The use and effectiveness of environmental management practices in Australia

by

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A thesis submitted to Macquarie University in fulfilment of the requirement for the degree of Doctor of Philosophy in the Faculty of Business and Economics

June 2017

CERTIFICATE OF ORIGINALITY

I hereby certify that this thesis is the result of my own research and that it has not, nor has any part of it, been submitted for a higher degree to any other university or institution. The sources of information used and the extent to which the work of others has been utilised, are acknowledged in the thesis. The thesis has also received the approval of the Ethics Review Committee (Human Research) at Macquarie University (see Appendix C).

Thanh Nguyet Phan

ACKNOWLEDGEMENT

First and foremost, I would like to express my deepest gratitude to my principle supervisor, Dr. Kevin Baird, for his continuous guidance, insightful feedback, extensive knowledge, dedication, patience, and encouragement throughout my PhD journey. This thesis would not have been possible without his tremendous help and support.

My sincerest appreciation also extends to my former associate supervisor, Mr. Bill Blair, and my associate supervisor, Dr. Sophia Su, for their constructive feedback and significant contribution to this thesis.

I am thankful to Kevin, Bill, and Sophia, for being not only brilliant supervisors, but also supportive colleagues, and kind and caring friends. Their advice on my research as well as on my career has been invaluable.

I would also like to thank the staff from the Department of Accounting and Corporate Governance for their assistance.

Last but not least, I am indebted to my family and friends for their unconditional love and support.

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ABSTRACT

This thesis examines the use of specific environmental management practices by Australian organisations, including Environmental Management Systems (EMSs) and Environmental Management Accounting (EMA), operationalised in respect to the use of physical and monetary components and Environmental Activity Management as a specific tool of EMA. In addition, the thesis investigates the influence of contingency factors on the use of these practices, and the association between the extent of use of such practices and environmental performance. Data were collected by mail survey questionnaire from a random sample of 208 senior managers in Australian organisations across different industries.

The thesis adopts the 'thesis by publication' format and consists of three academic papers. Paper One examines the influence of institutional pressures (coercive, mimetic and normative) on the comprehensiveness of EMSs, and the impact of EMS comprehensiveness on environmental performance. The findings indicate that both coercive and normative pressures influence the comprehensiveness of EMSs. In addition, organisations with more comprehensive EMSs were found to experience higher levels of all four dimensions of environmental performance (resource usage, regulatory compliance, productivity, and stakeholder interaction).

Paper Two examines the extent of use of both physical and monetary components of EMA and the influence of the comprehensiveness of the EMS, size, and top management support, on the use of EMA. In addition, the paper investigates the impact of EMA use on environmental performance. The results indicate a moderate extent of

physical EMA use, and a low extent of monetary EMA use. The comprehensiveness of the EMS and top management support were found to influence the use of EMA. In addition, the results revealed that the extent of use of physical EMA was associated with one dimension of environmental performance (stakeholder interaction), while the extent of use of monetary EMA was associated with all four dimensions of environmental performance (resource usage, regulatory compliance, productivity, and stakeholder interaction).

Paper Three provides an insight into the application of Environmental Activity Management utilising Gosselin's (1997) three levels of Activity Management (namely, Environmental Activity Analysis (EAA), Environmental Activity Cost Analysis (EACA), and Environmental Activity Based Costing (EABC)). The paper also examines the association between Environmental Activity Management and environmental performance, and the role of decision quality as a mediator in this relationship. The results indicate a relatively high extent of EAA use but a low extent of use of EACA and EABC. Organisations using each level of Environmental Activity Management to a greater extent were found to experience higher levels of environmental performance, while the relationship between EAA and EABC with environmental performance was found to be mediated by decision quality.

The thesis contributes to the limited empirical evidence concerning the extent of use of environmental management practices, and the effectiveness of such practices in terms of improving environmental performance. The findings highlight the importance of enhancing the comprehensiveness of EMSs, the extent of use of physical and monetary EMA, and the extent of use of different levels of Environmental Activity Management,

as a means of improving the environmental performance of organisations. In addition, given the importance of such practices in enhancing environmental performance, the study further contributes to the literature by providing an insight into the contingency factors that organisations should focus on in order to enhance the extent of use of EMSs and EMA.

CHAPTER ONE

INTRODUCTION

1.1 Background

Since the publication of the Brundtland Report by the United Nations World Commission on Environment and Development in 1987 and the subsequent Earth Summit in Rio de Janeiro in 1992, the concept of sustainable development has been cemented into the international political arena (Bebbington, 2001) and become one of the most prominent issues facing the world (Stefan and Lanoie, 2008). The environment is vulnerable to human activities which can cause substantial and irreparable damage to natural systems (Stefan and Lanoie, 2008), due to the pollution of air and water, acid rain, holes in the ozone layer, climate change, and the loss of biodiversity (Al-Kalbani and O'Higgins, 2015). Accordingly, there is an urgency to minimise the environmental impact of human activities with the conservation of natural resources being an important agenda item for many organisations that are increasingly aware that they can no longer treat natural resources as an infinite source of capital and exploit them with impunity (Lai et al., 2015; Blowfield, 2013).

Due to the enhanced emphasis on environmental concerns within society, organisations face increasing pressure from a variety of stakeholders (e.g. regulators, customers, investors, community) to improve their environmental management and performance. For example, the improved availability of environmental information has led to growing public awareness of and concern for environmental issues, with more customers being in favour of environmentally friendly products. Furthermore, investors and shareholders also have higher expectations regarding the environmental performance of

organisations. In addition, the traditionally lax legislation enforcement, whereby environmental issues were mainly addressed through negotiation, has become more stringent with the use of prosecution as an enforcement strategy. Such prosecutions for environmental offences can not only result in heavy penalties being imposed on organisations, but also cause significant adverse publicity (Sullivan and Wyndham, 2001).

To address the legislative requirements and the increased public concern for environmental sensitivity, organisations need to minimise their exposure to environmental risk and take a proactive approach to environmental management. Accordingly, many organisations have invested significant resources in the development and implementation of an Environmental Management System (EMS), a systematic approach which requires the integration of environmental issues into every aspect of business management. The use of an EMS offers a wide range of benefits to organisations, including improved energy efficiency, waste minimisation, reduced costs, an enhanced green company image, competitive advantage, and increased staff morale and corporate social responsibility (Tinsley and Pillai, 2006; Sullivan and Wyndham, 2001). By the end of 2015, more than 319,000 organisations worldwide had adopted and certified their EMSs to the international environmental management standard ISO 14001, a significant increase from about 14,000 in 1999 (ISO, 2015).

With the increased global adoption of EMSs, scholarly interest in environmental management has also increased. For instance, researchers have examined the adoption of EMSs (Darnall et al., 2010; Darnall and Edwards Jr, 2006; Potoski and Prakash, 2005; Anton et al., 2004; Melnyk et al., 2003) and the relationship between EMS

adoption and improved environmental and economic performance (Daddi et al., 2011; Darnall et al., 2008; King et al., 2005; Khanna and Anton, 2002; Darnall et al., 2000). However, while the majority of these studies only focus on whether or not an organisation implements an EMS, Anton et al. (2004) observe that organisations have flexibility in the extent to which they adopt different environmental practices and thus EMSs differ across organisations in respect to the comprehensiveness of their coverage. Therefore, this thesis aims to contribute to the literature by empirically examining the comprehensiveness of EMSs rather than just the presence of such systems. Specifically, Paper One examines the comprehensiveness of EMSs as the extent to which organisations adopt different environmental practices. Paper One also examines the influence of institutional pressures (coercive, mimetic and normative) on the comprehensiveness of EMSs, and the impact of EMS comprehensiveness on environmental performance.

While there has been a substantial increase in the number of organisations implementing EMSs, these systems typically do not provide accounting information to assist with various production or resource allocation decisions (Deegan, 2003). Accordingly, management generally have little understanding of their environmental costs due to the lack of environmental information in their accounting systems (Deegan, 2008; Deegan, 2003; United Nations Division for Sustainable Development (UNDSD), 2001), leading to management decision making being based on inadequate, inaccurate or misinterpreted information (International Federation of Accountants (IFAC), 2005). Consequently, Environmental Management Accounting (EMA) has emerged as a pragmatic response to this problem. While various definitions exist, EMA can be broadly defined as the identification, collection, analysis and use of two types of

information for internal decision making: physical information on the use, flows and destinies of energy, water and materials (including waste); and monetary information on environment-related costs, earnings and savings (UNDSD, 2001). Burritt et al. (2002) propose a comprehensive framework for EMA which integrates the two components of EMA (physical and monetary), and highlights the past/future and short/long-term time dimensions of different EMA tools, and the regularity of information generation (ad hoc versus routine). Examples of these EMA tools include material and energy flow accounting, the assessment of environmental impacts, physical environmental budgeting and investment appraisal, environmental cost accounting (e.g. variable costing, absorption costing, and activity based costing), environmental life cycle costing, and monetary environmental project investment appraisal (Burritt et al., 2002).

The benefits of EMA include more informed decision making, the identification of opportunities for cost savings and raising revenue, improved product mix and pricing decisions, and the avoidance of future costs associated with investment decisions (Ferreira et al., 2010; Bennett et al., 2003; Deegan, 2003). Despite the advocated benefits of EMA and the promotion of EMA by many organisations (e.g. International Federation of Accountants, Japanese Ministry of Environment, United Nations Division for Sustainable Development, Society of Management Accountants of Canada), empirical research involving EMA is limited (Ferreira et al., 2010), with most research on EMA being prescriptive and often based on a limited number of case studies (Christ and Burritt, 2013; Ferreira et al., 2010; Bouma and van de Veen, 2002). In addition, there is sparse research examining the effectiveness of EMA systems. Accordingly, this thesis aims to fill this gap in the literature by empirically examining the extent to which EMA is adopted in Australian organisations across various sectors and evaluating the

effectiveness of EMA systems in terms of improving environmental performance. Specifically, Paper Two provides empirical evidence regarding the extent of use of both physical and monetary EMA, and examines the impact of EMA use on environmental performance. Paper Two also examines the association between the comprehensiveness of the EMS, size, and top management support, with the use of EMA.

Furthermore, in line with Burritt et al.'s (2002) EMA framework, the thesis provides empirical evidence regarding the use and effectiveness of a specific EMA tool, Environmental Activity Management, which refers to the application of Activity Management (AM) in an environmental context. According to Gosselin (1997), AM consists of three levels: Activity Analysis (AA), Activity Cost Analysis (ACA), and Activity Based Costing (ABC). AA is the simplest level which reviews the activities carried out to convert resources into output. The next level is ACA which identifies the costs and cost drivers of each activity. The highest level of AM, ABC, traces the costs of activities to products and services. In line with Gosselin's (1997) approach, Paper Three examines the extent of use of Environmental Activity Management, which comprises three levels: Environmental Activity Analysis (EAA), Environmental Activity Cost Analysis (EACA), and Environmental Activity Based Costing (EABC). While Environmental Activity Management has been recommended as an effective method to accurately allocate environmental costs to products or processes (Deegan, 2003; Emblemsvåg and Bras, 2001; Bartolomeo et al., 2000), there is scant research on the extent of use of EAA, EACA, and EABC and their effectiveness. This thesis therefore aims to fill this gap in the literature. Paper Three also examines the association between the extent of use of each level of Environmental Activity Management with

environmental performance and the role of environmental decision quality as a mediator of these associations.

The remainder of this chapter is organised as follows. Section 1.2 discusses the motivation of the study, section 1.3 provides an overview of the three papers, and section 1.4 provides the overall structure of the remainder of the thesis.

1.2 Motivation

The motivation for this study is to: (1) provide a more detailed insight into the nature and the usefulness of EMSs, (2) address a gap in the literature by providing an insight into the use and effectiveness of EMA, and (3) examine environmental performance as a multidimensional construct.

1.2.1. To provide a more detailed insight into the nature and the usefulness of Environmental Management Systems

While the literature advocates the benefits of implementing an EMS including reducing environmental risk, better management of regulatory compliance, and improved utilisation of resources (Tinsley and Pillai, 2006; Sullivan and Wyndham, 2001; Steger, 2000), and a growing number of organisations have adopted an EMS, empirical evidence concerning the environmental effectiveness of an EMS is relatively limited (Hertin et al., 2008). Furthermore, those studies which have examined the effectiveness of EMSs in terms of its contribution to improvements in environmental performance have reported mixed results (Iraldo et al., 2009; Darnall et al., 2008; Anton et al., 2004; Bansal and Clelland, 2004; Johnstone et al., 2004; Dahlström et al., 2003; Schucht, 2000).

These mixed findings may be attributable to the way in which EMSs have been operationalised in prior studies with the majority of studies only focusing on whether or not the organisation has adopted an EMS (Zhu et al., 2013; González-Benito et al., 2011; Hertin et al., 2008). Such an approach fails to recognise that respondents have different interpretations of the exact nature of an EMS and ignores the comprehensiveness of EMSs. Alternatively, other studies utilise a better approach of measuring the comprehensiveness of EMSs by focusing on the total number of environmental practices implemented by organisations (Johnstone and Labonne, 2009; Anton et al., 2004; Khanna and Anton, 2002). However, this approach fails to take into account variations in the intensity with which specific practices are used by different organisations, thereby providing an opportunity to 'green wash' whereby organisations create the impression that they are committed to a number of environmental practices without really engaging in environmental management activities (Cho and Patten, 2007; O'Dwyer, 2002). Therefore, this study aims to provide a more detailed insight into the nature of EMSs by operationalising the comprehensiveness of EMSs in respect to the intensity of use of nine environmental practices identified as important components of an EMS in the literature (Henriques and Sadorsky, 2007; Anton et al., 2004). In addition, the study also aims to provide an insight into the usefulness of EMSs with Paper One examining the association between EMS comprehensiveness and environmental performance. The study also contributes to the body of literature on the determinants of implementing EMSs, by providing an insight into the institutional factors that influence the use of EMSs.

1.2.2 To address a gap in the literature by providing an insight into the use and effectiveness of Environmental Management Accounting

While there have been numerous normative arguments promoting the use of EMA among the global business community (Christ and Burritt, 2013), there is little empirical evidence regarding how widespread EMA is adopted, with the majority of EMA studies consisting of prescriptive or case-based research. This study aims to fill this gap in the literature by empirically examining the extent to which EMA is adopted in Australian organisations across various industries. Specifically, Paper Two provides an insight into the extent of EMA use, with EMA operationalised in respect to both physical and monetary components. Paper Two also investigates the organisational factors that influence the adoption of EMA, thereby extending current knowledge concerning the role of organisational characteristics in the development of EMA.

While the benefits of implementing an EMA system have been advocated in the literature (Jasch, 2006; IFAC, 2005; Deegan, 2003; UNDSD, 2001), and several case studies have described the implementation of and the benefits derived from EMA in a number of organisations (Kokubu and Nashioka, 2005; Deegan, 2003; Bennett et al., 2002; Bartolomeo et al., 2000), empirical research on EMA and the effectiveness of EMA systems is scarce (Ferreira et al., 2010; Bouma and van de Veen, 2002). This study therefore aims to fill this gap in the literature by empirically examining the effectiveness of an EMA system in terms of improved environmental performance. Specifically, Paper Two examines the association between the extent of EMA use and environmental performance. Such an evaluation provides an empirical insight into the claims of EMA advocates, and is crucial for organisations in determining whether to invest resources in implementing an EMA system.

While Paper Two examines EMA from a broader level by focusing on the physical and monetary components, Paper Three investigates a specific tool of EMA, Environmental Activity Management. Empirical evidence concerning the use of Environmental Activity Management in practice is scarce and limited to a number of cases studies. In line with Gosselin (1997), Paper Three aims to fill this gap in the literature by providing an insight into the use of the three levels of Environmental Activity Management, namely, Environmental Activity Analysis (EAA), Environmental Activity Cost Analysis (EACA), and Environmental Activity Based Costing (EABC). The focus on Environmental Activity Management is pertinent given that this tool is considered the most effective accounting method to enable the accurate treatment of environmental costs, which are usually hidden in general overhead accounts under traditional costing systems (Cagno et al., 2012; Rodríguez Rivero and Emblemsvåg, 2007). Furthermore, Paper Three empirically examines the association between Environmental Activity Management and environmental performance. Such an empirical evaluation of the effectiveness of Environmental Activity Management practices will enhance the understanding of these practices and assist managers in deciding whether to adopt and promote such practices in their organisations. In addition, to provide a further insight into the mechanism through which environmental performance can be enhanced, Paper Three examines the role of decision quality as a mediator in the relationship between Environmental Activity Management and environmental performance.

1.2.3 To examine environmental performance as a multidimensional construct

Increasing attention and concern over the environmental impact of organisations has led a number of organisations to actively account for their environmental performance (Adams and Frost, 2008). Environmental performance is defined as "the impact of an

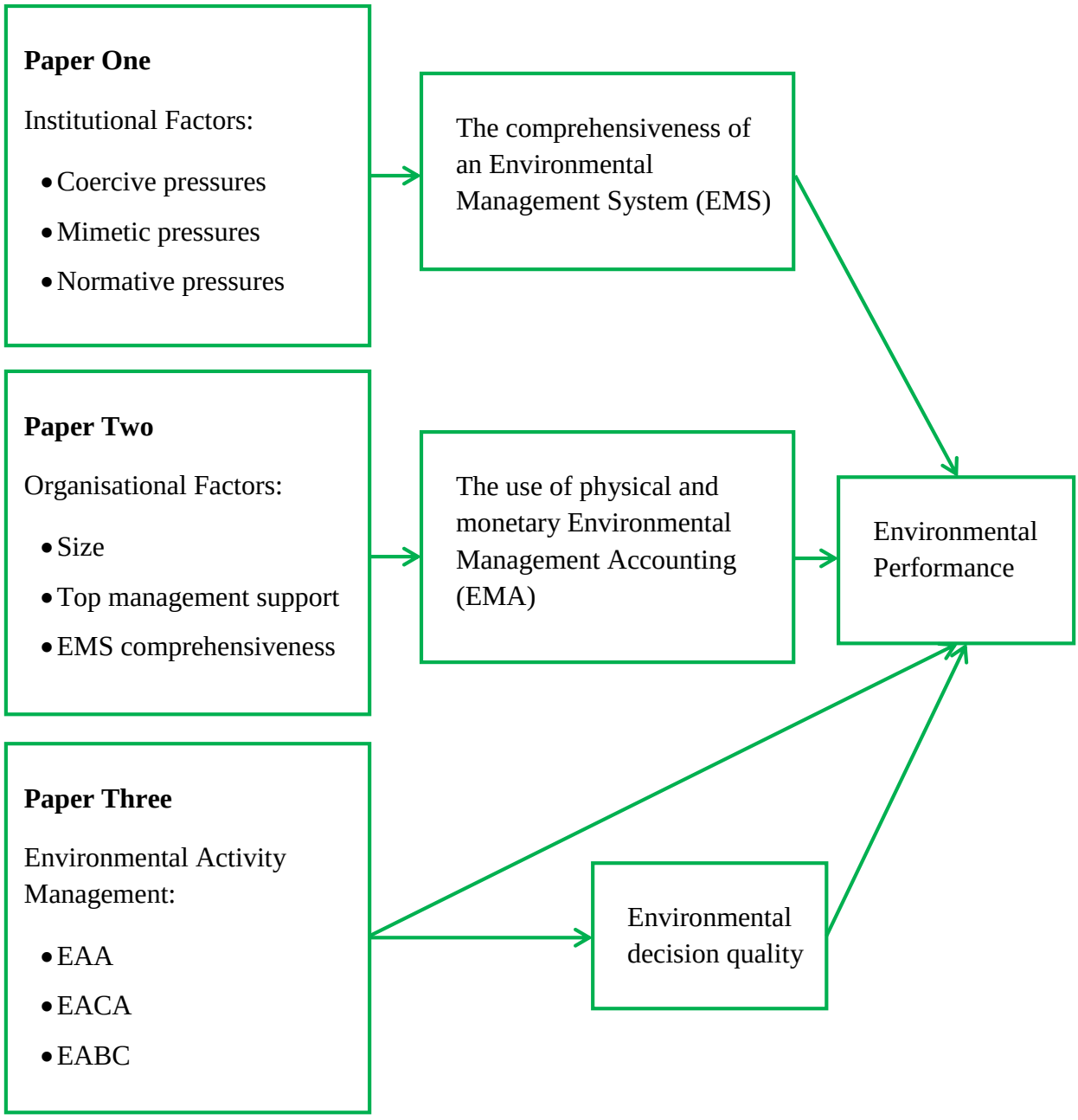
organisation's activities on the environment, including the natural systems such as land, air and water as well as on people and living organisms" (Langfield-Smith et al., 2015, p. 761). Since environmental issues are becoming more significant to a variety of stakeholders, there is an increased demand for corporate environmental performance information (Cho et al., 2010). However, Henri and Journeault (2010) note that there is a significant lack of agreement on the definition and operationalisation of this concept.

For the sake of simplicity and brevity, the majority of prior studies have examined environmental performance based on the environmental impact of organisational operations. For instance, some studies only focus on one performance indicator such as toxic releases (Patten, 2002), greenhouse gas emissions (Psaraftis and Kontovas, 2010), or an electricity index (Friedrich et al., 2011). Other studies use a combination of different impact measures such as the use of natural resources, solid waste, wastewater, local and regional air pollutants, and global air pollutants (Lanoie et al., 2011), or energy consumption, water consumption, waste collection and recycling, and carbon dioxide emissions (Kok et al., 2010). However, it is argued that the use of environmental impact as a proxy for environmental performance limits the scope of this multidimensional concept to only one aspect (Henri and Journeault, 2010). Therefore, this study contributes to the literature by providing a more comprehensive approach to measuring environmental performance. Specifically, the study measures environmental performance by incorporating fifteen desired environmental outcomes identified in the literature (Langfield-Smith et al., 2015; Henri and Journeault, 2010) which cover four dimensions: resource usage, regulatory compliance, productivity, and stakeholder interaction.

1.3 Overview of the three papers

This thesis employs the 'thesis by publication' format and presents three separate but interrelated papers. An overview of the three papers is shown in Figure 1.

Figure 1 Summary of the thesis



1.3.1 Paper One: The comprehensiveness of Environmental Management Systems: The influence of institutional pressures and the impact on environmental performance

This paper contributes to the EMS literature by providing a more detailed insight into the comprehensiveness of EMSs, specifically the intensity of use of nine environmental management practices identified as core components of an EMS (Henriques and Sadorsky, 2007; Anton et al., 2004). In addition, the paper examines the influence of institutional pressures (coercive, mimetic and normative) on the comprehensiveness of EMSs, and the impact of EMS comprehensiveness on environmental performance.

The findings indicate the variation in the extent of use of environmental management practices across industries and organisations, highlighting the limitations in empirical studies which simply categorise organisations into EMS users and non-users, or merely focus on the use of specific practices as opposed to encapsulating the intensity of their use. Both coercive and normative pressures were found to influence the comprehensiveness of EMSs. Specifically, the pressure exerted by the government, through the creation of appropriate regulatory pressure and public incentives, and by employees, customers, professional groups, the media, and community, influenced the comprehensiveness of the EMS. In addition, organisations with more comprehensive EMSs were found to experience higher levels of environmental performance. With more than 319,000 organisations worldwide adopting EMSs (ISO, 2015), the findings provide an important insight into the relevance of EMSs, and contribute to the literature regarding the association between EMSs and environmental performance. In particular, it is suggested that organisations should endeavour to implement a more comprehensive EMS and be conscious of the role that coercive and normative pressures play in influencing the comprehensiveness of their EMS.

1.3.2 Paper Two: The use and effectiveness of Environmental Management Accounting

While the benefits of EMA have been widely advocated in the literature, empirical evidence regarding the use and effectiveness of EMA systems is scarce (Christ and Burritt, 2013; Ferreira et al., 2010). This paper therefore fills this gap in the literature by providing an insight into the extent of use of both physical and monetary components of EMA, and the influence of the comprehensiveness of the EMS, size, and top management support, on the use of EMA. In addition, the paper investigates the impact of the extent of use of EMA on environmental performance.

The results indicate a moderate extent of physical EMA use, and a low extent of monetary EMA use. This low level of EMA use is consistent with the early stages of developing EMA, given that EMA is a recent innovation in management accounting. The comprehensiveness of the EMS and top management support were found to influence the use of EMA. Such findings contribute empirical evidence to enhance the understanding of the organisational factors associated with EMA adoption, which has received little attention in the literature (Christ and Burritt, 2013). In addition, the results reveal that the use of physical EMA is associated with one dimension of environmental performance (stakeholder interaction), while the use of monetary EMA is associated with all four dimensions of environmental performance (resource usage, regulatory compliance, productivity, and stakeholder interaction). The findings provide support for the promotion of the dissemination of EMA in practice.

1.3.3 Paper Three: Environmental Activity Management: Its use and impact on environmental performance

The study contributes to the EMA literature by examining the extent of use and the effectiveness of one of the cost management and accounting tools proposed in Burritt et al.'s (2002) EMA framework, Environmental Activity Management. Specifically, the paper provides an insight into the application of Environmental Activity Management utilising Gosselin's (1997) three levels of Activity Management (namely, Environmental Activity Analysis (EAA), Environmental Activity Cost Analysis (EACA), and Environmental Activity Based Costing (EABC)). The paper also examines the association between Environmental Activity Management and environmental performance, and the role of decision quality as a mediator of this relationship.

The results indicate a relatively high extent of EAA use but a low extent of use of EACA and EABC, suggesting that the focus on the costs of environmental activities is at the infancy stage with little emphasis placed on the more complex levels of Environmental Activity Management, EACA and EABC. In addition, organisations using each level of Environmental Activity Management to a greater extent were found to experience higher levels of environmental performance. Furthermore, the relationship between EAA and EABC with environmental performance was found to be mediated by environmental decision quality. Hence, the provision of more detailed and accurate information regarding the activities with environmental impacts (EAA), and tracing the environmental costs of activities to products and services (EABC) enhances environmental decision quality, which in turn positively influences environmental performance.

1.4 Structure of the thesis

The remainder of the thesis is structured as follows. Chapter Two provides a review of the literature on environmental management practices. Chapter Three then provides details in respect to the data collection and analysis procedures. Chapters Four, Five and Six comprise the three research papers with separate tables, figures, appendices and references. Finally, Chapter Seven provides an overall discussion of the results, the contributions to the relevant literature and practice, the limitations of the study and suggestions for future research.

CHAPTER TWO

LITERATURE REVIEW

This chapter provides a comprehensive literature review of studies on environmental management practices. First, section 2.1 provides an overview of the adoption of environmental management practices, in particular, Environmental Management Systems (EMSs) (section 2.1.1) and Environmental Management Accounting (EMA) (section 2.1.2). Section 2.2 then focuses on the factors influencing the use of EMSs and EMA, while section 2.3 discusses the impact of EMSs and EMA on financial performance and environmental performance. Finally, section 2.4 provides a summary of the chapter and an overview of the organisation of the remainder of the thesis.

2.1 The adoption of environmental management practices

Traditionally, organisations have followed the compliance approach to environmental management, with environmental strategies being driven solely by mandatory environmental regulations (Daily, 2007). However, in recent years, the environmental crisis has become a global issue (Pahuja, 2009) and increased pressure from a variety of stakeholders has imposed expectations that organisations move beyond legal compliance and adopt more proactive environmental management initiatives (Rivera, 2004). As a result, many organisations have adopted an Environmental Management System (EMS) as a systematic approach to ensure that improvements in environmental performance are achieved (Tinsley and Pillai, 2006). In addition, there has been a growing demand for environmental accounting information to assist business decision making and to account for efforts towards sustainable development (UNDSD, 2001), with the management accountant playing a significant role in accounting for sustainable

development and facilitating upper level management decision making (Mistry et al., 2014). This has given rise to the development of Environmental Management Accounting (EMA).

