

The effectiveness of environmental management

By

Man (Amy) Tung

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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 Ethic Review Committee (Human Research) at Macquarie University.

Man (Amy) Tung

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ABSTRACT

The thesis examines the environmental management practices of Australian manufacturing organisations with emphasis placed on the effectiveness of such practices and the role of organisational factors and the use of environmental performance measures in enhancing such effectiveness. The study also examines the effect of the adoption of environmental management systems on environmental performance. Data were collected by mail survey questionnaire from a random sample of senior financial officers in Australian manufacturing organisations.

The thesis adopts the ‘thesis by publication’ format and consists of three research papers. Paper One examines the association between five specific organisational factors with the effectiveness of environmental management. Paper Two examines the association between the extent to which environmental performance measures (EPMs) are used and the purpose of using EPMs with the effectiveness of environmental management.

The first two papers examine the effectiveness of environmental management from two perspectives, environmental performance and the effectiveness of environmental management processes. The results of both papers highlight the significance of the effectiveness of environmental management processes as an antecedent of environmental performance and a mediator of the association between the examined factors and environmental performance. Specifically, in Paper One, top management support, training and the link of performance to rewards exhibit a direct positive association with the effectiveness of environmental management processes and an indirect association with environmental performance, while teamwork exhibits a direct positive association with environmental performance. In Paper Two, using operational EPMs to a greater extent and

using EPMs for environmental decision making purposes exhibit a direct positive association with the effectiveness of environmental management processes and an indirect association with environmental performance.

Paper Three examines the effect of the adoption of environmental management systems (EMSs) on environmental performance. The results show that organisations that have an EMS achieve higher environmental performance than organisations that do not have an EMS. However, organisations that have an ISO 14001 certified EMS did not achieve higher environmental performance than organisations with a non-certified EMS. The results also reveal five specific environmental management initiatives that contribute to enhanced environmental performance.

The thesis contributes to the environmental management literature by empirically examining the contingency factors that influence the effectiveness of environmental management. The findings provide managers with an insight into the need to apply specific organisational factors, use operational EPMs to a greater extent, use EPMs for decision making, and to adopt EMSs, as a means to enhance the effectiveness of environmental management. The thesis also contributes to the limited empirical research by examining the effectiveness of environmental management from two perspectives: the effectiveness of environmental management processes and environmental performance. In particular, the identified mediating role of the effectiveness of environmental management processes in the association between specific organisational factors and EPMs with environmental performance highlights the need for systematic and formalised environmental management processes in Australian manufacturing organisations.

CHAPTER ONE

INTRODUCTION

The advent of capitalism and industrial development has caused severe environmental damage including acid rain, global warming and the depletion of the ozone layer, with environmental concerns becoming a norm in society. For instance, governments increasingly impose stringent legal requirements regarding environmental issues, customers are in favour of environmentally friendly products, financial institutions consider environmental risks of an organisation when conducting risk evaluations and approving loans, and shareholders place higher expectations on organisation's environmental performance. In order to meet the expectations of various stakeholders and obtain competitive advantage in the market, many organisations go beyond complying with environmental regulations and adopt a proactive environmental management approach which systematically incorporates environmental concerns into their production decisions in an attempt to reduce the negative impact on the environment from their business operations (Ervin et al., 2013; Garces-Ayerbe et al., 2012; Khanna and Anton, 2002).

This thesis focuses on the factors influencing the effectiveness of environmental management with the effectiveness of environmental management measured from two perspectives, the effectiveness of environmental management processes and environmental performance. Specifically, the study examines the association between five organisational factors (top management support, training, employee participation, teamwork and the link of environmental performance to rewards), the extent to which EPMs (operational and managerial EPMs) are used and the purpose of using EPMs (for legitimacy, accountability

and environmental decision making purposes), and the adoption of environmental management systems (EMSs) with the effectiveness of environmental management.

The remainder of the chapter is organised as follows. Section 1.1 provides an overview of the nature of environmental management, its development and the importance of ensuring effective environmental management. Section 1.2 provides a discussion of the motivation for the study and section 1.3 outlines the structure of the thesis.

1.1 Environmental Management

Environmental management has been defined as ‘the set of objectives, plans and systems that determine operations’ position and responsiveness to environmental issues and regulation’ (Klassen and Whybark, 1999, p. 604). In the environmental management literature, the concept of ‘environmental management’ is often used interchangeably with ‘environmental management system’ (EMS) which is defined as ‘a set of interrelated elements used to establish policy and objectives and to achieve those objectives. It includes organisational structure, planning activities, responsibilities, practices, procedures, processes, and resources’ (International Standards Organisation, 2004, p. 2). An EMS is a proactive environmental management initiative, which aims to elevate the process of environmental management and subsequently improve environmental performance. In other words, environmental management is broad in nature with an EMS representing a particular approach to environmental management. This study focuses on the broader concept of environmental management which includes EMSs.

