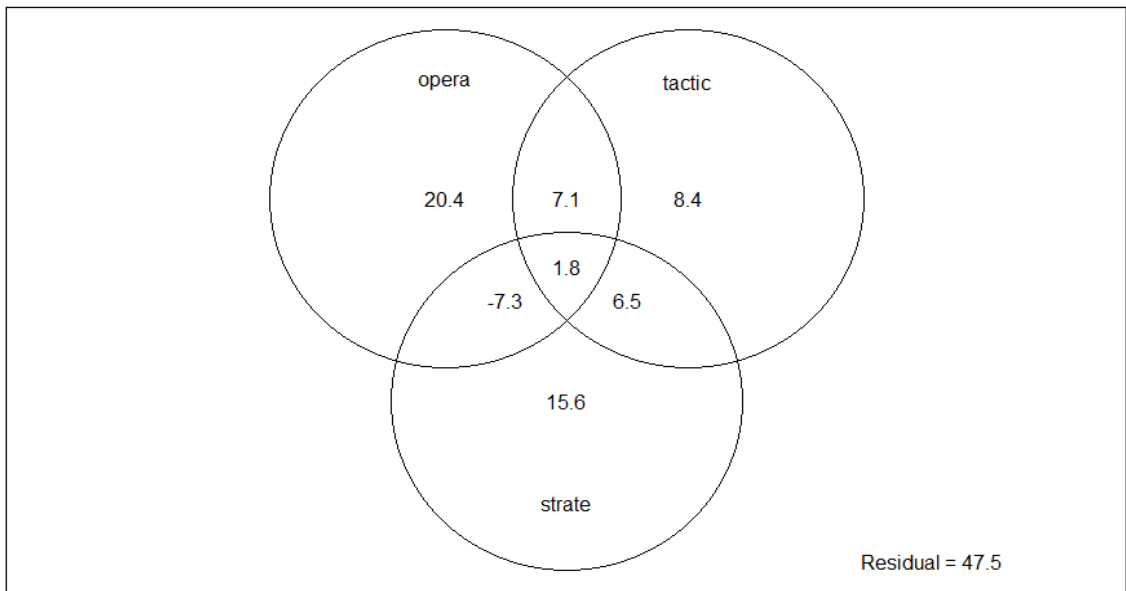


Table 15: Canonical Correspondence Analysis (CCA) of Model 2. Percentage of Environmental Financial Performance (EFP) explained by the three Environmental Management Practices (EMPs) subsets from 30 manufacturing firms

Environmental Management Practices (EMP)	Percentage of EFP variation Explained by Subsets
Operational practices	Operational
Create market for waste Energy consumption	20
Tactical practices	Tactical
Environmental awards Design targets/goals Environmental risk analysis	8
Strategic practices	Strategic
Corporate policy/procedure Environmental mission statement Environmental department Strategic alliance	16
Interactions	8
Total	53
Residual	48

To further explore the issues of sample size versus number of predictor EMPs, and the issue of managing multiple EFPs, the approach taken in developing Model 2 from Model 1 was repeated. Model 3 was developed by repeating the CAP and CCA analyses when only those EMPs that were significant in predicting at least 3 of the EFPs were used. There were 3 EMPs that met this criterion forming the basis for Model 3.

4.4 Model 3

Model 3 deleted EMPs that were statistically significant predictors of only 1 or 2 EFPs in Model 2, and used the remaining 3; one operational, one tactical, and one strategic, to predict the 5 EFPs.

4.4.1 CAP of the Model 3

CAP analysis estimates the percentage of constrained proportion which is the percentage of the variability in the variance of the response variables that can be explained by the predictive variables (Anderson and Willis, 2003; Legendre & Anderson, 1999; Hair et al., 1998). Table 16 presents the Model 3 CAP analysis which used the 3 EMPs that were significant ($\alpha \leq 0.05$) predictors of at least three of the five EFPs in the Model 2. Model 3 CAP analysis results accounted for **31%** of the variation in the EFP's.

Table 16: Constrained Analysis of Principal Components (CAP) of Model 3. Level of statistical significance of the 3 Environmental Management Practices (EMPs) predicting the five Environmental and Financial Performances (EFPs) variables from 30 manufacturing firms

Signif. Codes: 0.001 '***' 0.01 '**' 0.05 '*'

EMPs Subset/level	Environmental Management Practices (EMP)	Environmental and Financial Performance (EFP)				
		Tobin's q	ROA	Innovation product	Innovation process	Sales
Operational	Energy consumption	***	***	**		
Tactical	Environmental awards	**		**		*
Strategic	Environmental mission statement	***	*	***		

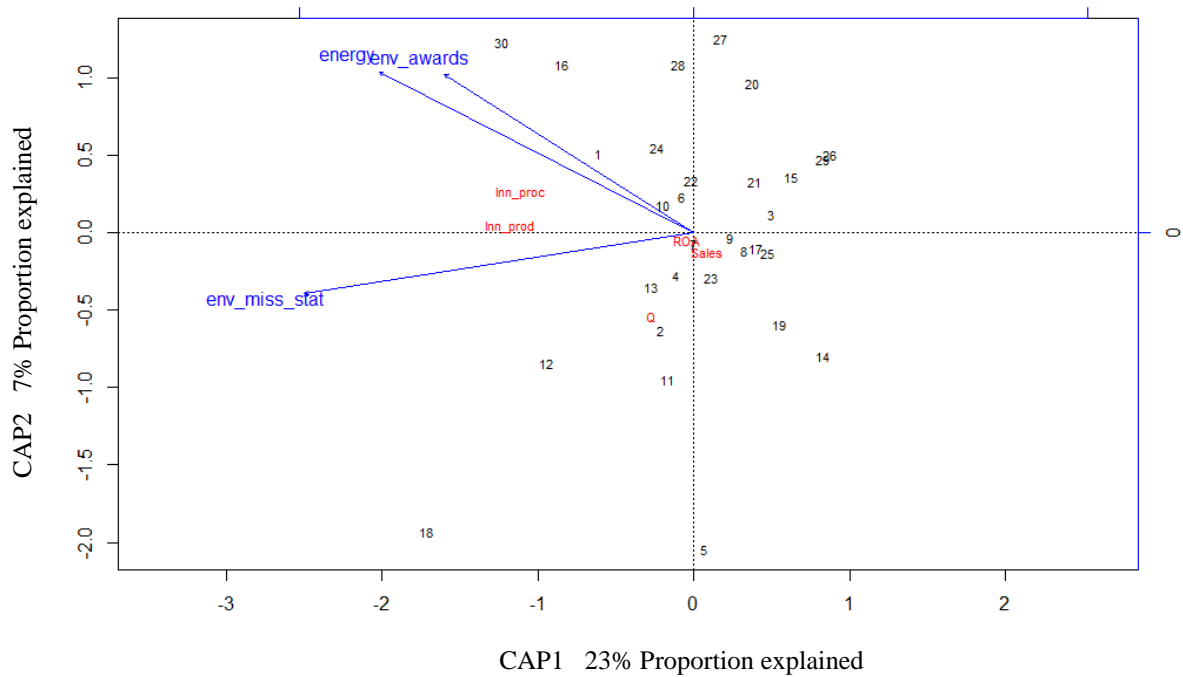
Of the 3 EMPs:

- Three EMPs, one operational (Energy consumption), one tactical (Environmental awards), and one strategic (Environmental mission statement), were significant predictors of Tobin's q.
- Two EMPs, one operational (Energy consumption), no tactical, and one strategic (Environmental mission statement) were significant predictors of ROA.
- Three EMPs, one operational (Energy consumption), one tactical (Environmental awards), and one strategic (Environmental mission statement), were significant predictors of Innovation product.
- No EMP was a significant predictor of Innovation process.

- One tactical EMP (Environmental awards) was a significant predictor of Sales Growth.

Figure 10 shows the triplot of Model 3 (3 predictive variables). The six variables that were dropped from Model 2 were one operational variable (Create market for waste), two tactical variables (Design targets/goals, Environmental risk analysis), and three strategic variables (Corporate policy/procedure, Environmental department, and Strategic alliance). There are two pairs of EFPs that can be considered similar, because they are located relatively close to each other in the ordination space. These are (1) Innovation product and Innovation process, and (2) Sales with ROA. Most of the firms tend to be clustered around Sales and ROA, while they also tend to be relatively far from Tobin's q. The EMP vectors have acute angles between them, thus, indicating positive correlations among them.

Figure 10: Triplot of the Constrained Analysis of Principal Components (CAP) of the Model 3



4.4.2 CCA of the Model 3

CCA quantifies the percentage of the constrained proportion on the response variables (EFPs) that can be explained by logical subsets of predictive variables (EMPs). Three subsets were used in this research: operational, tactical, and strategic. Figure 11 shows the Venn-diagram of the Model 3 CCA, which was able to explain **28%** of the variation within the five EFPs. This information is summarized in Table 17. The most important level was the operational level which explained 12% of the variation in the EFPs. The tactical and strategic levels explained 7% and 6% of the variability in the EFPs respectively. Interactions between the three levels explained 3% of the total variation in EFP.

Figure 11: Canonical Correspondence Analysis (CCA) Venn diagram of the Model 3

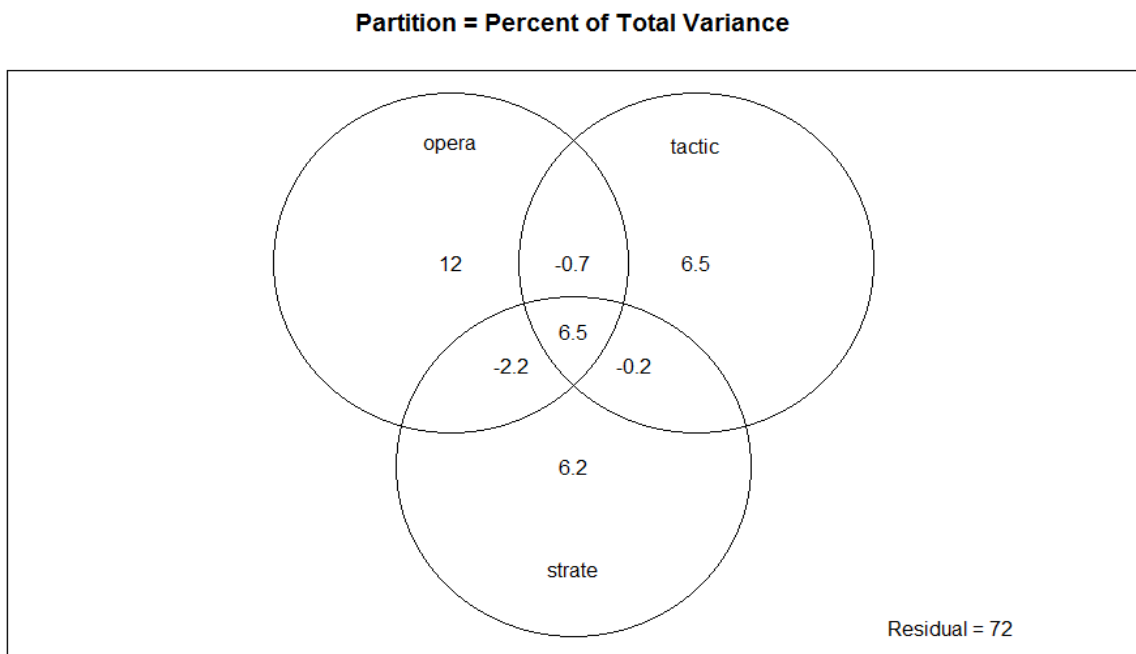


Table 17: Canonical Correspondence Analysis (CCA) of Model 3. Percentage of Environmental Financial Performance (EFP) explained by the three Environmental Management Practices (EMPs) subsets from 30 manufacturing firms

Environmental Management Practices (EMP)	Percentage of EFP variation Explained by Subsets
Operational practices	Operational
Energy consumption	12
Tactical practices	Tactical
Environmental awards	7
Strategic practices	Strategic
Environmental mission statement	6
Interactions	3
Total	28
Residual	72

The procedure used to create Model 1 from the Full Model (EMPs significant for at least one EFP), Model 2 from Model 1 (EMPs significant for at least 2 EFPs), and Model 3 from Model 2 (EFPs significant for at least 3 EFPs) was terminated as Model 3 had no situation where any EMP was a predictor of at least 4 of the EFPs.

4.5 Consistency of CAP and CCA Analyses of Models Predicting EFPs from EMPs

CAP analysis estimates the percentage of constrained proportion, which is the percentage of the variability in the variance of the response variables (EFPs) that can be explained by the predictive variables (EMPs) (Anderson and Willis, 2003; Legendre & Anderson, 1999) and is summarized in Table 18 for the four models.

Table 18: Constrained value of the CAP analyses expressed in % for the 4 models predicting 5 EFPs

Model	Number of predictive variables	Constrained value CAP (%)
Full Model	19	80
Model 1	15	73
Model 2	9	61
Model 3	3	31

CCA analysis estimates the percentage of the constrained proportion on the response variables (EFPs) that can be explained by logical subsets of predictive variables (EMPs). Table 19 summarizes the use of three subsets of predictive variables, operational, tactical, and strategic, that were used to separate the overall constrained proportion.

Table 19: Constrained value of the CCA expressed in % for the 4 models predicting 5 EFPs from operational, tactical, and strategic groupings of EMPs

Model	Number of predictive variables	Constrained value CCA (%)
Full Model	19	74
Model 1	15	69
Model 2	9	53
Model 3	3	28

In general, the CAP and CCA analyses presented similar results. The CCA analysis, which grouped EMPs in to the operational, tactical, and strategic subsets, explained 3-8 percentage points less (compare Tables 17 and 18) of the constrained variation in the EFPs than dis CAP which did not group the EMPs. A simple t-test analysis between the constrained proportion explained by these two analyses showed no significant differences between them ($\alpha \geq 0.05$) (See Appendix K). The constrained proportion explained by the CAP analyses was on average 10% higher than the CCA analyses. Figure 12 and Table 20 show the constrained proportion explained by each CAP and CCA models, and summarized the comparison between

these two analyses. In this study, the CCA performance was close to CAP even though the response variables in this research violated the normal distribution requirement of CCA.