2.1.1 Environmental Management Systems

An Environmental Management System (EMS) is defined by the British Standards Institute as "the organisational structure, responsibilities, practices, procedures and resources for determining and implementing environmental policy" (Tinsley and Pillai, 2006, p. 15). It is a formal set of procedures and policies that define how organisations identify, assess and manage their potential environmental impact throughout the entire organisation (Darnall et al., 2000). The adoption of an EMS generally includes establishing a written environmental policy and developing environmental objectives, identifying relevant environmental regulatory requirements imposed by the government, training employees to ensure the established objectives and responsibilities are clearly communicated within the organisation, documenting environmental management procedures and operations, developing environmental performance indicators and goals, and conducting internal and external environmental reviews and audits to determine the effectiveness of EMSs (González-Benito et al., 2011; Annandale et al., 2004; Anton et al., 2004; Melnyk et al., 2003; Netherwood, 1998).

An important objective of the adoption of EMSs is to assist organisations in achieving continuous improvements in environmental management and in reducing exposure to environmental risk (Tinsley and Pillai, 2006; Dahlström et al., 2003). A wide range of benefits from the establishment of an EMS have been identified in the literature, including reductions in environmental risk, better management of regulatory

compliance, improvements in resource usage, and the enhancement of public reputation (Tinsley and Pillai, 2006; Sullivan and Wyndham, 2001; Steger, 2000).

Various management standards have been created to assist organisations in developing formalised EMSs. The first of these was the British Standard BS 7750 which was created in the early 1990s (Schaefer, 2007). The standard was used to describe an organisation's EMS, evaluate its performance, define policy, practices, objectives and targets, and provide a catalyst for continuous improvement (Tinsley and Pillai, 2006). In 1996, from an idea based on BS 7750, the International Organization for Standardization introduced ISO 14001, which is the most commonly-used international standard for the development of an effective EMS (Tinsley and Pillai, 2006). ISO 14001 focuses on describing the characteristics of the system which can assist organisations in achieving their own environmental objectives, rather than providing specific criteria for environmental performance (Melnyk et al., 2003). Similar in structure to ISO 14001, the Eco-Management and Audit Scheme (EMAS) developed by the European Commission was launched in 1995 (Tinsley and Pillai, 2006). The EMAS is more rigorous than ISO 14001 in terms of mandating reductions in environmental impact and requiring organisations to make an increased amount of information publicly available. Consequently, while the number of ISO 14001 certificates exceeded 319,000 at the end of 2015 (ISO, 2015), only 9,200 organisations and 4,000 sites were EMAS registered as at May 2016 (EMAS, 2016).

Since EMSs arise in different organisational settings and organisations adopt different types of EMS guidelines or standards, there is often variation in the extent to which organisations utilise the different environmental management practices comprising an

EMS (Coglianese and Nash, 2001). Consequently, EMSs can differ considerably across organisations in the comprehensiveness of their coverage (Anton et al., 2004). However, the variation in the use of EMSs has generally been ignored in many prior studies which have simply used the dichotomous approach to inquire whether or not an organisation has an EMS in place (Zhu et al., 2013; González-Benito et al., 2011; Johnstone, 2007; Melnyk et al., 2003). This approach ignores the flexibility in the extent to which organisations can adopt EMS practices. For instance, some organisations may implement a restricted EMS with a minimal level of environmental commitment for the purpose of improving public image (Bansal and Clelland, 2004) or to avoid scrutiny from different groups of stakeholders (Anton et al., 2004).

Accordingly, emphasis should be placed on the characteristics and/or the comprehensiveness of the EMSs rather than the presence of such systems, with a number of studies such as Anton et al. (2004) and Henriques and Sadorsky (2007) measuring the comprehensiveness of EMSs in respect to the number of environmental management practices adopted. Paper One extends this approach by examining the comprehensiveness of EMSs in respect to the extent to which organisations implement the following nine environmental management practices: having policies, rules, regulations, procedures in relation to environmental management; having dedicated staff responsible for focusing on environmental issues; using environmental criteria in the evaluation and/or compensation of employees; having frequent environmental training programs; having frequent internal environmental audits; having frequent external environmental audits; benchmarking environmental performance; having processes to evaluate environmental risks when selecting suppliers, partners, or clients;

and having environmental performance indicators and goals (Henriques and Sadorsky, 2007; Anton et al., 2004).

2.1.2 Environmental Management Accounting

Environmental Management Accounting (EMA) is described as the process of identifying, collecting and analysing information about environmental costs and performance to help an organisation's decision making (USEPA, 1995). Similarly, the International Federation of Accountants (IFAC, 2005, p. 19) defines EMA as:

> "The management of environmental and economic performance through the development and implementation of appropriate environment-related accounting systems and practices. While this may include reporting and auditing in some companies, EMA typically involves life cycle costing, full cost accounting, benefits assessment, and strategic planning for environmental management."

A slightly different but complementary definition was developed by the United Nations Expert Working Group on EMA. This definition was based on an international consensus of the group members representing more than 30 countries, and states that:

> "The general use of EMA information is for internal organisational calculations and decision making. EMA procedures for internal decision making include both: physical procedures for material and energy consumption, flows and final disposal; and monetarised procedures for costs, savings and revenues related to activities with a potential environmental impact." (UNDSD, 2001, p. 1)

While there are different definitions of EMA, the main purpose of EMA is to develop internal organisational knowledge and decision making (UNDSD, 2001), with some of the major areas for the application of EMA being: the assessment of environmental

costs, product/process design, cost control and allocation, capital investments, waste management, product pricing, performance evaluation, risk management, and environmental compliance strategies (UNDSD, 2001; USEPA, 1995). The benefits associated with EMA include more informed decision making, the identification of opportunities for saving costs and raising revenues, improved product mix and pricing decisions, and avoidance of future costs associated with investment decisions (Ferreira et al., 2010; Bennett et al., 2003; Deegan, 2003). For example, the explicit consideration of environmental costs that are normally hidden in traditional costing systems will provide more accurate information for decision making and may reveal opportunities for raising revenues via recycling or the use of waste in other activities (Deegan, 2003). In addition, EMA may result in benefits that are more indirect (intangible) and less easily quantified, such as improved corporate image and reputation, increased competitive advantage, staff retention and attraction, minimisation of regulatory attention, and the generation of societal benefits (Christ and Burritt, 2013; Ferreira et al., 2010; Adams and Zutshi, 2004; Deegan, 2003).

Given the diversity of management decision situations, EMA encompasses a wide range of accounting tools (Schaltegger et al., 2013). Burritt et al. (2002) propose a comprehensive framework for EMA which systematically integrates two major components, physical EMA and monetary EMA. Physical EMA deals with environmental impact information expressed in terms of physical units such as kilograms of materials (Burritt et al., 2002). It is assumed that all physical inputs (energy, water and materials) will eventually become outputs (either physical products or wastes and emissions), and that all physical inputs and outputs should be tracked to ensure that no significant amounts are unaccounted for (IFAC, 2005). The physical

EMA tools include material and energy flow accounting, assessment of environmental impacts, physical environmental budgeting and investment appraisal, and environmental performance evaluation and indicators (Burritt et al., 2002; UNDSD, 2001). Monetary EMA focuses on environmental impact information expressed in monetary units, for example, the costs incurred to treat waste (Burritt et al., 2002). It provides an important tool to track, trace, and manage the costs incurred as a result of an organisation's activities relating to the environment (Schaltegger and Burritt, 2000). The monetary EMA tools include environmental cost accounting (e.g. variable costing, absorption costing, and activity based costing), carbon management accounting, environmental life cycle costing, and monetary environmental project investment appraisals (Burritt et al., 2011; Burritt et al., 2002).

Prior research on the implementation of EMA tools has mainly been limited to case studies of specific organisations (Herzig et al., 2012; Papaspyropoulos et al., 2012; Qian et al., 2011; Burritt et al., 2009; Burritt and Saka, 2006; Gale, 2006; Deegan, 2003). For example, Deegan (2003) undertook a research project involving the trial of EMA for six months in four Australian organisations. It was found that environmental costs relating to the use of water, energy and other resources were hidden in the general overhead accounts, and waste costs were generally not reported or grossly underestimated, resulting in the loss of significant opportunities for operational efficiency, cost reductions and revenue increases. Suggestions were made to capture the environmental costs and improve the allocation of environmental costs to products or processes, using some form of Activity Based Costing. Similarly, Herzig et al. (2012) conducted 12 case studies in South-East Asian countries to explore the application of various EMA tools, such as materials and energy flows and related cost calculations, in different decision

making situations. It was found that EMA tools were relevant and useful for analysing specific decision settings, such as environmental investments or the calculation of carbon emissions and their reduction. Another study by Qian et al. (2011) explored the use of EMA information in local government organisations. The interviews with managers responsible for waste and recycling issues revealed that a moderate level of EMA information was collected and used for waste management, with the majority of the councils identifying between 30 and 60 per cent of the listed environmental information items (e.g. quantity of waste collected, waste collection costs, etc.).

A limited number of survey-based studies have provided evidence on the use of EMA in practice, with many studies reporting a low level of EMA adoption. For instance, Frost and Wilmshurst (2000) found that approximately half of the 88 surveyed organisations did not include environmental information within their existing accounting systems, while less than a third of them undertook specific environmental accounting procedures. Similarly, Bartolomeo et al. (2000) revealed that although many of the 84 surveyed organisations claimed to use some form of EMA, it was generally found to be an isolated experimental project rather than a systematic and comprehensive implementation, with only 18% explicitly tracking environmental costs at the plant level. Ferreira et al. (2010), who were the first to provide a comprehensive multi-item measure of EMA use, reported a low level of EMA use (2.33 on a theoretical range of 0-6). Using a similar construct, Christ and Burritt (2013) also reported a low level of EMA use (2.98 on a theoretical range of 0-7).

Given the limited empirical evidence concerning EMA use and the stronger focus on the monetary component of EMA in the above-mentioned studies, Paper Two of this study

contributes to the literature by examining the extent to which both the physical and monetary components of EMA are used in practice based on a survey of a large sample of 208 organisations across different industries. In addition, given the sparse empirical research on specific EMA tools (Herzig et al., 2012; Burritt et al., 2009; Kokubu and Nashioka, 2005), Paper Three contributes to the literature by examining the use and effectiveness of an EMA tool, namely Environmental Activity Management, which encompasses three levels: Environmental Activity Analysis (EAA), Environmental Activity Cost Analysis (EACA), and Environmental Activity Based Costing (EABC) (Gosselin, 1997).

2.1.2.1 Environmental Activity Management as a tool of Environmental Management Accounting

Traditional costing systems have widely been criticised for their failure to provide accurate product cost information for management decision making, largely due to the aggregation of overhead costs into very large cost pools and the allocation of overhead costs using volume-based cost drivers (Langfield-Smith et al., 2015, Johnson and Kaplan, 1987). Activity Based Costing (ABC) was first developed by Cooper and Kaplan (Cooper and Kaplan, 1988) with the aim of reducing the level of arbitrary cost allocations associated with traditional costing systems and providing more accurate product cost information. The two main differences between ABC and traditional costing systems are: (1) ABC is based on the premise that cost objects consume activities which in turn consume resources, whereas traditional costing assumes cost objects directly consume resources; (2) ABC uses resource and activity drivers at different levels to trace costs from resources to activities to cost objects in a causal manner, while conventional costing uses only unit-level allocation bases (Kaplan and

Anderson, 2013; Emblemsvåg and Bras, 2001). By providing more accurate cost information, ABC can be used to support a wide range of economic activities, such as joint product decisions, product mix decisions, capital investment decisions, selecting advanced manufacturing systems, and environmental management (Tsai et al., 2015).

Since its inception, the benefits of ABC in improving the calculation of costs and the capability to better manage costs and activities have been advocated and supported by empirical evidence (Baird et al., 2007; Foster and Swenson, 1997; McGowan and Klammer, 1997; Anderson, 1995). Despite its attractive value proposition, ABC adoption rates vary, and the diffusion process has not been as strong as may have been anticipated (Gosselin, 2006). This so-called ABC paradox can be attributable to the complexity and high costs of implementing such systems, the resistance to change from employees, and the lack of support from top management (Kaplan and Anderson, 2013; Gosselin, 2006). In addition, Phan et al. (2014) and Baird et al. (2004) argue that this contradiction may lie in the differences in the ways in which prior studies have defined and operationalised ABC. Specifically, due to the diversity of the ABC models that have been proposed and implemented, there is a multiplicity of terms used such as ABC itself, Activity Accounting (Brimson, 1991), Activity-Based Cost Management (Foster and Swenson, 1997), Activity Based Management (Reeve, 1996), Activity Management, Activity Analysis, and Activity Cost Analysis (Gosselin, 1997). Gosselin (1997) identifies ABC as one of the three levels of Activity Management, with the other two being Activity Analysis (AA) and Activity Cost Analysis (ACA). According to Gosselin, ABC is the most complex level which subsumes AA and ACA, while AA is the prerequisite of ACA.

Within the EMA stream, ABC is considered to be the most effective cost accounting method to provide the quality information required to facilitate environmental decisions, as it identifies and allocates environmental costs, which are usually hidden in general overhead accounts under traditional costing systems, more accurately (Cagno et al., 2012; Rodríguez Rivero and Emblemsvåg, 2007). The integration of ABC into environmental management was first mentioned in the early 1990s (Emblemsvåg and Bras, 1994; Kreuze and Newell, 1994), with Emblemsvåg and Bras (2001) introducing basic principles on how to expand ABC into the environmental domain, explaining the steps for developing activity-based cost, energy, and waste management models, and applying their framework in a number of real-life case studies. Similarly, as part of the introduction of principles and procedures for EMA, the United Nations Division for Sustainable Development (UNDSD, 2001) discussed the use of the ABC method to allocate environmental costs to products. However, empirical evidence concerning the use of environmental ABC in practice has been scarce and limited to a number of case studies. For example, in a case study of four Australian organisations by Deegan (2003), greater use was made of ABC when refining the existing costing systems to improve the allocation of environmental costs. In addition, Cagno et al. (2012) proposed an extended activity based environmental costing model which considered not only products but also by-products and wastes, and applied it in an Italian manufacturing organisation.

Given the empirical evidence of the purported usefulness of ABC (Phan et al., 2014; Baird et al., 2007), the scant research on ABC in an environmental context, and the importance of ABC in the EMA literature (Cagno et al., 2012), this study aims to provide empirical evidence regarding the use of environmental ABC. In line with Baird et al. (2004) and Gosselin (1997) who recognise that ABC can be adopted at different

levels depending on organisational objectives, this study introduces the concept of Environmental Activity Management, which is based on Gosselin's (1997) three-level Activity Management approach. Specifically, the study examines three levels of Environmental Activity Management, namely Environmental Activity Analysis (EAA), Environmental Activity Cost Analysis (EACA), and Environmental Activity Based Costing (EABC). These three levels of Environmental Activity Management fit well in the EMA framework proposed by Burritt et al. (2002), with EAA being part of the physical EMA tools, while EACA and EABC can be classified as monetary EMA tools.

2.2 The influence of contingency factors on the use of Environmental Management Systems and Environmental Management Accounting

Contingency theory, which suggests that a particular management system is dependent on the specific circumstances in which an organisation operates (Otley, 1980), is one of the most widely applied theories in contemporary management accounting research. Prior studies have utilised different perspectives to examine the contingency factors influencing the adoption of environmental management practices, including EMSs and EMA practices. One approach has been to utilise institutional theory, which highlights the importance of social and cultural pressures on organisational structures and practices (Scott, 1992), to examine the impact of a range of stakeholders such as the government, customers, industry associations and the community (Yu and Ramanathan, 2014; Darnall et al., 2010; Sangle, 2010; Anton et al., 2004; Delmas and Toffel, 2004; Rivera, 2004; Khanna and Anton, 2002; Henriques and Sadorsky, 1996) on the adoption of environmental management practices. Alternatively, other studies have examined the relationship between a number of organisational factors, including size, industry, top management support, resources and capabilities, training, and teamwork, with

environmental management practices (Christ and Burritt, 2013; Henriques and Sadorsky, 2013; Ferreira et al., 2010; Darnall et al., 2008; Daily, 2007; Darnall and Edwards Jr, 2006). This section provides an overview of these studies.

2.2.1 Institutional factors

Institutional theory has been widely recognised as a prominent and powerful tool which is utilised to explain organisational behaviour (Dacin et al., 2002). In particular, institutional theory offers the opportunity to explore the influences of expectations and values both from inside and outside the organisation, along with rules in society, on the decision to introduce management accounting changes (Sharma et al., 2014; Burns and Scapens, 2000). Hoffman (1999) maintains that organisations adopt similar structures and practices to gain legitimacy and strive for social conformity in response to pressures from their institutional environment. Different groups of stakeholders exert coercive, mimetic and normative pressures that promote the isomorphic adoption of environmental management practices, with the government, customers, industry associations and the community being among the most influential stakeholders (Rivera, 2004).

2.2.1.1 Government pressure

Mandatory environmental regulations from the government have been shown to be an effective mechanism for motivating organisations to improve their environmental practices. For instance, Fryxell et al. (2004) found that ensuring regulatory compliance was the main driver of EMS adoption. Similarly, compliance with regulations or anticipated regulations is identified as one of the main reasons for participating in EMS programs in the Australian agriculture industry (Cary and Roberts, 2011). Organisations

that fail to comply with environmental regulations or maintain satisfactory communication with regulatory stakeholders risk legal sanctions, including incurring fines and penalties and losing their operating permits (Darnall et al., 2010; Henriques and Sadorsky, 1996). Khanna and Anton (2002) further indicate that while existing regulatory frameworks have a significant influence on incentives to improve environmental management, a credible threat of stringent and high cost regulations in the future can play an important role in encouraging organisations to develop a higher quality EMS. In the context of EMA, it is argued that organisations may adopt EMA practices because government agencies demand certain information or impose legislation requiring the use of certain EMA practices (Rikhardsson et al., 2005), such as the quantification of environmental costs.

2.2.1.2 Customer pressure

Due to the increased availability of environmental information about industrial environmental practices, customers have become more aware of their natural environment (Darnall et al., 2008). Organisations face pressure from customers who wish to ensure that the products they purchase sufficiently meet environmental quality standards (Yu and Ramanathan, 2014). Henriques and Sadorsky (1996), in a survey of the largest Canadian organisations, found that customer pressure was the second most cited source of pressure for organisations to adopt an environmental management plan. Similarly, Darnall et al. (2008) and Anton et al. (2004) confirm that organisations that endure greater pressure from customers adopt more comprehensive EMSs. Christmann and Taylor (2001) also found that customers in developed countries influenced organisations in China to improve their environmental compliance and adopt the ISO 14001 EMS standard.

2.2.1.3 Industry association pressure

Industry associations have a considerable interest in maintaining a positive environmental reputation so as to avoid increased scrutiny from the government and environmental groups and the imposition of more stringent environmental regulations (King and Lenox, 2000). It is argued that organisations are more likely to mimic the behaviour of other organisations that are within the same network (Guler et al., 2002), in order to gain legitimacy or remain competitive (Malmi, 1999). Furthermore, Kolln and Prakash (2002) found that pressure from industry associations strongly influenced the decision of organisations in the United Kingdom, Germany and the United States to pursue EMS certification. Similarly, the findings in Qian et al. (2011) indicate that the values and rules recognised and diffused in the industry had a positive impact on an organisation's EMA practices.

2.2.1.4 Community pressure

It is argued that environmental and community groups can mobilise public opinion in favour of or against an organisation's environmental approach (Sarkis et al., 2010), and draw attention to the environmental wrongdoings of organisations by leading protests and boycotts (Darnall et al., 2008). In a survey of 700 organisations, Henriques and Sadorsky (1996) found that community group pressure influenced organisations to adopt an environmental plan. Similarly, Florida and Davison (2001) found that the adoption of EMSs and pollution prevention programs was positively associated with an organisation's active engagement with community stakeholders. The findings in Qian et al. (2011) also indicated that the community's high expectation of, and interest in environmental improvement, was one of the motivating factors influencing organisations to implement an EMA system.

2.2.2 Organisational factors

Various organisational factors have been identified in the management accounting and environmental management literature as factors which influence the use of environmental management practices in general, and EMSs and EMA in particular. Such factors include size (Ferreira et al., 2010; Henri and Journeault, 2008), industry (Christ and Burritt, 2013; Ferreira et al., 2010), top management support (Ronnenberg et al., 2011; Kokubu and Nashioka, 2005), resources and capabilities (Henriques and Sadorsky, 2013; Darnall et al., 2008), training (Savely et al., 2007; Daily and Huang, 2001), and teamwork (Massoud et al., 2010; Daily, 2007).

2.2.2.1 Size

Prior research in the management accounting literature suggests that larger organisations are more likely to adopt formal management control systems and sophisticated management accounting techniques (Ferreira et al., 2010; Chenhall, 2003). For instance, Henriques and Sadorsky (2007) found that size was positively associated with the implementation of EMSs, while Christ and Burritt (2013) found that the use of EMA was associated with organisational size. Large organisations usually have the human and financial resources, training and information to commit to the implementation of environmental management practices (Ferreira et al., 2010; Henri and Journeault, 2008; Henriques and Sadorsky, 2007; Marshall and Brown, 2003). Furthermore, large organisations are more visible to external stakeholders and experience more pressure from regulatory bodies, environmental interest groups and the community, which may lead to greater involvement with proactive environmental management activities (Christ and Burritt, 2013). Alternatively, small organisations often face barriers such as a lack of training and information regarding new technology,

limited enforcement of national or community policies, and limited environmental awareness (Gribble and Dingle, 1996).

2.2.2.2 Industry

The industry sector is considered an essential variable in the study of environmental management since different industry sectors have different environmental impacts and are subject to different levels of scrutiny from institutions, social groups, and consumers. Accordingly, different industries tend to display different levels of environmental commitment (González-Benito and González-Benito, 2006). It has been suggested that environmental management practices are generally of greater use to organisations operating in environmentally-sensitive industries (Wilmshurst and Frost, 2000). For instance, Ferreira et al. (2010) found that the key driver of EMA use was industry, with EMA found to be used to a greater extent in high environmental risk industries (e.g. chemical, mining, and smelting). Similarly, Christ and Burritt (2013) found that EMA use was associated with the environmental sensitivity of the industry in which an organisation operates. Nakamura et al. (2001) also provided evidence that high-polluting industries are more receptive than low-polluting industries to voluntary environmental programs such as implementing an EMS.

2.2.2.3 Top management support

Top management support has been identified as an important contingency factor in supporting various environmental management practices (Ronnenberg et al., 2011; Ramus, 2002). Support from senior management is seen as a key prerequisite for environmental change to occur as the resources required for change typically have to be approved at a senior level (González-Benito and González-Benito, 2006). Top

management leadership and support is vital to ensure an organisation-wide understanding of and commitment to environmental issues (Darnall et al., 2008). Such commitment is also critical to maintain and improve an organisation's environmental strategy over time. Similarly, Daily and Huang (2001) suggest that top management support can affect the implementation of an EMS by promoting employee empowerment to affect changes, providing training, increasing communication throughout the organisation, and affecting organisational culture to support changes. In a survey of Japanese organisations, Kokubu and Nashioka (2005) found that the support from top management was a key factor in promoting adoption and maximising the benefits of EMA.

2.2.2.4 Resources and capabilities

A number of studies have examined the impact of resources and capabilities, including human resources, information technology, capital, equipment, and knowledge, on the adoption of environmental management practices. For example, Darnall et al. (2008), in a survey of manufacturing organisations in Canada, Germany, Hungary and the United States, found that organisations with greater resources and capabilities, such as quality management systems, employee commitment, and environmental research and development, adopt more comprehensive EMSs. The findings in Henriques and Sadorsky (2013) also indicated that the environmental research and development budget exerted a positive and significant impact on the adoption of EMSs. It is suggested that corporate resources play an important role in the adoption of EMSs, since implementing a formal EMS or certifying that system is a time consuming and potentially expensive activity (Melnyk et al., 2003). Similarly, Setthasakko (2010) indicated that the availability of resources was an important factor in implementing an EMA system.

2.2.2.5 Training

Previous studies have highlighted the importance of training in the implementation of environmental management practices. For example, Savely et al. (2007) suggested that environmental training is critical in gaining a better understanding of the purposes of environmental management and widespread support from employees. This suggestion is supported by Sammalisto and Brorson (2008) who found that training is a key factor during the implementation of an EMS, since it serves at least two purposes: to teach employees about company environmental policies and procedures, and to change employee attitudes towards the environment and create increased awareness about environmental issues. Daily and Huang (2001) also note that the successful implementation of an EMS requires culture transformation, which can be achieved through education and training in an attempt to encourage employees to become more aware of the need for quality and environmental control, to increase adaptability to change, and to have a more proactive attitude. In addition, the findings in Setthasakko (2010) indicated that the lack of environmental training was one of the barriers in respect to the development of an EMA system.

2.2.2.6 Teamwork

The majority of environmental projects require communication and coordination from different departments in an organisation, and the skills and knowledge of different types of individuals (Jabbour and Santos, 2008). In addition, effective environmental management requires changes and improvements from all organisational areas, including manufacturing, planning, and purchasing (Daily, 2007). Therefore, teamwork is an essential part of the implementation of environmental management practices. Teamwork provides benefits such as collective knowledge to develop comprehensive

solutions, avoiding duplication of effort, completing different tasks simultaneously, and empowering employees (Daily and Huang, 2001). Massoud et al. (2010) conclude that teamwork is a critical factor in implementing an EMS as it helps utilise multiple skills across boundaries in organisations on complex environmental challenges. Similarly, Deegan (2003) found that teamwork is essential in developing an EMA system as it requires people with different sets of skills, e.g. those who understand accounting systems, those who have an environmental background, and those who understand how resources are being used within the various activities of the organisation.

2.3 The impact of Environmental Management Systems and Environmental Management Accounting on organisational performance

One of the major obstacles of the widespread adoption of proactive environmental management practices is the uncertainty regarding the relationship between these practices and an organisation's financial performance (Melnyk et al., 2003) and/or environmental performance (Hertin et al., 2008). As such, a growing body of research has attempted to provide empirical evidence regarding such relationships. The following discussion will provide an overview of the impact of environmental management practices, including EMSs and EMA practices, on financial performance (section 2.3.1) and environmental performance (section 2.3.2).

2.3.1 Financial performance

A few decades ago there was virtually no debate over the association between environmental management and corporate financial performance, with the pursuit of environmental goals being perceived as a violation of the fiduciary duty of managers to shareholders (Melnyk et al., 2003). The most prominent opposition to corporate social

responsibility, which includes environmental management, was the typical economic argument proposed by Friedman (1962) who argued that social responsibility imposes an unfair and costly burden on shareholders. Specifically, it was perceived that investments in improving environmental management would lead to increased lead times, reduced quality or increased costs, all of which reduced profits, decreased returns to shareholders, and eroded an organisation's global competitiveness (Stefan and Lanoie, 2008; Melnyk et al., 2003).

While the conventional thinking remains, it is increasingly challenged with a growing number of scholars arguing that there are 'win-win' situations where an organisation can be both green and competitive (Tinsley and Pillai, 2006; King and Lenox, 2001). In particular, environmental management practices may have a positive influence on financial performance through facilitating reductions in costs and/or providing opportunities for product differentiation. For example, pollution prevention strategies may enable organisations to save costs by increasing efficiency, reducing compliance costs, minimising future liabilities, and reusing materials through recycling (Hart, 1997; Porter and Van der Linde, 1995). In addition, organisations adopting proactive environmental strategies may benefit from premium pricing for green products and increased sales as a result of enhanced market legitimacy and social approval (Rivera, 2002).

The debate regarding whether it pays to be green continues, with a growing number of quantitative studies examining the relationship between environmental management practices and corporate financial performance (for example, return on assets, return on equity, return on investment) with mixed results. On the one hand, some studies have

reported a negative link or no significant association between environmental management practices and financial performance. For example, Cordeiro and Sarkis (1997) found a significant negative relationship between environmental proactivism and earnings-per-share performance forecasts for a sample of 523 US organisations. Gilley et al. (2000) found that corporate environmental initiatives had no overall effect on anticipated firm performance using stock returns. Similarly, Watson et al. (2004) reported no significant association between the implementation of an EMS and a firm's financial performance.