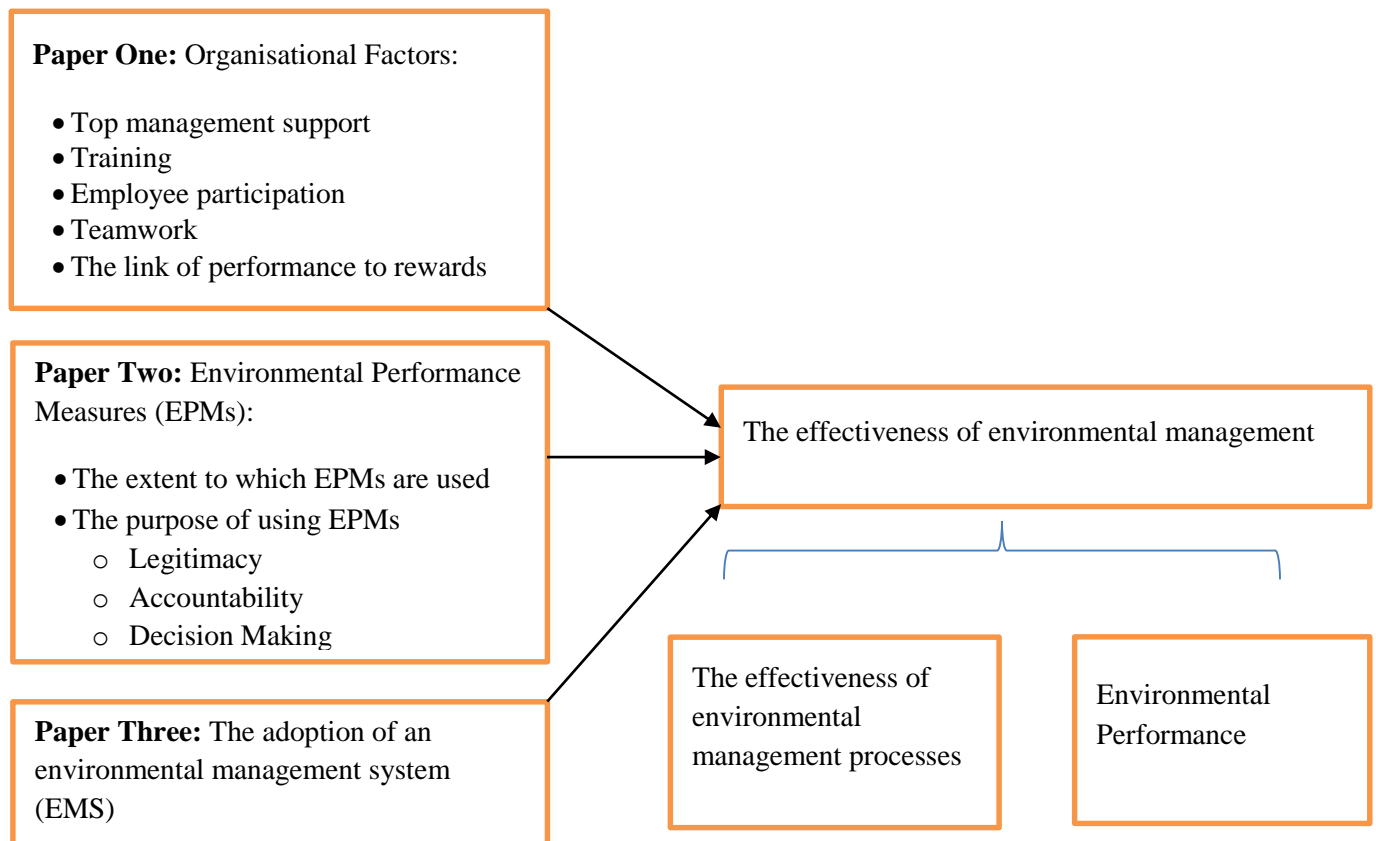
Research in the field of environmental management falls into two streams: 1) examination of the antecedents of environmental management practices and 2) examination of the factors influencing the effectiveness of environmental management. The majority of the

studies in this field have focused on examining the former (Mistry et al., 2014; Gattiker and Carter, 2010; Sarkis et al., 2010; Pagell and Gobeli, 2009; Delmas and Toffel, 2008; Reed, 2008; Zhu and Sarkis, 2007; Aragon-Correa and Sharma, 2003; Sroufe, 2003). In examining the effectiveness of environmental management, most studies have assessed the effectiveness of environmental management in respect of environmental outcomes (Massoud et al., 2011; Wagner, 2008; Yuksel, 2008; Savely et al., 2007; Prakash and Potoski, 2005; Anton et al., 2004; Morrow and Rondinelli, 2002; Montabon et al., 2000).