Figure 12: Difference in the constrained proportion explained by CAP and CCA

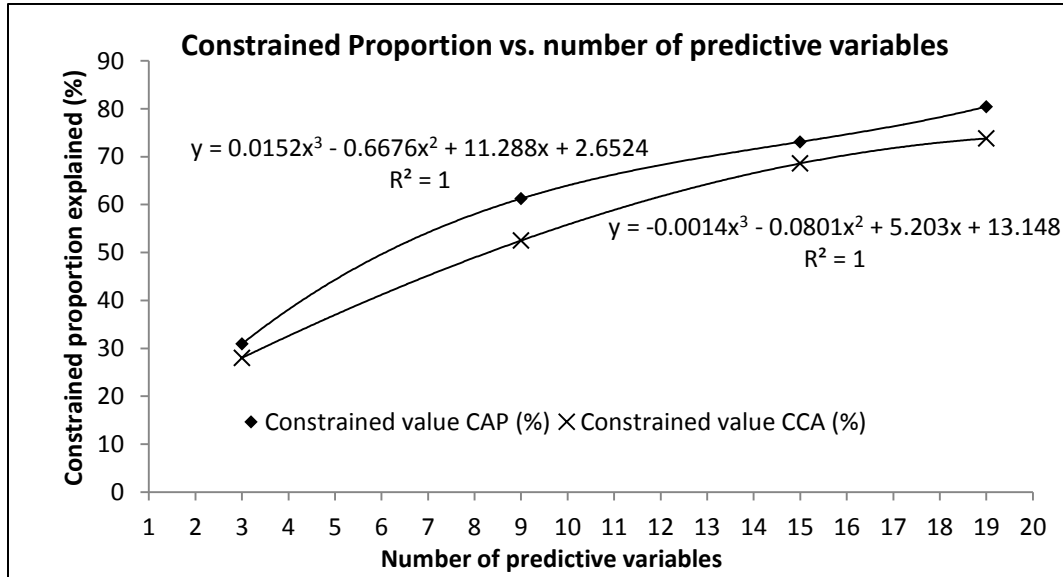


Table 20: Comparison CAP & CCA analyses

Model	Number of predictive variables	Constrained value CAP (%)	Constrained value CCA (%)	Reduction from CAP to CCA (%)
Full Model	19	80	74	8
Model 1	15	73	69	6
Model 2	9	61	53	14
Model 3	3	31	28	9
			Mean	10
			STDEV	3.4

Chapter 5.0 Discussion

Two analytical tools, CAP and CCA, were used to investigate the relationship between 19 environmental management practices, and 5 firms' environmental and financial performance metrics. These 5 response variables used to assess performance were:

ROA, defined as the firm's net income divided by total assets

Sales Growth, defined as the average rate of change from 2007 through 2011, measured as the slope of linear regression of annual 2007 through 2011 sales. The rate of change of each firm was sorted from highest to lowest, and then converted into a scale with values from 0 to 1. The relative scaling was accomplished by first applying a translation to make all values positive, then forming the quotient between the absolute slope value and the range of the translated values.

Tobin's q, defined as $Q = (\text{MKTVAL} + \text{PSVAL} + \text{DEBT}) / \text{TA}$ where:

- MKTVAL the market value is obtained by multiplying the number of shares outstanding by share price.
- PSVAL is the liquidating value of the outstanding preferred stock,
- DEBT is the long-term debt plus the difference between the value of the firms' short-term liabilities and its short-term assets.
- TA is the book value of the total assets.

Tobin's q compares the total value of external investments in the firm, i.e. by stockholders and lenders, with the book value of the firm's assets.

Innovation product, which was measured by grading the following question from the firm's corporate responsibility report: "Overall, how well has this firm done in introducing product innovations, and are they constantly looking for product innovations?"

Innovation process, which was measured by grading the following question from the firm's corporate responsibility report: "Overall, how well has this firm done in introducing process innovations, and are they constantly looking for process innovations?"

CAP was selected as one of the two analytical tools because it allows us to see those individual EMPs that are significantly related to a particular EFP, while CCA was selected because it allows us to group the EMPs into logical subsets. In this research, 3 subsets were

created according to the managerial level of the EMPs; operational, tactical, and strategic. Then, it is possible to find the amount of variation in the EFPs that is associated with each of these three managerial levels.

5.1 Models Developed with CAP

CAP was used to develop three models to determine the ability of 19 EMPs to predict 5 EFPs: Model 1 with 15 EMPs, Model 2 with 9 EMPs, and Model 3 with 3 EMPs; 4 EMPs were not significant. These models were able to explain 73%, 61%, and 31% respectively of the variability in the 5 EFPs. In general, the results of the 3 CAP analyses are relatively similar to each other, meaning that throughout the 3 models, the same EMPs were found to be related to the same EFPs. This was an expected result, because it would be presumed that an EMP that was closely related to a particular EFP in the first CAP analysis (Model 1) would continue related to the same EFP in subsequent CAP analyses (Model 2, Model 3).

In all 3 CAP models, Tobin's q did not have any EMP relatively close to it, suggesting that none of the EMPs used in this research are strongly related to the market value of the firm. This could be explained by the fact that all of the EMPs, and the other 4 EFPs, are all enacted by the firm itself. In other words, they are internal actions of the firms and measures of consequences. In contrast, market valuation, as measured by Tobin's q, is a measure of how entities external to the firm (i.e. investors and lenders) perceive the firm. If the firm is doing well, external perception of it is going to be good, and Tobin's q would go up.

In all 3 CAP models, ROA and Sales Growth were relatively close to each other in the ordination space. ROA and Sales Growth are both measurements of efficiency, sales is actually embedded in the numerator of ROA, and both metrics can be used to assess how well, or poorly, the firm is doing in terms of generating profits. These two EFPs were closely related to 3 EMPs: Early supplier involvement, Environmental audit suppliers, and Strategic alliance. It is suspected that the first two EMPs (Early supplier involvement, Environmental audit suppliers), which are related to suppliers, are primarily effective in reducing the cost of materials used in manufacturing the products, and are simultaneously indicators that the product is "green" or

environmentally friendly, which may help boost sales. Strategic alliance is mainly an indicator that the firm is participating with others to improve and promote market awareness of the environmental attributes of their products, thereby, improving sales of all members of the alliance.

Finally, in all 3 CAP models, Innovation product and Innovation process were relatively close to each other in the ordination space. It is suspected that it is difficult for a firm to do either of these EFPs without some effect on the other, thus, it was expected that they be related. Two EMPs were relatively closely related to these EFPs: Proactive waste reduction and Design targets. It is suspected that Waste reduction is a strong signal that the firm is changing product or process design, so there is less waste inherent in the final product environmental profile. Similarly, it is speculated that having established design targets is a strong indicator that the firm is making changes (less waste, less energy, etc.) to product and process.

5.2 Models Analyzed Using CCA

In the CCA analyses, the subsets of operational, tactical, and strategic management levels were significant in explaining the variation of firms' EFP in Models 1, 2, and 3. Among the three subsets, the operational level was the most important when explaining EFP in all three CCA models. In general, the tactical and strategic levels were similar, but with the tactical level being more important than the strategic level in all but Model 3. The interactions between two or three of these subsets were small. CCA results imply that to establish a successful environmental management strategy, a firm must consider all three managerial levels. Results showed that firms will not achieve good performance if they only focus in one managerial level. These results also showed that even though firms must pay attention to all three levels, the operational level was consistently the most critical set of EMPs related to firms' EFP, and thus, special attention should be dedicated to this level.

Overall, the CAP and CCA analyses were compatible in explaining the variation in EFPs. The differences between the CAP and CCA models were not significant ($\alpha \geq 0.05$). Given these results, it is recommended to utilize both analytical tools to analyze the performance of firms.

Given the recommendation that the number of predictor variables (EMPs) must be small relative to the sample size (number of firms) (Ter Braak, 1986), the recommended model would be Model 2. In Model 2, only 9 EMPs were analyzed, and it was possible to explain 61% of the variability in firms' EFPs in CAP, and 53% in CCA.

Model 1 explains more of the variation in EFPs than previous studies, while Models 2 and 3 explain a similar amount of variation (see Table 4). However, caution is needed when comparing this study's results with other studies. There are many factors; such as the selection of EMPs, selection of EFPs, selection of moderators, selection of analytical tools, data collection methods, etc. that are completely, or partially different among these studies. For example, Aragon-Correa (1998) using survey methodology, found a relationship between firms' strategic proactivity and firms' approaches to the natural environment. He first used principal components analysis to explain 60% of the variance in this relationship, and then used cluster analysis to group his original 14 firms' approaches to the natural environment into three broader natural environmental dimensions. Furthermore, the author only controlled for firms' size, and country of origin, but incorporated firms from different economic sectors.

Another example, Darnall et al. (2010) using data from a 12 page survey developed by the Organisation for Economic Co-Operation and Development (OECD), found that the relationship between stakeholder pressure and environmental strategy tends to vary with firms' size. To estimate this relationship, the authors used a count model. This study relied on a cross-section of multiple-country data that included 2,687 firms from numerous manufacturing sectors. The response variables studied by these authors were nine proactive environmental practices, such as: whether (a) the firm had a written environmental policy, (b) used environmental accounting, (c) had environmental training programmes, etc. and their explanatory variables were firms' size, and a measurement of stakeholder pressure. The authors also incorporated five control variables: (1) whether or not the firms were publicly traded, (2) whether or not the firms were foreign owned, (3) export orientation, (4) firm's age, and (5) business performance over the last three years.

Another example of a similar investigation, whose results need to be compared with caution with this study, is Simpson & Samson (2010). The authors studied the manner in which corporate strategy and operational practices influence environmental performance. By using a sample of 55 manufacturing firms, interviews and survey to collect the data, and factor and hierarchical regression analysis to analyze the data, the authors found that the two most significant influences on environmental performance were environmental expertise and information-intensive practices, such as quality and data management. The authors derived environmental performance in terms of the organizations performance on overall waste reduction, and material use efficiency. Corporate strategy was measured from the perspective of proactivity. Two separate control variables were used in this study: size of the firm, and age of the plant.

These and other studies are summarized in Table 4. They all greatly contributed to the topic of environmental management strategy, however, as it was mentioned above, the results and recommendations provided by them, should be compared with extreme caution.

5.3 Contributions of This Research

A main contribution of this research is the incorporation of two analytical tools in the analysis of the data. The use of these two tools (CAP and CCA) allowed a broad exploration of the results. It is important to emphasize that during the literature review process, no study was found that had used CCA, so unlike others, this study was able to identify the relative importance of three different managerial levels; operational, tactical, and strategic in explaining the variation in EFP.

The results demonstrate strong positive relationships between some EMPs, and a firm's EFP. These results agree with previous studies such as Montabon et al. (2007), and Bonifant (1994), who stated that EMPs will have a significant effect on a firm's environmental and financial performance. This research also contributed by empirically testing and supporting Porter and van der Linde's (1995a) "win-win" argument, which states that it is likely that when a firm performs well environmentally, it could also improve its financial performance.

This research also contributes to the management field by demonstrating the importance of incorporating multiple moderators into an EMP/EFP analysis. The use of multiple moderators, which narrowed the focus to firms with similar characteristics, reduced the possibility of differences in firms' financial and environmental performance due to differences such as; country, size, and general economic categories in which firms participate. It is very likely that firms in different countries, firms of greatly different size, and firms in very different economic sectors, would differ greatly as to which EMPs they would emphasize to improve their EFP. By using moderators to create a more homogeneous sample than in past studies, models in this study were able to account for more of the variation in firms' EFPs.

5.4 Study Limitations

There are some limitations in this study. Most of these limitations are similar to the limitations encountered by Montabon et al. (2007). One limitation is the lack of standardization of environmental reporting. Most of the 30 reports studied during this research followed a similar format; however, there is no mandatory standard to report firms' sustainable efforts. Future standardization of the measurement of EMPs and reporting would greatly help the development of the environmental management field.

A second limitation is the time lag between the implementation of an EMP, and its effect on EFP. It is difficult to know how and when an EMP will have an effect on firms' performance. A dynamic research would account and control for this limitation.

A third limitation is the large number of EMPs that could potentially affect a firms' performance. This research considered 19 of many possible EMPs (see Table 2). These 19 were chosen because data could be collected from routine company reports. Similarly, this study used 5 of many possible EFPs (Table 1), but again, these 5 were chosen because data can be easily collected from company reports. A similar situation occurs with moderators used for selecting the sample firms. Five moderators were used in this research to target a homogeneous sample of US firms; nonetheless, others (e.g. complementary assets) could have been included or substituted to alter or further homogenize the sample. Identification of a set of moderators that

leads to CAP and CCA results that explain a high percentage of variation in EFPs for different targeted samples is an interesting topic for future research.

As in Montabon et al. (2007), the sample size in this research must be considered a limitation. In a CAP analysis, the number of predictive variables must be small relative to the number of objects (Ter Braak, 1986). It was disappointing to find that only 10% of the 304 targeted sample firms had produced both financial and environmental reports. Hopefully this will improve in the future.

A broader limitation is related to what it means to be a successful sustainable business. The most common definition of sustainability was proposed by the Brundtland Commission of the United Nations on March 20, 1987: “sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” This definition is composed of two main sections; the first section emphasizes today’s needs (“...meets the needs of the present...”), while the second section emphasizes tomorrow’s needs (“...future generations to meet their own needs”). Historically, businesses have mostly considered the first part of this definition. Sustainable business has mainly focused on the concept of efficiency, meaning that the focus has been put on answering the question, “how to produce more with less?” The logic behind this focus is that if firms are concentrating on efficiency, they can reduce their overall impact on the environment, which will hopefully create a competitive advantage, resulting in growth. The underlying problem with focusing on efficiency is not efficiency itself, but rather, that the goal of being efficient is to create permanent growth (Daly, H. 2006; Max-Neef, M., Smith, P. 2011). A more sustainable business focus would be a shift from the concept of efficiency, towards the concept of sufficiency. With this shift in focus, growth will not be the ultimate goal of firms. Firms should not measure sustainable performance in terms of growth, rather, they should be measuring sustainable performance in terms of development, and development does not necessarily require growth. Real sustainability must acknowledge that continuous growth is impossible, and it goes against the very definition of sustainability (Daly, H. 2006; Max-Neef, M., Smith, P. 2011). This shift does not mean that growth is forbidden, but instead, growth should not be the only indicator of

success. A more holistic view of performance, meaning a more complete interpretation of the definition of sustainability, would be a better way to evaluate firm's performance.

Chapter 6.0 Conclusions

This study developed three models to predict five environmental and financial performance variables (EFPs: Sales Growth, Innovation process, Innovation product, Tobin's q, and ROA) from 19 environmental management practices variables (EMPs: Recycling, Proactive waste reduction, Reactive waste reduction, Consume internally, Create market for waste, Water consumption, Energy consumption, Early supplier involvement, Environmental standard for suppliers, Environmental audits suppliers, Environmental awards, Life cycle analysis, Design targets/goals, Environmental risk analysis, Corporate policy/procedure, Environmental mission statement, Environmental department, Surveillance of market, Strategic alliance) for 30 US manufacturing firms that met the following five moderator conditions: Firm size (firms with 500 or more paid employees), Industry type (manufacturing sectors), Industry Growth (declining contribution to GDP), Industry concentration (moderate to low according to the Herfindahl-Hirschman Index), and Industry dynamism (low market volatility).

Using Constrained Analysis of Principal Components (CAP), three models of the 5 EFP response variables were developed:

1. Model 1 based on the 15 EMP variables that were statistically significant ($\alpha \leq 0.05$) predictors of at least one of the EFPs,
2. Model 2 based on the 9 EMP variables in Model 1 that occurred as a significant predictor of at least two of the EFPs,
3. Model 3 based on the 3 EMP variables in Model 2 that occurred as a significant predictor of at least three of the EFPs,

These models respectively explained 73%, 61% and 31% of the variability in the EFPs.

Canonical Correspondence Analyses (CCA) of the same three models, with the EMPs grouped into operational, tactical and strategic management level subsets, explained 69%, 53% and 28% respectively of the variability in the EFPs.

CCA results suggest that for firms to be successful in developing EMPs to improve EFP, they must allocate resources to all three managerial levels, however, the operational level always explained the greatest percent of EFP variation, followed by the tactical and strategic levels.

Literature Cited

Aldrich, H., 1969. An Organization-Environment Perspective on Cooperation and Conflict Between Organization in the Manpower Training System. In A. Negandhi (Ed.), *Inter-Organizational Theory*. Kent, Ohio: Kent State University Press, 1969, 49-70.

Ambec, S., Lanoie, P., 2008. Does It Pay to Be Green? A Systematic Overview. *The Academy of Management Perspectives* 22 (4), 45-62.

Anderson, M., Willis, T., 2003. Canonical analysis of principal coordinates: a useful method of constrained ordination for ecology 84, 511–525

Aragon-Correa, J., 1998. Strategic Proactivity and Firm Approach to the Natural Environment. *The Academy of Management Journal* 41 (5), 556-567.