Alternatively, the findings from other studies suggest that the use of environmental management practices can lead to improvements in financial performance. For instance, Judge and Douglas (1998) found that the integration of environmental issues into the strategic planning process had a positive and significant impact on financial performance in terms of return on investment, earnings growth, sales growth, and market share change. In a study of 614 US manufacturing organisations, King and Lenox (2002) found a significant positive relationship between waste prevention methods and financial performance, measured in respect to return on assets and Tobin's Q ratio. Similarly, Montabon et al. (2007) studied 46 organisations in different industries and found that environmental practices (recycling, waste reduction, remanufacturing, and environmental design) had a significant positive impact on various measures of financial performance. Another study of 156 Egyptian organisations by Wahba (2008) found that the implementation of an EMS exerted a positive and significant impact on the organisation's market value measured by Tobin's Q ratio. Finally, Yu et al. (2009) conducted a literature review of the quantitative studies analysing the relationship between environmental management and financial

performance, concluding that although the results were mixed, studies exhibiting a positive association between environmental management and financial performance were dominant.

2.3.2 Environmental performance

Environmental performance refers to "the impact of an organisation's activities on the environment, including natural systems such as land, air and water, as well as on people and living organisms" (Langfield-Smith et al., 2015, p. 761). Prior studies have examined the impact of environmental management practices on the environmental performance of organisations with mixed results. For instance, a number of studies have reported a significant positive relationship between the two, with Henri and Journeault (2010) reporting that eco-control, which refers to the integration of environmental matters within management control systems, had a positive and significant impact on environmental performance. Similarly, Anton et al. (2004) found that the adoption of a more comprehensive EMS lead to lower toxic emissions, with the impact magnified for those organisations with inferior past environmental records. Another study by King et al. (2005) on US manufacturing facilities during 1995-2001, found evidence that EMS adoption results in improved environmental performance, measured as a logarithm of the toxicity-weighted sum of all Toxic Release Inventory. Other studies have found that organisations pursuing proactive environmental strategies demonstrated improvements in environmental performance, especially in the areas of air and waste emission reductions, waste recycling and environmental incidence reduction (Iraldo et al., 2009; Zutshi and Sohal, 2004; Morrow and Rondinelli, 2002).

However, contrasting evidence has also been collected. For example, in a study of European industrial organisations and production sites with different EMS policies, Hertin et al. (2004) found that the link between the adoption of an EMS and environmental performance (measured by eco-efficiency indicators) was weak and ambiguous: organisations with a formal EMS performed better on a number of indicators, but worse on several others, and only a small number of correlations were statistically significant. Similarly, Cary and Roberts (2011) found that although the adoption of environmental management practices appeared to have a minor positive impact on a small number of performance measures, there was no evidence of a significant positive impact on environmental performance.

This study contributes to the literature by providing empirical evidence regarding the association between the use of various environmental management tools, specifically EMSs (Paper One), EMA (Paper Two), and Environmental Activity Management (Paper Three) with the environmental performance of organisations. Consequently, to facilitate this analysis, the following section provides a discussion of the measurement of environmental performance.

2.3.2.1 Environmental performance measurement

A range of measures have been developed by different groups, such as regulatory agencies, the business press and corporations themselves, to capture various aspects of environmental performance (Ilinitch et al., 1998). However, Lober (1996) notes that although judgements are frequently made about which organisation is ‘greener’, there is no clear or agreed upon definition of ‘greenness’, or in other words, what constitutes

environmental performance. Henri and Journeault (2010) also state that there is a significant lack of consensus on the definition and operationalisation of this concept.

According to Delmas and Blass (2010), corporate environmental performance indicators are usually divided into three main categories: environmental impacts (toxicity, emissions, energy use etc.), regulatory compliance (non-compliance status, violation fees, number of audits etc.), and organisational processes (environmental accounting, audits, reporting, environmental management systems etc.). Using different combinations of these categories, many investment research organisations have developed methodologies to evaluate the environmental performance of organisations to inform investors. For example, in 1999, Sustainable Asset Management (RobecoSAM) collaborated with S&P Dow Jones Indices to launch the Dow Jones Sustainability Indices (DJSI), which were the first global sustainability indices tracking the performance of leading sustainability-driven organisations worldwide (RobecoSAM, 2016). Another example is the MSCI ACWI Sustainable Impact Index which includes organisations that derive 50% or more of their revenues from products and services in one or more of the sustainable impact categories such as alternative energy, energy efficiency, green building, sustainable water or pollution prevention (MSCI, 2016).

Organisations themselves release environmental information in the form of environmental or sustainability reports and strategic advertising and marketing campaigns. However, although environmental statements provide reliable quantitative data on the performance of organisations, there are a number of problems with the availability and comparability of the data: the lack of harmonisation (indicators, measurement units), different reporting levels (process, site, firm), the lack of time

series data, and the lack of publicly available measures for some environmental performance metrics (Daddi et al., 2011; Ilinitch et al., 1998).

In many prior studies, for the sake of simplicity and brevity, environmental performance has been mainly examined based on the environmental impact generated by the operations of organisations. For example, some studies only use one performance indicator such as an electricity index (Friedrich et al., 2011), total material requirements (Baboulet and Lenzen, 2010), greenhouse gas emissions (Psaraftis and Kontovas, 2010), or toxic releases (Patten, 2002). A combination of different impact measures are used in other studies such as Lanoie et al. (2011) (use of natural resources, solid waste, wastewater, local and regional air pollutants, and global air pollutants), and Kok et al. (2010) (energy consumption, water consumption, waste collection and recycling, and carbon dioxide emission). However, Henri and Journeault (2010) argue that the use of environmental impact as a proxy for environmental performance limits the scope of this multidimensional concept to only one aspect.

Consequently, this study incorporates a more comprehensive measure which covers different dimensions of environmental performance. Specifically, this study examines the extent to which each of fifteen desired environmental outcomes, identified in the literature (Langfield-Smith et al., 2015; Henri and Journeault, 2010), are achieved: reductions in energy consumption; reductions in water usage; reductions in material costs due to the efficient use of material; reductions in the levels of waste; reductions in levels of emissions; reductions in process/production costs; reductions in the costs of regulatory compliance; reductions in the costs associated with cleaning up environmental damage; reductions in the fines paid and remediation costs regarding

environmental damage; increased process/production efficiency; increased knowledge about effective ways of managing operations; increased organisation-wide learning among employees; better relationships with stakeholders such as local communities, regulators, and environmental groups; increased filters and controls on emissions and discharges; and increased residue recycling.

2.4 Summary

This chapter has provided a comprehensive review of the studies examining the adoption of Environmental Management Systems (EMSs), Environmental Management Accounting (EMA) practices, and Environmental Activity Management as a specific tool of EMA. The chapter also discussed the studies examining the contingency factors, both institutional factors and organisational factors, which affect the use of EMSs and EMA. The study aims to contribute to the literature examining the use of environmental management practices and the influential contingency factors. Specifically, Paper One contributes to the literature by providing a more detailed insight into the comprehensiveness of EMSs and the impact of institutional pressures (coercive, mimetic and normative) on the comprehensiveness of EMSs. In addition, Paper Two extends the literature by providing an insight into the extent of use of both physical and monetary components of EMA and the influence of organisational factors (size, top management support, EMS comprehensiveness) on the use of EMA, while Paper Three investigates the extent of use of the three levels of Environmental Activity Management, namely EAA, EACA, and EABC.

The chapter also provides a discussion of the impact of EMSs and EMA use on financial and environmental performance. Consistent with the pragmatists' view that

organisations should engage in activities designed to achieve sustainable outcomes (Larrinaga-Gonzalez and Bebbington, 2001), this study aims to contribute to the literature by examining the association between environmental management practices and environmental performance. Specifically, Paper One examines the association between the comprehensiveness of EMSs and environmental performance, while Paper Two examines the impact of the use of physical and monetary components of EMA on environmental performance. Finally, Paper Three investigates the relationship between the three levels of Environmental Activity Management, namely EAA, EACA, and EABC, and environmental performance.

The remaining chapters are structured as follows. Chapter Three provides an overview of the data collection and analysis procedures. Chapters Four, Five, and Six consist of the three self-contained papers presented in an academic journal article format with each paper including separate tables, figures and references. Chapter Seven then summarises the findings of each of the three papers, discusses the contributions to both the relevant literature and practice, identifies the limitations and provides suggestions for future research.

CHAPTER THREE

DATA COLLECTION AND ANALYSIS

3.1 Data collection

The study uses the mail survey method to collect data. The survey method is the most commonly used approach in management accounting research with the mail survey being the most popular data collection method used in accounting studies (Veal, 2005). The mail survey method was chosen in this study for a number of reasons. This approach allows for a wide geographic coverage of respondents which is of importance given this study requires the examination of a large number of organisations across Australia. In addition, less time is required to complete the data collection phase of surveys, and hence data can be collected in a timely manner. Furthermore, the mail survey method is an appropriate and efficient data-gathering technique as it allows for a large number of questions to be included (Singleton and Straits, 2005).

The Dillman Tailored Design Method (Dillman, 2007) was used to administer the survey. This method provides guidelines in respect to the design of the survey, distribution procedures, and personalisation approaches to maximise the response rate. The survey questionnaire was designed in a respondent-friendly style with simple-worded questions and was presented in colour to attract respondents' attention. All efforts were made to ensure that the survey questionnaire was comprehensive yet as succinct as possible, given that shorter questionnaires yield higher response rates (Dillman, 2007). The survey questionnaire consisted of six pages collated in the form of a booklet and included 10 questions (see Appendix A). The final page included a statement of appreciation for the respondents' participation and the contact information

of the researcher, allowing respondents to clarify any concerns about the survey, thereby reducing non-completion of the survey due to insufficient information or a lack of understanding.

The survey commenced with three simple demographic questions and ended with more complex questions designed to measure the use of EMSs and EMA, the institutional and organisational factors affecting the use of EMSs and EMA, and environmental performance. Multi-item scales were used to increase reliability. The majority of the questions were close-ended questions and respondents did not have to undertake any further investigation to complete the questionnaire. The reliability and validity of the survey instrument was assured as all measures were adopted from prior studies with only a few minor amendments made to reflect the context of the current study. The questionnaire was pilot tested by ten academics prior to distribution to ensure the questions were not misleading or ambiguous, and that the format was appropriate. Amendments were subsequently made to the questionnaire based on the feedback received.

Survey questionnaires were distributed to 820 Australian organisations across various industries in the primary (agriculture, mining), secondary (manufacturing, construction), and tertiary (utilities, transport, health) sectors. These organisations were randomly selected from the population of all organisations in Australia, using the OneSource database which provides in-depth business information of organisations in Asia and the Pacific Rim. The target respondents were managers at different levels, including chief executive officers (CEOs)/managing directors, chief financial officers (CFOs)/finance managers, and chief operating officers (COOs)/production managers.

In addition to the survey questionnaire, three other documents were mailed out to the target respondents: a cover letter (see Appendix B), a postcard and a self-addressed reply-paid envelope. The cover letter expressed the objective of the survey, guaranteed respondents anonymity and confidentiality, described the purpose of the postcard, advised the expected length of time to complete the survey, and provided an ethics approval statement. Given evidence that personalisation of the correspondence can increase response rates (Dillman, 2007), the cover letter was printed on university letterhead and was signed by the researcher, while the respondents mailing addresses were hand-written on the envelope. The mailing date, target respondent's name, salutation, position and mailing address were also printed on the cover letter. A self-addressed reply-paid postcard with an identification number was included in the survey package in order to identify respondents without compromising anonymity. The follow-up mail-out was then distributed to non-respondents. The postcard also allowed respondents to indicate whether they would like to receive a copy of the results of the study. This was designed to increase response rates as receiving feedback from the study can be regarded as an attractive reward.

A total of 217 questionnaires were returned for a response rate of 26.5%, of which 85 (10.4%) questionnaires were from the first mail-out, and 132 (16.1%) from the second mail-out. Nine questionnaires were omitted due to substantial missing data, resulting in 208 usable questionnaires (25.4%). In accordance with Roberts (1999), non-response bias was evaluated by comparing dependent and independent variable values between the early and late respondents, with no significant differences found. Furthermore, the comparison between respondents and non-respondents with respect to the average size (based on the number of employees) and industry did not detect any significant

differences. Therefore, non-response bias was not considered to be a major concern in the study.

3.2 Data analysis

The data collected were analysed using a two-stage process of structural equation modelling (SEM), with stage one involving the estimation and refinement of the measurement model for each variable, followed by stage two where the structural model is estimated. SEM has become more frequently used in social sciences as it can provide a comprehensive method to evaluate and modify theoretical models (Anderson and Gerbing, 1988). SEM is considered especially useful when one dependent variable becomes an independent variable in subsequent relationships (Hair et al., 2006). The justification of the two-stage approach is that the reliability of the measures is best accomplished in two stages to avoid the interaction of measurement and structural models (Hair et al., 2006).

CHAPTER FOUR

PAPER ONE

The comprehensiveness of Environmental Management Systems: The influence of institutional pressures and the impact on environmental performance

(A journal article based on this paper has been published in the Journal of Environmental Management)

Phan, T. N. and Baird, K. (2015). 'The comprehensiveness of Environmental Management Systems: The influence of institutional pressures and the impact on environmental performance'. *Journal of Environmental Management*, 160, 45-56.

Abstract

This study contributes to the EMS literature through providing a more detailed insight into the comprehensiveness of Environmental Management Systems (EMSs) by focusing on the intensity of use of environmental management practices. In addition, the study examines the influence of institutional pressures (coercive, mimetic and normative) on the comprehensiveness of EMSs, and the impact of EMS comprehensiveness on environmental performance. A mail survey questionnaire was used to collect data from a random sample of Australian senior managers across various industries. Both coercive and normative pressures were found to influence the comprehensiveness of EMSs. Specifically, the pressure exerted by the government, through the creation of appropriate regulatory pressure and public incentives, and by employees, customers, professional groups, the media, and community, influenced the comprehensiveness of the EMS. In addition, organisations with more comprehensive EMSs were found to experience higher levels of environmental performance. With more than 319,000 organisations worldwide adopting EMSs (ISO, 2015), the findings provide an important insight into the relevance of EMSs. In particular, it is suggested that organisations should endeavour to implement a more comprehensive EMS and be conscious of the role that coercive and normative pressures play in influencing the comprehensiveness of their EMSs.

Keywords: Environmental Management System, environmental performance, institutional theory.

1 Introduction

Increasing attention and concern over the environmental impact of organisational operations has led organisations to actively seek ways to minimise their exposure to environmental risk and take a proactive approach to environmental management. The pressure exerted on organisations to improve their environmental management can be attributed to regulatory bodies, increased public awareness and media coverage of environmental issues, and organisations' awareness of the need to improve efficiency through reducing environmental costs (Tinsley and Pillai, 2006; Deegan, 2003; Sullivan and Wyndham, 2001).

A growing number of organisations have invested significant resources in the implementation of an Environmental Management System (EMS), a systematic approach which requires the integration of environmental issues into every aspect of business management (Tinsley and Pillai, 2006). By 2005, more than 111,000 organisations worldwide had adopted and certified their EMSs to the international environmental management standard ISO 14001 (ISO, 2015), and thousands more had adopted other types of EMSs (Darnall et al., 2008). The number of ISO 14001 compliant EMSs had increased to 319,000 in over 170 countries around the world by 2015 (ISO, 2015).

While many authors advocate the merits of EMSs (Tinsley and Pillai, 2006; Sullivan and Wyndham, 2001; Steger, 2000), empirical studies have been inconsistent in respect to the approach used to define and operationalise EMSs. The majority of studies have incorporated a simplistic approach of inquiring whether or not an organisation has adopted an EMS. Such an approach is problematic given respondents have different

interpretations of the exact nature of an EMS. Furthermore, even if the users of an EMS were successfully captured, this approach ignores the comprehensiveness of the EMS (Edwards and Darnall, 2010) and hence, fails to distinguish between EMS users. Alternatively, other studies (Johnstone and Labonne, 2009; Anton et al., 2004; Khanna and Anton, 2002) have used the total number of environmental practices implemented by organisations as a proxy for the comprehensiveness of EMSs. While this approach is better in the sense that it explores the nature of the environmental management practices utilised by organisations, it fails to take into account variations in the intensity with which specific practices are used by different organisations. Accordingly, this approach provides an opportunity to 'green wash' with organisations being able to create the impression that they are committed to a number of environmental practices without really engaging in environmental management activities (Cho and Patten, 2007; O'Dwyer, 2002).

Since EMSs are developed in different organisational settings and organisations follow different types of EMS (Darnall et al., 2008), it is expected that EMSs differ across organisations in respect to the comprehensiveness of their coverage (Anton et al., 2004). Accordingly, the first objective of this study is to attempt to overcome the limitations of previous studies by providing a more detailed insight into the nature of EMSs within organisations. Specifically, we operationalise the comprehensiveness of EMSs in respect to the intensity of use of nine environmental practices identified as important components of an EMS in the literature (Henriques and Sadorsky, 2007; Anton et al., 2004).

In conjunction with the incorporation of an improved approach of measuring EMS comprehensiveness, the study also aims to contribute to the contingency based literature examining the antecedents or determinants of EMS comprehensiveness. Previous literature has examined the association between organisational factors such as size (Edwards and Darnall, 2010; González-Benito and González-Benito, 2006), quality management systems (Johnstone and Labonne, 2009; Henriques and Sadorsky, 2007), financial resources (Clarkson et al., 2011; Johnstone and Labonne, 2009), and management capabilities (Sangle, 2010; Delmas and Toffel, 2004) with the use of EMSs and other proactive environmental management initiatives. Other research has investigated the influence of the institutional pressures exerted by a variety of stakeholders such as the government (Zhu et al., 2013; Uchida and Ferraro, 2007; Delmas and Toffel, 2004), customers (Sangle, 2010; Khanna and Anton, 2002; Darnall et al., 2000), employees (Darnall et al., 2010; Kirkland and Thompson, 1999), and the community (Sarkis et al., 2010; Henriques and Sadorsky, 1996) on environmental management initiatives.

Many authors such as Schaefer (2007) and Delmas (2002) indicate that institutional pressures are the predominant driver of the adoption of proactive environmental practices. Accordingly, this study places emphasis on the effect of institutional pressures on EMS comprehensiveness. The extant literature has tended to focus on the impact of specific stakeholder groups on the use of environmental management initiatives. Therefore, rather than concentrating on specific stakeholders, this study contributes to the literature by utilising DiMaggio and Powell's (1983) theoretical construct of institutional isomorphism to gain an insight into the influence of an organisation's overall institutional environment.

Given the majority of studies in the extant literature are prescriptive (Delmas and Toffel, 2004; Delmas, 2002) and/or adopt a case-based approach (Schaefer, 2007; Darnall et al., 2000), the second objective of the study is to contribute to the literature by adopting an empirical approach to examine the influence of institutional pressures on the comprehensiveness of EMSs. Further, since the few extant empirical studies are limited to large US or European organisations operating in the manufacturing industry (Yu and Ramanathan, 2014; Boiral and Henri, 2012; Anton et al., 2004; Henriques and Sadorsky, 1996), this study addresses the dearth of studies examining this relationship in alternate industries in Australia.

Finally, in response to Yu and Ramanathan's (2014) claim that there is a research gap in the literature regarding the clarification of the effect of environmental management practices on environmental performance, the third objective of the study is to investigate the association between EMS comprehensiveness and environmental performance. There has been ongoing debate as to whether it is worthwhile to be 'green', or environmentally proactive, with mixed findings reported in relation to the association between EMSs and environmental performance (Iraldo et al., 2009; Hertin et al., 2008; Johnstone et al., 2004; Melnyk et al., 2003). Such mixed findings can be attributed to the way in which EMSs and environmental performance have been operationalised in prior studies.

Accordingly, this study aims to provide further insight into this association by incorporating a more comprehensive approach to the measurement of both EMSs and environmental performance. In terms of EMSs, as mentioned previously, many studies fail to account for the variation in the comprehensiveness of EMSs (Anton et al., 2004),

and therefore this study incorporates an approach which focuses on the intensity of use of environmental management practices associated with an EMS. Similarly, in examining environmental performance, we aim to provide a broader perspective than previous studies which have simply focused on examining the environmental impact generated by operations using measures such as an electricity index (Friedrich et al., 2011), total material requirements (Baboulet and Lenzen, 2010), greenhouse gas emissions (Psaraftis and Kontovas, 2010), or toxic releases (Patten, 2002). Henri and Journeault (2010) argue that this approach limits the measurement of environmental performance to one aspect. Consequently, we utilise Henri and Journeault's (2010) broader approach which incorporates measures covering different dimensions of environmental performance.

2 Theory and hypotheses development

2.1 Environmental Management Systems

An Environmental Management System (EMS) is defined by the British Standards Institute as "the organisational structure, responsibilities, practices, procedures and resources for determining and implementing environmental policy" (Tinsley and Pillai, 2006, p. 15). An EMS is a transparent and systematic process with the objective of "prescribing and implementing environmental goals, policies, and responsibilities, as well as regular auditing of its elements" (Steger, 2000, p. 24). The establishment of an EMS provides a wide range of benefits. For instance, many organisations have reported that environmental management has led to reduced environmental risk, better management of regulatory compliance, improved utilisation of resources and employees, and improved public reputation (Tinsley and Pillai, 2006; Sullivan and Wyndham, 2001; Steger, 2000).

Various management standards have been introduced to assist organisations in developing formalised EMSs. The first of these was the UK national standard BS 7750 which was created in the early 1990s (Schaefer, 2007). The European Eco-Management and Audit Scheme (EMAS) was then launched in 1995 (Tinsley and Pillai, 2006), while the most commonly referred to international standard for environmental management, ISO 14001, which was based on BS 7750, was created in 1996 (Tinsley and Pillai, 2006). The number of certifications to ISO 14001 has been rising, with 319,000 registrations worldwide in 2015, a significant increase from about 14,000 registrations in 1999 (ISO, 2015). In Australia there had been 4,400 certifications issued to organisations by the end of 2015 (ISO, 2015). The key elements of an ISO 14001 EMS include: development of an environmental policy; identification of environmental aspects and evaluation of associated environmental impact; establishment of relevant legal and regulatory requirements; development and maintenance of environmental objectives and targets; implementation of a documented system, including elements of training, operational controls and dealing with emergencies; monitoring and measurement of operational activities; environmental internal auditing; and management review of the system to ensure its continuing effectiveness and suitability (Whitelaw, 2004).

It is important to note that the ISO 14001 standard does not specify a particular level of environmental performance that organisations need to achieve. Rather, it focuses on requiring organisations to comply with the specified characteristics of the system with such compliance expected to assist organisations in achieving their own environmental objectives (Melnyk et al., 2003). However, given the emphasis placed on environmental

management practices is expected to differ across organisations (Darnall et al., 2008), it is imperative that we examine the comprehensiveness of EMSs.

2.2 The comprehensiveness of Environmental Management Systems

The adoption of EMSs and the certification of EMSs is voluntary, and therefore there is often variation in the extent to which organisations utilise different environmental management practices comprising an EMS (Coglianese and Nash, 2001). Consequently, EMSs can differ significantly across organisations in the comprehensiveness of their coverage and the ambitiousness of their objectives (Anton et al., 2004).

Many prior studies on EMSs have utilised the dichotomous measure which only inquires whether or not an organisation has implemented an EMS, thereby failing to account for the variation in the use of EMSs (Zhu et al., 2013; González-Benito et al., 2011; Johnstone, 2007; Melnyk et al., 2003). Given the flexibility in the extent to which they adopt different EMS practices, some organisations may implement a limited EMS involving a minimum level of environmental commitment (González-Benito et al., 2011). For instance, some organisations may only implement an EMS for the purpose of avoiding the scrutiny of different groups of stakeholders rather than seeking environmental improvements (Anton et al., 2004). In these cases, EMSs represent a symbolic effort to improve public image (Bansal and Clelland, 2004). Accordingly, emphasis should be placed on the characteristics and/or the comprehensiveness of the EMS as opposed to whether an EMS is adopted.

Anton et al. (2004) was the first study to examine the comprehensiveness of EMSs with an EMS being considered more comprehensive if it includes a greater number of

environmental practices. Several studies such as Darnall et al. (2010) and Johnstone and Labonne (2009) have followed the approach used in Anton et al. (2004). However, these studies measure the comprehensiveness of EMSs by simply adding the number of practices undertaken by firms. Using the sum of these practices to proxy for EMS comprehensiveness does not account for the variation across organisations in the intensity with which the same practices are used by different organisations. For example, two organisations may both have environmental audits, but they can differ in terms of how frequent these audits are undertaken. Accordingly, in order to take into consideration the intensity of use, this study examines the comprehensiveness of EMSs by (1) examining the use of a number of environmental practices recognised as important components constituting an EMS rather than just inquiring whether or not an EMS is in place, and (2) inquiring as to the extent to which each practice is used rather than just counting the number of practices used.

2.3 The association between institutional pressures and Environmental Management System comprehensiveness

Institutional theory highlights the importance of social and cultural pressures on organisational structures and practices (Scott, 1992). In response to pressures from their institutional environment, organisations adopt structures and practices that are considered legitimate and appropriate organisational choices, even though there is uncertainty regarding their actual usefulness (Carpenter and Feroz, 2001). Institutional theory has been widely recognised as a prevalent and powerful justification for organisational actions (Dacin et al., 2002). It was also maintained that the institutional approach has provided significant insights into the importance of the institutional environment to organisational structure and actions (Teo et al., 2003). DiMaggio and

Powell (1983, p. 149) introduced the concept of isomorphism, a process that "forces one unit in a population to resemble other units that face the same set of environmental conditions". Organisations adopt similar structures and practices to gain legitimacy and strive for social conformity in response to the pressures from their institutions (Hoffman, 1999). DiMaggio and Powell (1983) suggest that managerial decisions are greatly influenced by coercive, mimetic and normative isomorphism. Coercive isomorphism results from "both formal and informal pressures exerted on organisations by other organisations upon which they are dependent" (DiMaggio and Powell, 1983, p. 150). Mimetic isomorphism happens when organisations imitate other organisations in response to uncertainty (DiMaggio and Powell, 1983). Normative isomorphism is primarily associated with professionalisation (DiMaggio and Powell, 1983). This study proposes that the coercive, mimetic and normative pressures imposed on organisations by different groups of stakeholders (including the government, regulators, suppliers, customers, competitors, industry associations and the community) influence the comprehensiveness of EMSs.

2.3.1 Coercive pressures

Coercive pressures are "formal and informal pressures exerted on organisations by other organisations upon which they are dependent and by cultural expectations in the society within which organisations function" (DiMaggio and Powell, 1983, p. 150). In relation to environmental issues, coercive pressures are typically associated with government and regulatory bodies (Sarkis et al., 2010). In particular, mandatory environmental regulations have proven to be an effective tool in motivating organisations to improve their environmental management (Winter and May, 2001; Henriques and Sadorsky, 1996). For example, the fines and penalties associated with regulatory non-compliance,

including the loss of operating permits, constrain the strategic actions of organisations (Darnall et al., 2010; Darnall et al., 2008; Henriques and Sadorsky, 1996). Furthermore, the threat of legal sanctions is perceived to be the main reason why organisations implement proactive environmental strategies (Hoffman, 2001).

Environmental legislation in Australia imposes liabilities not only on corporations but also on directors and managers for the offences of their corporations, thereby forcing organisations to minimise their environmental impacts to comply with legal requirements. For example, under the Protection of the Environment Operations Act 1997, the most serious environmental protection offences carry maximum penalties of five million dollars for corporations and one million dollars and/or seven years imprisonment for individuals (EPANSW, 2014). Hence, it is expected that organisations that face greater coercive pressures will devote more effort and resources to minimising environmental impacts and costs.

H1: Organisations subject to greater coercive pressures are expected to use a more comprehensive EMS.