This outcome orientated approach is not in line with Hamilton and Chervany's (1981) assertion that the impact of any initiatives on organisational performance, including operational and financial performance, is directly influenced by improvements in organisational processes. While Hamilton and Chervany (1981) emphasise the importance of organisational process effectiveness in enhancing performance, no study to date has examined the effectiveness of environmental management in respect to environmental management processes. This study, therefore, fills a gap in the literature by examining the effectiveness of environmental management from two perspectives, the effectiveness of environmental management processes and environmental performance. In addition, the study explores the mediating role of the effectiveness of environmental management processes in the association between specific contingency factors and environmental performance.

The thesis uses the 'thesis by publication' format and presents three separate but interrelated papers. A summary of the papers is shown in Figure 1.

Figure 1 Summary of the thesis



1.2 Motivation of the study

There are four main motivations for the study. First, since all the studies in the environmental management field appear to have examined the effectiveness of environmental management in relation to environmental performance, the study is motivated to fill a gap in the literature by examining the effectiveness of environmental management from two perspectives, environmental management processes and environmental performance. Secondly, while there is limited empirical evidence regarding the effect of specific organisational factors on the effectiveness of environmental management, the study aims to provide empirical evidence of the association between five organisational factors (top management support, training, employee participation, teamwork and the link of environmental performance to rewards) with the effectiveness of

environmental management. Thirdly, given that the majority of studies in the environmental measurement literature focus on EPM disclosure, as an inadequate proxy of environmental management effectiveness, the study is motivated to fill this gap in the literature by providing empirical evidence of the association between the extent to which EPMs are used and the purpose of using EPMs with the effectiveness of environmental management. Fourthly, given that there are mixed findings in relation to the association between the adoption of an EMS and environmental performance, the study contributes to the environmental management literature by re-examining this association. These four motivations are discussed in greater detail in the following sections.

1.2.1 Examining the effectiveness of environmental management from two perspectives

According to Hamilton and Chervany (1981), ‘effectiveness’ can be assessed on the basis of (i) usefulness of information (ii) improvement in organisational processes and (iii) improvement in organisational performance. Similarly, the effectiveness of environmental management can be assessed as follows:

1. The usefulness of environmental information
2. Improvements in environmental management processes (e.g. motivating environmental performance, enhancing staff awareness towards environmental issues and providing training in relation to EMSs).
3. Improvements in environmental performance (e.g. reductions in water usage and reductions in wastage).

The majority of studies in the environmental management field have focused on the effectiveness of environmental management in terms of its contributions to the achievement of environmental performance (Yang et al., 2011; Johnstone and Labonne,

2009; Hertin et al., 2008; Schylander and Martinuzzi, 2007; Melnyk et al., 2003; Rondinelli and Vastag, 2000). However, improvements in environmental performance do not occur directly, but rather result from the employment of environmental management practices and the effect on environmental management processes. Accordingly, desired environmental outcomes such as reductions in water usage and reductions in wastage may not be realised unless improvements in environmental management processes are achieved. When the environmental management process is effective, the desired environmental performance will follow (Skerlavaj et al., 2007).

Despite the importance of the improvement in environmental management processes, no study has examined the effectiveness of environmental management in respect to its effect on environmental management processes. Accordingly, this study will fill this gap in the literature by examining the effectiveness of environmental management from two perspectives, environmental management processes and environmental performance.

1.2.2 Examining the association between specific organisational factors and the effectiveness of environmental management

Christmann (2000) suggested that while many manufacturing organisations have integrated environmental management initiatives into their operational processes, the ability of these organisations to achieve the benefits of these initiatives varies due to the different organisational settings, for example the different strategies and structures. Hence, understanding the specific organisational settings that lead to improvements in environmental performance becomes increasingly important for managers. Five organisational factors (top management support, training, employee participation, teamwork and rewards) were proposed by Daily and Huang (2001), who discussed how

each of these factors leads to improvements in environmental performance. While previous studies have focused on these five organisational factors as direct enablers of environmental performance (Massoud et al., 2011; Daily et al., 2007; Daily and Huang, 2001), no study to date has empirically examined the mechanisms through which specific organisational factors contribute to environmental performance. Hence, the study is motivated to fill this gap in the literature by examining the direct and indirect link between the five organisational factors and environmental performance. In particular, it is proposed that any association between specific organisational factors and environmental performance is mediated by the effectiveness of environmental management processes.