Aragon-Correa, J., Sharma, S., 2003. A Contingent Resource-Based View of Proactive Corporate Environmental Strategy. *Academy of Management* 28(1), 71-88.

Banerjee, S., Iyer, E., Kashyap, R., 2003. Corporate Environmentalism: Antecedents and Influence of Industry Type. *Journal of Marketing* 67, 106-122.

Barney, J. B., 1986a. Strategic Factor Markets: Expectations, Luck and Business Strategy. *Management Science* 32, 1512-1514.

Barney, J. B., 1991a. Firm Resources and Sustained Competitive Advantage. *Journal of Management* 17, 99-120.

Barney, J. B., 1991b. The Resource Based View of Strategy: Origins, Implications, and Prospects. Editor of Special Theory Forum in *Journal of Management* 17, 97-211.

- Baron, R., Kenny, D., 1986. The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations. *Journal of Personality and Social Psychology* 51 (6), 1173-1182.
- Berry, M., Rondinelli, D., 1998. Proactive Corporate Environmental Management: A New Industrial Revolution. *Academy of Management Executive* 12 (2), 38-50.
- Bonifant, B., 1994. Competitive Implications of Environmental Regulation in the Electronics Manufacturing Industry. Management Institute for the Environment and Business, Washington, DC.
- Carpenter, M., Westphal, J., 2001. The Strategic Context of External Network Ties: Examining the Impact of Director Appointments on Board Involvement in Strategic Decision Making. *Academy of Management Journal* 44 (4), 639-660.
- Carpenter, M., 2002. The Implications of Strategy and Social Context for the Relationship between Top Management Team Heterogeneity and Firm Performance. *Strategic Management Journal* 23 (3), 275-284.
- Caves R, Porter M., 1977. From Entry Barriers to Mobility Barriers: Conjectural Decisions and Contrived Deterrence to New Competition. *Quarterly Journal of Economics* 91, 241–262.
- Caves R, Porter M., 1978. Market Structure, Oligopoly, and Stability of Market Shares. *Journal of Industrial Economics* 29 (1), 289–313.
- Chamberlain E., 1932. *The Theory of Monopolistic Competition*. Harvard University Press, Cambridge, MA.
- Child, J., 1972. Organizational Structure, Environment, and Performance: The Role of Strategic Choice. *Sociology* 6, 1-22.

Christmann, P., 2000. Effects of “Best Practices” of Environmental Management on Cost Advantage: The Role of Complementary Assets. *The Academy of Management Journal* 43, 663-680.

Coate, M., Higgins, R., McChesney, F., 1990. Bureaucracy and Politics in FTC Merger Challenges. *Journal of Law and Economics* 33 (2), 463-482.

Dahlmann, F., Brammer, S., 2011. Exploring and Explaining Patterns of Adaptation and Selection in Corporate Environmental Strategy in the USA. *Organizational Studies* 32 (4), 527-553.

Daly, H., 2005. Economics in a full world. *Scientific American*, September 2005, Vol. 293, Issue 3.

Darnall, N., Henriques, I., Sadorsky, P., 2010. Adopting Proactive Environmental Strategy: The Influence of Stakeholders and Firm Size. *Journal of Management Studies* 47 (6), 1072-1094.

Dess, G., Beard, D., 1984. Dimensions of Organizational Task Environments. *Administrative Science Quarterly* 29, 52-73.

Dill, W., 1958. Environments as an Influence on Managerial Autonomy. *Administrative Science Quarterly* 2, 409-43.

Duncan, R., 1972. Characteristics of Organizational Environments and Perceived Environmental Uncertainty. *Administrative Science Quarterly* 17 (3), 313-327.

Eisenhardt, K., Martin, J., 2000. Dynamic Capabilities: What Are They? *Strategic Management Journal* 21, 1105-1121.

Farjoun, M., Levin, M., 2011. A Fractal Approach to Industry Dynamism. *Organizations Studies*, special issue on complexity 36 (6), 825-851.

Ferrier, W., 2001. Navigating the Competitive Landscape: The Drivers and Consequences of Competitive Aggressiveness. *The Academy of Management Journal* 44 (4), 858-877.

Florida, R., 1996. Lean and Green: The Move to Environmentally Conscious Manufacturing. *California Management Review* 39 (1), 80-105.

Grant, R., 1991. The Resource-Based Theory of Competitive Advantage. Implications for Strategy Formulation. *California Management Review* 33 (3), 114-35.

Hagel III, J., Brown, J., Davison. L., 2010. HBR Blog Network / John Hagel III and John Seely Brown. *Harvard Business Review*. N.p., 2010. Web. 06 Oct. 2012.
<<http://blogs.hbr.org/bigshift/2010/03/the-best-way-to-measure-compan.html>>.

Hair Jr., J., Anderson, R., Tatham, R., Black, W., 1998. *Multivariate Data Analysis*. Prentice Hall, New Jersey, Upper Saddle River.

Hanna, M., Newman, W., 1995. Operations and Environment: An Expanded Focus for TQM. *The International Journal of Quality and Reliability Management* 12 (5), 38-53.

Hart, S., 1995. A Natural-Resource-Based View of the Firm. *Academy of Management Review* 20 (4), 986-1014.

Hitt, M., Ireland, R., Hoskisson, R., 2005. *Strategic Management: Competitiveness and Globalization Concepts*. Mason, Ohio: Thomson/South-Western.

Huselid, M., 1995. The Impact of Human Resource Management on Turnover, Productivity, and Corporate Performance. *Academy of Management Journal* 38, 635-672.

IBM Corp. Released 2012. *IBM SPSS Statistics for Windows, Version 21.0*. Armonk, NY: IBM Corp.

- Jones, K., Alabaster, T., Hetherington, K., 1999. Internet-based Environmental Reporting: Current Trends. *Greener Management International* 26, 69-90.
- Kast, F., Rosenzweig, J., 1978. *Organization and Management: A Systems and Contingency Approach*. New York: McGraw-Hill Book Company, 1978; Chicago: SRA.
- Klassen, R., McLaughlin, C., 1996. The Impact of Environmental Management on Firm Performance. *Management Science* 42 (8), 1199-1214.
- Lee, D., Tompkins, J., 1999. A modified version of the Lewellen and Badrinath measure of Tobin's q. *Financial Management* 28 (1), 20-31.
- Legendre, P., and Anderson, M.J., 1999. Distance-based redundancy analysis: testing multispecies responses in multifactorial ecological experiments. *Ecol. Monogr.* 69, 1-24.
- Makhija, M., 2003. Comparing the Resource-based and Market-based Views of the Firm: Empirical Evidence from Czech Privatization. *Strategic Management Journal* 24, 433-51.
- Max-Neef, M., Smith, P., 2011. *Economics Unmasked: From Power and Greed to Compassion and the Common Good*. UIT Cambridge LTD.; 1 edition (February 1, 2011). Print.
- Microsoft. (2010). *Microsoft Excel [computer software]*. Redmond, Washington: Microsoft.
- Montabon, F., Sroufe, R., and Narasimhan, R., 2007. An Examination of Corporate Reporting, Environmental Management Practices and Firm Performance, *Journal of Operations Management* 25 (5), 998-1014.
- Morhardt, E., 2002. *Clean, Green, and Read All Over: Ten Rules for Effective Corporate Environmental and Sustainability Reporting*. Milwaukee: ASQ Quality, 2002.
- Nunnally, J., 1978. *Psychometric Theory*. McGraw Hill, New York.

- Orlitzky, M., Schmidt, F., Rynes, S., 2003. Corporate Social and Financial Performance: A Meta-Analysis. *Organizational Studies* 24 (3), 403-441.
- Porter, M., 1991. America's Green Strategy, *Scientific America* 264 (4), 96.
- Porter, M., van der Linde, C., 1995a. Green and Competitive: Ending the Statement. *Harvard Business Review* 73 (5), 120-134.
- Porter, M., van der Linde, C., 1995b. Toward a New Conception of the Environment-Competitive Relationship. *Journal of Economic Perspective* 9 (4), 97-118.
- Porter M, Kramer, M., 2006. Strategy and society: The link between competitive advantage and corporate social responsibility. *Harvard Business Review* 84, 78-92.
- Richard, O., Murthi, B., Ismail, K., 2007. The Impact of Racial Diversity on Intermediate and Long-Term Performance: The Moderating Role of Environmental Context. *Strategic Management Journal* 28, 1213-1233.
- Rondinelli, D., Vastag, G., 1996. International Environmental Standards and Corporate Policies: An Integrative Framework. *California Management Review* 39 (1), 106-122.
- RStudio (2012). RStudio: Integrated development environment for R (Version 0.96.122) [Computer software]. Seattle, WA. Retrieved November 10, 2012.
Available from <http://www.rstudio.org/>
- Russo, M., Fouts, P., 1997. A-Resource-Based Perspective on Corporate Environmental Performance and Profitability. *Academy of Management Journal* 40 (3), 534-559.
- Sanchez, C., 1997. Reflections on Firm and National Inventories. *Business and Society* 36 (2), 140-168.

Schroeder, D., Robinson, A., 2010. Green is Free: Creating Sustainable Competitive Advantage Through Green Excellence. *Organizational Dynamics* 39, 345-352.

Shapiro, S.S., & Wilk, M.B. (1965). An Analysis of Variance Test for Normality (complete samples). *Biometrika* 52, 591-611.

Sharma, S., Vredenburg, H., 1998. Proactive Corporate Environmental Strategy and the Development of Competitively Valuable Organizational Capabilities. *Strategic Management Journal* 19, 729-753.

Shrout, PE., Fleiss, J.L., 1979. Intraclass correlations: uses in assessing rater reliability. *Psychological Bulletin* 86 (2), 420-428.

Shughart, W., 2008. Industrial Concentration. *The Concise Encyclopedia of Economics*. N.p., 2008. Web. 05 Oct. 2012. <<http://www.econlib.org/library/Enc/IndustrialConcentration.html>>.

Simpson, D., Samson, D., 2010. Environmental Strategy and Low Waste Operations: Exploring Complementarities. *Business Strategy and the Environment* 19, 104-118.

Snyder, N., Glueck, W., 1982. Can Environmental Volatility Be Measured Objectively? *The Academy of Management Journal* 25 (1), 185-192.

Starbuck, W., 1976. Organizations and their environment. In Dunnette (Ed.). *Handbook of Organizational and Industrial Psychology*. Chicago: Rand McNally.

Stead, W., Stead, J., 1992. *Management for a Small Planet: Strategic Decision Making and the Environment*, Sage Publications Inc., Newbury Park, CA.

Stewart-Koster, B., Kennard, M.J., Harch, B.D., Sheldon, F., Arthington, A.H., Pusey, B.J., 2007. Partitioning the variation in stream fish assemblages within a spatio-temporal hierarchy. *Marine and Freshwater Research*, 58, 675-686.

- Stigler, G., 1964. A Theory of Oligopoly. *The Journal of Political Economy* 72, 44-61.
- Tallman SB., 1991. Strategic Management Models and Resource-Based Strategies Among MNEs in a Host Market. *Strategic Management Journal*, Summer Special Issue 12, 69–82.
- Ter Braak, C.J.F. 1986b. Canonical correspondence analysis: a new eigenvector technique for multivariate direct gradient analysis. *Ecology* 67:1167-1179.
- Tirole, J., 1988. *The Theory of Industrial Organization*. MIT Press, Cambridge, MA.
- Tosi, H., Aldag, R., Storey, R., 1973. On the Measurement of the Environment An Assessment of the Lawrence and Lorsch Environmental Uncertainty Scale. *Administrative Science Quarterly* 18, 27-36.
- Ullmann, A., 1985. Data in Search of a Theory: A Critical Examination of the Relationships among Social Performance, Social Disclosure, and Economic Performance of U.S. Firms. *Academy of Management Review* 10, 540-557.
- United Nations General Assembly (1987) *Report of the World Commission on Environment and Development: Our Common Future*. Transmitted to the General Assembly as an Annex to document A/42/427 - Development and International Co-operation: Environment.
- Valentine, S., 2009. The Green Onion: A Corporate Environmental Strategy Framework. *Corporate Social Responsibility and Environmental Management* 17, 284-98.
- Wernerfelt, B., 1984. A Resource-based View of the Firm. *Strategic Management Journal* 5, 171–80.

Chapter 7.0 Appendix

Appendix A. The North American Industry Classification System (NAICS)

Code	Description
11	Agriculture, Forestry, Fishing and Hunting
21	Mining
22	Utilities
23	Construction
31	Manufacturing (31-33)
32	Manufacturing (31-33)
33	Manufacturing (31-33)
42	Wholesale Trades
44	Retail Trade (44-45)
45	Retail Trade (44-45)
48	Transportation and Warehousing (48-49)
49	Transportation and Warehousing (48-49)
51	Information
52	Finance and Insurance
53	Real Estate and Rental and Leasing
54	Professional, Scientific, and Technical Services
55	Management of Companies and Enterprises
56	Administrative and Support and Waste Management and Remediation Services
61	Educational Services
62	Health Care and Social Assistance
71	Arts, Entertainment, and Recreation
72	Accommodation and Food Services
81	Other Services (except Public Administration)
92	Public Administrations

Appendix B. Manufacturing NAICS System

Code	Description
31	Manufacturing (31-33)
311	Food Manufacturing
312	Beverage and Tobacco Product Manufacturing
313	Textile Mills
314	Textile Product Mills
315	Apparel Manufacturing
316	Leather and Allied Product Manufacturing
32	Manufacturing (31-33)
321	Wood Product Manufacturing
322	Paper Manufacturing
323	Printing and Related Support Activities
324	Petroleum and Coal Products Manufacturing
325	Chemical Manufacturing
326	Plastics and Rubber Products Manufacturing
327	Nonmetallic Mineral Product Manufacturing
33	Manufacturing (31-33)
331	Primary Metal Manufacturing
332	Fabricated Metal Product Manufacturing
333	Machinery Manufacturing
334	Computer and Electronic Product Manufacturing
335	Electrical Equipment, Appliance, and Component Manufacturing
336	Transportation Equipment Manufacturing
337	Furniture and Related Product Manufacturing
339	Miscellaneous Manufacturing

Appendix C. Contribution to GDP by Industry Sector. Years 2000, 2005, 2007, 2008, and 2009

		Dollar values are in current dollars (Billions). Published in 2011					
		Years					
	Industry (NAICS code)	2000	2005	2007	2008	2009	Slopes
1	wood products (321)	28.3	33	28.2	25.1	20.9	-2.27
2	Nonmetallic mineral products (327)	41.9	45.3	44.4	39.4	38.2	-1.33
3	Motor vehicle, bodies and trailers, and parts (3361 - 3363)	117.7	112.6	103.4	81.1	78.2	-11.05
4	Furniture and related products (337)	33.8	34.3	34.7	28.8	24.2	-2.47
5	Textile mills and textile products (313, 314)	27.9	23.5	21.7	22.4	17.6	-2.17
6	Apparel and leather and allied products (315, 316)	21.4	16	14.9	13.5	11.7	-2.19
7	Paper products (322)	61.7	53.8	58.6	53.8	56.1	-1.12
8	Printing and related support activities (323)	40.3	37.5	38.5	37	32.8	-1.55
9	Plastics and rubber products (326)	64.6	65.6	69.5	59.4	56.7	-2.2
10	Durable goods (33, 321, 327)	839.1	877.6	924.8	927.3	867.2	10.59
11	Primary metals (331)	46.3	53.7	59	61.5	43.4	0.2
12	Fabricated metal products (332)	120.7	120.4	134.3	135.1	121.9	1.71
13	Machinery (333)	110.5	109.5	125.3	125.3	112.7	20.2
14	Computer and electronic products (334)	172.1	183.3	196.4	204.1	206.4	8.94
15	Electrical equipment, appliance, and components (335)	44.1	39.9	45.8	50.6	51.7	2.59
16	Food and beverage and tobacco products (311, 312)	164.8	172.1	179.9	181.2	206.1	9.17
17	Other transportation equipment (3364 - 66, 69)	65.8	76	92.4	95.7	90.7	6.95
18	Miscellaneous manufacturing (339)	58.3	69.6	78.8	80.6	79	5.24
19	Nondurable goods (31, 32 (except 321 and 327))	576.5	690.4	756.1	720.3	717.6	31.21
20	Petroleum and coal products (324)	43.6	139.3	149.7	151.9	120	16.54
21	Chemical products (325)	152.2	182.7	223.2	201.1	216.5	14.7
	Manufacturing (31-33)	1415.6	1568	1698.9	1647.6	1584.8	

Appendix D. Analysis of Variance (anova) of Market Volatility Index among Manufacturing Sectors

lm(formula = Market_volatility ~ naics)

Residuals:

Min	1Q	Median	3Q	Max
-0.26776	-0.07095	-0.02397	0.04295	0.50262

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	0.14313	0.06920	2.068	0.04252 *
naics315	0.01774	0.07872	0.225	0.82236
naics321	0.02907	0.11300	0.257	0.79776
naics322 -	0.03193	0.08630 -	0.370	0.71262
naics323 -	0.04457	0.09786 -	0.455	0.65026
naics326 -	0.02197	0.09786 -	0.225	0.82303
naics327	0.04145	0.08630	0.480	0.63259
naics337	0.03857	0.09060	0.426	0.67173
naics3362	0.26093	0.07990	3.266	0.00173 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1547 on 66 degrees of freedom

Multiple R-squared: 0.3436, Adjusted R-squared: 0.264

F-statistic: 4.318 on 8 and 66 DF, p-value: 0.0003188

Appendix E. Environment Practices Definition Sheet for Raters. (Based on the research conducted by Montabon et al., 2007)

C.1.1. Environmental practices

Please remember that there are no rights or wrong answers to the report evaluations. We simply need your evaluation of the intensity of involvement by a firm in the following activities and practices.