2.3.2 Mimetic pressures

Mimetic isomorphism refers to the fact that in situations where there is uncertainty, organisations may "limit the selection of structures and practices to those structures and practices that are being used by organisations who they view as being successful in the institutional environment" (Carpenter and Feroz, 2001, p. 571). Hence, organisations mimic other organisations in order to gain legitimacy (DiMaggio and Powell, 1983; Meyer and Rowan, 1977) and/or to minimise the risk of a drop in competitive advantage (Malmi, 1999; Abrahamson and Rosenkopf, 1993). Mimicry has been found to be

relevant in explaining management activities (Rikhardsson et al., 2005; Abrahamson, 1991). It can also be a motivation for management to develop a system that provides information for evaluating sustainability issues (Schaltegger and Burritt, 2010). In the context of environmental management, organisations face general mimetic pressures from market leaders who "engage in activities so far beyond compliance that they raised the bar environmentally for everyone competing in their industry" (Sharfman et al., 2004, p. 26). Organisations facing such strong mimetic pressures are expected to strive to improve their environmental management initiatives in order to remain competitive. For example, Zhu and Geng (2013) found that mimetic drivers were an important motivation for Chinese manufacturers to implement extended supply chains to achieve Energy Saving and Emission Reduction goals.

H2: Organisations subject to greater mimetic pressures are expected to use a more comprehensive EMS.

2.3.3 Normative pressures

Normative pressures arise from social obligation or professionalisation, and "generally take the form of rules-of-thumb, standard operating procedures, occupational standards, and educational curricula" (Hoffman, 1999, p. 1999). Industry associations document their working conditions to legitimise their professional autonomy (Darnall et al., 2008). Normative pressures have been found to encourage organisations to implement environmental practices in order to be perceived as having legitimate organisational activities (Zhu and Geng, 2013). The normative pressures that organisations face to improve their environmental management can be manifested in many ways. Internally, in organisations with strong normative integration, evidenced by greater emphasis on performance, accountability and environmental policy, the corporate values and beliefs

will push organisations to extend their environmental management practices beyond compliance (Sharfman et al., 2004). Such pressure is even more likely if organisations have a high number of employees who are concerned about environmental issues. Furthermore, employees can play an important role in the implementation of EMSs, as they are often the originators and receivers of an organisation's proactive environmental activities (Sarkis et al., 2010).

Externally, normative pressures can be imposed on organisations through a variety of sources, including customers, professional groups, media and the community. Customers have proven to be a significant motivator for organisations to adopt environmental management practices. For example, Henriques and Sadorsky (1996) found that customers exerted the second highest pressure on Canadian firms to adopt an environmental plan. In addition, Zhang et al. (2008) also found that pressure from customers played a positive role in engaging organisations to improve environmental management performance.

Professional groups also influence the use of environmental management practices. In particular, they pay a great deal of attention to upholding a good environmental reputation to prevent increased scrutiny from regulators, environmentalists, and the media, which may result in the introduction of new regulations (King and Lenox, 2000). Furthermore, organisations that are members of a particular industry group are likely to exhibit a higher level of environmental innovation as a result of their internal transfer of knowledge (Ferreira et al., 2010).

Schaefer (2007) suggests that an important reason for the adoption of EMSs is the need to improve external legitimacy given the increased public scrutiny with regards to environmental issues. For example, according to a survey of public opinion by the New South Wales Office of Environment and Heritage (OEH, 2012), 78% of people said they were concerned to some extent about environmental problems with the environment ranking in the top five issues that the state government should focus on. Furthermore, the State of Climate Report 2012 revealed that the concentration of carbon dioxide in 2011 was "higher than at any time for the past 800,000 years" (CSIRO, 2012, p. 8) and that the "annual-average daily maximum temperatures have increased by 0.75 degrees Celsius since 1910" (CSIRO, 2012, p. 3). These findings will further raise public awareness and concern towards environmental issues, with Henriques and Sadorsky (2013) arguing that community groups can exert their power through the ability to lobby the regulatory system, and influence consumer purchasing patterns through media attention.

H3: Organisations subject to greater normative pressures are expected to use a more comprehensive EMS.

2.4 The association between Environmental Management System comprehensiveness and environmental performance

In addition to examining the antecedents of EMS comprehensiveness, the study also examines the influence of EMS comprehensiveness on environmental performance. Environmental performance refers to "the impact of an organisation's activities on the environment, including the natural systems such as land, air and water as well as on people and living organisms" (Langfield-Smith et al., 2015, p. 761). As environmental issues are becoming more important to a broad range of stakeholders, including

consumers, shareholders, potential investors, creditors, regulators, employees and the general public, there is an increased demand for corporate environmental performance information (Ilinitch et al., 1998). A range of measures have been developed by different groups, such as regulatory agencies, the business press and corporations themselves, to capture various aspects of environmental performance (Ilinitch et al., 1998). However, Lober (1996) notes that although judgements are frequently made about which organisation is 'greener', there is no clear or agreed upon definition of 'greenness', or in other words, what constitutes environmental performance. Similarly, Henri and Journeault (2010) state that there is a significant lack of consensus on the definition and operationalisation of this concept.

As previously mentioned, the measurement of environmental performance using environmental impact measures such as an electricity index (Friedrich et al., 2011), total material requirements (Baboulet and Lenzen, 2010), greenhouse gas emissions (Psaraftis and Kontovas, 2010), or toxic releases (Patten, 2002) limits the scope of this multidimensional concept to only one aspect. Hence, consistent with Henri and Journeault (2010), this study evaluates environmental performance using an instrument which measures the beneficial outcomes of organisational environmental capabilities. Specifically, Henri and Journeault (2010) required respondents to indicate the extent to which environmental practices have led to various types of benefits, including reductions in material/process/production costs, reductions in the costs of regulatory compliance, increased process/product efficiency, and better relationships with stakeholders.

In the environmental management literature, many studies have examined the relationship between EMSs and environmental performance (Iraldo et al., 2009; Hertin et al., 2008; Bansal and Clelland, 2004; Johnstone et al., 2004; Dahlström et al., 2003; Melnyk et al., 2003; Schucht, 2000) with mixed results. For example, Johnstone et al. (2004) found that EMSs played an important role in motivating organisations to undertake measures to improve their environmental performance. The use of EMSs was found to be particularly important in controlling waste water and air emissions and reducing the environmental impact of accidents. Similarly, Schucht (2000) reported that the adoption of EMSs had a significant influence on waste generation, resource use and water consumption. Finally, Iraldo et al. (2009) reported the positive impact of well-designed EMSs on environmental performance.

Alternatively, other studies have found little or no evidence of improved environmental performance. For example, Hertin et al. (2008) only found a weak link between EMSs and environmental performance in the manufacturing sector in six EU countries. Dahlström et al. (2003) did not find a significant relationship between the adoption of an EMS and actual performance, although having an EMS was found to improve a number of procedural aspects of environmental management such as plant maintenance, process operation, implementation of authorisation requirements and the recording of information.

There is scant research examining the impact of the comprehensiveness of EMSs on environmental performance, and hence this study aims to fill this gap in the literature. There are a number of reasons why a comprehensive EMS can lead to improved performance. Organisations that implement a more comprehensive EMS demonstrate a

greater commitment towards environmental improvement (Darnall et al., 2010). A well-designed EMS can assist organisations in managing, measuring and improving the environmental aspects of their operations (Sroufe, 2003). EMSs can reduce the possibility of unintended non-compliance with environmental regulations (Johnstone and Labonne, 2009). In addition, a comprehensive EMS can assist managers in identifying economical ways of meeting environmental goals, which can result in improved performance (Johnstone and Labonne, 2009). EMSs can generate information regarding regulatory requirements and internal environmental practices, and assist in resolving internal agency control issues which may cause negative environmental impacts (Potoski and Prakash, 2005). Furthermore, comprehensive EMSs are seen to have the potential to enhance the effectiveness of input usage, and thereby reduce waste generation (Anton et al., 2004). Alternatively, it is argued that organisations without a comprehensive EMS are not likely to implement systematic methods for improving their environmental performance including those that are not directly regulated by laws (Uchida and Ferraro, 2007).

H4: The comprehensiveness of an EMS is positively associated with environmental performance.

3 Method

3.1 Data collection

Survey questionnaires were distributed to 820 Australian organisations across various industries in the primary (agriculture, mining), secondary (manufacturing, construction), and tertiary (utilities, transport, health) sectors. These organisations were identified using the OneSource database which provides in-depth business information of organisations in Asia and the Pacific Rim. The target respondents were managers at

different levels, including chief executive officers (CEOs)/managing directors, chief financial officers (CFOs)/finance managers, and chief operating officers (COOs)/production managers. The format of questions, techniques to personalise the survey and the distribution procedures followed Dillman's (2007) Tailored Designed Method which has been shown to maximise response rates.

Two hundred and seventeen (217) questionnaires were returned for a response rate of 26.5%, of which 85 (10.4%) questionnaires were from the first mail-out, and 132 (16.1%) from the second mail-out. Nine questionnaires were omitted due to substantial missing data, resulting in 208 usable questionnaires (25.4%). Appendix 1 presents the details regarding the respondents based on management level and industry.

In accordance with Roberts (1999), non-response bias was evaluated by comparing dependent and independent variable values between the early and late respondents, with no significant differences found. Furthermore, the comparison between respondents and non-respondents with respect to the average size (based on the number of employees) and industry did not detect any significant difference. Therefore, non-response bias did not appear to be a major concern.

3.2 Data analysis

Structural equation modelling (SEM) was used to test the hypotheses. With its ability to provide scholars with a comprehensive method to evaluate and modify theoretical models, SEM has become more frequently used in social sciences (Anderson and Gerbing, 1988). SEM is considered useful especially when one dependent variable becomes an independent variable in subsequent relationships (Hair et al., 2006).

According to Sroufe (2003), a two-stage process of SEM has been proposed by many researchers. Stage one involves the estimation and refinement of the measurement model for each variable, followed by stage two where the structural model is estimated. The justification of this approach is that the reliability of the measures is best accomplished in two stages to avoid the interaction of measurement and structural models (Hair et al., 2006). Section 3.3 provides details of the measurement models for the variables, whereas the result of the final structural model is presented in section 4.2.

3.3 Measurement of variables

Appendix 2 shows the instruments used to measure the variables in the study. These latent variables were measured using reflective indicators, with changes in the latent variables reflected in changes in the observable indicators. The uni-dimensionality of each variable was established by performing exploratory factor analysis (EFA) using maximum likelihood with a direct oblimin rotation. Items with loadings below the cut-off point of 0.4 as recommended by Hair et al. (1998) were dropped from the analysis. The validity of the measurement models for each of the scales resulting from EFA was tested using confirmatory factor analysis (CFA). The assessment of these models was done by examining the squared multiple correlation coefficients, modification indices, and a number of fit indices. The redundant items were eliminated to improve the goodness of fit of the models. These items are marked with an asterisk (*) in Appendix 2. Cronbach's alpha coefficients for the final scales were calculated to ensure the reliability values exceeded the threshold of 0.7 (Nunnally, 1978). Details of the measurement and analysis of each construct are discussed below, with Cronbach's alpha coefficients and selected fit indices of the final and refined measurement models reported in Table 1.

Table 1 Results of the measurement models

Variable	No. of items	Cronbach's alpha	Chi-square	df	Normed chi-square	GFI	CFI	RMSEA
EMS Comprehensiveness	9	0.921	63.074	26	2.426	0.941	0.967	0.083
Institutional pressures								
Coercive	3	0.785	0.002	1	0.002	1	1	0
Mimetic	2	0.884	0	0	-	1	1	-
Normative	8	0.901	40.745	17	2.397	0.953	0.973	0.082
Performance								
Resource usage	4	0.773	4.128	2	2.064	0.990	0.991	0.072
Regulatory compliance	3	0.798	0.204	1	0.204	0.999	1	0
Productivity	2	0.802	0	0	-	1	1	-
Stakeholder interaction	2	0.679	0	0	-	1	1	-

Recommended threshold: Normed chi square < 3, GFI and CFI > 0.90, RMSEA < 0.10

3.3.1 Environmental Management System comprehensiveness

Respondents were asked to indicate, on a scale of '1 = not at all' to '5 = to a great extent' the extent to which their organisation had implemented each of nine environmental management practices adapted from Anton et al. (2004) and Henriques and Sadorsky (2007) (see Appendix 2). Anton et al. (2004) was the first study to propose and operationalise the concept of the comprehensiveness of an EMS. Henriques and Sadorsky (2007) adopted the measure with some adjustments and tested it in a large survey of more than 4,000 facilities across seven countries.

Exploratory factor analysis using the maximum likelihood extraction method and varimax with Kaiser normalisation rotation method was performed to analyse the variable's uni-dimensionality. The analysis resulted in only one factor with an eigenvalue greater than 1 (Cronbach's alpha = 0.921). To test the validity of the measurement model, confirmatory factor analysis was then conducted. The model fit

was assessed using several common model fit measures[1]. The measurement model for EMS comprehensiveness exhibited a good fit to the data (see Table 1). Therefore, there was no need to respecify or refine the model and all nine items were retained in the scale.

3.3.2 Institutional pressures

The 16-item institutional pressures measure was mainly adapted from Zhu and Geng (2013) (8 items) and Boiral and Henri (2012) (5 items), both of which examined institutional forces in the context of environmental management. The remaining three items were self-developed based on institutional theory (DiMaggio and Powell, 1983). Respondents were asked to indicate, on a scale from '1 = not at all' to '5 = to a great extent', the extent to which these factors had influenced their organisation's focus on environmental issues (see Appendix 2).

Exploratory factor analysis using maximum likelihood and varimax rotation resulted in three factors with eigenvalues greater than 1, which accounted for 62.5% of the total variance (see Table 2). Two items (7 and 10) did not load onto any factor and therefore were removed. The first factor includes 'compliance with international environmental standards', 'compliance with national/regional environmental regulations', and 'compliance with national/regional resource saving and conservation regulations' and was labelled 'coercive pressures'. The second factor includes 'the green strategies of same product producers', 'the green strategies of substitute product producers', and 'pressures from suppliers, partners, and clients with respect to environmental issues' and was labelled 'mimetic pressures'. The remaining factor was labelled 'normative

[1] The common fit measures and their recommended threshold values are: norm chi-square < 3 (Ballantyne et al., 2011); GFI and CFI > 0.90 (López-Gamero et al., 2010); and RMSEA < 0.10 (Henri, 2006).

pressures' and includes: 'awareness of best practices in the industry', 'the environmental awareness of employees', 'the extent of media focus on the industry', 'public environmental awareness', 'the legitimisation of the organisation's activities', 'the focus on performance and accountability', 'the focus on environmental policy in the organisational vision and/or mission statement', 'and professional groups' attention to environmental issues'.

Table 2 Factor analysis – Institutional pressures

Item*	Factor		
	Coercive	Mimetic	Normative
1	**.641**	.182	.200
2	**.699**	.030	.382
3	**.733**	.248	.177
4	.253	**.476**	.350
5	.120	**.834**	.200
6	.152	**.898**	.095
7	.328	.341	.351
8	.312	.151	**.632**
9	.179	.174	**.620**
10	.291	.309	.338
11	.225	.121	**.631**
12	.184	.113	**.740**
13	.107	.174	**.772**
14	.200	.123	**.746**
15	.267	.274	**.657**
16	.282	.326	**.584**

Extraction Method: Maximum Likelihood.
Rotation Method: Varimax with Kaiser Normalisation.
Rotation converged in 5 iterations.
* Item numbers as listed in Appendix 2.

The reliability of these three factors was assessed by estimating the Cronbach's alphas (coercive pressures 0.785, mimetic pressures 0.811, and normative pressures 0.901). With respect to mimetic pressures, item 4 did not contribute to the Cronbach's alpha

and therefore was eliminated. The resulting scale of items 5 and 6 for mimetic pressures has a Cronbach's alpha of 0.884. Confirmatory factor analysis was performed for each of the scales to assess their validity. The measurement model for mimetic pressures could not be tested as it had only two indicators and zero degrees of freedom. The other two measurement models exhibit a good overall fit (see Table 1).

3.3.3 Environmental performance

Respondents were asked to indicate, on a 5-point scale ranging from '1 = not at all' to '5 = to a great extent', the extent to which each of the 15 environmental outcomes were achieved in their organisation (see Appendix 2). These environmental performance measures were identified from previous research on environmental management and performance (Langfield-Smith et al., 2015; Henri and Journeault, 2010).

Factor analysis was performed to analyse the different dimensions of environmental performance. Four factors with eigenvalues greater than 1 were extracted, which accounted for 55.6% of the total variance (see Table 3). Item 14 (increased filters and controls on emissions and discharges) did not load onto any factor (cut-off point of 0.4) and therefore was eliminated. The first factor includes 'reductions in energy consumption', 'reductions in water usage', 'reductions in material costs due to the efficient use of material', 'reductions in levels of waste', 'reductions in levels of emissions', and 'increased residue recycling', and was labelled 'resource usage'. The second factor includes 'reductions in the costs of regulatory compliance', 'reductions in the costs associated with cleaning up environmental damage', and 'reductions in the fines paid and remediation costs regarding environmental damage', and was labelled 'regulatory compliance'. The third factor was labelled 'productivity' and includes

'reductions in process/production costs', 'increased process/production efficiency', and 'increased knowledge about effective ways of managing operations'. The last factor includes 'increased organisation-wide learning among employees' and 'better relationships with stakeholders such as local communities, regulators, and environmental groups', and was labelled 'stakeholder interaction'.

Table 3 Factor analysis – Environmental performance

Item*	Factor			
	Resource usage	Regulatory compliance	Productivity	Stakeholder interaction
1	**.699**	.008	.187	-.024
2	**.718**	.132	.187	.133
3	**.567**	.098	.522	.071
4	**.487**	.174	.117	.264
5	**.499**	.321	.183	.075
15	**.426**	.231	.096	.205
7	.216	**.485**	.258	.169
8	.163	**.770**	.207	.144
9	.112	**.841**	.140	.143
6	.314	.189	**.769**	.021
10	.169	.330	**.708**	.164
11	.284	.197	**.462**	.399
12	.169	.055	.204	**.808**
13	.058	.334	-.040	**.614**
14	.343	.387	.200	.286

Extraction Method: Maximum Likelihood.
Rotation Method: Varimax with Kaiser Normalisation.
Rotation converged in 6 iterations.
* Item numbers as listed in Appendix 2.

Each environmental performance dimension was evaluated in terms of reliability (Cronbach's alpha) and validity (confirmatory factor analysis) with the results reported in Table 1. With respect to the 'resource usage' dimension, the initial Cronbach's alpha

for this scale (6 items) was 0.798. Confirmatory factor analysis revealed two items ('reductions in levels of emissions' and 'increased residue recycling') with low squared multiple correlation coefficients (0.251 and 0.298 respectively) and hence these two items were removed. The scale then exhibited a good fit and a Cronbach's alpha of 0.773. The 'regulatory compliance' dimension has a Cronbach's alpha of 0.798 and the measurement model showed a good fit. The item 'increased knowledge about effective ways of managing operations' in the 'productivity' dimension did not contribute to the Cronbach's alpha and therefore was deleted, resulting in a final scale of two items with a Cronbach's alpha of 0.802. The measurement models for the 'productivity' and 'stakeholder interaction' (Cronbach's alpha 0.679) dimensions could not be tested as they have only two indicators and zero degrees of freedom.

3.3.4 Control variables

Size

Common findings in the literature suggest that larger organisations are more likely to adopt formal management control systems (Ferreira et al., 2010), in particular environmental management practices (Henriques and Sadorsky, 2007), as they usually have more resources and experience more pressure from stakeholders. The size of organisations was measured by the natural logarithm of the number of full-time employees.

Industry

Organisations operating in more environmentally sensitive industries, which have a greater impact on the environment, tend to display higher levels of environmental

commitment (Christ and Burritt, 2013). The three industry sectors examined in this study are primary (agriculture and mining), secondary (manufacturing and construction), and tertiary (utilities, transport, health and other services). Dummy variables were used to measure industry sectors.

4 Results

4.1 Environmental Management System comprehensiveness

Table 4 provides the descriptive statistics on the extent of use of each of the nine environmental practices used to evaluate the comprehensiveness of EMSs. The practice that organisations used to the greatest extent is 'having policies, rules, regulations, procedures in relation to environmental management' (mean score = 3.72), followed by 'having dedicated staff responsible for focusing on environmental issues' (mean score = 3.13) and 'having frequent internal environmental audits' (mean score = 2.98). The practices that received the least attention were 'using environmental criteria in the evaluation and/or compensation of employees' (mean score = 2.26), 'having frequent environmental training programs' (mean score = 2.46) and 'benchmarked environmental performance' (mean score = 2.60).

Table 5 provides the descriptive statistics on the EMS comprehensiveness across different industries, with the EMS comprehensiveness score computed as the sum of the scores for the nine environmental practices. Overall the extent of EMS comprehensiveness is below the mid-point of the range (with a mean of 25.63). The utilities industry exhibited the highest level of EMS comprehensiveness (mean score = 31.09), followed by mining (28.70) and construction (28.23). The agriculture and health industries reported the lowest mean scores (21.22 and 21.55 respectively).

Table 4 Summary statistics for EMS comprehensiveness

Item	Mean	Standard deviation
1. Policies, rules, regulations, procedures in relation to environmental management	3.72	1.099
2. Dedicated staff responsible for focusing on environmental issues	3.13	1.377
3. Used environmental criteria in the evaluation and/or compensation of employees	2.26	1.087
4. Frequent environmental training programs	2.46	1.129
5. Frequent internal environmental audits	2.98	1.315
6. Frequent external environmental audits	2.84	1.316
7. Benchmarked environmental performance	2.60	1.208
8. Processes to evaluate environmental risks when selecting suppliers, partners, or clients	2.75	1.199
9. Environmental performance indicators and goals	2.89	1.275

N = 208. Minimum (actual and theoretical) = 1. Maximum (actual and theoretical) = 5.

Table 5 EMS comprehensiveness by industry category

Industry	N (%)	EMS comprehensiveness			
		Mean	Std Error	Min^	Max^
Agriculture	27 (13.5)	21.22	1.346	9	34
Mining	33 (16.5)	28.70	1.354	10	44
Manufacturing	29 (14.5)	25.62	1.582	10	40
Construction	22 (11.0)	28.23	1.595	10	42
Health	31 (15.5)	21.55	1.325	10	38
Transport	25 (12.5)	23.96	1.758	10	43
Utilities	33 (16.5)	31.09	1.406	12	45
Total	200 (100)	25.63	0.600	9	45

^ Minimum theoretical = 9, Maximum theoretical = 45

4.2 The structural equation model

Figure 1 represents the conceptual and structural model of the study. The structural model was tested by means of maximum likelihood estimate using AMOS version 21 software. Table 6 reports the results in terms of path coefficients, t-values, significance, proportion of variance (R^2) and the fit indices used to assess the model fit. With regards to the fit indices, the normed chi-square (2.007) and RMSEA (0.070) are satisfactory and the CFI (0.857) is close to the recommended threshold.

Figure 1 The structural equation model

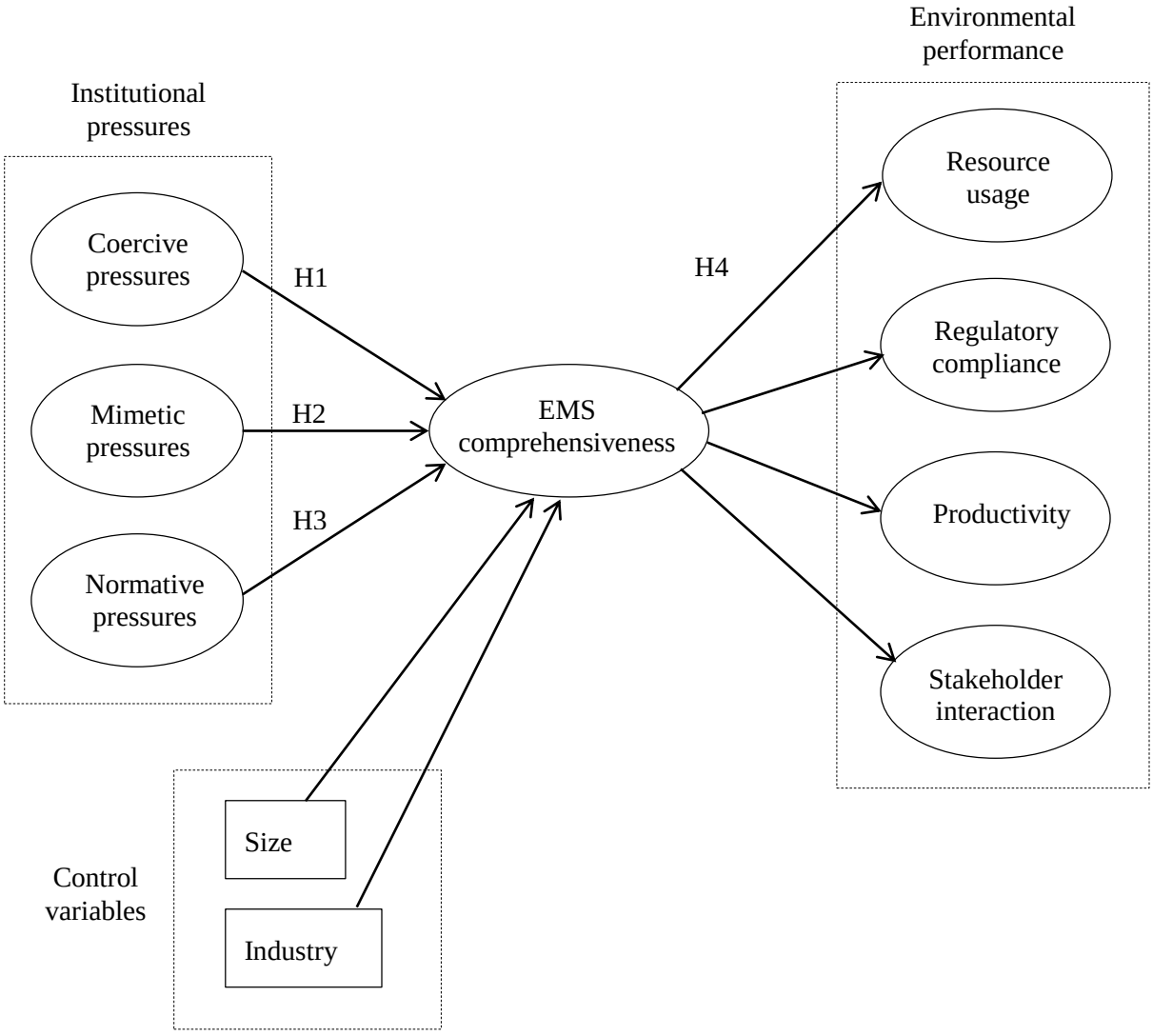


Table 6 Results of the structural equation model

Description of path	Path coefficient	t-value	p	R^2
Coercive pressures → EMS Comprehensiveness	0.354	3.636	0.000	
Mimetic pressures → EMS Comprehensiveness	-1.153	-2.511	0.012	
Normative pressures → EMS Comprehensiveness	0.694	7.293	0.000	0.744
Size → EMS comprehensiveness	0.140	5.080	0.000	
Industry_Primary → EMS comprehensiveness	0.158	1.253	2.000	
Industry_Secondary → EMS comprehensiveness	0.281	4.349	0.000	
EMS Comprehensiveness → Resource usage	0.113	2.058	0.040	0.027
EMS Comprehensiveness → Regulatory compliance	0.223	4.349	0.000	0.135
EMS Comprehensiveness → Productivity	0.129	2.137	0.033	0.028
EMS Comprehensiveness → Stakeholder interaction	0.324	5.535	0.000	0.364

Goodness-of-fit indices: Norm chi-square = 2.007, CFI = 0.857, RMSEA = 0.070

Table 6 shows that the two control variables, size and industry, are associated with EMS comprehensiveness. Specifically, larger organisations exhibited a more comprehensive EMS, while organisations from the secondary industry have a more comprehensive EMS than those from the tertiary industry. In addition, coercive ($\beta = 0.354$, $p = 0.000$) and normative ($\beta = 0.694$, $p = 0.000$) pressures were positively associated with the comprehensiveness of EMSs, thereby providing support for hypotheses 1 and 3. However, contrary to our prediction, mimetic pressures were found to be negatively associated with EMS comprehensiveness ($\beta = -1.153$), $p = 0.012$), and hence hypothesis 2 is not supported.

The comprehensiveness of EMSs was found to be positively associated with all four dimensions of environmental performance, namely resource usage ($\beta = 0.113$, $p = 0.040$), regulatory compliance ($\beta = 0.223$, $p = 0.000$), productivity ($\beta = 0.129$, $p = 0.033$), and stakeholder interaction ($\beta = 0.324$, $p = 0.000$). Therefore hypothesis 4 is supported.

Given the significant findings regarding the impact of EMS comprehensiveness on environmental performance, further exploratory analysis was undertaken to examine the association between each of the nine environmental management practices and the four dimensions of environmental performance. The results of the multiple regression analyses (using forced entry method) are reported in Table 7. The findings indicate that 'benchmarking environmental performance' ($\beta = 0.204$) was significantly associated with the resource usage dimension of environmental performance, while 'using environmental criteria in the evaluation and/or compensation of employees' ($\beta = 0.256$) was significantly associated with the regulatory compliance dimension. Furthermore, there was a significant relationship between 'having processes to evaluate environmental risks when selecting suppliers, partners or clients' ($\beta = 0.204$) and the productivity dimension. Finally, 'having policies, rules, regulations, procedures in relation environmental performance' ($\beta = 0.220$) was found to be associated with the stakeholder interaction dimension of environmental performance.

Table 7 The relationship between EMS comprehensiveness and environmental performance dimensions

Item ^	Standardised coefficient - Environmental performance			
	Resource usage	Regulatory compliance	Productivity	Stakeholder interaction
1	0.012	-0.079	0.036	0.220**
2	0.152	0.191*	0.035	-0.023
3	0.022	0.256**	-0.024	0.149*
4	0.052	0.008	0.109	0.096
5	-0.084	-0.052	-0.117	0.149
6	-0.157	0.060	0.055	-0.092
7	0.204**	0.022	0.030	-0.053
8	0.161*	0.071	0.204**	0.082
9	-0.193*	-0.050	-0.132	0.037
R^2	0.067	0.144	0.044	0.239
F	1.590	3.706	1.008	6.891

^ EMS comprehensiveness items numbered 1 to 9 as listed in Appendix 2

** Significant at the 0.05 level; * Significant at the 0.10 level

5 Discussion

The first objective of this paper was to provide a more detailed insight into the nature of EMSs within organisations. Consequently, the study examined the comprehensiveness of EMSs using a measure which focused on the extent to which nine environmental management practices associated with the use of an EMS were used by Australian organisations across various industries.

The findings highlight the variation in the extent of use of environmental management practices across industries and organisations. In particular, it was found that of the seven industries examined, the utilities and mining industries used the most comprehensive EMSs, while the health and agriculture industries used EMSs to the least extent. Such findings serve to highlight the relevance of environmental management practices for specific industries and the necessity to up the ante in respect to the focus on such initiatives in other industries. Furthermore, by capturing the variation in the use of the nine initiatives, the findings reinforce claims in the literature concerning the difference in EMSs across organisations (Darnall et al., 2008). Importantly, such findings also highlight the limitations associated with empirical studies which simply categorise organisations into EMS users and non-users, or merely focus on the use of specific practices as opposed to encapsulating the intensity of use of specific practices. Finally, the findings make organisations aware of the areas in which their focus on environmental management may be deficient. For example, given 'using environmental criteria in the evaluation and/or compensation of employees' was used to the least extent, organisations may need to concentrate on this aspect to a greater extent.

The second objective of the study was to investigate the influence of institutional pressures, namely coercive, mimetic and normative pressures, on the comprehensiveness of EMSs. The findings contribute to the literature by providing empirical evidence of the determinants of the comprehensiveness of EMSs and reinforcing the importance and relevance of institutional theory in explaining the adoption of environmental practices. Surprisingly, mimetic pressures were found to have a negative influence on the comprehensiveness of EMSs, suggesting that organisations do not follow the leads of competitors who adopt proactive 'green' strategies. Alternatively, the threat of coercive pressures was found to be associated with EMS comprehensiveness, implying that the government can significantly affect the use and comprehensiveness of EMSs. The earlier finding that the heavily regulated utilities and mining industries reported higher levels of EMS comprehensiveness supports this suggestion. In addition, in line with Uchida and Ferraro (2007) and Anton et al. (2004), the findings suggest that the government can induce improvements in environmental performance by creating regulatory pressures such as the threat of more stringent mandatory regulation. Therefore, environmental policy should focus on encouraging organisations with a limited EMS to use more practices and use them to a greater extent to achieve better environmental outcomes. Effort should be directed to the practices that received the least attention from organisations, including using environmental criteria in the evaluation and/or compensation of employees, providing frequent environmental training programs, and benchmarking environmental performance. This could be achieved by providing public information sessions, technical assistance, or subsidised training sessions to organisations with limited resources.

The government can also potentially induce the improvement of environmental performance indirectly through appropriately designed public incentives, since normative pressures from a variety of sources, including employees, professional groups, media and the community, were found to be an antecedent of EMS comprehensiveness. This can be achieved through designing and targeting public policy efforts towards public recognition of the improved environmental performance which allows organisations to differentiate themselves from others, mandatory provision of organisations' environmental information to the public, and educating the public about the adverse consequences of various undesirable environmental actions (Clarkson et al., 2011; Khanna and Anton, 2002).

The third objective of this study was to address the gap in the literature concerning the effectiveness of environmental management initiatives by examining the association between EMS comprehensiveness and environmental performance. In examining this association, the study incorporated Henriques and Journeault's (2010) broader measure of environmental performance in conjunction with the more detailed measure of EMS comprehensiveness. Organisations with more comprehensive EMSs were found to experience better environmental performance in all four areas of resource usage, regulatory compliance, productivity and stakeholder interaction. The results suggest that when organisations take a systematic and whole-hearted approach in developing a comprehensive EMS, their environmental performance is perceived to be better. Further analysis also revealed specific environmental management practices that organisations should focus on to achieve improvements in a particular area of environmental performance. For example, to improve resource usage, organisations should benchmark their environmental performance to a greater extent.

In addition to improving environmental performance, the development of a more comprehensive EMS enables organisations to respond to the coercive and normative pressures they face. Organisations can anticipate rather than submit to emerging regulatory constraints, reduce the stringency of anticipated mandatory regulations and thus reduce the expected costs of compliance in the future (Khanna and Anton, 2002; De Borchgrave, 1993). Organisations can also communicate, consult and collaborate with key stakeholders to address environmental issues, for instance, hosting environmental forums or establishing advisory panels (Delmas and Toffel, 2004).

6 Conclusion

The study contributes to the literature by providing a more detailed insight into the nature of EMSs, the influence of institutional pressures on EMS comprehensiveness, and the association between EMS comprehensiveness and environmental performance. Given the reported positive association between EMS comprehensiveness with environmental performance, it is suggested that organisations should endeavour to implement environmental management practices to a greater extent. In considering this, the current study highlights the merits of examining EMS comprehensiveness utilising an approach which assesses the intensity of use of specific environmental management practices.

In addition, given the importance of EMS comprehensiveness in enhancing environmental performance, organisations should be aware of the factors that affect the comprehensiveness of EMSs and other proactive strategies. In particular, this study highlights the importance of institutional pressures, specifically coercive and normative pressures, in enhancing the comprehensiveness of EMSs. Organisations should be

aware of and anticipate such pressures with a view to minimising the costs of disruption and compliance, while at the same time reflecting on the comprehensiveness of their EMS and its role in enhancing environmental performance.

Given the inherent limitations of the mail survey method, future studies may utilise interviews together with surveys in an attempt to provide further insights into the extent to which environmental practices are used. In addition, given the study is static, i.e. it only examines the use of EMSs at the present time, future studies could expand the research by investigating the improvement in environmental performance through the use of more comprehensive EMSs over time.

While the study measures EMS comprehensiveness using an established instrument, future studies could reinforce the findings by incorporating other key components of an EMS set out in internationally recognised guidelines or standards such as the ISO 14001 or EMAS. Similarly, in evaluating environmental performance, researchers may refer to the ISO 14031 standard which provides guidance on the design and use of environmental performance evaluation within an organisation. Furthermore, in response to claims that survey data fails to capture actual environmental performance, future research may use more objective data to assess environmental performance. Alternatively, future studies could use such objective data to confirm the validity of survey-based environmental performance instruments.

Appendix 1: Respondents by management level and industry

	n	%
Panel A: Management level		
CEO/Managing director	62	30.4
CFO/Finance manager	26	12.7
COO/Production manager	120	56.9
Total	208	100
Panel B: Industry category		
Agriculture	27	13.0
Mining	33	15.9
Manufacturing	29	13.9
Construction	22	10.6
Health	31	14.9
Transport	25	12.0
Utilities	33	15.9
Other	8	3.8
Total	208	100

Appendix 2: Measurement of variables

The items marked with an asterisk (*) were removed after testing the measurement models.

EMS comprehensiveness

Please indicate the extent to which your organisation has:

1. Policies, rules, regulations, procedures in relation to environmental management [a,b]
2. Dedicated staff responsible for focusing on environmental issues [a]
3. Used environmental criteria in the evaluation and/or compensation of employees [a,b]
4. Frequent environmental training programs [b]
5. Frequent internal environmental audits [a,b]
6. Frequent external environmental audits [a,b]
7. Benchmarked environmental performance [b]
8. Processes to evaluate environmental risks when selecting suppliers, partners, or clients [a]
9. Environmental performance indicators and goals [b]

[a] Anton et al. (2004); [b] Henriques and Sadorsky (2007)

Institutional pressures

Please indicate the extent to which the following factors have influenced your organisation's focus on environmental issues:

1. Compliance with international environmental standards [a]
2. Compliance with national/regional environmental regulations [a]
3. Compliance with national/regional resource saving and conservation regulations [a]
4. * Pressures from suppliers, partners, and clients with respect to environmental issues[b]
5. The green strategies of same product producers [a]
6. The green strategies of substitute product producers [a]
7. * Competition in the industry [b]
8. Awareness of best practices in the industry [b]
9. The environmental awareness of employees [b]
10. * The environmental awareness of customers [b]
11. The extent of media focus on your industry [a]
12. Public environmental awareness (community, NGO etc.) [a]

13. The legitimisation of your organisation's activities [c]

14. The focus on performance and accountability [c]

15. The focus on environmental policy in the organisational vision and/or mission statement [c]

16. Professional groups' attention to environmental issues [a]

[a] Zhu and Geng (2013); [b] Boiral and Henri (2012); [c] Self-developed based on institutional theory

Environmental performance

Below is a list of desired environmental outcomes. Please indicate the extent to which each of the following outcomes is achieved in your organisation:

1. Reductions in energy consumption [a]

2. Reductions in water usage [a]

3. Reductions in material costs due to the efficient use of material [b]

4. Reductions in the levels of waste [a]

5. * Reductions in levels of emissions [a]

6. Reductions in process/production costs [b]

7. Reductions in the costs of regulatory compliance [b]

8. Reductions in the costs associated with cleaning up environmental damage [a]

9. Reductions in the fines paid and remediation costs regarding environmental damage[a]

10. Increased process/production efficiency [b]

11. * Increased knowledge about effective ways of managing operations [b]

12. Increased organisation-wide learning among employees [b]

13. Better relationships with stakeholders such as local communities, regulators, and environmental groups [b]

14. * Increased filters and controls on emissions and discharges [b]

15. * Increased residue recycling [b]

[a] Langfield-Smith et al. (2015); [b] Henri & Journeault (2010)

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CHAPTER FIVE

PAPER TWO

The use and effectiveness of Environmental Management Accounting

(A journal article based on this paper is currently under a 'Revise and Resubmit' at the Australasian Journal of Environmental Management)

Abstract

This study examines the extent of use of both physical and monetary components of Environmental Management Accounting (EMA) and the influence of the comprehensiveness of the Environmental Management System (EMS), size, and top management support, on the use of EMA. The study also investigates the impact of EMA use on environmental performance. Data were collected from 208 Australian organisations across different industries using a mail survey questionnaire. The results indicate a moderate extent of physical EMA use, and a low extent of monetary EMA use. The comprehensiveness of the EMS and top management support were found to influence the use of EMA. In addition, organisations using EMA to a greater extent, in particular monetary EMA, were found to experience higher levels of environmental performance. The findings provide support for the promotion of the dissemination of EMA in practice.

Keywords: Environmental Management Accounting, environmental performance, environmental management, management accounting.

1 Introduction

Over the last few decades, the expanding population and increasing industrial development has led to environmental degradation, including acid rain, global warming and depletion of the ozone layer, becoming one of the largest threats to society worldwide (Zailani et al., 2012). Consequently, organisations face increasing pressure from a variety of stakeholders, including shareholders, customers, employees, the government and regulatory bodies, to monitor and control the impact of their operational activities on the natural environment (Burnett and Hansen, 2008). Such pressures require management to provide timely information about various aspects of their operations beyond those reflected in traditional financial and cost accounting methods (Burritt, 2005; IFAC, 2005; UNDSD, 2001). However, managers are generally unaware of the environmental costs generated by their organisation (Herzig et al., 2012) with traditional accounting systems failing to separately identify, measure and report environmental information, particularly environmental costs. Similarly, Burritt (2005) identified a number of problems in traditional management accounting in regard to the lack of recognition of environmental impacts such as environmental costs not being identified or tracked, investment appraisals excluding environmental considerations, and limited accounting for externalities and sustainability issues.

In response to such limitations, a new field of accounting called Environmental Management Accounting (EMA) has emerged and received increased attention. EMA represents "a combined approach which provides for the transition of data from financial accounting, cost accounting and material flow balances to increase material efficiency, reduce environmental impact and risk and reduce costs of environmental protection" (Jasch, 2003, p. 668). It facilitates the integration of environmental issues

into management decision making by providing both physical and monetary information regarding the environmental impact of organisations. To maintain sustainable global economic growth, every organisation is required to be actively engaged in environmental activities such as reducing energy and resource costs, improving production efficiency, and reducing compliance costs (Zhang, 2014).

The promotion of EMA has been undertaken by a number of international government bodies, evidenced through the publication of various guidance documents developed by international organisations, including the 'International guidance document: EMA' by the International Federation of Accountants (IFAC, 2005), the 'EMA Workbook' by the Japanese Ministry of Economy, Trade and Industry (METI, 2002), the 'EMA: Procedures and principles' by the United Nations Division for Sustainable Development (UNDSD, 2001), and 'An introduction to environmental accounting as a business management tool: Key concepts and terms' by the United States Environmental Protection Agency (USEPA, 1995).

However, the growth of EMA is relatively slow (Doorasamy, 2015), with many organisations only integrating minimal environmental activities in a few isolated experimental projects rather than implementing systematic and comprehensive EMA systems (Bartolomeo et al., 2000). Consequently, this study aims to provide an empirical insight into the use and effectiveness of EMA within Australian organisations. Given the need to address the global concern regarding environmental issues including resource scarcity, air pollution, and toxic waste, EMA represents a crucial source of information which can enhance manager's awareness of environmental issues, thereby enabling them to respond to external pressures in an appropriate fashion. EMA

information is also expected to support decision making by managers aimed towards achieving environmental outcomes.

This study contributes to the EMA literature by providing a more detailed insight into the nature and use of EMA, the contingent factors affecting the use of such practices, and the impact of the use of EMA on environmental performance. First, the study incorporates a comprehensive measure of EMA use. While most EMA studies have only examined a single aspect of EMA, Ferreira et al. (2010) was the first paper to develop a multi-item measure of EMA. However, their measure mainly focused on the monetary component of EMA with only a limited number of physical EMA measurement items included. Accordingly, this paper contributes to the development of EMA measurement by developing a multi-item measure of EMA which focuses on both monetary and physical EMA.

Secondly, this study aims to provide an insight into the contingency factors influencing the use of EMA. Contingency theory suggests that a particular accounting system is dependent on the specific circumstances in which an organisation operates (Otley, 1980). Despite being one of the most widely applied theories in contemporary management accounting research, contingency theory has been underutilised in EMA research (Christ and Burritt, 2013; Bouma and van de Veen, 2002). Abdel-Kader and Luther (2008) argue that contingency theory provides a foundation in understanding factors that affect the adoption of EMA, while Christ and Burritt (2013) highlight the importance of such an understanding in promoting the adoption of EMA. Accordingly, the study contributes to the EMA literature by applying contingency theory to examine factors that influence the adoption of EMA, with the factors chosen in a way to extend

the contingency based literature. Specifically, based on the findings of Christ and Burritt (2013), size was chosen as one of the contingency factors in this study. While environmental strategy was also identified as one of the contingency factors in Christ and Burritt (2013), this study argues that organisations with environmental strategies can significantly vary in terms of the extent of their environmental proactivity and the integration of environmental initiatives into their organisational strategic plans. Accordingly, in order to provide an insight into this specific aspect of environmental strategy, the study includes the comprehensiveness of an Environmental Management System (EMS) as a contingency factor. An additional contingency factor, top management support, was chosen as while it was found to be one of the most important factors affecting the adoption of various contemporary accounting systems (such as activity-based management, performance measurement systems and total quality management) in management accounting research (Tung et al., 2011; Baird et al., 2007), it has been largely ignored in EMA studies.

Thirdly, in line with the pragmatists view, this study aims to examine the association between the use of EMA and environmental performance. Critical theorists assert that organisations adopt environmental accounting practices only if they can improve financial performance while pragmatists propose that organisations adopt environmental accounting practices in an attempt to enhance sustainability (Springett, 2003; Larrinaga-Gonzalez and Bebbington, 2001). By examining the role of EMA in achieving desired environmental outcomes, operationalised as environmental performance, the study provides an empirical insight into the pragmatists view that organisations should engage in activities designed to achieve sustainable outcomes. In particular, the study examines

the role of EMA as a facilitator of managerial decision making which achieves desirable environmental outcomes.

2 Theory and hypotheses development

2.1 Environmental Management Accounting

The concept of Environmental Management Accounting (EMA) was developed during the 1990s as a result of the recognition of the importance of accounting for sustainable development (Qian and Burritt, 2009). The International Federation of Accountants (IFAC, 2005, p. 19) defines EMA as "the management of environmental and economic performance through the development and implementation of appropriate environment-related accounting systems and practices". EMA identifies, collects and analyses two types of information for internal decision making: physical information on the use, flows and destinies of energy, water and materials (including waste); and monetary information on environment-related costs, earnings and savings (UNDSD, 2001).

Physical EMA deals with environmental impact information expressed in terms of physical units such as kilograms of materials (Burritt et al., 2002). For example, it is assumed that all physical inputs (energy, water and materials) will eventually become outputs (either physical products or wastes and emissions), and that all physical inputs and outputs should be tracked to ensure that no significant amounts are unaccounted for (IFAC, 2005). The physical EMA information can be used to support the monetary side of EMA. Monetary EMA focuses on environmental impact information expressed in monetary units, for example, the costs incurred to treat waste (Burritt et al., 2002). It provides an important tool to track, trace, and treat costs incurred as a result of an organisation's activities relating to the environment (Schaltegger and Burritt, 2000).

There are various reasons why more managers are becoming interested in EMA information, including compliance with the environmental regulations imposed on organisations, an increased awareness of the importance of managing organisational environmental impacts, the promotion of EMA by international and national bodies, and the availability of EMA tools to assist in the management process (Burritt, 2005; Gray and Bebbington, 2001; Ansari et al., 1997). Although there are different definitions of EMA, the main purpose of EMA is for internal organisational knowledge and decision making (UNDSD, 2001), with some of the major areas for the application of EMA being: the valuation of environmental costs, product/process design, cost control/allocation, capital investments, waste management, product pricing, performance evaluation, risk management, and environmental compliance strategies (UNDSD, 2001; USEPA, 1995). EMA is especially valuable for internal management initiatives with a specific environmental focus, such as cleaner production, supply chain management, 'green' product or service design, environmentally preferable purchasing and EMSs (IFAC, 2005). Prior studies suggest that the benefits of EMA practices include the identification of cost savings opportunities, avoidance of future costs related to investment decisions, improved product mix and pricing decisions, and improved environmental performance (Ferreira et al., 2010; Qian and Burritt, 2009; Deegan, 2003).

While there is a growing body of research investigating EMA use in practice, the majority of these studies are case-based (Herzig et al., 2012; Papaspyropoulos et al., 2012; Qian et al., 2011; Burritt et al., 2009), and mainly focus on the implementation of EMA in a specific organisational setting. Of the limited survey-based research, some studies only examined a single aspect of EMA use. For example, Collison et al. (2003)

reported the percentage of respondents who separately quantified the environmental costs or benefits associated with their environmental agenda, while Burritt et al. (2003) inquired whether the organisation collected EMA information in financial, physical and qualitative terms. Alternatively, Ferreira et al. (2010) was the first published paper to develop a comprehensive 12-item measure of EMA which incorporated both physical and monetary components of EMA. This measure was also used by Christ and Burritt (2013) with both studies reporting low levels of EMA use based on samples of 40 (Ferreira et al., 2010) and 108 (Christ and Burritt, 2013) organisations. This study contributes to the literature by providing a more detailed empirical insight into the current state of EMA use in practice by surveying 208 Australian organisations across different industries. The study also examines the factors that influence the use of EMA, with the association between the comprehensiveness of the EMS, size, and top management support, with EMA use discussed in the next section.

2.2 The factors affecting the extent of Environmental Management Accounting use

While contingency theory has been underutilised in environmental accounting research, increasing attention has been drawn in recent EMA studies which emphasise the importance of contingency theory in the further development of EMA knowledge (Christ and Burritt, 2013). Therefore, this study addresses the scarcity of prior contingency-based EMA studies by examining the association between EMS comprehensiveness, size and top management support with the adoption of EMA.

2.2.1 Environmental Management System comprehensiveness

An EMS is a "collection of internal efforts at formally articulating environmental goals, making choices that integrate the environment into production decisions, identifying

opportunities for pollution (waste) reduction and implementing plans to make continuous improvements in production methods and environmental performance" (Khanna and Anton, 2002, p. 541). A number of management standards have been introduced to help organisations develop formalised EMSs, including the UK national standard BS 7750 launched in the early 1990s, the European Eco-Management and Audit Scheme (EMAS) created in 1995, and the most commonly used international standard ISO 14001 established in 1996 (Schaefer, 2007). The number of certifications to ISO 14001 has been increasing, with 4,400 certifications issued to Australian organisations by the end of 2015 (ISO, 2015). Given that there is no specific level of environmental performance that organisations are required to achieve ISO 14001 certification, organisations have flexibility in the extent to which they adopt different environmental management practices in an EMS. Specifically, Anton et al. (2004) argue that EMSs can vary significantly among organisations in the comprehensiveness of their coverage, with an EMS considered to be more comprehensive if it includes a greater number of environmental practices. However, Phan and Baird (2015) contend that the use of the total number of practices as a proxy for EMS comprehensiveness does not account for the differences in the intensity with which the same practice is used by different organisations. Therefore, they examined the extent to which a number of environmental practices were used and totalled the scores to measure EMS comprehensiveness.

While EMSs generally do not provide accounting information to assist managers in various decisions (Deegan, 2003), it is suggested that environmental accounting is an important part of a comprehensive EMS, as it "supports the compilation and analysis of relevant environmental information that is required to make decisions based on

environmental impact added data" (Gadenne and Zaman, 2002, p. 130). Organisations adopting a more comprehensive EMS demonstrate a higher level of environmental commitment, and are more likely to provide better resources to facilitate the development of EMA. For example, in a comprehensive EMS, environmental training programs are conducted more frequently which will equip employees with the skills and knowledge to collect and process EMA information, facilitating the greater use of both physical and monetary EMA.

H1: Organisations with more comprehensive EMSs are expected to use EMA to a greater extent.

2.2.2 Size

Common findings in the management accounting literature suggest that larger organisations are more likely to adopt formal management control systems and sophisticated management accounting techniques (Ferreira et al., 2010; Chenhall, 2003). Henriques and Sadorsky (2007) found that size was positively associated with the implementation of environmental management practices. Barriers often faced by small organisations include a lack of training and information regarding new technology, limited enforcement of national or community policies, and limited environmental awareness (Gribble and Dingle, 1996). For instance, according to the key participants interviewed by the Environment Protection Authority New South Wales (EPANSW, 1997), within small organisations, there is often limited awareness or understanding of environmental issues other than the narrow sense of regulatory compliance, and it is particularly difficult to find the time, skills and resources to access reliable and practical environmental information and outside expertise. In addition, due to the lack of resources, small organisations might not have their own management accounting system

and would be unlikely to adopt an EMA system on a standalone basis. Furthermore, Venturelli and Pilisi (2005), through the case analysis of small and medium-sized enterprises, observed that small organisations generally do not have significant environmental impacts and do not reap substantial benefits from the adoption of EMA in terms of the improvement of visibility, or the enlargement of market share.

Alternatively, large organisations usually have the confidence, resources (both human and financial), training and information to commit to the implementation of EMA (Ferreira et al., 2010; Henri and Journeault, 2008; Henriques and Sadorsky, 2007; Marshall and Brown, 2003). Furthermore, large organisations are more visible to external stakeholders and experience more pressures from regulatory bodies, environmental interest groups and the community, which may lead to greater involvement with EMA activities (Christ and Burritt, 2013).

H2: The size of an organisation is positively associated with the extent of EMA use.

2.2.3 Top management support

The literature suggests that top management support plays an essential role in the adoption of administrative innovations (Sisaye and Birnberg, 2012; Gosselin, 2006). Specifically, top management provides leadership, training, and an open line of communication which facilitates the commitment from employees at all levels within the organisation towards the adoption of the administrative innovation (Sisaye and Birnberg, 2012). In the context of EMA, Darnall et al. (2008) argue that top management leadership and support is vital to ensure an organisation-wide understanding of and commitment to environmental issues. Such commitment is also

critical to maintain and improve an organisation's environmental strategy over time. Kokubu and Nashioka (2005) contend that implementing EMA and deriving benefits from it will be very difficult without top management awareness and support because the advantages derived from any management information system require management to understand the metrics and utilise the information provided by the system. Furthermore, Kokubu et al. (2003) suggest that environmental accounting is more likely to be introduced from the top down than from the bottom up, while Christie et al. (1995) indicate that top management support is essential in advocating environmental projects that might not be economical in the short term.

H3: Top management support is positively associated with the extent of EMA use.

2.3 The association between Environmental Management Accounting use and environmental performance

Environmental performance refers to "the impact of an organisation's activities on the environment, including the natural systems such as land, air and water as well as on people and living organisms" (Langfield-Smith et al., 2015, p. 761). Improvements in environmental performance can assist organisations in meeting their ISO 14001 certification requirement to demonstrate an ongoing commitment to improve their organisational performance (Tung et al., 2014). In particular, it is argued that enhanced environmental performance can influence both revenues and costs of an organisation by producing environmentally compatible products and reducing wastage, emissions and legal costs (Azzone and Manzini, 1994).

With a variety of stakeholders, including shareholders, consumers, employees, and the government and regulatory bodies, showing increased concern regarding environmental issues, there is an increased demand for improving environmental performance (Ilinitch et al., 1998). In line with the pragmatists view that organisations adopt environmental accounting practices to improve sustainable outcomes, it is expected that the use of EMA will lead to higher environmental performance. Specifically, the use of physical EMA tools, such as eco-balance or materials flow accounting, provides information regarding the usage of materials, energy, water and the amount of emissions which assists management in managing resources more efficiently and reducing the potential environmental impact of waste and emissions. The physical information collected under EMA is also crucial to the development and accurate assessment of environment-related costs with Wagner (2005) reporting that the use of an eco-balance was positively correlated with better environmental performance.

Environment-related costs can form a significant part of an organisation's total operating costs (Ferreira et al., 2010). Monetary EMA provides the essential environment-related cost information required to effectively manage environmental performance (IFAC, 2005). Cost allocation, an active tool of EMA, can also have an impact on environmental performance as better accounting for environmental costs is crucial to long-term business sustainability (Burritt, 1998). For instance, Kokubu et al. (2003) found that 85% of the organisations in their survey reported an improved understanding of environment-related costs as a result of implementing environmental accounting. Organisations with a good understanding of their environment-related costs are better equipped to control these costs (Bouma and van de Veen, 2002). Similarly, Deegan (2003), based on a case study of four Australian organisations, indicated that

the refinement of existing management accounting systems to include environment-related costs can lead to changes in strategies that improve both financial and environmental performance.

H4: The extent of EMA use is positively associated with environmental performance.