Key words are in *italics*—1: not doing it, 2: eludes to doing it,5: quantitative measures, categories, and targets.

Operational practices

1. *Recycling*: are they doing it? (Yes/no) How long (number of years) have they been doing it? Scope of recycling (office paper (low) vs. production process (high))
2. *Waste reduction (proactive): Pollution prevention, proactive* Talk in terms of proactive approaches to pollution prevention. *Elimination* of waste before it is produced. More specific to pollution prevention
3. *Waste reduction (reactive): emissions reduction*, talk in terms of “reactive” approaches to reducing waste, i.e., scrubbers, and incinerators, and treatment of waste
4. *Consume internally*: consume waste, or scrap internally. Sometimes done for the generation of electricity
5. Creating a market for *waste products*: treating waste as an input to another product that can be made and sold at a profit. Buying scraps or waste back from customers to be re-utilized, recycled, etc.
6. *Water consumption (efficiency)*: Are they concern about water efficiency? What are they doing to reduce consumption (third party consulting)? Any statistics, investment level, goals, etc.?
7. *Energy (electricity, gas, etc.) consumption (efficiency)*: Are they concern about energy efficiency? What are they doing to reduce consumption (third party consulting)? Any statistics, investment level, goals, etc.?

Tactical

8. *Early supplier involvement: Suppliers* are suppliers involved in new product design? (Yes/no)
9. *Environmental standards for suppliers: Suppliers* (yes/no)
10. *Environmental audits of suppliers: suppliers, Audit* (yes/no) are suppliers audited on environmental dimensions?
11. *Environmental awards/recognition: Awards corporate citizen* recognition by government bodies (Fed, State, and Local), magazines, and environmental groups for environmental achievement
12. Use of life cycle analysis or design for environment: *Life Cycle (LCA)* (yes/no)
13. *Specific design targets: Goals* % improvements, do they quantify environmental design goals?
14. *Environmental risk analysis: Risk, Audit, Prior Assessment* Do they assess the risks of materials to the environment, to people

Strategic

15. *Corporate policies and procedures: Integrated Management, Precautionary Approaches extent?* Level of detail, extent of involvement throughout the organization. Compliance, commitment to exceed compliance
16. *Environmental mission statement: Corporate priority, Strategic, Leadership* Mission/Vision Statement
17. *Environmental department/teams (existence/extent of formal organizational structure): Environmental Team* How high is it in corporate hierarchy? How large of a budget does it have? Where do they report to? Number of people
18. *Surveillance of the market for environmental issues: CFC or PVC free cars . . .* Do they look for opportunities in the future for environmentally friendly opportunities
19. *Strategic alliances: Alliances* with other firms and/or governmental agencies (such as the EPA) to jointly work on environmental projects

Performance measures

20. Return on assets
21. Tobin’s q
22. Sales Growth.
23. *Innovation performance (products)*: Overall, how well have they done in introducing innovations and are they constantly looking for innovations? Are there specific mentions of innovations? Innovations attributed to environmental efforts should be scored higher

24. *Innovation performance (process)*: Overall, how well have they done in introducing innovations and are they constantly looking for innovations? Are there specific mentions of innovations? Innovations attributed to environmental efforts should be scored higher

Appendix F. Environmental Practices Matrix. (Based on the research conducted by Montabon et al., 2007)

If an environmental practice is not mentioned, it should be rated as a 1 in the matrix.

Firm: _____
 Rater: _____

Question	Yes/no	Low	Intensity Scale			High	Page
Operational practices							
1	Recycling	1	2	3	4	5	
2	Waste Reduction (Pro)	1	2	3	4	5	
3	Waste Reduction (Real)	1	2	3	4	5	
4	Consume internally	1	2	3	4	5	
5	Create market for waste	1	2	3	4	5	
6	Water consumption	1	2	3	4	5	
7	Energy consumption	1	2	3	4	5	
Tactical							
8	Early supplier involve	1	2	3	4	5	
9	Environmental standard for suppliers	1	2	3	4	5	
10	Environmental audits suppliers	1	2	3	4	5	
11	Environmental awards	1	2	3	4	5	
12	Life cycle analysis	1	2	3	4	5	
13	Design targets/goals	1	2	3	4	5	
14	Environmental risk analysis	1	2	3	4	5	
Strategic							
15	Corp. policy/procedure	1	2	3	4	5	
16	Environmental mission statement	1	2	3	4	5	
17	Environmental department	1	2	3	4	5	
18	Surveillance of market	1	2	3	4	5	
19	Strategic alliance	1	2	3	4	5	
Environmental/financial/market performance							
20	Return on assets						
21	Tobin's q						
22	Sales Growth						
23	Innovation product	1	2	3	4	5	
24	Innovation process	1	2	3	4	5	

Appendix G. Intraclass Correlation Coefficient (ICC) for Reliability within Each Rater

Rater #1:

Case Processing Summary

		N	%
Cases	Valid	63	100.0
	Excluded ^a	0	.0
	Total	63	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.809	2

Intraclass Correlation Coefficient

	Intraclass Correlation ^a	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.675 ^b	.516	.790	5.247	62	62	.000
Average Measures	.806^c	.681	.883	5.247	62	62	.000

Two-way mixed effects model where people effects are random and measures effects are fixed.

- a. Type A intraclass correlation coefficients using an absolute agreement definition.
- b. The estimator is the same, whether the interaction effect is present or not.
- c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Rater # 2

Case Processing Summary

		N	%
Cases	Valid	63	100.0
	Excluded ^a	0	.0
	Total	63	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.758	2

Intraclass Correlation Coefficient

	Intraclass Correlation ^a	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.474 ^b	.046	.715	4.136	62	62	.000
Average Measures	.644^c	.088	.834	4.136	62	62	.000

Two-way mixed effects model where people effects are random and measures effects are fixed.

- a. Type A intraclass correlation coefficients using an absolute agreement definition.
- b. The estimator is the same, whether the interaction effect is present or not.
- c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Rater # 3

Case Processing Summary

		N	%
Cases	Valid	63	100.0
	Excluded ^a	0	.0
	Total	63	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.820	2

Intraclass Correlation Coefficient

	Intraclass Correlation ^a	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.649 ^b	.416	.790	5.541	62	62	.000
Average Measures	.787^c	.588	.882	5.541	62	62	.000

Two-way mixed effects model where people effects are random and measures effects are fixed.

- a. Type A intraclass correlation coefficients using an absolute agreement definition.
- b. The estimator is the same, whether the interaction effect is present or not.
- c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Rater # 4

Case Processing Summary

		N	%
Cases	Valid	63	100.0
	Excluded ^a	0	.0
	Total	63	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.838	2

Intraclass Correlation Coefficient

	Intraclass Correlation ^a	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.718 ^b	.575	.819	6.169	62	62	.000
Average Measures	.836^c	.730	.901	6.169	62	62	.000

Two-way mixed effects model where people effects are random and measures effects are fixed.

- a. Type A intraclass correlation coefficients using an absolute agreement definition.
- b. The estimator is the same, whether the interaction effect is present or not.
- c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Rater # 5

Case Processing Summary

		N	%
Cases	Valid	63	100.0
	Excluded ^a	0	.0
	Total	63	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.937	2

Intraclass Correlation Coefficient

	Intraclass Correlation ^a	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.870 ^b	.777	.923	15.956	62	62	.000
Average Measures	.930^c	.874	.960	15.956	62	62	.000

Two-way mixed effects model where people effects are random and measures effects are fixed.

- a. Type A intraclass correlation coefficients using an absolute agreement definition.
- b. The estimator is the same, whether the interaction effect is present or not.
- c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Rater # 6

Case Processing Summary

		N	%
Cases	Valid	63	100.0
	Excluded ^a	0	.0
	Total	63	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.834	2

Intraclass Correlation Coefficient

	Intraclass Correlation ^a	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.675 ^b	.459	.805	6.027	62	62	.000
Average Measures	.806^c	.629	.892	6.027	62	62	.000

Two-way mixed effects model where people effects are random and measures effects are fixed.

- Type A intraclass correlation coefficients using an absolute agreement definition.
- The estimator is the same, whether the interaction effect is present or not.
- This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Appendix H. Intraclass Correlation Coefficient (ICC) for Reliability across the Five Raters

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	21	95.5
	Excluded ^a	1	4.5
	Total	22	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.897	5

Intraclass Correlation Coefficient

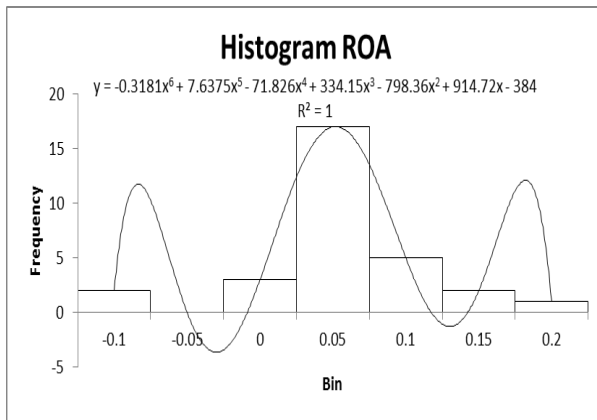
	Intraclass Correlation ^a	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.541 ^b	.320	.746	9.744	20	80	.000
Average Measures	.855 ^c	.701	.936	9.744	20	80	.000

Two-way mixed effects model where people effects are random and measures effects are fixed.

- a. Type A intraclass correlation coefficients using an absolute agreement definition.
- b. The estimator is the same, whether the interaction effect is present or not.
- c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Appendix I. Histograms & Shapiro-Wilk's Normality Test

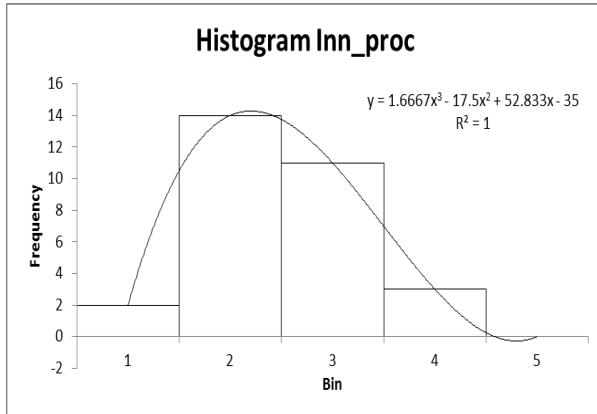
Response variables



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
ROA	.160	30	.048	.927	30	.040

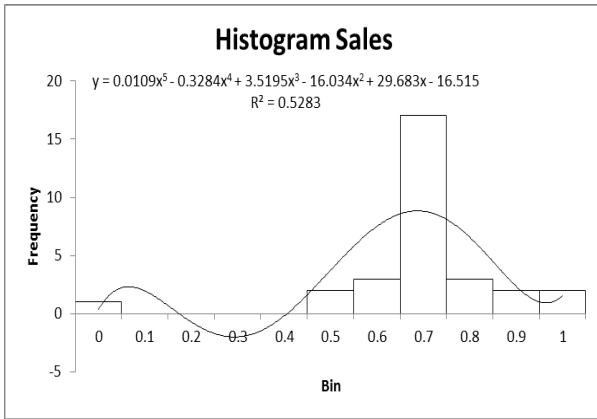
a. Lilliefors Significance Correction



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Inn_proc	.158	30	.055	.927	30	.042

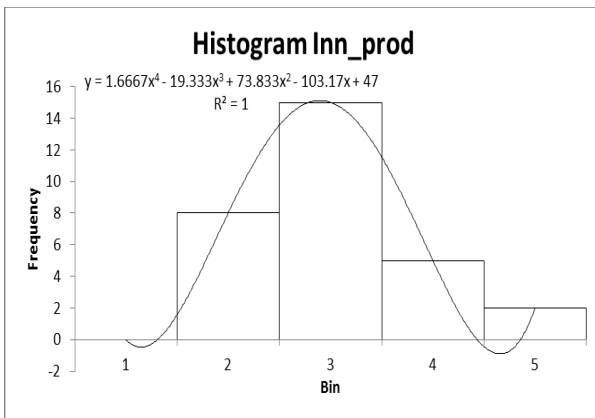
a. Lilliefors Significance Correction



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Sales	.209	30	.002	.779	30	.000

a. Lilliefors Significance Correction

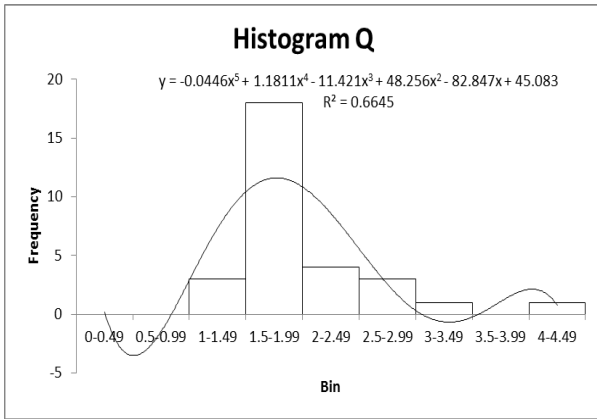


Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Inn_prod	.086	30	.200*	.982	30	.869

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

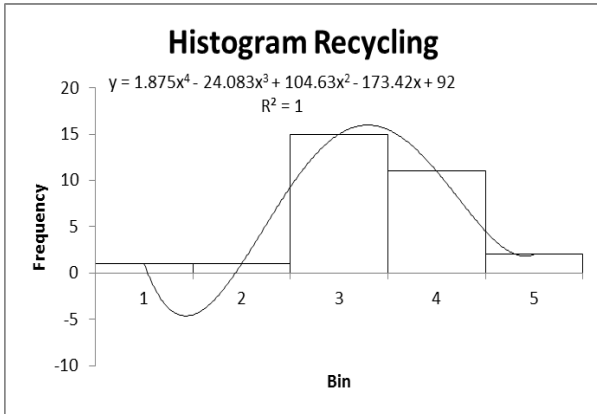


Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Q	.213	30	.001	.815	30	.000

a. Lilliefors Significance Correction

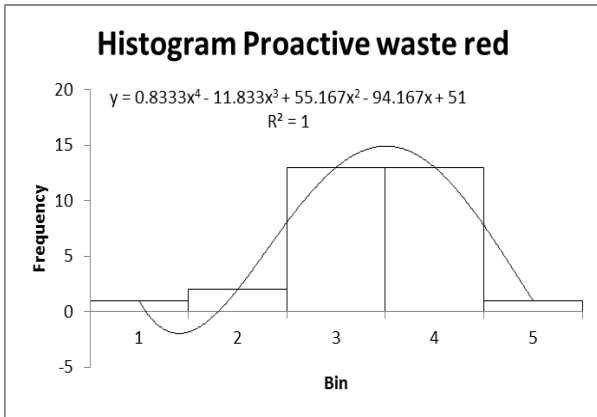
Predictive variables



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Recycling	.176	30	.018	.950	30	.169

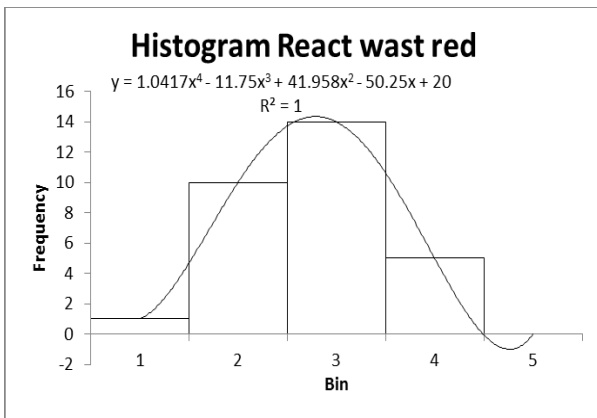
a. Lilliefors Significance Correction



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pro_we_re	.179	30	.016	.952	30	.195

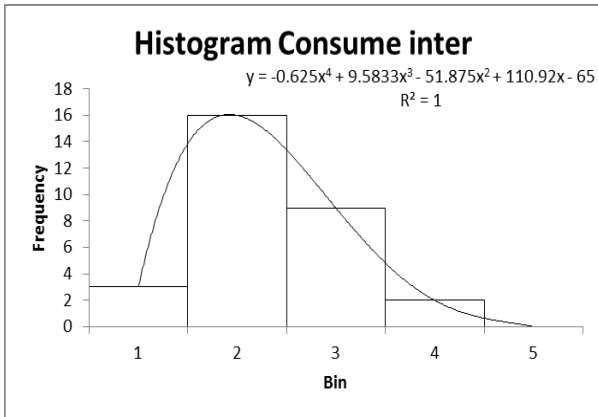
a. Lilliefors Significance Correction



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Rea_wa_re	.158	30	.055	.960	30	.306

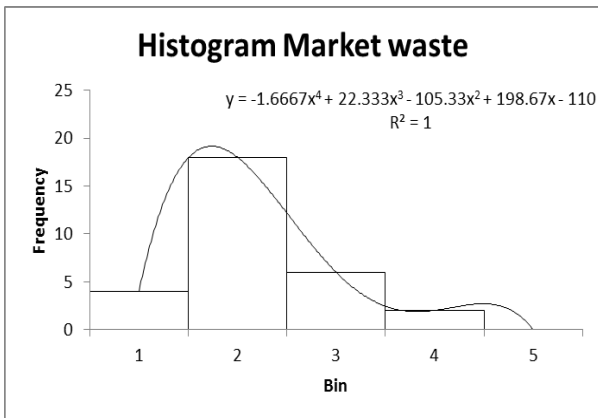
a. Lilliefors Significance Correction



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Cons_inter	.155	30	.065	.913	30	.018

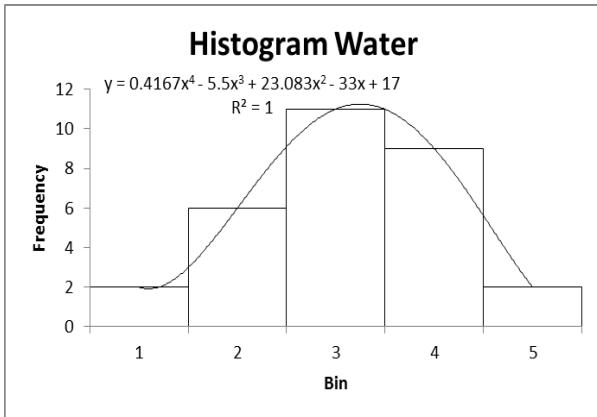
a. Lilliefors Significance Correction



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Mkt_waste	.164	30	.039	.936	30	.073

a. Lilliefors Significance Correction

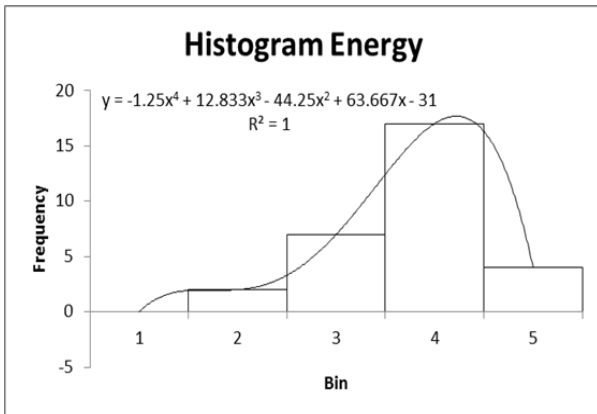


Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Water	.120	30	.200*	.965	30	.419

a. Lilliefors Significance Correction

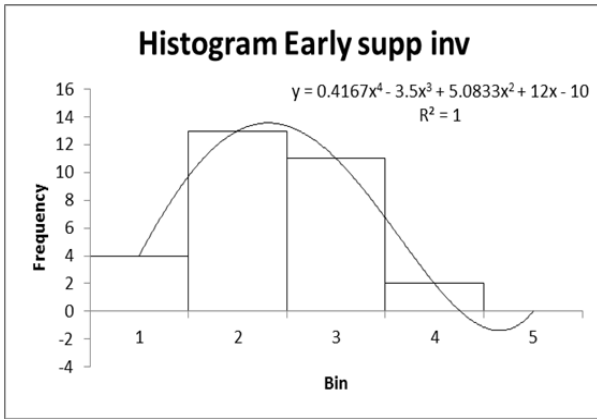
*. This is a lower bound of the true significance.



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Energy	.180	30	.015	.959	30	.285

a. Lilliefors Significance Correction

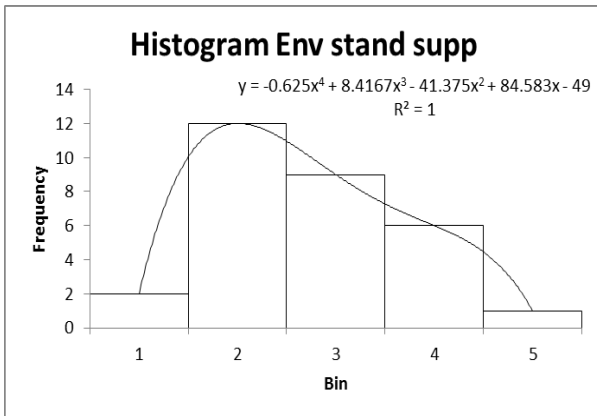


Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Ear_su_in	.116	30	.200*	.947	30	.143

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

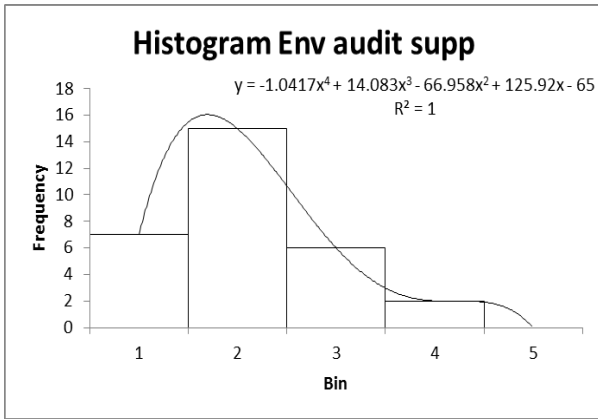


Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
En_st_sup	.130	30	.200*	.931	30	.052

a. Lilliefors Significance Correction

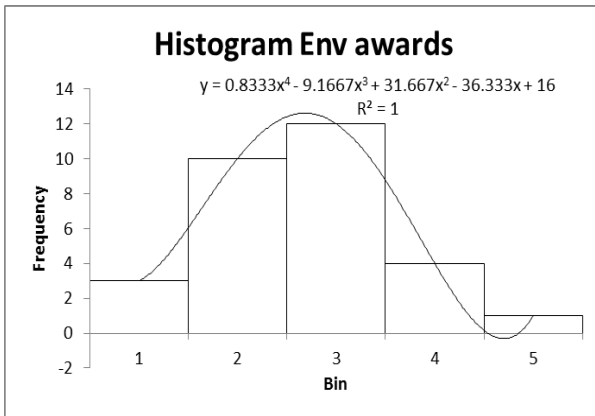
*. This is a lower bound of the true significance.



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
En_au_sup	.156	30	.061	.873	30	.002

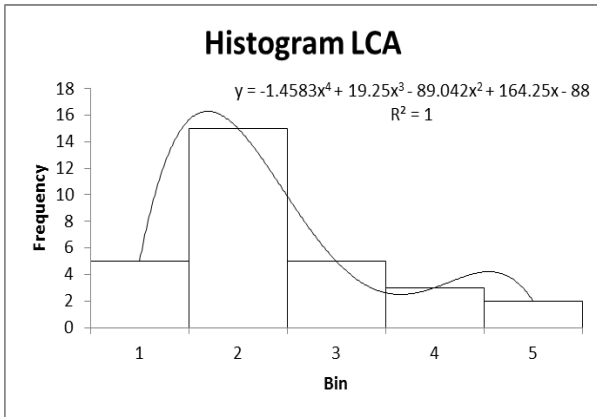
a. Lilliefors Significance Correction



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
En_awards	.153	30	.072	.930	30	.048

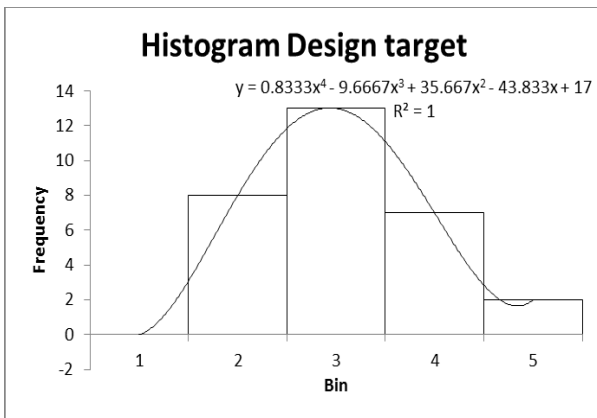
a. Lilliefors Significance Correction



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
LCA	.195	30	.005	.874	30	.002

a. Lilliefors Significance Correction

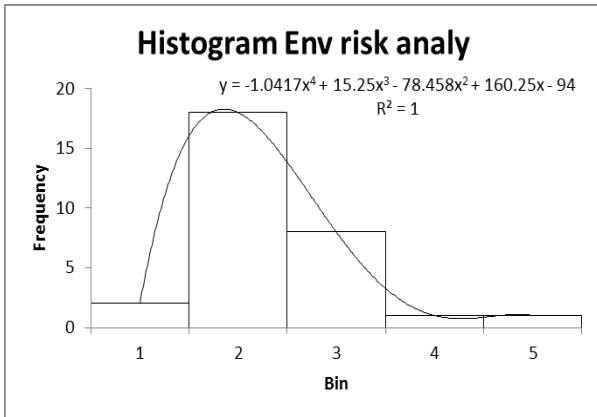


Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Desi_targ	.114	30	.200*	.970	30	.539

a. Lilliefors Significance Correction

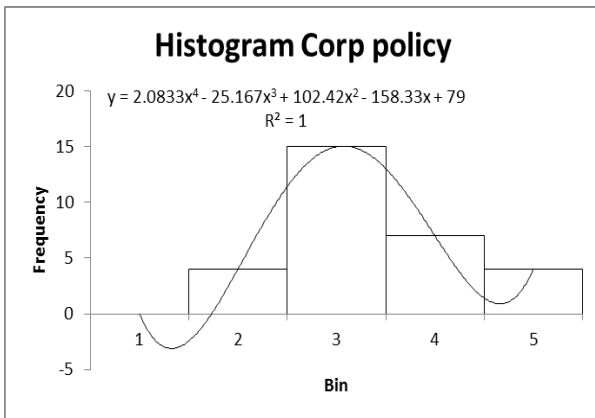
*. This is a lower bound of the true significance.