3 Method

3.1 Data collection

A random sample of 820 Australian organisations across various industries in the primary (agriculture, mining), secondary (manufacturing, construction), and tertiary (utilities, transport, health) industries was selected from the OneSource database, which provides detailed business information of organisations in Asia and the Pacific Rim. Survey questionnaires were distributed to the chief executive officer (CEO)/ managing director, chief financial officer (CFO)/ finance manager, or chief operating officer (COO)/ production manager. Dillman's (2007) Tailored Designed Method, which has been shown to maximise response rates, was utilised to design the format and style of the questions, the techniques to personalise the survey, and the distribution procedures.

Two hundred and seventeen (217) completed questionnaires were returned for a response rate of 26.5%. These comprised 85 (10.4%) questionnaires from the initial distribution, and 132 (16.1%) from the follow-up. Nine questionnaires were omitted due to missing data, resulting in a final sample of 208 usable questionnaires (25.4%). Non-response bias was assessed by comparing the independent and dependent variable values between the 85 survey questionnaires from the initial distribution and the 132 from the follow-up, with Roberts (1999) suggesting that late respondents can represent

non-respondents. No significant differences were detected. Furthermore, a comparison between respondents and non-respondents with respect to the average size (proxied by the number of employees) and industry did not reveal any significant differences. Therefore, non-response bias was not considered to be a problem in the sample. In addition, common method bias was assessed by Harman's (1967) single-factor test, with the results indicating that the total variance explained by a single factor (33.61%) was below the 50% threshold indicative of common method bias problems (Podsakoff et al., 2003), while the full ranges on the variables suggested that social desirability response bias was not a problem.

3.2 Measurement of variables

3.2.1 Environmental Management Accounting

Respondents were asked to indicate, on a scale of '1 = not at all' to '5 = to a great extent', the extent to which each of 14 EMA practices was applied within their organisations. The first 5 items were derived from IFAC's (2005) international guidance document on EMA. The remaining 9 items were taken from Ferreira et al. (2010).

Factor analysis (maximum likelihood analysis extraction method and varimax with Kaiser normalisation rotation method) resulted in two factors with eigenvalues greater than 1, which accounted for 66.3% of the total variance (see Table 1). In line with Hair et al. (2006), given the sample size exceeds 200, a cut-off point of 0.4 is considered acceptable. The first five items loaded onto the one factor. These items relate to the recording of physical inputs and outputs, the monitoring of material flows, and the use of performance targets for physical inputs and outputs. Hence this factor was labelled 'physical EMA'. The other factor was labelled 'monetary EMA' as it contained the 9

items relating to the identification, classification, allocation and use of environment-related costs.

Table 1 Factor analysis – Environmental Management Accounting (EMA)

Item	Factor	
	Physical EMA	Monetary EMA
Recording all physical inputs (energy, water, materials)	**.438**	.325
Recording all physical outputs (wastes, emissions)	**.569**	.313
Monitoring material flows through all the different material management steps, from acquisition to disposal	**.555**	.323
Using environmental performance targets for physical inputs	**.923**	.253
Using environmental performance targets for physical outputs	**.901**	.278
Identification of environment-related costs	.378	**.687**
Estimation of environment-related contingent liabilities	.233	**.641**
Classification of environment-related costs	.309	**.650**
Allocation of environment-related costs to production processes	.398	**.736**
Allocation of environment-related costs to products	.240	**.763**
Improvements to environment-related cost management	.399	**.734**
Creation and use of environment-related cost accounts	.300	**.769**
Development and use of environment-related key performance monetary indicators (e.g. reductions in energy costs)	.384	**.596**
Product life cycle cost assessments	.205	**.614**

Extraction method: Maximum likelihood.
Rotation method: Varimax with Kaiser normalisation.
Rotation converged in 3 iterations.

Confirmatory factor analysis (CFA) was performed to evaluate the validity of the measurement models for physical EMA and monetary EMA, with the results reported in Table 2. The evaluation procedure includes the investigation of the squared multiple correlation coefficients, modification indices, and a number of commonly used fit indices[1]. The measurement models for both physical EMA and monetary EMA exhibit a

[1] The common fit measures and their recommended threshold values are: norm chi-square < 5 (Marsh and Hocevar, 1985); GFI and CFI > 0.90 (López-Gamero et al., 2010); and RMSEA < 0.10 (Henri, 2006).

good fit. An average score of the relevant items was calculated for each factor, with higher (lower) scores indicating a greater (lesser) extent of EMA use.

Table 2 Results of the measurement models

Variable	No. of items	Chi-square	df	Normed chi-square	GFI	CFI	RMSEA
Physical EMA	5	0.019	2	0.009	1.000	1.000	0.000
Monetary EMA	9	54.011	23	2.348	0.948	0.975	0.081
EMS comprehensiveness	9	63.074	26	2.426	0.941	0.967	0.083
Top management support	4	3.052	2	1.526	0.992	0.999	0.050
Performance							
Resource usage	4	2.841	2	2.064	0.990	0.991	0.072
Regulatory compliance	3	0.204	1	0.204	0.999	1.000	0.000
Productivity	2	0.000	0	-	1.000	1.000	-
Stakeholder interaction	2	0.000	0	-	1.000	1.000	-

3.2.2 Environmental Management System comprehensiveness

The comprehensiveness of EMSs is measured using Phan and Baird's (2015) construct. In particular, respondents were asked to indicate, on a scale of '1 = not at all' to '5 = to a great extent', the extent to which their organisation had implemented each of the following nine environmental management practices: having policies, rules, regulations, procedures in relation to environmental management; having dedicated staff responsible for focusing on environmental issues; using environmental criteria in the evaluation and/or compensation of employees; having frequent environmental training programs; having frequent internal environmental audits; having frequent external environmental audits; benchmarking environmental performance; having processes to evaluate environmental risks when selecting suppliers, partners, or clients; and having environmental performance indicators and goals.

Exploratory factor analysis was conducted using the maximum likelihood extraction method and varimax with Kaiser normalisation rotation method. Only one factor with an eigenvalue greater than 1 was extracted. The measurement model for EMS comprehensiveness exhibits a good fit (see Table 2). EMS comprehensiveness was measured by the average score of the nine items, with a higher (lower) score indicating a more (less) comprehensive EMS.

3.2.3 Size

The size of organisations was measured by the approximate number of full-time employees in each organisation, logarithmically converted to increase the normality of the distribution.

3.2.4 Top management support

Top management support was measured using a four-item scale. These items were taken from Krumwiede (1998), Grover (1993) and Baird et al. (2007) with modifications to reflect the environmental management context of the study. Respondents were asked to indicate, on a scale from '1 = not at all' to '5 = to a great extent', the extent to which top management provided active support, provided adequate resources, communicated effectively, and exercised its authority in support of environmental management practices. Exploratory factor analysis (using the maximum likelihood extraction method and varimax with Kaiser normalisation rotation method) was conducted to evaluate the uni-dimensionality of the variable. Only one factor with an eigenvalue greater than 1 was extracted. The measurement model for top management support exhibits a good fit (see Table 2). Top management support was measured by the average score of the four items, with higher (lower) score indicating higher (lower) level of support.

3.2.5 Environment performance

Previous studies have simply focused on examining the environmental impact generated by operations such as an electricity index (Friedrich et al., 2011), total material requirements (Baboulet and Lenzen, 2010), or toxic releases (Patten, 2002). However, this approach restricts the scope of the multidimensional concept of environmental performance, which covers numerous aspects including environmental impact and corporate image, stakeholder relations, financial impact, and process and product improvements (Henri and Journeault, 2010). Therefore, this study attempts to provide a broader perspective into environmental performance by capturing different dimensions of environmental performance. Specifically, respondents were asked to indicate the extent to which each of 15 environmental outcomes were achieved in their organisation. A 5-point Likert-type scale was used with anchors of 1 'not at all' and 5 'to a great extent'. These environmental performance measures were identified from previous research on environmental management and performance (Langfield-Smith et al., 2015; Henri and Journeault, 2010).

Exploratory factor analysis (maximum likelihood extraction method and varimax with Kaiser normalisation rotation method) was performed to analyse the different dimensions of environmental performance. The item 'increased filters and controls on emissions and discharges' did not load onto any factor (based on a cut-off point of 0.4) and therefore was eliminated. Four factors with eigenvalues greater than 1 were extracted, which accounted for 64.9% of the total variance (see Table 3). The four factors were labelled 'resource usage', 'regulatory compliance', 'productivity' and 'stakeholder interaction'.

Table 3 Factor analysis – Environmental performance

Item	Factor			
	Resource usage	Regulatory compliance	Productivity	Stakeholder interaction
Reductions in energy consumption	**.699**	.008	.187	-.024
Reductions in water usage	**.718**	.132	.187	.133
Reductions in material costs due to the efficient use of material	**.567**	.098	.522	.071
Reductions in the levels of waste	**.487**	.174	.117	.264
Reductions in levels of emissions	**.499**^	.321	.183	.075
Increased residue recycling	**.426**^	.231	.096	.205
Reductions in the costs of regulatory compliance	.216	**.485**	.258	.169
Reductions in the costs associated with cleaning up environmental damage	.163	**.770**	.207	.144
Reductions in the fines paid and remediation costs regarding environmental damage	.112	**.841**	.140	.143
Reductions in process/production costs	.314	.189	**.769**	.021
Increased process/production efficiency	.169	.330	**.708**	.164
Increased knowledge about effective ways of managing operations	.284	.197	**.462**^	.399
Increased organisation-wide learning among employees	.169	.055	.204	**.808**
Better relationships with stakeholders such as local communities, regulators, and environmental groups	.058	.334	-.040	**.614**
Increased filters and controls on emissions and discharges	.343^	.387	.200	.286

Extraction method: Maximum likelihood.
Rotation method: Varimax with Kaiser normalisation. Rotation converged in 3 iterations.
^ Items that were eliminated after examining measurement model

Confirmatory factor analysis for the 'resource usage' dimension revealed that the squared multiple correlation of the two items 'reductions in levels of emissions' and 'increased residue recycling' were low (0.251 and 0.298 respectively) and therefore these two items were eliminated. The scale then exhibited a good fit (see Table 2). The measurement model for the 'regulatory compliance' dimension also indicated a good fit. In regard to the 'productivity' dimension, the item 'increased knowledge about effective ways of managing operations' was eliminated as it did not contribute to the Cronbach's alpha, resulting in a final scale of two items. The confirmatory factor analysis for the 'productivity' and 'stakeholder interaction' measurement models could not be performed as there were only two indicators and zero degrees of freedom. The average scores of the relevant items in each dimension were calculated, with higher (lower) scores reflecting higher (lower) levels of performance.

4 Results

4.1 Descriptive statistics

Table 4 presents descriptive statistics for all of the continuous variables measured using multi-item scales. All Cronbach's alpha coefficients exceed the 0.70 benchmark generally considered acceptable with respect to reliability (Nunnally, 1978), with the exception of 'stakeholder interaction' for which the coefficient is just below 0.70. In addition, bivariate (Pearson) correlations (see Table 5) show that none of the correlations between the variables were greater than the 0.7 threshold (Harrison and Tamaschke, 1984). The mean score of physical EMA (2.927) is slightly below the mid-point of the theoretical range (1 to 5), suggesting that the extent of physical EMA use is

moderate. On the other hand, the mean score of monetary EMA (2.568) is well below the mid-point of the range (1 to 5), indicating a low extent of monetary EMA use.

Table 4 Descriptive statistics

Variable	Mean (N =208)	Standard deviation	Min	Max	Cronbach's alpha
EMS comprehensiveness	2.848	0.961	1	5	0.921
Number of employees	785.61	1634.66	1	9000	
Size ^	4.968	2.011	-	-	-
Top management support	3.504		1	5	0.938
EMA					
Physical EMA	2.927	1.023	1	5	0.892
Monetary EMA	2.568	0.902	1	5	0.925
Environmental performance					
Resource usage	3.418	0.770	1	5	0.798
Regulatory compliance	3.064	1.040	1	5	0.837
Productivity	3.367	1.020	1	5	0.802
Stakeholder interaction	3.480	0.847	1	5	0.679

^ Log transformation of number of employees

Table 5 Pearson correlations between independent variables

Variable	1	2	3
1. Size	1.000	-0.026	0.338
2. Top management support	-0.026	1.000	0.504
3. EMA comprehensiveness	0.338	0.504	1.000

4.2 The structural equation model

Structural equation modelling was employed to examine the hypotheses. The structural model was tested by means of maximum likelihood estimate using AMOS version 21 software. The paths that were not statistically significant were gradually removed until all remaining paths in the model were significant and the final model exhibited a good fit (see Figure 1).

Figure 1 The structural equation model

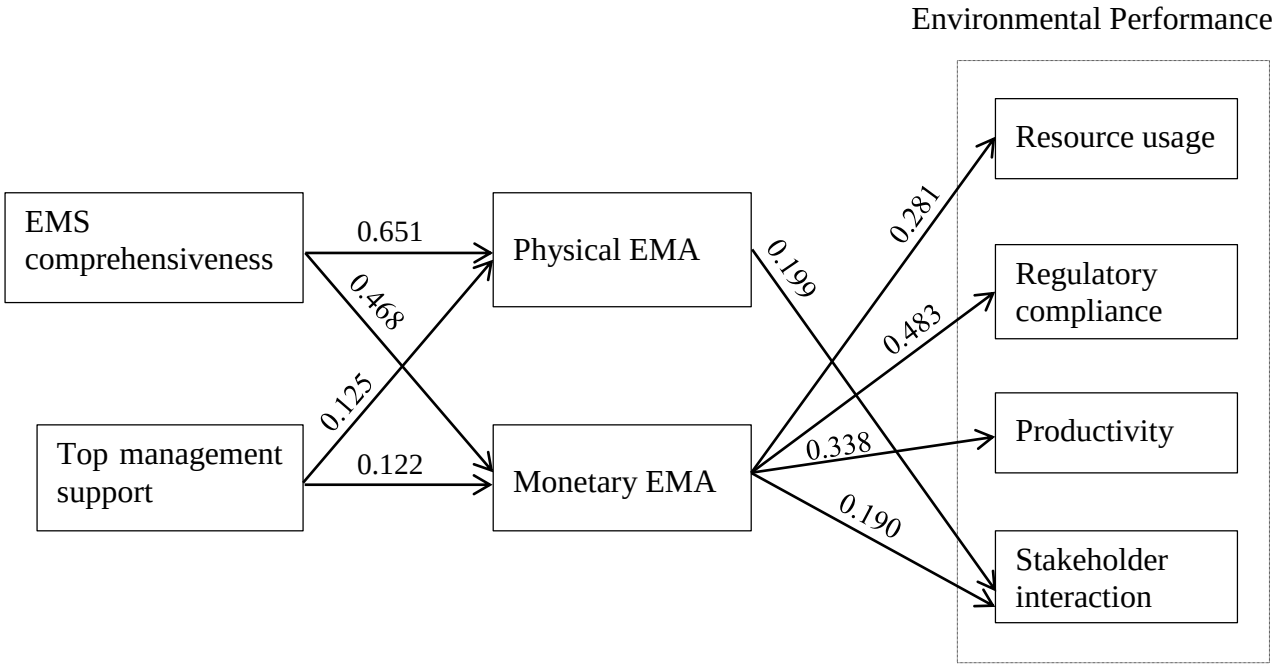

Table 6 reports the detailed results of the path analysis in terms of path standardised beta, standardised error, critical ratio, p-values, and the fit indices used to assess the model fit. The comprehensiveness of EMS was found to be significantly associated with both physical EMA (β = 0.651, p = 0.000) and monetary EMA (β = 0.468, p = 0.000), which supports hypothesis 1. Significant relationships were also found between top management support and both physical EMA (β = 0.125, p = 0.047) and monetary EMA (β = 0.122, p = 0.048). Therefore hypothesis 3 is supported. While monetary EMA was found to be associated with all four dimensions of environmental performance, namely 'resource usage' (β = 0.281, p = 0.000), 'regulatory compliance' (β = 0.483, p = 0.000), 'productivity' (β = 0.338, p = 0.000), and 'stakeholder interaction' (β = 0.190, p = 0.018), physical EMA was found to be significantly associated with only one dimension of environmental performance, 'stakeholder interaction' (β = 0.199, p = 0.004). Therefore, hypothesis 4 was partially supported. No significant relationship was found between size and EMA use, resulting in the rejection of hypothesis 2.

Table 6 Results of the path analysis

Description of path	Std beta	Std error	Critical ratio	P-value
EMS comprehensiveness → Physical EMA	0.651	0.063	10.353	0.000
EMS comprehensiveness → Monetary EMA	0.468	0.062	7.568	0.000
Top management support → Physical EMA	0.125	0.063	1.986	0.047
Top management support → Monetary EMA	0.122	0.062	1.976	0.048
Physical EMA → Stakeholder interaction	0.199	0.070	2.858	0.004
Monetary EMA → Resource usage	0.281	0.057	4.971	0.000
Monetary EMA → Regulatory compliance	0.483	0.072	6.730	0.000
Monetary EMA → Productivity	0.338	0.075	4.513	0.000
Monetary EMA → Stakeholder interaction	0.190	0.080	2.363	0.018
Goodness of fit statistics				
CMIN = 53.82, df = 13, CMIN/df = 4.14, GFI = 0.943, CFI = 0.930, RMSEA = 0.123				

5 Discussion

This study contributes to the literature by providing an empirical insight into the use of both physical and monetary EMA based on a sample of 208 Australian organisations of different sizes across a wide range of industries. Overall, the results indicate that physical EMA was used to a moderate extent, while monetary EMA was used to a low extent. Such results are consistent with Christ and Burritt (2013) and Ferreira et al. (2010), both of which reported that the extent of EMA use was below the mid-point of the theoretical range. Ferreira et al. (2010) suggest that this low level of EMA use is consistent with the early stages of developing EMA, given that EMA is a recent innovation in management accounting.

The study assessed the effectiveness of EMA by investigating the association between EMA use and environmental performance. The results revealed that physical EMA was associated with one dimension of environmental performance (stakeholder interaction),

while monetary EMA was associated with all four dimensions of environmental performance (resource usage, regulatory compliance, productivity, and stakeholder interaction). While the importance of focusing on monetary EMA measures is apparent, the findings in respect to the physical EMA measures are particularly significant given the importance of stakeholder perceptions for organisations, both in respect to exerting political pressure and placing demands on them in regard to the impact of their operational activities on the environment. Hence, while previous studies have tended to emphasise the use of monetary measures, the findings here also highlight the significant role of physical EMA measures and suggest that managers should endeavour to enhance their usage in order to achieve such desirable environmental outcomes.

Overall the findings indicate the significant role of EMA in enhancing the environmental performance of organisations. Hence, it is implied that EMA information is crucial in providing information which enhances managers' awareness of environmental issues, enables them to respond better to external pressures, supports the consideration of environmental issues when making decisions, and implementing actions that enhance the likelihood of achieving desirable environmental outcomes. Such findings make a significant contribution to the critical – pragmatist debate concerning the pursuit of environmental outcomes by organisations. Specifically, the findings support the pragmatist viewpoint by providing evidence of the means by which organisations can manage the achievement of desirable sustainable outcomes. Specifically, the findings suggest that managers should incorporate EMA practices to a greater extent, both physical and monetary EMA measures, as a means of achieving improvements in desired sustainable outcomes. While both physical and monetary EMA measures are important, given the low level of monetary EMA use reported, it is

suggested that organisations should place more emphasis on monetary EMA to gain the benefits of improved environmental performance.

Given the observed impact of EMA use on environmental performance, it is important to understand the factors that influence the use of EMA to assist organisations in implementing EMA. Accordingly, the paper contributes empirical evidence to enhance the understanding of the organisational factors associated with EMA adoption, which has received little attention in the literature (Christ and Burritt, 2013). Contrary to expectations, there were no significant associations between size and EMA use. The finding provides support to the notion that EMA use can provide economic and environmental benefits to organisations of different sizes (Christ and Burritt, 2013). On the other hand, the comprehensiveness of the EMS and top management support were found to be positively associated with the extent of use of both physical and monetary EMA.

The findings highlight the importance of top management support and the comprehensiveness of an EMS in increasing the use of EMA, especially monetary EMA, which was shown to improve the perceived environmental performance. Since top management support is the key to the introduction and development of EMA, it is critical for top management to have a good understanding of EMA practices, provide adequate resources to support the implementation of EMA, effectively communicate its support for EMA to lower level employees to enhance environmental commitment, and exercise its authority in support of EMA during the implementation process. In addition, it is necessary for top management to take actions to initiate the implementation of EMSs.

It is suggested that the government can play an important role in inducing organisations to improve the comprehensiveness of their EMSs, for example, by creating regulatory threats of more stringent environmental regulations, providing public information sessions and technical assistance regarding EMS implementation, or subsidising environmental training sessions to those with limited resources (Phan and Baird, 2015). Furthermore, organisations with limited environmental management experience could obtain external advice from environmental consultants, or could consider employing staff with expertise in designing an EMS (Tung et al., 2014).

While advocating the increased use of EMA, it is acknowledged that the implementation of EMA can pose a challenge to organisations with limited resources. Managers should therefore be aware that an EMA system can be implemented on different scales, such as for a specific product or process, for a particular division or location, or across the whole organisation (Deegan, 2003). In practice, EMA ranges from simple modifications to current accounting systems to more sophisticated EMA systems that link conventional physical and monetary information systems (IFAC, 2005). Indeed, there has been considerable emphasis on the adjustment of conventional management accounting to integrate environmental issues (Burritt, 2005; Howes, 2002). For instance, Deegan (2003), based on a case analysis of four Australian organisations, suggests that EMA is likely to be more successful when it is implemented in an incremental manner. Similarly, Bartolomeo et al. (2000) found that the financial benefits of introducing a comprehensive EMA system were not justified and suggested that organisations integrate EMA into existing change programs such as the introduction of Activity Based Costing. Professional accounting bodies should endeavour to develop more detailed guidelines for EMA implementation that suit the needs of organisations at

different levels of operations. Such guidelines may serve to assist organisations in implementing EMA and achieving the improvement in environmental performance highlighted in this study.

The study is subject to several limitations, including the inherent limitations of survey-based research and the use of managers' perception instead of objective data in measuring environmental performance. Future studies could use a combined approach of survey and interviews to strengthen the findings. In addition, while it is argued that in terms of consistently providing valid and reliable performance assessment, neither objective nor subjective measures are superior (Henri and Journeault, 2010), future studies could obtain objective environmental performance data to validate the survey-based environmental performance measures. Furthermore, given the finding that the use of EMA is associated with environmental performance, more effort should be devoted to investigating why the extent of EMA use is low and how to encourage organisations to commit to EMA. Finally, given the current study is static (i.e. it only examines the use of EMA at one point in time), future longitudinal studies could be conducted to examine the association between the use of EMA and the improvement in environmental performance over time.

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CHAPTER SIX

PAPER THREE

Environmental Activity Management: Its use and impact on environmental performance

(A journal article based on this paper has been accepted for publication in the Accounting, Auditing & Accountability Journal)

Phan, T. N., Baird, K. and Su, S. (forthcoming). 'Environmental Activity Management: Its use and impact on environmental performance'. *Accounting, Auditing & Accountability Journal.*

Abstract

This study provides an insight into the application and usefulness of Activity Management practices in an environmental context. Specifically, the study examines the extent of use of Environmental Activity Management utilising Gosselin's (1997) three levels of Activity Management (namely, Environmental Activity Analysis (EAA), Environmental Activity Cost Analysis (EACA), and Environmental Activity Based Costing (EABC)). The study also examines the association between Environmental Activity Management and environmental performance. Data were collected from 208 Australian organisations across different industries using a mail survey questionnaire. The results indicate a relatively high extent of EAA use but a low extent of use of EACA and EABC. In addition, organisations using each level of Environmental Activity Management to a greater extent were found to experience higher levels of environmental performance. Furthermore, the relationship between EAA and EABC with environmental performance was found to be mediated by decision quality. The findings suggest that organisations should endeavour to increase their use of Environmental Activity Management, and hence modify their existing costing systems to consider the drivers and costs of environmental activities.

Keywords: Environmental Activity Management, Environmental Activity Analysis, Environmental Activity Cost Analysis, Environmental Activity Based Costing, environmental performance, decision quality.

1 Introduction

The focus on environment-related costs has increased significantly over the past few decades due to a number of reasons including regulatory compliance as well as social and customer requirements (Sarkis et al., 2006). Since many environment-related costs are now absorbed by organisations, there is a need for organisations to accurately account for these costs to provide better estimates of product costs and transmit the increased costs to customers through appropriate pricing policies (Tsai et al., 2012). However, in traditional costing systems, environment-related costs are often hidden in overhead accounts or not recorded, resulting in a lack of awareness and understanding by managers in respect to the magnitude of the environmental costs generated by their organisations (Deegan, 2003). Consequently, Activity Based Costing (ABC) has been recommended as an effective method to attribute environmental costs to the activities that generate them, thereby enabling the allocation of environmental costs to products or processes (Deegan, 2003; Emblemsvåg and Bras, 2001; Bartolomeo et al., 2000).

The first thoughts of integrating ABC into environmental management were articulated in the 1990s, with suggestions to utilise the ABC method for life-cycle assessments of environmental impact in terms of energy consumption (Emblemsvåg and Bras, 1994), or to combine ABC and life-cycle costing for calculating environmental expenditures (Kreuze and Newell, 1994). Since then, there has been an increased interest in the literature regarding the integration of ABC into different aspects of environmental management. However the majority of studies in this area are theoretical and focus on developing a conceptual methodology (Tsai et al., 2011; Karatzoglou and Spilanis, 2010; Sarkis et al., 2006). For example, Tsai et al. (2011) proposed a decision making model based on the use of ABC to justify the adoption of green manufacturing systems,

and Karatzoglou and Spilanis (2010) integrated ABC into the development of an environmental scorecard to provide information on the environmental impact of critical corporate activities. Evidence of the practical implementation of environmental ABC has been limited to a number of case studies which were all conducted in a single manufacturing organisation (Cagno et al., 2012; Tsai et al., 2012; Rodríguez Rivero and Emblemsvåg, 2007). For instance, Cagno et al. (2012) implemented an extended activity-based environmental product and waste costing method in an Italian manufacturer to estimate the full industrial costs of their products, and Tsai et al. (2012) demonstrated the use of ABC to estimate the waste generated by and environmental costs of final products in a Taiwanese manufacturer. Hence, there has been a lack of empirical evidence regarding the extent of use of environmental ABC across organisations. Consequently, this study aims to fill this gap in the literature by providing an insight into the extent of use of environmental ABC in practice based on a large sample of organisations operating in various industries.

While the literature only focuses on ABC, this study adopts the broader approach of Activity Management proposed by Gosselin (1997). Specifically, according to Gosselin (1997), ABC is considered to be just one level of a much more complex management innovation called Activity Management (AM), with the other two levels being Activity Analysis (AA) and Activity Cost Analysis (ACA). AA is the simplest level of AM which reviews the activities carried out to convert resources into output. The next level is ACA which identifies the costs and cost drivers of each activity. The highest level of AM, ABC, traces the costs of activities to products and services. Baird et al. (2004) argued that organisations may choose to adopt different levels of AM depending on their organisational objectives. Similarly, Nanni et al. (1992) suggested that many

organisations found the most benefit in AA and ACA, and therefore did not proceed to the ABC level. This study will therefore integrate Gosselin's (1997) three-level AM approach with environmental management, resulting in the development of the following terms: Environmental Activity Management, environmental AA (EAA), environmental ACA (EACA), and environmental ABC (EABC).

The benefits of AM have been widely advocated in the literature with many academics and practitioners suggesting that the implementation of AM has a favourable impact on organisational performance (Gosselin, 2006). For example, Kennedy and Affleck-Graves (2001) found that the adoption of a management accounting system, such as ABC, has a significant influence on firm value, while Ittner et al. (2002) found a positive association between the use of ABC and manufacturing performance. However, there has been no study to date which has examined the effectiveness of Environmental Activity Management in terms of improving environmental performance. This study is therefore motivated to fill this gap in the literature by providing empirical evidence regarding the association between each of the three levels of Environmental Activity Management (EAA, EACA, and EABC) with the environmental performance of organisations. Such an empirical evaluation of the effectiveness of Environmental Activity Management will enhance the understanding of Environmental Activity Management practices and assist managers in deciding whether to adopt and promote such practices in their organisations.