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
En_ris_ana	.182	30	.013	.875	30	.002

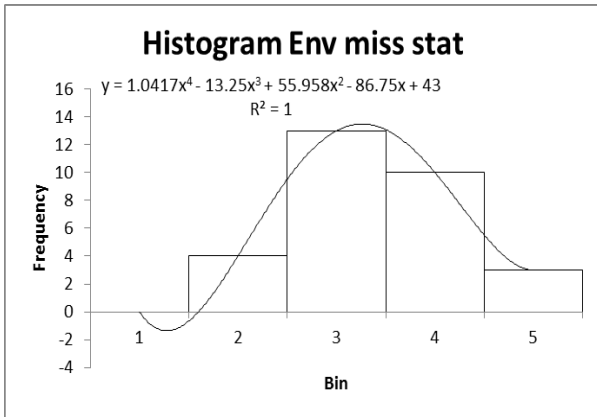
a. Lilliefors Significance Correction



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Corp_polic	.170	30	.027	.958	30	.271

a. Lilliefors Significance Correction

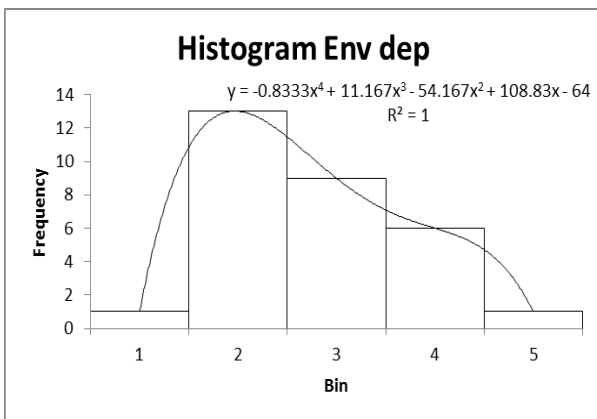


Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
En_mis_st	.077	30	.200*	.972	30	.606

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

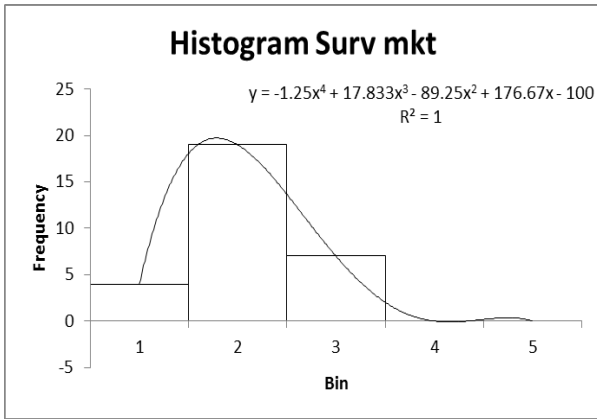


Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Env_dep	.092	30	.200*	.953	30	.204

a. Lilliefors Significance Correction

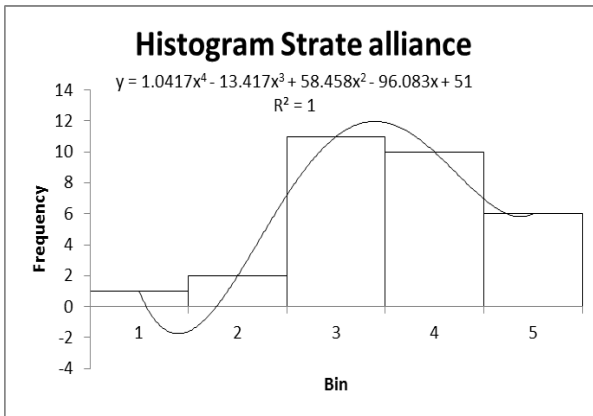
*. This is a lower bound of the true significance



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Surv_mkt	.138	30	.152	.918	30	.024

a. Lilliefors Significance Correction



Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Stra_allia	.130	30	.200*	.962	30	.353

Appendix J. Stepwise Results

Summary Stepwise regression analysis				Full Model	
19 Explanatory variables	Management level	Response variable	significance (α)	Management level	# of explanatory variables
Energy	Operational	Tobin's_Q	0	Operational	7
		ROA	0.001	Tactic	7
		Inn_prod	0.01	Strategic	5
Env miss statement	Strategic	Tobin's_Q	0.001	Total	19
		ROA	0.05		
		Inn_prod	0.001		
Env awards	Tactic	Tobin's_Q	0.01	Model 1	
		Sales	0.05	Management level	# of explanatory variables
		Inn_prod	0.01	Operational	5
Strategic alliance	Strategic	Tobin's_Q	0.001	Tactic	6
		ROA	0.05	Strategic	4
				Total	15
Design target	Tactic	Tobin's_Q	0.01	Model 2	
		Inn_prod	0.01	Management level	# of explanatory variables
		ROA	0.05	Operational	2
Corporate policy	Strategic	Inn_proc	0.001	Tactic	3
		Inn_prod	0.001	Strategic	4
				Total	9
Mkt_waste	Operational	Tobin's_Q	0.05	Model 3	
		Inn_proc	0.01	Management level	# of explanatory variables
		Sales	0.01	Operational	1
Env_risk_ana	Tactic	Sales	0.01	Tactic	1
				Strategic	1
				Total	3
Env department	Strategic	Sales	0.001		
		Tobin's_Q	0.01		
		ROA	0.05		
LCA	Tactic	Inn_prod	0.01		
		Inn_proc	0.05		
		Sales	0.05		
Proact waste red	Operational	Inn_proc	0.05		
Recycling	Operational				
Consume inter	Operational				
Early supply inv	Tactic				
Env stand suppliers	Tactic				
React waste red	Operational				
Water	Operational				
Env audit supp	Tactic				
Surv of mkt	Strategic				

Color code	
Three Management levels	Five Response variables
Operational	Tobin's_Q
Tactic	ROA
Strategic	Inn_prod

It is recommended to read this table from left to right. For example: On the far left column there is a list with all 19 explanatory variables. The explanatory variable “Energy” that belongs to the Operational management level; was considered to be a significant predictive variable ($\alpha \leq 0.1$) against three of the five response variables, these three response variables were Tobin’s q, ROA, and Innovation product. Example 2: The explanatory variable “LCA” that belongs to the Tactical management level; was considered to be a significant predictive variable ($\alpha \leq 0.1$) against one of the five response variables, this response variable was ROA.

Appendix K. Difference in the Constrained Proportion Explained by CAP and CCA

Consistency
CAP vs. CCA
P(T<=t) one-tail
0.358

No significant differences ($\alpha \geq 0.05$) between the means of these two groups.

Appendix L. Output CAP Analyses, and Monte Carlo Global Randomization Tests

Full Model

Partitioning of squared Gower distance:

	Inertia	Proportion
Total	1.2744	1.0000
Constrained	1.0252	0.8045
Unconstrained	0.2492	0.1955

Eigenvalues, and their contribution to the squared Gower distance

Importance of components:

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6	CAP7	CAP8
Eigenvalue	0.5239	0.2429	0.07602	0.06758	0.04048	0.02610	0.01953	0.01081
Proportion Explained	0.4112	0.1906	0.05966	0.05303	0.03176	0.02048	0.01533	0.00848
Cumulative Proportion	0.4112	0.6017	0.66139	0.71442	0.74618	0.76666	0.78199	0.79047

	CAP9	CAP10	CAP11	CAP12	CAP13	CAP14
Eigenvalue	0.008783	0.003838	0.003017	0.00131	0.0007145	0.000192
Proportion Explained	0.006890	0.003010	0.002370	0.00103	0.0005600	0.000150
Cumulative Proportion	0.797360	0.800380	0.802740	0.80377	0.8043300	0.804480

	MDS1	MDS2	MDS3	MDS4	MDS5	MDS6	MDS7	MDS8
Eigenvalue	0.07773	0.07214	0.04008	0.02718	0.01101	0.009982	0.004732	0.004207
Proportion Explained	0.06099	0.05661	0.03145	0.02133	0.00864	0.007830	0.003710	0.003300
Cumulative Proportion	0.86548	0.92209	0.95354	0.97487	0.98351	0.991340	0.995060	0.998360

	MDS9	MDS10
Eigenvalue	0.001475	0.0006184
Proportion Explained	0.001160	0.0004900
Cumulative Proportion	0.999510	1.0000000

Accumulated constrained eigenvalues

Importance of components:

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6	CAP7	CAP8
Eigenvalue	0.5239	0.2429	0.07602	0.06758	0.04048	0.02610	0.01953	0.01081
Proportion Explained	0.5111	0.2369	0.07416	0.06592	0.03948	0.02545	0.01905	0.01054
Cumulative Proportion	0.5111	0.7480	0.82213	0.88805	0.92753	0.95299	0.97204	0.98258

	CAP9	CAP10	CAP11	CAP12	CAP13	CAP14
Eigenvalue	0.008783	0.003838	0.003017	0.00131	0.0007145	0.000192
Proportion Explained	0.008570	0.003740	0.002940	0.00128	0.0007000	0.000190
Cumulative Proportion	0.991150	0.994890	0.997840	0.99912	0.9998100	1.000000

Scaling 2 for species and site scores

* Species are scaled proportional to eigenvalues

* Sites are unscaled: weighted dispersion equal on all dimensions

* General scaling constant of scores: 2.352134

Species scores

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6
Q	-7.317e-01	0.81910	-0.032936	0.01763	0.41215	0.03462
ROA	-5.911e-02	0.07516	0.016258	0.03000	-0.01779	-0.01003
Sales	-2.784e-05	0.22233	-0.001084	-0.09945	-0.15288	0.01596
Inn_prod	-1.341e+00	-0.61063	0.219774	-0.67837	-0.11380	0.16153
Inn_proc	-1.423e+00	-0.46571	-0.373661	0.37026	-0.09143	-0.03337

Site scores (weighted sums of species scores)

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6
1	-0.390032	-0.492549	0.2132534	-0.04639	-0.43533	0.53298
2	-0.217606	0.434500	-0.7193641	0.60673	-0.15498	-0.19164
3	0.389934	0.001024	0.0005271	-0.30369	0.51833	0.02407
4	-0.105017	0.186291	-0.2980181	0.30344	0.16243	0.15386
5	-0.156458	1.288291	-0.5788937	-0.43237	0.26625	-0.73477
6	-0.042117	-0.128300	-0.3511042	0.11026	-0.64274	0.07332
7	-0.038313	0.190517	-0.4637370	1.01971	0.39604	0.95504
8	0.218558	0.022511	0.5635194	-0.78394	-0.64365	-0.35850
9	0.165435	0.036700	0.1323911	-0.40543	-0.16413	-0.56869
10	-0.124385	-0.166256	0.1131510	-0.22269	-0.06000	-0.12970
11	-0.192555	0.434667	0.6367737	-0.69303	0.73960	0.55294
12	-0.779530	0.261812	0.3280403	-0.10197	-0.13100	0.70493
13	-0.231016	0.187351	-0.2835041	-0.04959	0.25489	0.66755
14	0.545732	0.645418	0.7085672	0.54637	0.32511	0.88696
15	0.499041	-0.093189	0.3031617	0.39516	0.13528	-0.32672
16	-0.519387	-0.885587	0.2090580	0.28110	-0.44766	-0.03506
17	0.299209	0.125454	0.1878038	-0.04353	0.04977	-0.21961
18	-1.447878	0.767911	0.1348175	0.07522	-0.19285	-0.59883
19	0.328673	0.511929	0.5746316	0.31816	-0.39374	-1.08685
20	0.341824	-0.334731	-0.5860781	0.83795	0.19737	-0.30711
21	0.322835	-0.193552	0.1540746	-0.75412	-0.43023	0.34229
22	0.008792	-0.154218	-0.3809890	0.54200	-0.71947	0.13512
23	0.081463	0.093520	0.6202185	-0.60096	0.34492	-0.20041
24	-0.129737	-0.357113	-0.2810042	0.35490	-0.18606	-0.28406
25	0.350210	0.095343	0.2338077	-0.28136	-0.63191	0.06545
26	0.682416	-0.106393	0.1971232	0.40023	-0.37635	0.21116
27	0.242115	-0.689560	-0.5513973	-1.10605	1.03742	-0.54812
28	0.001027	-0.573023	-1.2350145	-0.63452	-0.25169	0.58402
29	0.645863	-0.029716	-0.1249480	0.02260	0.45401	-0.02336
30	-0.749098	-1.079052	0.5431324	0.64579	0.98039	-0.27626

Site constraints (linear combinations of constraining variables)

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6
1	-0.32717	-0.32192	0.43605	-0.43380	-0.38337	0.311184
2	-0.45593	0.15257	-0.62123	0.58758	0.08085	-0.009307
3	0.07085	0.35835	0.11876	-0.12777	0.55256	0.001914
4	-0.01107	0.21486	-0.24435	0.39674	0.35987	0.435403
5	-0.13032	1.20257	-0.58966	-0.18798	-0.06320	-0.553293
6	-0.07620	0.12764	-0.26092	0.27082	-0.62641	-0.456822
7	0.15330	0.25698	-0.12648	0.52011	0.56067	0.579489
8	-0.11510	-0.08244	0.42455	-0.24709	-0.48660	-0.219038
9	0.33861	0.04521	0.12959	-0.64803	-0.01100	-0.486177
10	-0.05110	-0.42598	0.21517	0.04734	0.09666	0.110216
11	-0.10923	0.18745	0.19060	-0.13113	0.58136	0.549115
12	-0.93098	0.18032	0.28467	-0.20016	-0.32024	0.510156
13	-0.24552	-0.12658	-0.58075	-0.29246	0.22019	0.389517
14	0.54938	0.55940	0.75923	0.40077	0.08964	0.719788
15	0.57172	-0.45600	-0.07834	0.23559	0.37399	-0.293054
16	-0.25801	-0.98187	0.21808	0.40170	-0.65423	0.166274
17	0.42541	0.08254	0.47110	-0.52866	0.06253	-0.333925
18	-1.15846	0.67583	0.04369	-0.05916	0.10243	-0.222635
19	0.33106	0.18499	0.57145	0.23636	-0.31738	-0.965829
20	0.30336	-0.11857	-0.60475	1.07135	-0.16521	-0.158142
21	0.21987	-0.03588	0.09406	-0.36559	-0.42570	0.709186
22	0.13081	0.06853	-0.38340	0.28552	-0.71783	-0.206085
23	0.08094	0.14951	0.42366	-0.49551	0.02592	-0.129954
24	-0.18400	-0.48578	-0.44524	-0.03466	-0.19647	-0.336019
25	0.27175	0.19813	0.24001	0.03039	-0.50568	0.001426
26	0.56622	-0.16372	0.09699	0.32510	-0.22767	0.546300
27	0.15231	-0.76327	-0.49877	-0.57966	0.81854	-0.387739
28	0.03836	-0.30008	-0.92183	-0.87530	-0.20777	0.446533
29	0.67972	0.23022	-0.07082	-0.12237	0.50974	-0.195884
30	-0.83058	-0.61302	0.70889	0.52000	0.87381	-0.522599

Biplot scores for constraining variables

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6
recycling	-0.5022	-0.22529	-0.2032939	0.0842818	-0.058148	-0.106065
proact_waste_red	-0.5892	-0.35163	0.0247982	-0.1691029	-0.044572	-0.132079
react_waste_red	-0.6392	-0.28648	-0.0786958	-0.1018400	-0.045051	0.171126
consume_inter	-0.3146	-0.46052	0.1086252	0.0474220	-0.045150	0.280443
mkt_waste	-0.4556	-0.61372	-0.1235893	-0.0419859	-0.032843	0.127411
water	-0.6754	-0.25708	0.1128811	0.0740560	-0.058627	0.062552
energy	-0.5419	-0.43828	-0.0360839	-0.0667577	-0.030835	-0.018808
early_supp_inv	-0.4574	-0.06403	0.0983410	0.0457407	-0.005674	-0.209569
env_stand_supp	-0.5087	-0.04755	0.2181798	0.0368329	0.045032	0.034280
env_aud_supp	-0.4291	-0.06332	0.2567750	-0.0911715	0.151472	-0.203847
env_awards	-0.4193	-0.36110	-0.1340067	0.2907334	0.348853	-0.017221

LCA	-0.4798	-0.43331	0.0546716	-0.3895647	0.202781	0.109180
design_target	-0.7891	-0.30676	0.1487111	-0.1018331	0.075113	0.029757
env_risk_ana	-0.7269	-0.12912	0.2332245	0.0703713	0.185220	-0.253413
corp_policy	-0.7583	-0.14321	0.1752901	0.1355229	0.085837	0.127653
env_miss_stat	-0.7258	-0.15591	0.0556006	0.0007979	0.123503	-0.001697
env_dep	-0.6934	-0.11035	0.3770377	-0.1906119	-0.188290	-0.060875
surv_mkt	-0.5638	-0.29346	0.0007724	0.0313003	0.067986	-0.105296
strategic_alliance	-0.5934	-0.03719	-0.2273369	-0.1002722	0.172605	-0.160399

anova(perfor.cap)

	Df	Var	F	N.Perm	Pr(>F)
Model	19	1.02520	2.1656	199	0.005 **
Residual	10	0.24916			

Model 1

Partitioning of squared Gower distance:

	Inertia	Proportion
Total	1.2744	1.000
Constrained	0.9315	0.731
Unconstrained	0.3428	0.269

Eigenvalues, and their contribution to the squared Gower distance

Importance of components:

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6	CAP7	CAP8
Eigenvalue	0.5016	0.2187	0.06778	0.05549	0.03292	0.02023...	0.01478	0.008369
Proportion Explained	0.3936	0.1716	0.05318	0.04355	0.02583	0.01587.	0.01160	0.006570
Cumulative Proportion	0.3936	0.5652	0.61843	0.66197	0.68780	0.70368	0.71528	0.721840

	CAP9	CAP10	CAP11	CAP12	CAP13	CAP14	MDS1
Eigenvalue	0.007143	0.002742	0.0009062	0.0006678	0.0001264	4.023e-05	0.12447
Proportion Explained	0.005610	0.002150	0.0007100	0.0005200	0.0001000	3.000e-05	0.09768
Cumulative Proportion	0.727450	0.729600	0.7303100	0.7308400	0.7309400	7.310e-01	0.82864

	MDS2	MDS3	MDS4	MDS5	MDS6	MDS7	MDS8	MDS9
Eigenvalue	0.08683	0.04143	0.02903	0.02410	0.01280	0.007891	0.00609	0.00467
Proportion Explained	0.06814	0.03251	0.02278	0.01891	0.01004	0.006190	0.00478	0.00366
Cumulative Proportion	0.89678	0.92929	0.95207	0.97098	0.98102	0.987220	0.99200	0.99566

	MDS10	MDS11	MDS12	MDS13	MDS14
Eigenvalue	0.002562	0.00167	0.00104	0.000201	4.546e-05
Proportion Explained	0.00201	0.0013	0.00082	0.000160	4.000e-05
Cumulative Proportion	0.99768	0.99899	0.99981	0.999960	1.000e+00

Accumulated constrained eigenvalues

Importance of components:

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6	CAP7	CAP8
Eigenvalue	0.5016	0.2187	0.06778	0.05549	0.03292	0.02023	0.01478	0.008369
Proportion Explained	0.5385	0.2348	0.07276	0.05957	0.03534	0.02171	0.01587	0.008980
Cumulative Proportion	0.5385	0.7733	0.84604	0.90561	0.94095	0.96266	0.97854	0.987520

	CAP9	CAP10	CAP11	CAP12	CAP13	CAP14
Eigenvalue	0.007143	0.002742	0.0009062	0.0006678	0.0001264	4.023e-05
Proportion Explained	0.007670	0.002940	0.0009700	0.0007200	0.0001400	4.000e-05
Cumulative Proportion	0.995190	0.998130	0.9991000	0.9998200	0.9999600	1.000e+00

Scaling 2 for species and site scores

* Species are scaled proportional to eigenvalues

* Sites are unscaled: weighted dispersion equal on all dimensions

* General scaling constant of scores: 2.352134

Species scores

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6
Q	-0.65199	0.83587	-0.096790	0.10063	0.35489	-0.024452
ROA	-0.05168	0.07494	0.018775	0.01928	-0.02558	0.006568
Sales	0.03157	0.17778	0.006566	-0.14021	-0.08387	0.015207
Inn_prod	-1.37493	-0.54748	0.122759	-0.66956	0.07038	-0.087652
Inn_proc	-1.38496	-0.41104	-0.252104	0.37827	-0.20455	0.049661

Site scores (weighted sums of species scores)

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6
1	-0.412693	-0.49705	0.35056	-0.17267	-0.218511	-0.20227
2	-0.191476	0.44452	-0.64028	0.77648	-0.605426	0.08085
3	0.390677	-0.01348	-0.11513	-0.20886	0.534358	-0.23870
4	-0.094436	0.19191	-0.25535	0.43994	0.022492	-0.32107
5	-0.109577	1.35863	-0.91353	-0.33320	0.019783	0.45631
6	-0.039582	-0.15775	-0.26733	0.04735	-0.741099	-0.31598
7	-0.017988	0.20341	-0.21967	1.22068	-0.017783	-0.81776
8	0.212034	0.01522	0.41834	-1.08116	-0.385042	0.40509
9	0.165307	0.02600	0.02555	-0.50760	-0.003579	0.63047
10	-0.134714	-0.17164	0.08774	-0.25516	0.152764	0.20207
11	-0.193326	0.50740	0.41856	-0.74176	1.117076	-0.47046
12	-0.785262	0.33800	0.32716	-0.16936	-0.001954	-0.53140
13	-0.225029	0.20600	-0.30485	0.08013	0.238014	-0.91417
14	0.577698	0.65929	0.85939	0.45179	0.376528	-0.82816
15	0.502067	-0.11381	0.37328	0.31832	0.036932	0.26801
16	-0.562336	-0.87802	0.33868	0.15232	-0.523145	0.03827
17	0.307004	0.11268	0.17376	-0.09077	0.122417	0.27021
18	-1.447578	0.92710	-0.03397	0.05842	-0.458573	0.73480
19	0.351006	0.50957	0.62753	0.15545	-0.299570	1.71787
20	0.347740	-0.39616	-0.38103	1.03342	-0.035839	0.41166
21	0.315576	-0.22648	0.06151	-0.93986	-0.220669	-0.49779
22	0.015448	-0.18937	-0.17283	0.50237	-0.999441	-0.16275
23	0.071863	0.11528	0.44268	-0.65785	0.655737	0.21629
24	-0.141226	-0.36828	-0.20667	0.40207	-0.447835	0.15360
25	0.358684	0.06705	0.22931	-0.51532	-0.540674	-0.32923
26	0.693324	-0.15740	0.36458	0.23195	-0.486143	-0.26406
27	0.212464	-0.74529	-0.85523	-0.80956	1.457702	0.47686
28	-0.007622	-0.65917	-1.24819	-0.40360	-0.177561	-0.64041
29	0.657546	-0.08497	-0.08717	0.14826	0.572601	0.38673
30	-0.815593	-1.02319	0.60262	0.86777	0.856439	0.08512

Site constraints (linear combinations of constraining variables)

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6
1	-0.18698	-0.53542	0.68147	-0.69846	0.27506	0.20165
2	-0.36577	0.08469	-0.42298	0.70054	-0.12203	0.05465
3	-0.01289	0.52870	-0.29147	-0.09260	0.36370	-0.38072
4	0.02879	0.15033	0.02812	0.76765	0.16961	-0.27621
5	-0.05474	1.23116	-0.75095	-0.12257	-0.38725	0.35276
6	0.03476	0.05289	-0.15260	-0.06658	-0.47057	0.38998
7	0.16363	0.36113	-0.06425	0.61267	0.22188	-0.57244
8	-0.17762	-0.05563	0.37819	-0.29071	-0.57874	0.22177
9	0.20322	0.07609	-0.26489	-0.66411	0.22828	0.01846
10	-0.0790	-0.27810	0.13615	-0.23028	0.29356	-0.18806
11	-0.13985	0.31048	0.25038	0.17124	0.35894	0.02088
12	-0.80812	0.20074	0.46210	-0.52680	0.08845	-0.14716
13	-0.2895	-0.27488	-0.68022	0.13745	0.16227	-0.80698
14	0.5609	0.63330	0.79322	0.07297	0.22703	-0.87445
15	0.5622	-0.43741	-0.10035	0.17551	0.35778	0.08749
16	-0.3618	-0.82047	0.26708	0.18619	-0.98746	-0.33563
17	0.34283	0.12643	0.30195	-0.39556	-0.01760	0.52241
18	-1.0293	0.60667	-0.04337	-0.18466	0.31807	0.16223
19	0.20322	0.11391	0.42870	0.38171	-0.39269	0.94619
20	0.5062	-0.44032	-0.17224	0.93867	0.03198	0.25292
21	0.1524	0.10136	0.05059	-0.49355	-0.45502	-0.59823
22	0.1137	0.12686	-0.34578	0.04323	-0.78748	0.08548
23	0.0595	-0.02307	0.30794	-0.32404	0.21035	-0.04499
24	-0.1930	-0.30071	-0.46976	-0.15544	-0.42594	0.49785
25	0.3659	-0.10303	0.38527	-0.06639	-0.29447	-0.16993
26	0.6334	-0.18380	0.40914	0.07700	-0.09535	-0.29922
27	0.0871	-0.73044	-0.69843	-0.37971	1.08116	0.34140
28	0.0380	-0.50198	-0.86678	-0.38800	-0.28361	-0.50380
29	0.7086	0.29458	-0.03633	-0.01534	0.47247	0.76105
30	-1.0660	-0.31406	0.48011	0.82997	0.43764	0.28064

Biplot scores for constraining variables

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6
recycling	-0.5176	-0.205564	-0.19714	0.16571	-0.140602	0.09231
proact_waste_red	-0.6158	-0.320894	-0.02244	-0.15554	-0.004230	0.16551
consume_inter	-0.3389	-0.453561	0.15939	0.03997	-0.019781	-0.36485
mkt_waste	-0.4870	-0.610226	-0.10400	0.01009	-0.030378	-0.24940
energy	-0.5690	-0.419234	-0.03898	-0.02730	-0.001596	0.04566
early_supp_inv	-0.4695	-0.030638	0.08449	0.06354	0.014727	0.33965
env_awards	-0.4399	-0.342313	-0.10024	0.45075	0.248030	-0.08393
LCA	-0.5098	-0.412532	-0.02740	-0.33937	0.381617	-0.11342
design_target	-0.8189	-0.252793	0.10750	-0.06850	0.122565	0.02479
env_risk_ana	-0.7500	-0.062861	0.17969	0.10476	0.148658	0.28855
env_stand_supp	-0.5225	-0.003090	0.20929	0.03581	0.086625	0.07613

corp_policy	-0.7795	-0.082622	0.18089	0.17249	0.053288	-0.08315
env_miss_stat	-0.7473	-0.101210	0.01289	0.06668	0.084371	-0.05795
env_dep	-0.7160	-0.053031	0.32313	-0.27509	-0.089257	0.13729
strategic_alliance	-0.6056	0.003717	-0.31134	0.01920	0.120266	0.12418

anova(perfor.cap)

	Df	Var	F	N.Perm	Pr(>F)
Model	15	0.93151	2.5359	199	0.005 **
Residual	14	0.34284			

Model 2

Partitioning of squared Gower distance:

	Inertia	Proportion
Total	1.2744	1.0000
Constrained	0.7806	0.6126
Unconstrained	0.4937	0.3874

Eigenvalues, and their contribution to the squared Gower distance

Importance of components:

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6	CAP7	CAP8
Eigenvalue	0.4547	0.1938	0.05633	0.04374	0.01572	0.00649	0.004072	0.003833
Proportion Explained	0.3568	0.1521	0.04420	0.03432	0.01234	0.00509	0.003200	0.003010
Cumulative Proportion	0.3568	0.5089	0.55310	0.58743	0.59976	0.60485	0.608050	0.611060

	CAP9	MDS1	MDS2	MDS3	MDS4	MDS5	MDS6	MDS7
Eigenvalue	0.001941	0.1740	0.1083	0.06010	0.03896	0.03558	0.02639	0.01600
Proportion Explained	0.001520	0.1366	0.0850	0.04716	0.03057	0.02792	0.02071	0.01255
Cumulative Proportion	0.612580	0.7491	0.8341	0.88129	0.91186	0.93978	0.96050	0.97305

	MDS8	MDS9	MDS10	MDS11	MDS12	MDS13	MDS14
Eigenvalue	0.01187	0.009495	0.005965	0.002794	0.001993	0.001396	0.0008304
Proportion Explained	0.00932	0.007450	0.004680	0.002190	0.001560	0.001100	0.0006500
Cumulative Proportion	0.98237	0.989820	0.994500	0.996690	0.998250	0.999350	1.0000000

Accumulated constrained eigenvalues

Importance of components:

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6	CAP7	CAP8	CAP9
Eigenvalue	0.4547	0.1938	0.05633	0.0437	0.0157	0.0064	0.00407	0.00383	0.00194
Proportion Explained	0.5825	0.2482	0.07216	0.0560	0.0201	0.0083	0.00522	0.00491	0.00249
Cumulative Proportion	0.5825	0.8307	0.90291	0.9589	0.9790	0.9873	0.99260	0.99751	1.0000

Scaling 2 for species and site scores

* Species are scaled proportional to eigenvalues

* Sites are unscaled: weighted dispersion equal on all dimensions

* General scaling constant of scores: 2.352134

Species scores

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6
Q	-0.63474	-0.79711	0.20221	0.18336	-0.177272	0.053782
ROA	-0.04459	-0.06648	-0.02925	0.01952	-0.000379	0.005887
Sales	0.05752	-0.17087	-0.03674	-0.16591	0.071345	-0.031605
Inn_prod	-1.32986	0.46990	-0.13736	-0.50704	0.014035	0.031381
Inn_proc	-1.29740	0.33765	0.16406	0.22307	0.128863	-0.043925

Site scores (weighted sums of species scores)

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6
1	-0.43900	0.521095	-0.40314	-0.220944	0.77156	-0.95715
2	-0.18977	-0.486436	0.52411	0.694551	0.62871	-0.02069
3	0.40380	0.021583	0.20461	-0.062736	-0.38777	1.37019
4	-0.09833	-0.214326	0.27617	0.485549	0.66233	0.63929
5	-0.09318	-1.476408	0.76883	-0.334498	-0.99283	0.76304
6	-0.03558	0.158532	0.20465	-0.120437	0.69498	0.69103
7	-0.01738	-0.192557	0.39023	1.212317	1.18166	-1.75131
8	0.23308	-0.004884	-0.54308	-1.207277	-0.61745	0.69450
9	0.17641	-0.033855	-0.11432	-0.503158	-0.79316	0.21245
10	-0.14561	0.167182	-0.08949	-0.265172	-0.16046	-0.24407
11	-0.21247	-0.541743	-0.34948	-0.499773	-0.50305	-0.15442
12	-0.81888	-0.374044	-0.33977	-0.226459	0.98869	-0.80581
13	-0.23876	-0.237308	0.39724	0.090659	0.92687	0.33647
14	0.60416	-0.642646	-0.83265	0.755254	0.88637	0.28221
15	0.52469	0.164458	-0.35819	0.490614	-0.79653	0.84372
16	-0.59494	0.943061	-0.29809	-0.000354	-0.26054	-0.16557
17	0.32007	-0.109440	-0.24630	0.033047	-0.33651	0.31265
18	-1.49791	-1.022468	-0.17543	-0.092734	-0.38820	-0.98161
19	0.38231	-0.524057	-0.85213	0.143190	-0.70015	-2.04980
20	0.36188	0.426148	0.52075	0.993591	-0.03309	-1.30540
21	0.32918	0.244783	-0.09572	-1.054756	0.03109	0.62821
22	0.02418	0.210203	0.07585	0.312294	0.95353	-0.04217
23	0.06742	-0.122852	-0.46943	-0.482694	-0.68519	0.69134
24	-0.14549	0.393601	0.21266	0.322412	-0.04882	0.47176
25	0.38187	-0.052812	-0.36512	-0.522217	0.20426	2.01464
26	0.72957	0.218487	-0.36868	0.226779	0.11280	0.38333
27	0.20102	0.735376	1.14039	-0.755354	-1.60786	-0.22824
28	-0.01101	0.640988	1.38662	-0.773620	1.20500	-0.96131
29	0.68191	0.096670	0.16748	0.224391	-0.20427	-1.70353
30	-0.88324	1.093671	-0.36856	1.137534	-0.73196	1.03625

Site constraints (linear combinations of constraining variables)

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6
1	-0.20365	0.26841	-0.93241	-0.10377	0.002394	-0.26348
2	-0.41798	0.05877	0.18744	0.60708	0.178939	-0.57849
3	-0.02539	-0.55685	0.44641	-0.06982	0.455196	0.15711
4	0.03499	-0.23477	-0.02715	0.89142	0.908373	0.94600
5	0.03985	-1.32907	0.36431	-0.04169	-0.730301	0.46791
6	0.09998	-0.19559	-0.09476	-0.15724	-0.169712	0.02797
7	0.09853	-0.04720	0.39281	0.36129	-0.054105	-0.08526
8	0.19728	0.26810	-0.36570	-0.01370	-0.175387	0.23087
9	0.31098	0.00957	0.31866	-0.28518	0.008748	-0.65005
10	-0.16312	0.10384	0.04651	-0.14331	0.036561	0.16474
11	-0.10062	-0.26390	-0.04410	0.26741	0.014714	-1.02106