The study also provides an insight into the mechanism by which the information provided by Environmental Activity Management can improve environmental performance. Specifically, the study examines the role of environmental decision

quality as a mediator in the relationship between Environmental Activity Management and environmental performance. With organisations experiencing increases in both product diversity and indirect costs, it is imperative for managers to obtain accurate cost information to help them make important strategic decisions. It is argued that Environmental Activity Management can provide more accurate and comprehensive information to assist managers in making environmentally-informed decisions (Sarkis et al., 2006), and that once managers are equipped with the right tools to improve their environmental decision quality, it is likely that the environmental performance of their organisations will be enhanced. Therefore, it is proposed that the positive impact of Environmental Activity Management on environmental performance is mediated by environmental decision quality.

2 Theory and hypotheses development

2.1 Environmental Activity Management

Traditional costing systems have widely been criticised for their failure to accurately allocate overhead costs, largely due to their reliance on volume-based cost drivers. In particular, with the introduction of advanced technology, overhead costs increase substantially and become more non-volume driven, which means that traditional costing systems are likely to result in distorted product costs (Langfield-Smith et al., 2015). ABC has emerged as an innovative costing system that can overcome the problems with traditional costing systems and provide more accurate product cost information. For instance, O'Guin (1990) indicates that a product cost calculated by a traditional costing system can differ by several hundred per cent compared to an ABC system. The two main differences between ABC and traditional costing systems are: (1) ABC is based on the premise that cost objects consume activities which in turn consume resources,

whereas conventional costing assumes cost objects directly consume resources; (2) ABC uses resource and activity drivers at different levels to trace costs from resources to activities to cost objects in a causal manner, while conventional costing uses only unit-level allocation bases (Emblemsvåg and Bras, 2001).

Due to its capability to reduce costs and manage resource consumption, ABC has been increasingly utilised in more areas, including environmental management (Emblemsvåg and Bras, 2001). The integration of ABC into environmental management was first mentioned in the early 1990s (Emblemsvåg and Bras, 1994; Kreuze and Newell, 1994), with Emblemsvåg and Bras (2001) introducing basic principles on how to expand activity-based costing and management into the environmental domain, explaining the steps for developing activity-based cost, energy, and waste management models, and applying their framework in a number of real-life case studies. Similarly, as part of the introduction of principles and procedures for Environmental Management Accounting, the United Nations Division for Sustainable Development (UNDSD, 2001) illustrated the ABC method to allocate environment-related costs to products.

Due to the diversity of the ABC models that have been proposed and implemented, there is a multiplicity of terms used such as ABC itself, Activity Accounting (Brimson, 1991), Activity-Based Cost Management (Foster and Swenson, 1997), Activity Based Management (Reeve, 1996), Activity Management, Activity Analysis, and Activity Cost Analysis (Gosselin, 1997). As noted earlier, Gosselin (1997) identifies ABC as one of the three levels of AM, with the other two being AA and ACA. According to Gosselin, ABC is the most complex level which subsumes AA and ACA, while AA is the prerequisite of ACA. Hence, in line with Baird et al. (2004) and Gosselin (1997)

who recognise that ABC can be adopted at different levels depending on organisational objectives, this study introduces the concept of Environmental Activity Management, which is based on Gosselin's (1997) three-level Activity Management approach. Specifically, the study examines three levels of Environmental Activity Management, namely EAA, EACA, and EABC.

2.2 The association between Environmental Activity Management and environmental performance

EAA, the first level of Environmental Activity Management, can provide detailed information regarding the activities with potential environmental impacts carried out to convert materials, labour and other resources into outputs (Gosselin, 1997). It enables managers to be more aware of the activities involved in the operations of their organisations and more conscious of the environmental impact of these activities. Furthermore, by identifying non-value-added activities, EAA can assist organisations in refining their operational processes by replacing, removing or diminishing these activities. The next level of Environmental Activity Management, EACA, identifies and calculates the costs of activities with potential environmental impacts, and the factors that cause them to vary. This enables organisations to reduce environment-related costs and resource consumption by eliminating non-value-added activities, improving the efficiency of existing activities by managing their cost drivers, and promoting products and process designs that consume less activity costs (Ittner et al., 2002), thereby leading to improvements in environmental performance. Furthermore, EACA provides information to assist managers in conducting cost benefit analysis relating to improvements in environmental performance.

EABC, the highest level of Environmental Activity Management, traces the costs of activities to products and services to enable a more accurate assessment of product and service costs. Since better accounting for environmental costs is vital to long-term business sustainability (Burritt, 1998), EABC can have a significant impact on environmental performance. EABC can provide accurate cost information based on the true consumption of resources (Bahnub, 2010), and resolve the issues of environment-related costs being hidden in general overhead accounts (IFAC, 2005). Organisations are better equipped to control environment-related costs when they have a good understanding of these costs. Emblemsvåg and Bras (2001) argue that EABC can provide a generic and integrated cost and environmental management framework which enables organisations to manage environmental issues as they manage costs and reap benefits in terms of both cost savings and improved environmental performance. Similarly, Deegan (2003) indicated that the refinement of existing management accounting systems to include environment-related costs can lead to changes in strategies that improve both financial and environmental performance.

H1: Environmental Activity Management (EAA, EACA, and EABC) is positively associated with environmental performance.

2.3 The association between Environmental Activity Management, environmental decision quality, and environmental performance

While it was previously hypothesised that Environmental Activity Management is positively associated with environmental performance, it is argued that the relationship between Environmental Activity Management and environmental performance is mediated by the quality of environmental decisions made by management. In particular, the use of Environmental Activity Management is expected to lead to better judgement and decision quality with the more accurate information provided by Environmental

Activity Management likely to assist the decision making process of managers (Langfield-Smith et al., 2015). Within the Environmental Management Accounting research stream, Environmental Activity Management is considered an effective system to achieve the necessary quality of information to improve the quality of environmental managerial decisions (Cagno et al., 2012). Environmental Activity Management can integrate conventional costs, hidden costs, contingent costs, and relationship and image costs, thereby providing more accurate and comprehensive information to assist managers in making environmentally-informed decisions (Sarkis et al., 2006). Specifically, the information from Environmental Activity Management can be used for a wide range of decisions including product pricing, product mix, outsourcing, quality improvement, financial and physical flow analysis, and environmental management (Tsai et al., 2011). Furthermore, Environmental Activity Management becomes a primary source of information to improve productivity by managing non-value-added activities and to understand the profitability of products, channels and customers (Cokins and Căpuşneanu, 2011). It therefore provides a powerful tool for decision making.

When managers are provided with accurate and comprehensive information from Environmental Activity Management, it is expected that the quality of their environmental decisions will be improved, which in turn will have a positive impact on environmental management in terms of improving environmental performance. One of the main difficulties in environmental management is the identification and calculation of costs across organisational activities and processes (Sarkis et al., 2006). Once equipped with the more accurate information from Environmental Activity Management, managers are likely to make better environmentally-informed decisions which will enhance environmental performance. For example, when managers are more

aware of the activities with potential environmental impacts involved in producing goods and services, they will make better decisions in terms of refining their business processes to increase process/production efficiency, which can also lead to reductions in the consumption of energy, water and materials. In addition, using the information provided by Environmental Activity Management, managers can make effective investment decisions in respect to equipment or technologies which can help reduce the levels of waste and emissions and/or the costs associated with cleaning up environmental damage.

H2: Decision quality mediates the relationship between Environmental Activity Management (EAA, EACA, and EABC) and environmental performance.

3 Method

3.1 Data collection

A survey questionnaire was distributed to a random sample of 820 Australian organisations selected from the OneSource online database which provides in-depth information of organisations in Asia and the Pacific Rim. These organisations operate across various industries in the primary (mining, agriculture), secondary (construction, manufacturing), and tertiary (health, transport, utilities) sectors. The target respondents included chief executive officers (CEOs)/managing directors, chief financial officers (CFOs)/finance managers, and chief operating officers (COOs)/production managers. The survey was administered in accordance with the Dillman Tailored Designed Method (Dillman, 2007), which has been shown to maximise response rates. This method provides guidelines in respect to the format and style of questions, distribution procedures, and techniques to personalise the survey.

A total of 217 questionnaires were returned (26.5%), of which 85 (10.4%) questionnaires were from the initial distribution, and 132 (16.1%) from the follow-up mail-out. Nine questionnaires were omitted due to significant missing data, resulting in a final sample of 208 usable questionnaires (25.4%). Following Roberts (1999), non-response bias was assessed by comparing dependent and independent variable values between the early and late respondents. Furthermore, respondents and non-respondents were compared with respect to their average size (proxied by the number of employees) and the industry in which they operate. No significant differences were detected in any of these comparisons, indicating that non-response bias was not a major problem.

3.2 Measurement of variables

3.2.1 Environmental Activity Management

The extent of Environmental Activity Management use was measured using Baird et al.'s (2004) measure of Activity Management, with modifications made to reflect the environmental context. Specifically, respondents were asked to indicate the extent to which they: (1) identified and analysed the activities with potential environmental impacts involved in producing goods and services (EAA), (2) identified and calculated the costs of the activities with potential environmental impacts involved in producing goods and services, for the purpose of identifying the factors which influenced costs (EACA), and (3) identified and calculated the costs of the activities with potential environmental impacts involved in producing goods and services, for the purpose of enabling a more accurate assessment of the costs of each product (EABC). A five-point Likert scale was used with anchors of '1 = not at all' and '5 = to a great extent'.

3.2.2 Environmental performance

Respondents were asked to indicate on a 5-point scale ranging from '1 = not at all' to '5 = to a great extent', the extent to which their organisation achieved each of 15 environmental outcomes identified in a review of prior studies on environmental management and performance (Langfield-Smith et al., 2015; Henri and Journeault, 2010).

Factor analysis (varimax rotation) resulted in four dimensions with eigenvalues greater than 1, which accounted for 55.6% of the total variance (see Table 1). Based on the characteristics of the items in each dimension, the four dimensions were labelled 'resource usage', 'regulatory compliance', 'productivity', and 'stakeholder interaction'. The item 'increased filters and controls on emissions and discharges' did not load onto any dimension (using a cut-off point of 0.4) and therefore was removed.

Confirmatory factor analysis (CFA) was performed to assess the validity of the measurement models for each of the four dimensions of environmental performance, with the results reported in Table 2. The assessment process includes the investigation of the squared multiple correlation coefficients, modification indices, and a number of commonly used fit indices[1], which resulted in the elimination of redundant items in some cases. In addition, Cronbach's alpha coefficients were calculated to assess the reliability of the scales.

[1] The common fit measures and their recommended threshold values are: norm chi-square < 3 (Ballantyne et al., 2011); GFI and CFI > 0.90 (López-Gamero et al., 2010); and RMSEA < 0.10 (Henri, 2006).

Table 1 Factor analysis – Environmental performance

Item	Factor			
	Resource usage	Regulatory compliance	Productivity	Stakeholder interaction
Reductions in energy consumption	**.699**	.008	.187	-.024
Reductions in water usage	**.718**	.132	.187	.133
Reductions in material costs due to the efficient use of material	**.567**	.098	.522	.071
Reductions in the levels of waste	**.487**	.174	.117	.264
Reductions in levels of emissions	**.499** ^	.321	.183	.075
Increased residue recycling	**.426** ^	.231	.096	.205
Reductions in the costs of regulatory compliance	.216	**.485**	.258	.169
Reductions in the costs associated with cleaning up environmental damage	.163	**.770**	.207	.144
Reductions in the fines paid and remediation costs regarding environmental damage	.112	**.841**	.140	.143
Reductions in process/production costs	.314	.189	**.769**	.021
Increased process/production efficiency	.169	.330	**.708**	.164
Increased knowledge about effective ways of managing operations	.284	.197	**.462** ^	.399
Increased organisation-wide learning among employees	.169	.055	.204	**.808**
Better relationships with stakeholders such as local communities, regulators, and environmental groups	.058	.334	-.040	**.614**
Increased filters and controls on emissions and discharges	.343	.387	.200	.286 ^

^ Items that were eliminated

Table 2 Results of the measurement models

Variable	No. of items	Cronbach's alpha	Chi-square	df	Normed chi-square	GFI	CFI	RMSEA
Environmental performance								
Resource usage	4	0.773	4.128	2	2.064	0.990	0.991	0.072
Regulatory compliance	3	0.798	0.204	1	0.204	0.999	1	0
Productivity	2	0.802	0	0	-	1	1	-
Stakeholder interaction	2	0.679	0	0	-	1	1	-
Decision quality	5	0.919	2.293	3	0.764	0.996	1	0

Recommended threshold: Normed chi square < 3, GFI and CFI > 0.90, RMSEA < 0.10

The measurement model for the 'regulatory compliance' dimension showed a good fit with a Cronbach's alpha of 0.798, which exceeds the 0.70 benchmark generally considered acceptable with respect to reliability (Nunnally, 1978). Confirmatory factor analysis for the 'resource usage' dimension indicated that two items 'reductions in levels of emissions' and 'increased residue recycling' exhibited low squared multiple correlation (0.251 and 0.298 respectively) and therefore these items were eliminated. The scale then exhibited a good fit and a Cronbach's alpha of 0.773. With respect to the 'productivity' dimension, the item 'increased knowledge about effective ways of managing operations' was deleted as it did not contribute to the Cronbach's alpha, resulting in a final scale of two items with a Cronbach's alpha of 0.802. The confirmatory factory analysis for the 'productivity' and 'stakeholder interaction' (Cronbach's alpha 0.679) measurement models could not be performed as there were only two indicators and zero degrees of freedom. The total scores of the relevant items in each dimension were calculated, with higher (lower) scores reflecting higher (lower) levels of performance.

3.2.3 Decision quality

Decision quality was measured using a five-item scale adapted from Nevries et al. (2010) with modifications made to reflect the environmental context. Respondents were asked to indicate, on a 5-point scale ranging from '1 = strongly disagree' to '5 = strongly agree', the extent to which they were satisfied with: (1) the quality of the information that environmental decisions are based on, (2) the environmental decision making process, (3) the outcomes of environmental decisions, (4) the implementation of environmental actions, and (5) the monitoring of environmental decisions. The measurement model for decision quality exhibited a good fit (see Table 2). Hence, the level of decision quality was measured as the combined scores for the 5 items in the scale, with higher (lower) scores indicating higher (lower) levels of decision quality.

4 Results

4.1 Environmental Activity Management

Table 3 reports the extent of use of each level of Environmental Activity Management, namely EAA, EACA, and EABC. The mean score of EAA use is the highest (3.49), while mean scores for both EACA use (2.90) and EABC use (2.61) are below the mid-point of the range. This ranking is consistent with Baird et al. (2004) and Phan et al. (2014) who found that organisations might only implement AA or ACA without proceeding to the full implementation of ABC.

Table 3 Extent of use of Environmental Activity Management practices

Activity management practice	Means	Standard deviation	Non-adopter (1)	Adopt to a moderate extent (2-3)	Adopt to a great extent (4-5)
EAA	3.49	1.081	12 (5.8%)	83 (39.9%)	113 (54.3%)
EACA	2.90	1.090	25 (12.0%)	122 (58.7%)	61 (29.3%)
EABC	2.61	1.062	36 (17.3%)	130 (62.5%)	42 (20.2%)

The extent of Environmental Activity Management use was broken down into three categories: non-adopter, adopt to a moderate extent, and adopt to a great extent (scored as response points 1, 2-3, and 4-5 on the scale, respectively). The results indicate that EAA is widely used, with 54.3% of Australian organisations found to use EAA to a great extent. Alternatively, the proportion of respondents using EACA and EABC to a great extent is shown to be much lower (29.3% and 20.2% respectively).

4.2 The structural equation model

The hypotheses were examined using structural equation modelling. The structural model was tested by means of maximum likelihood estimate using AMOS version 21 software. The paths that were not statistically significant were gradually removed until all remaining paths in the model were significant and the final model exhibited a good fit (see Figure 1). This approach enabled the model to determine the most parsimonious explanation of variation in variables (Anderson and Gerbing, 1988).

Figure 1 The structural equation model

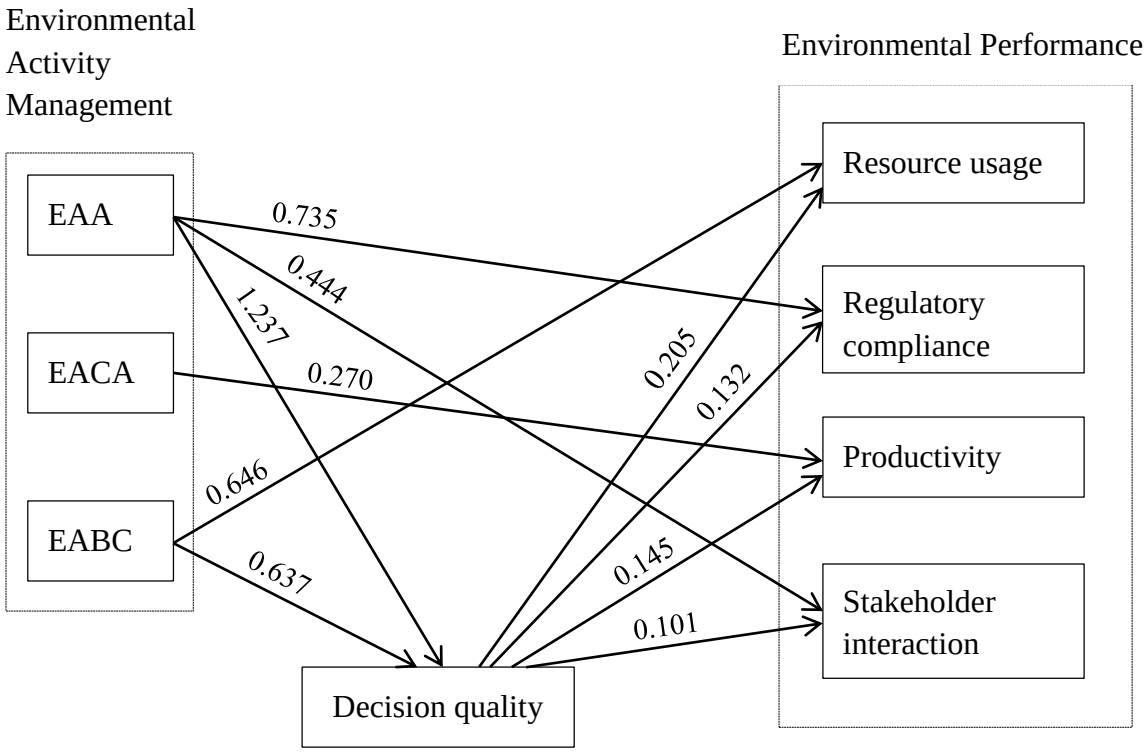

Table 4 reports the results of the path analysis in terms of path standardised beta, standardised error, critical ratio, p-values, and the fit indices used to assess the model fit. In regard to the fit indices, the normed chi-square (1.306), GFI (0.983), CFI (0.994) and RMSEA (0.038) are satisfactory, indicating a good fit of the model. The use of EAA was found to be associated with two dimensions of environmental performance, namely regulatory compliance (β = 0.735, p = 0.000) and stakeholder interaction (β = 0.444, p = 0.000). Significant relationships were also found between EACA use and the productivity dimension of environmental performance (β = 0.270, p = 0.020), and between EABC and the resource usage dimension (β = 0.646, p = 0.000). Therefore hypothesis 1 is supported for all three levels of Environmental Activity Management.

Table 4 Results of the path analysis

Description of path	Std beta	Std error	Critical ratio	P-value
EAA → Decision quality	1.237	0.260	4.750	0.000
EABC → Decision quality	0.637	0.265	2.405	0.016
Decision quality → Resource usage	0.205	0.054	3.785	0.000
Decision quality → Regulatory compliance	0.132	0.057	2.332	0.020
Decision quality → Productivity	0.145	0.036	4.012	0.000
Decision quality → Stakeholder interaction	0.101	0.030	3.339	0.000
EAA → Regulatory compliance	0.735	0.189	3.884	0.000
EAA → Stakeholder interaction	0.444	0.109	4.086	0.000
EACA → Productivity	0.270	0.116	2.335	0.020
EABC → Resource usage	0.646	0.186	3.468	0.000
Goodness of fit statistics				
CMIN	14.366			
df	11			
CMIN/df	1.306			
GFI	0.983			
CFI	0.994			
RMSEA	0.038			

Recommended threshold: Normed chi square < 3, GFI and CFI > 0.90, RMSEA < 0.10

Table 4 also reveals significant relationships between EAA and decision quality (β = 1.237, p = 0.000), and between EABC and decision quality (β = 0.637, p = 0.016). In addition, decision quality was found to be associated with all four dimensions of environmental performance, namely resource usage (β = 0.205, p = 0.000), regulatory compliance (β = 0.132, p = 0.020), productivity (β = 0.145, p = 0.000), and stakeholder interaction (β = 0.101, p = 0.000).

Since EACA does not affect decision quality, the mediating effect of environmental decision quality was only assessed for EAA and EABC, using the bootstrapping with bias-corrected confidence intervals method. Under this approach, a mediation effect is confirmed if the confidence interval (CI) between the lower limit (LL) and the upper limit (UL) does not cross zero. The results in Table 5 confirm that decision quality

mediates the relationship between EAA and EABC with all four dimensions of environmental performance. In particular, decision quality fully mediates the positive relationship between EAA with two dimensions of environmental performance (resource usage (CI_{LL} = 0.108, CI_{UL} = 0.477), and productivity (CI_{LL} = 0.093, CI_{UL} = 0.303)), and partially mediates the positive relationship between EAA with the two other dimensions of environmental performance (regulatory compliance (CI_{LL} = 0.497, CI_{UL} = 1.257), and stakeholder interaction (CI_{LL} = 0.345, CI_{UL} = 0.782)). In addition, decision quality fully mediates the positive relationship between EABC with three dimensions of environmental performance (regulatory compliance (CI_{LL} = 0.009, CI_{UL} = 0.224), productivity (CI_{LL} = 0.015, CI_{UL} = 0.238), and stakeholder interaction (CI_{LL} = 0.010, CI_{UL} = 0.170)), and partially mediates the positive relationship between EABC and the resource usage dimension (CI_{LL} = 0.333, CI_{UL} = 1.155). Hypothesis 2 is therefore partially supported.

Table 5 Bootstrapped regression analysis of mediation effects

	Resource usage		Regulatory compliance		Productivity		Stakeholder interaction	
	LL CI	UL CI	LL CI	UL CI	LL CI	UL CI	LL CI	UL CI
EAA	0.108	0.477	0.497	1.257	0.093	0.303	0.345	0.782
EABC	0.333	1.155	0.009	0.224	0.015	0.238	0.010	0.170

CI: confidence interval; LL: lower limit 95%; UL: upper limit 95%

5 Discussion and conclusion

The study contributes to the literature by providing an insight into the use of the three levels of Activity Management in an environmental context, namely Environmental Activity Analysis (EAA), Environmental Activity Cost Analysis (EACA) and Environmental Activity Based Costing (EABC). Although 54.3% of respondents report

that they use EAA to a great extent, only 29.3% and 20.2% use the higher levels of EACA and EABC to a great extent. Hence, not all organisations who use EAA proceed to EACA or EABC, which is consistent with Baird et al. (2004) and Reeve (1996) who argue that organisations might choose not to proceed to higher levels of Activity Management as they achieve satisfactory benefits through the use of AA.

The EAA adoption rate is similar to that found in Baird et al. (2004), who reported 57.3% of business units using AA to a great extent. However Baird et al. (2004) found a much higher proportion of business units using ACA (49.6%) and ABC (41.9%) to a great extent. Hence, our findings suggest that the focus on the costs of environmental activities is at the infancy stage with little emphasis placed on EACA and EABC. This may be attributable to a number of factors. First, there could be a lack of awareness of Environmental Activity Management practices and their usefulness given that Environmental Activity Management is a recent innovation in the management accounting literature. Hence, while managers may have a good understanding of the notion of Activity Management (especially ABC) in general, they may have less awareness of the application and suitability of Activity Management in an environmental context. Secondly, given the use of the higher levels of Environmental Activity Management (i.e. EACA or EABC) requires a detailed analysis of the costs involved with different environmental activities and allocating such costs to products, the use of such a sophisticated costing system may be less attractive to organisations that are more concerned with financial performance rather than environmental performance. For instance, organisations may believe that pursuing proactive environmental practices is detrimental to the managerial goals of profitability since the costs of such practices are significant and may result in reduced profits and decreased

returns to shareholders (Tinsley and Pillai, 2006; Melnyk et al., 2003). Thirdly, the failure to go beyond focusing on the environmental impact of operational activities (EAA) is consistent with the literature which suggests that many organisations are only concerned with enhancing their corporate image by creating the impression that they are undertaking sound environmental practices (Cho and Patten, 2007; Larrinaga-Gonzalez et al., 2001). Hence, such organisations would be more likely to engage in 'greenwashing' whereby they publicly tout their sustainability efforts without engaging in more proactive environmental management activities, including EACA and EABC, and integrating the analysis of the environmental costs of activities and products into decision making (Hitchcock and Willard, 2009).

While critical theorists maintain that organisations will only pursue environmental management activities that achieve financial benefits (Springett, 2003), pragmatists maintain that academics should engage with organisations to devise mechanisms that enable them to achieve sustainable outcomes (Larrinaga-Gonzalez and Bebbington, 2001). In line with the pragmatists view, this study examines the role of Environmental Activity Management in achieving sustainable outcomes. Specifically, this study investigated the direct association between Environmental Activity Management and environmental performance, and the indirect impact of Environmental Activity Management on environmental performance through environmental decision quality. In respect to the direct association, it was found that the use of EAA had a significant positive impact on the 'regulatory compliance' and 'stakeholder interaction' dimensions of environmental performance. This can be explained by the fact that EAA enables organisations to identify and eliminate the activities which can cause environmental damage, resulting in savings in the costs associated with regulatory compliance and

cleaning up pollution. In addition, EAA can also help organisations raise the environmental awareness of employees which can lead to better relationships with various stakeholders in regard to environmental management issues. A significant positive relationship was also found between EACA and the 'productivity' dimension of environmental performance. Such findings are plausible, since the detailed information regarding the costs of activities and their drivers can help managers in reducing their process/production costs and also improve process/production efficiency by managing the drivers of activity costs. Finally, the highest level of Environmental Activity Management, EABC, exhibited a significant positive relationship with the 'resource usage' dimension of environmental performance. This finding is attributable to the fact that EABC enables a more accurate allocation of environment-related costs to cost objects, which provides more information for managers to better manage the usage of resources.

While the results reveal that all three levels of Environmental Activity Management exhibit a positive relationship with environmental performance, the findings indicate that the actualisation of the positive impact of two levels of Environmental Activity Management, namely EAA and EABC, occurs through environmental decision quality. Specifically, the relationship between EAA and EABC with environmental performance was found to be mediated by the quality of environmental decisions made by management. Hence, the provision of more detailed and accurate information regarding the activities with environmental impacts (EAA) and tracing the environmental costs of activities to products and services (EABC) can enhance environmental decision quality, which in turn will positively influence environmental performance.

The findings highlight the importance of practitioners' awareness of the benefits of Environmental Activity Management in improving environmental performance, in particular, through enhanced environmental decision quality. Specifically, environmental cost information is crucial in assisting internal decision makers in various production and resource-allocation decisions (Deegan, 2008). Therefore, it is imperative for organisations to correctly assess environmental costs to provide better estimates of product costs as the increased costs of environmental protection need to be passed on to customers via accurate pricing policies.

Increased environmental pressures from various stakeholders have forced many organisations to seek new, creative and cost-effective methods to manage and minimise their environmental impacts (IFAC, 2005). For instance, these pressures include increasingly stringent environmental regulations by the government which imposes fines, imprisonment, and environment-related taxes (Phan and Baird, 2015; IFAC, 2005), suppliers and customers' pressures on greener products and processes (Zhang et al., 2008), and financing pressures via the worldwide growth of socially responsible investment funds and sustainability-based investment rating systems (IFAC, 2005). Given these circumstances, and the findings in regard to the impact of Environmental Activity Management on environmental performance, it is expected that Environmental Activity Management practices will become increasingly relevant for organisations. The use of Environmental Activity Management could also become imperative should the government impose more stringent regulations and/or policies concerning the accountability of organisations for the costs of environment-related activities.