12	-0.91862	-0.02714	-0.23451	-0.82861	0.296344	0.03573
13	-0.31474	0.11287	0.86445	0.06622	0.668890	0.26353
14	0.52015	-0.60415	-0.65471	0.59224	0.722627	0.12770
15	0.25598	0.44666	0.06171	0.28943	-0.455040	0.30733
16	-0.22592	0.97966	-0.39316	-0.09186	0.493675	0.38012
17	0.43299	0.09963	-0.09528	-0.41608	-0.412706	-0.04385
18	-0.95721	-0.60775	0.14448	-0.13421	-0.313111	-0.06666
19	0.18923	-0.35705	-0.77411	-0.02720	-0.202760	-0.50574
20	0.58392	0.53351	0.40182	0.80297	0.028077	-0.79268
21	-0.06202	-0.13436	-0.29292	-0.77612	0.742546	-0.62613
22	0.29513	-0.06935	0.10195	-0.31274	0.432792	0.20636
23	-0.07721	0.15969	-0.32072	-0.29446	-0.159247	0.62760
24	0.05807	0.10618	0.13209	-0.11848	-0.230774	0.07868
25	0.32352	0.28356	-0.34425	-0.25939	-0.304498	0.46132
26	0.66474	0.23016	-0.03153	-0.10442	-0.407764	0.23234
27	-0.06307	0.53851	0.77367	-0.19288	-0.527470	0.23777
28	0.02818	0.30440	0.81353	-0.47790	0.231129	-0.23856
29	0.55717	-0.37344	-0.12888	0.01834	-0.361408	-0.06902
30	-1.16114	0.29712	-0.31564	0.95266	-0.716721	-0.01210

Biplot scores for constraining variables

	CAP1	CAP2	CAP3	CAP4	CAP5	CAP6
mkt_waste	-0.5182	0.63097	0.197726	-0.08198	0.145105	0.1871
energy	-0.6024	0.42378	0.070465	-0.10502	0.009237	-0.3528
env_awards	-0.4697	0.35009	0.208482	0.48505	0.059555	0.1080
design_target	-0.8640	0.24418	-0.085893	-0.11209	-0.002060	-0.3909
env_risk_ana	-0.7892	0.05157	-0.180659	0.12439	-0.390724	-0.1854
corp_policy	-0.8209	0.07226	-0.173325	0.16271	0.229421	-0.3500
env_dep	-0.7510	0.04023	-0.390858	-0.32176	-0.024714	-0.1469
env_miss_stat	-0.7871	0.08546	-0.004098	0.05717	0.072970	0.1620
strategic_alliance	-0.6358	-0.03681	0.330136	-0.04098	-0.103160	-0.3434

anova(perfor.cap)

	Df	Var	F	N.Perm	Pr(>F)
Model	9	0.78065	3.5137	199	0.005 **
Residual	20	0.49371			

Model 3

Partitioning of squared Gower distance:

	Inertia	Proportion
Total	1.2744	1.0000
Constrained	0.3940	0.3092
Unconstrained	0.8803	0.6908

Eigenvalues, and their contribution to the squared Gower distance

Importance of components:

	CAP1	CAP2	CAP3	MDS1	MDS2	MDS3	MDS4	MDS5
Eigenvalue	0.2899	0.08722	0.01693	0.3369	0.1902	0.1003	0.08396	0.04284
Proportion Explained	0.2275	0.06844	0.01329	0.2644	0.1492	0.0787	0.06588	0.03361
Cumulative Proportion	0.2275	0.29591	0.30920	0.5736	0.7228	0.8015	0.86739	0.90101

	MDS6	MDS7	MDS8	MDS9	MDS10	MDS11
Eigenvalue	0.03744	0.03309	0.01981	0.01281	0.009221	0.006767
Proportion Explained	0.02938	0.02596	0.01555	0.01006	0.007240	0.005310
Cumulative Proportion	0.93039	0.95635	0.97190	0.98196	0.989190	0.994500

	MDS12	MDS13	MDS14
Eigenvalue	0.003512	0.002388	0.001108
Proportion Explained	0.002760	0.001870	0.000870
Cumulative Proportion	0.997260	0.999130	1.000000

Accumulated constrained eigenvalues

Importance of components:

	CAP1	CAP2	CAP3
Eigenvalue	0.2899	0.08722	0.01693
Proportion Explained	0.7357	0.22135	0.04297
Cumulative Proportion	0.7357	0.95703	1.00000

Scaling 2 for species and site scores

* Species are scaled proportional to eigenvalues

* Sites are unscaled: weighted dispersion equal on all dimensions

* General scaling constant of scores: 2.352134

Species scores

	CAP1	CAP2	CAP3	MDS1	MDS2	MDS3
Q	-0.27590	-0.54361	0.124029	-0.97584	0.37229	-0.04318
ROA	-0.03590	-0.04708	0.008611	-0.07135	0.06289	0.01129
Sales	0.08833	-0.12546	-0.084402	-0.14660	0.18147	-0.02279
Inn_prod	-1.18125	0.03740	-0.313683	-0.49378	-0.72997	-0.81172
Inn_proc	-1.10952	0.25799	0.128851	-0.94725	-0.78906	0.52350

Site scores (weighted sums of species scores)

	CAP1	CAP2	CAP3	MDS1	MDS2	MDS3
1	-0.612450	0.51148	-0.9779659	-0.0054710	-0.64305	0.224109
2	-0.214752	-0.63470	1.0860204	-0.1236487	0.84622	0.711829
3	0.498494	0.11381	0.3188881	0.6670305	-0.07813	-0.071243
4	-0.113938	-0.27950	1.0875757	0.0906120	-0.02254	0.126820
5	0.067111	-2.04217	0.3732852	-0.4637885	0.62706	-0.160957
6	-0.075992	0.23171	-0.0721776	-0.1166604	-0.18920	0.098409
7	-0.002675	-0.07436	1.6600100	-0.3489405	0.04475	0.763560
8	0.325414	-0.11723	-1.7122128	0.2428341	0.19980	-0.636917
9	0.231324	-0.03436	-0.6652098	-0.3639440	0.18604	-0.536050
10	-0.200771	0.17288	-0.5174870	0.4156491	0.34923	-0.215496
11	-0.170413	-0.94854	-0.6043867	-0.3723986	0.46649	-0.814610
12	-0.946733	-0.84019	-0.2912452	-0.5414185	0.09615	-0.049917
13	-0.271281	-0.35505	0.5995404	-0.1929968	0.39606	-0.017609
14	0.828074	-0.79486	1.2829071	-0.0062754	0.11093	0.242558
15	0.628396	0.35466	0.5371755	0.6555436	0.36990	0.254262
16	-0.844278	1.08642	-0.8559166	-0.2749186	-1.00695	-0.020897
17	0.399943	-0.10435	-0.0001093	0.1963263	0.30502	0.093069
18	-1.716655	-1.93328	-0.2965351	-1.5047388	-0.12618	-0.124506
19	0.546993	-0.59492	-0.0933685	-0.0824033	0.44570	0.209630
20	0.378572	0.96565	1.2796314	0.0007081	0.38006	0.544342
21	0.393000	0.33042	-1.5370154	0.3188605	0.06173	-0.417759
22	-0.018209	0.33248	0.1849927	0.3833415	-0.34451	0.932056
23	0.108884	-0.29452	-0.5797603	0.6081202	0.35110	-0.642283
24	-0.236208	0.54962	0.3738554	-0.3110181	-0.62885	0.115249
25	0.474794	-0.13230	-0.6209035	-0.0956173	-0.30644	-0.297402
26	0.878123	0.49869	0.0708601	0.3681049	-0.14476	0.283626
27	0.172027	1.24843	-0.6758077	0.3359626	-0.55969	-0.874587
28	-0.099516	1.08347	-0.8058889	0.1357581	-0.42724	0.127392
29	0.829334	0.47064	0.2423515	0.1978262	-0.04003	0.150198
30	-1.236610	1.22997	1.2088969	0.1875607	-0.71867	0.003122

Site constraints (linear combinations of constraining variables)

	CAP1	CAP2	CAP3	MDS1	MDS2	MDS3
1	-0.305518	-0.19205	-0.59910	-0.0054710	-0.64305	0.224109
2	-0.527806	0.36699	0.06161	-0.1236487	0.84622	0.711829
3	-0.009290	-0.65951	-0.02857	0.6670305	-0.07813	-0.071243
4	-0.194157	-0.43612	1.27901	0.0906120	-0.02254	0.126820
5	0.157334	-0.95727	-0.09178	-0.4637885	0.62706	-0.160957
6	0.094511	0.13433	0.26073	-0.1166604	-0.18920	0.098409
7	0.199212	0.16532	0.61255	-0.3489405	0.04475	0.763560
8	0.002194	0.03759	-0.17408	0.2428341	0.19980	-0.636917
9	0.475629	0.73233	0.12522	-0.3639440	0.18604	-0.536050
10	-0.724558	0.10086	0.17087	0.4156491	0.34923	-0.215496
11	-0.016450	0.17082	-0.27355	-0.3723986	0.46649	-0.814610

12	-0.558067	-0.12770	-0.34029	-0.5414185	0.09615	-0.049917
13	-0.281383	0.30091	0.06827	-0.1929968	0.39606	-0.017609
14	0.803653	-0.62777	0.32677	-0.0062754	0.11093	0.242558
15	-0.121018	0.07063	-0.17741	0.6555436	0.36990	0.254262
16	-0.152046	0.26960	-0.19387	-0.2749186	-1.00695	-0.020897
17	0.125272	0.07375	-0.61869	0.1963263	0.30502	0.093069
18	-0.385184	-0.49293	-0.22103	-1.5047388	-0.12618	-0.124506
19	0.384213	-0.1272	6 -0.24709	-0.0824033	0.44570	0.209630
20	0.167150	1.19635	0.08564	0.0007081	0.38006	0.544342
21	0.106628	0.20698	-0.71816	0.3188605	0.06173	-0.417759
22	-0.231077	-0.65574	-0.64919	0.3833415	-0.34451	0.932056
23	-0.539156	-0.39932	0.65506	0.6081202	0.35110	-0.642283
24	0.310039	0.19804	0.69888	-0.3110181	-0.62885	0.115249
25	0.735338	-0.16235	0.11138	-0.0956173	-0.30644	-0.297402
26	0.605867	-0.06184	-0.07442	0.3681049	-0.14476	0.283626
27	0.211463	0.16877	0.08160	0.3359626	-0.55969	-0.874587
28	-0.035093	0.30404	-0.37301	0.1357581	-0.42724	0.127392
29	0.698051	0.10410	-0.08755	0.1978262	-0.04003	0.150198
30	-0.995750	0.29843	0.33021	0.1875607	-0.71867	0.003122

Biplot scores for constraining variables

	CAP1	CAP2	CAP3	MDS1	MDS2	MDS3
energy	-0.7983	0.4084	-0.4426	0	0	0
env_awards	-0.6334	0.4041	0.6600	0	0	0
env_miss_stat	-0.9875	-0.1560	-0.0238	0	0	0

anova(perfor.cap)

	Df	Var	F	N.Perm	Pr(>F)
Model	3	0.39403	3.8791	199	0.005 **
Residual	26	0.88033			

Appendix M. Output CCA Analyses

Full Model

Explanatory tables:

X1: opera

X2: tactic

X3: strate

Partitioning of mean squared contingency coefficient:

	Inertia	Proportion
Total	0.063	1.000
Constrained	0.047	0.738
Unconstrained	0.017	0.262

Marginal effects:

	Inertia	Prop.Total	Prop.Constrained	Pvalue
x1	0.021	0.328	0.444	0.115
x2	0.022	0.349	0.473	0.060
x3	0.014	0.225	0.305	0.260
x12	0.037	0.583	0.790	0.130
x13	0.035	0.551	0.747	0.037
x23	0.030	0.468	0.634	0.220

Components:

	Inertia	Prop.Total	Prop.Constrained	Pvalue
v1	0.017	0.270	0.366	0.26
v2	0.012	0.187	0.253	0.43
v3	0.010	0.155	0.210	0.33
v12	0.004	0.056	0.076	NA
v13	-0.002	-0.037	-0.050	NA
v23	0.004	0.068	0.093	NA
v123	0.002	0.038	0.052	NA

Model 1

Explanatory tables:

X1: opera

X2: tactic

X3: strate

Partitioning of mean squared contingency coefficient:

	Inertia	Proportion
Total	0.063	1.000
Constrained	0.043	0.686
Unconstrained	0.020	0.314

Marginal effects:

	Inertia	Prop.Total	Prop.Constrained	Pvalue
x1	0.017	0.269	0.393	0.077
x2	0.022	0.340	0.496	0.022
x3	0.010	0.166	0.242	0.230
x12	0.036	0.564	0.822	0.015
x13	0.031	0.497	0.724	0.015
x23	0.027	0.421	0.614	0.140

Components:

	Inertia	Prop.Total	Prop.Constrained	Pvalue
v1	0.017	0.265	0.386	0.024
v2	0.012	0.190	0.276	0.180
v3	0.008	0.122	0.178	0.190
v12	0.004	0.066	0.096	NA
v13	-0.003	-0.041	-0.060	NA
v23	0.007	0.105	0.153	NA
v123	-0.001	-0.020	-0.029	NA

Model 2

Explanatory tables:

X1: opera

X2: tactic

X3: strate

Partitioning of mean squared contingency coefficient:

	Inertia	Proportion
Total	0.063	1.000
Constrained	0.036	0.577
Unconstrained	0.027	0.423

Marginal effects:

	Inertia	Prop.Total	Prop.Constrained	Pvalue
x1	0.017	0.269	0.467	0.075
x2	0.015	0.238	0.413	0.017
x3	0.010	0.166	0.288	0.340
x12	0.027	0.431	0.747	0.015
x13	0.031	0.497	0.861	0.015
x23	0.020	0.321	0.556	0.160

Components:

	Inertia	Prop.Total	Prop.Constrained	Pvalue
v1	0.016	0.256	0.444	0.038
v2	0.005	0.080	0.139	0.410
v3	0.009	0.146	0.253	0.140
v12	0.005	0.075	0.129	NA
v13	-0.004	-0.063	-0.110	NA
v23	0.005	0.081	0.140	NA
v123	0.000	0.002	0.004	NA

Model 3

Explanatory tables:

X1: opera

X2: tactic

X3: strate

Partitioning of mean squared contingency coefficient:

	Inertia	Proportion
Total	0.063	1.00
Constrained	0.018	0.28
Unconstrained	0.045	0.72

Marginal effects:

	Inertia	Prop.Total	Prop.Constrained	Pvalue
x1	0.010	0.156	0.555	0.005
x2	0.008	0.121	0.431	0.025
x3	0.006	0.102	0.364	0.024
x12	0.014	0.218	0.779	0.010
x13	0.014	0.215	0.768	0.005
x23	0.010	0.160	0.572	0.015

Components:

	Inertia	Prop.Total	Prop.Constrained	Pvalue
v1	0.008	0.120	0.428	0.010
v2	0.004	0.065	0.232	0.105
v3	0.004	0.062	0.221	0.115
v12	0.000	-0.007	-0.024	NA
v13	-0.001	-0.022	-0.080	NA
v23	0.000	-0.002	-0.008	NA
v123	0.004	0.065	0.230	NA