Consequently, efforts should be directed towards improving the currently low adoption rates of Environmental Activity Management practices. Training should be provided to increase the understanding of Environmental Activity Management practices and their benefits, and the implementation of an Environmental Activity Management system should involve a team of people from both accounting and environmental backgrounds who can work together to incorporate the significant environmental impacts and costs into the existing accounting system (Deegan, 2003). More importantly, top management should provide support for Environmental Activity Management and communicate their support throughout the implementation process as top management support is vital to ensure an organisation-wide understanding of and commitment to environmental issues (Darnall et al., 2008). For organisations with limited financial resources, an incremental approach may be appropriate with modifications made to existing management accounting systems to include relevant environmental cost data. This approach can be relatively inexpensive yet generate significant benefits (Deegan, 2003). For example, organisations could start with a review of overhead accounts to identify the hidden environmental costs and how these costs are allocated to processes or products. They could then incorporate a number of environmental measures to the existing system, such as energy and waste, and identify their drivers to enable the assignment of energy/waste costs to activities and products.

The study is subject to the inherent limitations of the mail survey method, including the restriction in determining causal relationships, the limited number of questions, the absence of opportunities to probe answers, and measurement errors resulting from respondents' misunderstanding of the questions (Singleton and Straits, 2005). A combination of different methods in future studies, for instance, interviews together

with surveys, would provide further insights into the extent of Environmental Activity Management use, the range of decisions that require environmental cost consideration, and different aspects of environmental performance. Another limitation of the study is the use of managers' perception instead of objective data in measuring environmental performance. Accordingly, future studies could obtain objective environmental performance data when available to validate the survey-based environmental performance measures. Given the positive relationship between environmental decision quality and environmental performance, future studies may also investigate the influence of other contingency factors on environmental decision quality. Finally, while the findings suggest that Environmental Activity Management practices are important due to their impact on environmental performance, given the critical theorists' view that organisations are only concerned with economic outcomes, and the literature in regard to the interrelationship between environmental performance and financial performance (Stefan and Lanoie, 2008), future studies can empirically examine the relationship between the use of Environmental Activity Management practices with both environmental performance and financial performance.

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CHAPTER SEVEN

CONCLUSION

The increasing attention on environmental issues and the concerns of a variety of stakeholders regarding the environmental performance of organisations have led organisations to move beyond complying with legal requirements to adopt proactive approaches to environmental management in an attempt to minimise the environmental impact of their organisational operations (Tinsley and Pillai, 2006). This study sought to provide a more detailed insight into the use and effectiveness of such environmental management practices. Specifically, Paper One examined the comprehensiveness of the Environmental Management Systems (EMSs) adopted by organisations and the association between three institutional factors (coercive, mimetic, and normative pressures) with the comprehensiveness of the EMS. In addition, Paper Two examined the extent of use of both physical and monetary components of Environmental Management Accounting (EMA) and the influence of organisational factors (size, top management support, and EMS comprehensiveness) on EMA use, while Paper Three examined a specific tool of EMA, Environmental Activity Management, which encompasses three levels of Environmental Activity Analysis (EAA), Environmental Activity Cost Analysis (EACA) and Environmental Activity Based Costing (EABC).

The effectiveness of such environmental management practices was assessed with respect to the achievement of desired environmental outcomes, operationalised as environmental performance. In particular, hypotheses were developed in regard to the association between the comprehensiveness of the EMS (Paper One), and the extent of use of EMA (Paper Two), with environmental performance. Furthermore, Paper Three

investigated both the direct association between Environmental Activity Management practices and environmental performance, and the indirect impact of such practices on environmental performance through environmental decision quality.

The remainder of this chapter is structured as follows. Section 7.1 presents the findings of the thesis. Section 7.2 discusses the contributions and implications of the thesis, and section 7.3 outlines the limitations of the thesis and provides suggestions for future research.

7.1 Summary of findings

Using the mail survey method, data were collected from 208 senior managers in Australian organisations across various industries. The results provide a significant insight into the use of environmental management practices. First, the findings highlight the variation in the comprehensiveness of EMSs across industries and organisations, reinforcing claims in the literature concerning the differences in EMSs across organisations (Darnall et al., 2008). Secondly, the results indicate a moderate extent of use of physical EMA, and a low extent of use of monetary EMA. Such findings are in line with Christ and Burritt (2013) and Ferreira et al. (2010), who suggest that EMA, as a recent innovation in management accounting, is still in the early stages of development. Thirdly, in regard to the extent of use of the three levels of Environmental Activity Management, while EAA was used to a great extent, little emphasis was placed on EACA and EABC, suggesting that the focus on the costs of environmental activities is at the infancy stage. Such findings are consistent with the finding concerning the low extent of use of monetary EMA.

In addition to providing an insight into the extent of use of environmental management practices, the study also contributes to the contingency based research by examining the factors influencing the adoption of such practices. First, in respect to the adoption of EMSs, Paper One revealed that coercive and normative pressures were positively associated with the comprehensiveness of EMSs, implying that the government and a variety of stakeholders including employees, customers, professional groups, media and the community can significantly affect the use of EMSs. Secondly, in respect to the adoption of EMA, Paper Two revealed that the comprehensiveness of the EMS and top management support were positively associated with the extent of use of both physical and monetary EMA.

Finally, the study provides an insight into the effectiveness of environmental management practices with all three papers examining such effectiveness in respect to environmental performance. The results support the usefulness of environmental management practices with the use of more comprehensive EMSs, the use of physical and monetary EMA, and the use of Environmental Activity Management all found to have a positive impact on environmental performance. Specifically, in Paper One, organisations with more comprehensive EMSs were found to experience better environmental performance in respect to all four dimensions of resource usage, regulatory compliance, productivity and stakeholder interaction. In addition, Paper Two indicated that the use of physical EMA was associated with the 'stakeholder interaction' dimension of environmental performance, while the use of monetary EMA was associated with all four dimensions of environmental performance. Furthermore, Paper Three revealed that the extent of use of all three levels of Environmental Activity Management (namely, EAA, EACA, and EABC) were positively associated with

environmental performance. Specifically, the use of EAA was found to be positively associated with the 'regulatory compliance' and 'stakeholder interaction' dimensions of environmental performance, while EACA and EABC exhibited a positive relationship with the 'productivity' and 'resource usage' dimensions of environmental performance respectively. In addition, Paper Three also revealed that the relationship between EAA and EABC with environmental performance was mediated by the quality of environmental decisions made by management.

7.2 Contributions and implications

This study contributes to the environmental management literature in several ways. First, the study provides a more detailed insight into the extent of use of environmental management practices by utilising improved measures of specific practices. For instance, this study focuses on the comprehensiveness of an EMS, operationalised in respect to the extent of use of nine environmental practices identified as important components of an EMS in the literature (Henriques and Sadorsky, 2007; Anton et al., 2004). By capturing the intensity of use of such practices, this approach overcomes the limitations of previous studies which simply categorise organisations into EMS users and non-users, or merely focus on the total number of practices used, and hence provide the opportunity for organisations to 'green wash' by creating the impression that they are committed to a number of environmental practices without really engaging in those activities. In addition, the study contributes to the understanding of EMA practices by developing a multi-item measure of EMA which focuses on both monetary and physical components. This measure extends the first multi-item measure of EMA proposed by Ferreira et al. (2010) which mainly focuses on the monetary component. Such a comprehensive measure of EMA is pertinent to empirical studies given the lack of

consensus on the definition of EMA in the literature (IFAC, 2005). The study further contributes to the EMA literature by providing an insight into the use of a specific EMA tool, Environmental Activity Management. Specifically, the study extends the literature by incorporating Gosselin's (1997) Activity Management concept into the environmental context, resulting in three levels of Environmental Activity Management, namely EAA, EACA, and EABC. Furthermore, in conveying the different levels at which organisations may choose to adopt Environmental Activity Management, this approach does not rely on respondents' interpretation of terms; rather respondents are required to indicate the extent to which they are engaging in activities which reflect each of the three levels of Environmental Activity Management.

Secondly, the study extends the literature examining the effectiveness of environmental management practices by providing an empirical insight into the association between the comprehensiveness of EMSs, the use of physical and monetary EMA, and the use of Environmental Activity Management, with environmental performance. Environmental performance was assessed in respect to the achievement of fifteen desired environmental outcomes and was subsequently measured using four dimensions (resource usage, regulatory compliance, productivity and stakeholder interaction). The findings suggest that organisations experience higher level of environmental performance when they commit to developing a comprehensive EMS, implement both physical and monetary EMA to a greater extent, and focus on analysing the activities with environmental impacts (EAA), managing them via their cost drivers (EACA), and allocating environmental activity costs to products and services (EABC).

The findings make a significant contribution to the critical – pragmatist debate concerning the pursuit of environmental initiatives by organisations. Specifically, while critical theorists assert that organisations will only pursue environmental management activities that improve financial performance (Springett, 2003), the findings support the pragmatists who maintain that organisations should engage in activities designed to achieve sustainable outcomes (Larrinaga-Gonzalez and Bebbington, 2001). In particular, through examining the role of EMSs, EMA, and the three levels of Environmental Activity Management in achieving desired environmental outcomes, operationalised as environmental performance, the study provides an empirical insight into the pragmatist viewpoint by providing evidence of the means by which organisations can manage the achievement of desirable sustainable outcomes. Accordingly, it is suggested that organisations take a proactive approach to improve the comprehensiveness of their EMS, use both physical and monetary EMA to a greater extent, and use the three levels of Environmental Activity Management to a greater extent, so as to enhance their environmental performance.

In addition, the identified mediating effect of environmental decision quality on the relationship between two levels of Environmental Activity Management, namely EAA and EABC, and environmental performance suggests that while the presence of such practices is crucial in improving environmental performance, their positive impact is actualised through decision quality. The findings reinforce Deegan's (2008) assertion that environmental cost information is crucial in assisting internal decision makers in various production and resource-allocation decisions (Deegan, 2008). Therefore, it is imperative for organisations to correctly assess environmental costs through the use of Environmental Activity Management, to provide better estimates of product costs.

Thirdly, given the significant impact of environmental management practices on environmental performance, the study contributes to the literature by utilising the contingency approach to empirically examine the factors that affect the extent of use of such practices. The findings highlight the importance of coercive and normative pressures in enhancing the comprehensiveness of EMSs. Hence, it is suggested that the government can induce improvements in environmental performance directly through regulatory pressure such as the threat of more stringent regulations, and that environmental policy should focus on encouraging organisations with a limited EMS to use more practices and use them to a greater extent to achieve better environmental outcomes. Furthermore, given the impact of normative pressure from a variety of sources, including employees, professional groups, media and the community, on EMS comprehensiveness, the government can also potentially induce improvements in environmental performance indirectly through appropriately designed public incentives such as public recognition of the improved environmental performance of organisations, or mandatory provision of organisations' environmental information to the public.

In regard to the association between organisational factors and EMA use, the findings highlight the importance of top management support and the comprehensiveness of an EMS in enhancing the use of EMA. Hence, it is recommended that top management have a good understanding of EMA practices, provide adequate resources to support the implementation of EMA and communicate their support throughout the implementation process. Top management can also take actions to initiate the implementation of comprehensive EMSs, while organisations with limited environmental management experience could obtain external advice from environmental consultants, and/or consider employing staff with expertise in designing an EMS (Tung et al., 2014).

In addition to the significant contribution to the environmental management literature, the study also provides important implications for practice. Specifically, the findings provide organisations with empirical evidence of the positive association between various environmental management practices and environmental performance, which enhances the awareness of managers in regard to the effectiveness of such practices. Hence, the implication for organisations is that they should endeavour to improve the comprehensiveness of their EMSs, the extent of use of EMA, and the extent of use of the three levels of Environmental Activity Management in order to reap the benefits of improved environmental performance. In addition, by providing an insight into the factors affecting the comprehensiveness of EMSs, the results suggest that organisations should be aware of and anticipate the institutional pressures, specifically coercive and normative pressures, with a view to minimising the costs of disruption and compliance. The findings also highlight the importance of top management support and the comprehensiveness of an EMS in increasing the use of EMA, which implies that top management should have a good understanding of EMA, provide adequate resources to support the implementation of EMA, and take actions to initiate the implementation of EMSs. In addition, it is imperative for organisations to correctly assess environmental costs through the use of Environmental Activity Management. Environmental Activity Management can be used to provide managers with better estimates of product costs, which is essential as the increased costs of environmental protection need to be passed on to customers via accurate pricing policies.

7.3 Limitations and suggestions for future studies

This study has a number of limitations. First, it is subject to the usual criticisms associated with the use of the mail survey method, including the inability to determine

causal relationships, the absence of opportunities to probe answers, common method bias, social desirability bias, and measurement errors resulting from respondents' misunderstanding of the questions (Kuasirikun, 2005; Singleton and Straits, 2005). Common method bias was assessed by Harman's (1967) single-factor test, with the results indicating that the total variance explained by a single factor was below the 50% threshold indicative of common method bias problems (Podsakoff et al., 2003), while the full ranges on the variables suggest that social desirability response bias was not a problem. Future studies may utilise other methods, such as interviews, together with surveys in an attempt to provide further insights into the use of environmental practices. A further limitation of the study is that it relies on the use of managers' perception instead of objective data in measuring environmental performance. Accordingly, future studies could seek more objective environmental performance data to validate the survey-based environmental performance measures. In addition, given the current study is static (i.e. it only examines the use of environmental management practices and environmental performance at one point in time), future longitudinal studies could be conducted to examine the improvement in environmental performance through the greater use of environmental management practices over time.

While the findings suggest that environmental management practices are important due to their impact on environmental performance, given the critical theorists' view that organisations only focus on economic outcomes, and the literature in regard to the interrelationship between environmental performance and financial performance (Stefan and Lanoie, 2008), future studies can empirically examine the relationship between the use of environmental management practices with both environmental performance and financial performance. Furthermore, it is acknowledged that the study only addresses one aspect of sustainability accounting and reporting, the management aspect, and the

focus is on environmental issues. This limitation provides the scope for future studies to explore the social issues management aspect. Finally, given the positive association between environmental decision quality and environmental performance, future studies may also investigate the influence of contingency factors on environmental decision quality.

APPENDIX A: SURVEY QUESTIONNAIRE

Environmental Management Survey

1 **What is your position within the organisation?** _____

2 **What is the approximate number of full time employees in your organisation?** _____

3 **Please indicate the main industry in which your organisation operates:**

☐ Utilities ☐ Manufacturing ☐ Agriculture

☐ Transport ☐ Construction ☐ Mining

☐ Health ☐ Other, please specify: _____

4 **Please indicate the extent to which you agree or disagree with the following statements regarding environmental management practices (EMPs):**

	Strongly disagree				**Strongly agree**
Top management provides active support for EMPs.	☐1	☐2	☐3	☐4	☐5
Top management provides adequate resources to support EMPs.	☐1	☐2	☐3	☐4	☐5
Top management effectively communicates its support for EMPs.	☐1	☐2	☐3	☐4	☐5
Top management exercises its authority in support of EMPs.	☐1	☐2	☐3	☐4	☐5

5 **Below is a list of desired environmental outcomes. Please indicate the extent to which each of the following outcomes is achieved in your organisation:**

		Not at all				To a great extent
1.	Reductions in energy consumption	☐1	☐2	☐3	☐4	☐5
2.	Reductions in water usage	☐1	☐2	☐3	☐4	☐5
3.	Reductions in material costs due to the efficient use of material	☐1	☐2	☐3	☐4	☐5
4.	Reductions in the levels of waste	☐1	☐2	☐3	☐4	☐5
5.	Reductions in levels of emissions	☐1	☐2	☐3	☐4	☐5
6.	Reductions in process/production costs	☐1	☐2	☐3	☐4	☐5
7.	Reductions in the costs of regulatory compliance	☐1	☐2	☐3	☐4	☐5
8.	Reductions in the costs associated with cleaning up environmental damage	☐1	☐2	☐3	☐4	☐5
9.	Reductions in the fines paid and remediation costs regarding environmental damage	☐1	☐2	☐3	☐4	☐5
10.	Increased process/production efficiency	☐1	☐2	☐3	☐4	☐5
11.	Increased knowledge about effective ways of managing operations	☐1	☐2	☐3	☐4	☐5
12.	Increased organisation-wide learning among employees	☐1	☐2	☐3	☐4	☐5
13.	Better relationships with stakeholders such as local communities, regulators, and environmental groups	☐1	☐2	☐3	☐4	☐5
14.	Increased filters and controls on emissions and discharges	☐1	☐2	☐3	☐4	☐5
15.	Increased residue recycling	☐1	☐2	☐3	☐4	☐5

6 **Please indicate the extent to which you agree or disagree with the following statements:**

In my organisation overall, I am very satisfied with:		Strongly disagree				Strongly agree
1.	The quality of the information that environmental decisions are based on	☐1	☐2	☐3	☐4	☐5
2.	The environmental decision making process	☐1	☐2	☐3	☐4	☐5
3.	The outcomes of environmental decisions	☐1	☐2	☐3	☐4	☐5
4.	The implementation of environmental actions	☐1	☐2	☐3	☐4	☐5
5.	The monitoring of environmental decisions	☐1	☐2	☐3	☐4	☐5

7 **Please indicate the extent to which your organisation has:**

		Not at all				To a great extent
1.	Policies, rules, regulations, procedures in relation to environmental management	☐1	☐2	☐3	☐4	☐5
2.	Dedicated staff responsible for focusing on environmental issues	☐1	☐2	☐3	☐4	☐5
3.	Used environmental criteria in the evaluation and/or compensation of employees	☐1	☐2	☐3	☐4	☐5
4.	Frequent environmental training programs	☐1	☐2	☐3	☐4	☐5
5.	Frequent internal environmental audits	☐1	☐2	☐3	☐4	☐5
6.	Frequent external environmental audits	☐1	☐2	☐3	☐4	☐5
7.	Benchmarked environmental performance	☐1	☐2	☐3	☐4	☐5
8.	Processes to evaluate environmental risks when selecting suppliers, partners, or clients	☐1	☐2	☐3	☐4	☐5
9.	Environmental performance indicators and goals	☐1	☐2	☐3	☐4	☐5

8 **Please indicate the extent to which the following statements describe current practices in your organisation:**

1. Our organisation identifies and analyses the activities with potential environmental impacts involved in producing goods and services.

   Not at all To a great extent

   ☐1 ☐2 ☐3 ☐4 ☐5

2. Our organisation identifies and calculates the *costs* of the activities with potential environmental impacts involved in producing goods and services, for the purpose of identifying the *factors which influence costs.*

   Not at all To a great extent

   ☐1 ☐2 ☐3 ☐4 ☐5

3. Our organisation identifies and calculates the *costs* of the activities with potential environmental impacts involved in producing goods and services, for the purpose of enabling a more *accurate assessment of the costs of each product.*

   Not at all To a great extent

   ☐1 ☐2 ☐3 ☐4 ☐5

9 **Please indicate the extent to which the following factors have influenced your organisation's focus on environmental issues:**

		Not at all				To a great extent
1.	Compliance with international environmental standards	☐1	☐2	☐3	☐4	☐5
2.	Compliance with national/regional environmental regulations	☐1	☐2	☐3	☐4	☐5
3.	Compliance with national/regional resource saving and conservation regulations	☐1	☐2	☐3	☐4	☐5
4.	Pressures from suppliers, partners, and clients with respect to environmental issues	☐1	☐2	☐3	☐4	☐5
5.	The green strategies of same product producers	☐1	☐2	☐3	☐4	☐5
6.	The green strategies of substitute product producers	☐1	☐2	☐3	☐4	☐5
7.	Competition in the industry	☐1	☐2	☐3	☐4	☐5
8.	Awareness of best practices in the industry	☐1	☐2	☐3	☐4	☐5
9.	The environmental awareness of employees	☐1	☐2	☐3	☐4	☐5
10.	The environmental awareness of customers	☐1	☐2	☐3	☐4	☐5
11.	The extent of media focus on your industry	☐1	☐2	☐3	☐4	☐5
12.	Public environmental awareness (community, NGO etc.)	☐1	☐2	☐3	☐4	☐5
13.	The legitimisation of your organisation's activities	☐1	☐2	☐3	☐4	☐5
14.	The focus on performance and accountability	☐1	☐2	☐3	☐4	☐5
15.	The focus on environmental policy in the organisational vision and/or mission statement	☐1	☐2	☐3	☐4	☐5
16.	Professional groups' attention to environmental issues	☐1	☐2	☐3	☐4	☐5

10 **Please indicate the extent to which the following practices apply within your organisation:**

		Not at all				To a great extent
1.	Recording all physical inputs (energy, water, materials)	☐1	☐2	☐3	☐4	☐5
2.	Recording all physical outputs (wastes, emissions)	☐1	☐2	☐3	☐4	☐5
3.	Monitoring material flows through all the different material management steps, from acquisition to disposal	☐1	☐2	☐3	☐4	☐5
4.	Using environmental performance targets for physical inputs	☐1	☐2	☐3	☐4	☐5
5.	Using environmental performance targets for physical outputs	☐1	☐2	☐3	☐4	☐5
6.	Identification of environment-related costs	☐1	☐2	☐3	☐4	☐5
7.	Estimation of environment-related contingent liabilities (e.g EPA fines)	☐1	☐2	☐3	☐4	☐5
8.	Classification of environment-related costs	☐1	☐2	☐3	☐4	☐5
9.	Allocation of environment-related costs to production processes	☐1	☐2	☐3	☐4	☐5
10.	Allocation of environment-related costs to products	☐1	☐2	☐3	☐4	☐5
11.	Improvements to environment-related cost management	☐1	☐2	☐3	☐4	☐5
12.	Creation and use of environment-related cost accounts	☐1	☐2	☐3	☐4	☐5
13.	Development and use of environment-related key performance monetary indicators (e.g. reductions in energy costs)	☐1	☐2	☐3	☐4	☐5
14.	Product life cycle cost assessments	☐1	☐2	☐3	☐4	☐5

Thank you for taking the time to complete this survey. Return of the questionnaire will be regarded as consent to use the information for research purposes. Your assistance in providing this information is very much appreciated. If there is anything else you would like to tell me in relation to your experience with environmental management practices please do so in the space provided below.

Please return your completed survey in the enclosed envelope to:

Thanh Phan, C/- Dr Kevin Baird
Department of Accounting and Corporate Governance
Faculty of Business and Economics
Macquarie University, NSW 2109.

Please also return the enclosed postcard **separately** in the mail. My receipt of the postcard will alert me that your survey has been returned and prevent a reminder survey being sent to you.

Thank you for your participation.

APPENDIX B: SURVEY COVER LETTER

Faculty of Business and Economics
Department of Accounting and Corporate Governance
MACQUARIE UNIVERSITY NSW 2109

Phone +61 (0)2 9850 8532
Email thanhnguyet.phan@students.mq.edu.au

«Title» «Name»
«Job Position»
«Company Name»
«Address»

Information Letter

Dear «Title» «Surname»,

Chief Investigator's / Supervisor's Name: Kevin Baird
Chief Investigator's / Supervisor's Title: Associate Professor

Name of Project: The use and effectiveness of environmental management practices.

You are invited to participate in a study examining the environmental management practices of organisations across different industries. The study aims to provide an insight into the influence of organisational and institutional factors on environmental management systems and environmental management accounting systems, and the impact of these systems on environmental performance. The study is being conducted by Thanh Phan (02-98508532, thanhnguyet.phan@students.mq.edu.au) to meet the requirements for the Doctor of Philosophy under the supervision of Associate Professor Kevin Baird (02-98508532, kevin.baird@mq.edu.au) and Mr. Bill Blair (02-98506873, bill.blair@mq.edu.au) of the Department of Accounting and Corporate Governance.

Participation in this study is entirely voluntary. You are not obliged to participate and if you decide to participate, you are free to withdraw at any time without having to provide a reason and without consequence. Return of the questionnaire will be regarded as consent to use the information for research purposes. If you decide to participate, you will be required to complete the questions on the attached questionnaire. The questionnaire should take approximately ten minutes to complete.

Any information or personal details gathered in the course of the study are confidential and only the researchers will have access to the data. No individual will be identified in any publication of the results. While a postcard is provided, the purpose of this is to inform us that you have completed the questionnaire, thereby preventing a follow up being sent. If you would like a copy of the results of the study please indicate so on the postcard.

Thank you for your assistance.

Yours Sincerely,

Thanh Phan.

The ethical aspects of this study have been approved by the Macquarie University Human Research Ethics Committee. If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Committee through the Director, Research Ethics (telephone (02) 9850 7854; email ethics@mq.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

APPENDIX C: FINAL ETHICS APPROVAL

Mrs Yanru Ouyang <yanru.ouyang@mq.edu.au> Fri, Oct 19, 2012 at 9:58 AM
To: A/Prof Kevin Baird <kevin.baird@mq.edu.au>
Cc: Ms Thanh Nguyet Phan <thanhnguyet.phan@students.mq.edu.au>, Mr Bill Blair <bill.blair@mq.edu.au>

Dear A/Prof Baird,
Re: 'The use and effectiveness of environmental management practices.'
Reference No.: 5201200758

Thank you for your recent correspondence. Your response has addressed the issues raised by the Faculty of Business & Economics Human Research Ethics Sub Committee. Approval of the above application is granted, effective 19 October 2012 and you may now commence your research.

This research meets the requirements of the National Statement on Ethical Conduct in Human Research (2007). The National Statement is available at the following web site:
http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/e72.pdf.

The following personnel are authorised to conduct this research:
A/Prof Kevin Baird
Ms Thanh Nguyet Phan
Mr Bill Blair
NB. STUDENTS: IT IS YOUR RESPONSIBILITY TO KEEP A COPY OF THIS APPROVAL EMAIL TO SUBMIT WITH YOUR THESIS.

Please note the following standard requirements of approval:
1. The approval of this project is conditional upon your continuing compliance with the National Statement on Ethical Conduct in Human Research (2007).
2. Approval will be for a period of five (5) years subject to the provision of annual reports.
Progress Report 1 Due: 19th Oct 2013
Progress Report 2 Due: 19th Oct 2014
Progress Report 3 Due: 19th Oct 2015
Progress Report 4 Due: 19th Oct 2016
Final Report Due: 19th Oct 2017
NB. If you complete the work earlier than you had planned you must submit a Final Report as soon as the work is completed. If the project has been discontinued or not commenced for any reason, you are also required to submit a Final Report for the project. Progress reports and Final Reports are available at the following website:
http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/forms
3. If the project has run for more than five (5) years you cannot renew approval for the project. You will need to complete and submit a Final Report and submit a new application for the project. (The five year limit on renewal of approvals allows the Committee to fully re-review research in an environment where legislation, guidelines and requirements are continually changing, for example, new child protection and privacy laws).
4. All amendments to the project must be reviewed and approved by the Committee before implementation. Please complete and submit a Request for Amendment Form available at the following website:
http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/forms
5. Please notify the Committee immediately in the event of any adverse effects on participants or of any unforeseen events that affect the continued ethical acceptability of the project.
6. At all times you are responsible for the ethical conduct of your research in accordance with the guidelines established by the University. This information is available at the following websites:
http://www.mq.edu.au/policy/
http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/policy
If you will be applying for or have applied for internal or external funding for the above project it is your responsibility to provide the Macquarie University's Research Grants Management Assistant with a copy of this email as soon as possible. Internal and External funding agencies will not be informed that you have final approval for your project and funds will not be released until the Research Grants Management Assistant has received a copy of this email.
If you need to provide a hard copy letter of Final Approval to an external organisation as evidence that you have Final Approval, please do not hesitate to contact the FBE Ethics Committee Secretariat, via fbe-ethics@mq.edu.au or 9850 4826.
Please retain a copy of this email as this is your official notification of final ethics approval.

Yours sincerely
Alan Kilgore
Chair, Faculty of Business and Economics Ethics Sub-Committee

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