1.2.3 Examining the association between EPMs and the effectiveness of environmental management

While environmental performance measures (EPMs) represent a crucial component of the effectiveness of environmental management and have been discussed widely in the environmental management literature (Henri and Journeault, 2010; Iraldo et al., 2009; Clarkson et al., 2008; Henri and Journeault, 2008; Al- Tuwaijri et al., 2004; Melnyk et al., 2003; Hughes et al., 2001; Freedman and Wasley, 1990), the majority of these studies have focused on environmental disclosure practices and the association thereof with the effectiveness of environmental management. Further, there is limited empirical research examining the purpose of using EPMs (Henri and Journeault, 2008; Cho and Patten, 2007) and their association with the effectiveness of environmental management. Accordingly, this study is motivated to fill this gap in the literature by focusing on the extent to which EPMs are used and the purpose of using EPMs rather than environmental information disclosure practices. In particular, the thesis examines the three main uses of EPMs identified in the literature: managing public image (Adams and Frost, 2008; Henri and Journeault, 2008; Cho and Patten, 2007; O'Dwyer, 2002; Larrinaga-Gonzalez et al., 2001; Deegan and Gordon,

1996), fulfilling accountability requirements to stakeholders (accountability) (Bansal and Roth, 2000) and environmental decision making (Wagner, 2007; Berry and Rondinelli, 1998).

1.2.4 Examining the association between the adoption of an EMS and environmental performance

The benefits of using an EMS such as improved public image, improved relations with various stakeholders, and improved environmental performance are advocated by both practitioners and academics (Carruthers and Vancley, 2012; Hertin et al., 2008). Despite these benefits, many organisations tend to focus mainly on adopting certain environmental management initiatives such as setting up environmental policies and documenting environmental procedures without implementing a formal EMS (Massoud et al., 2011; Hertin et al., 2008). This raises concerns about the actual contribution of a formal EMS to environmental performance in practice. Hence, this study aims to provide empirical evidence in relation to the association between the adoption of an EMS and environmental performance in Australian manufacturing organisations.

1.3 Structure of the thesis

The remainder of the thesis is structured as follows: Chapter two provides a review of the literature on environmental management and chapter three provides details in respect to the data collection and analysis. Chapters four, five and six comprise the three research papers with separate references, appendices, tables and figures. Finally, chapter seven provides an overall discussion of the results, the contribution to the environmental management literature, the limitations of the study and suggestions for future research.

CHAPTER TWO

LITERATURE REVIEW

This chapter is organised into four sections. Section 2.1 outlines the nature of environmental management with emphasis placed on the proactive approach to environmental management. Section 2.2 discusses the factors influencing the adoption of environmental management practices. Section 2.3 then provides a review of the literature examining the effectiveness of environmental management and section 2.4 provides a summary of the chapter.

2.1 Environmental Management

Traditionally, organisations have used the compliance approach to environmental management, whereby changes and initiatives are driven solely by legal requirements (Daily and Huang, 2001). While in recent years, governments have imposed more stringent legal liabilities on organisations for the environmental degradation caused by daily operations, consumers have also become more environmentally conscious, shareholders have reacted negatively to organisations caught in environmental crises, and bankers increasingly consider environmental risks in their lending decisions (Khanna and Anton, 2002). The growing environmental awareness and scrutiny from a variety of stakeholders have created the need for a growing number of organisations to move beyond legal compliance and adopt a proactive environmental management approach to manage their environmental performance (Stevens et al., 2012; Wong et al., 2012). For example, many organisations have adopted an environmental management system (EMS) as an aid to improve their environmental performance (Stevens et al., 2012; Wong et al., 2012).

2.1.1 Environmental Management System (EMS)

An EMS is ‘a set of interrelated elements used to establish policy and objectives and to achieve those objectives. It includes organisational structure, planning activities, responsibilities, practices, procedures, processes, and resources’ (International Standards Organisation, 2004 p. 2). In 1996, the International Standards Organisation released ISO 14001, which is an international standard for the development of an effective EMS. While the implementation of an ISO 14001 certified EMS is aimed at improving environmental performance, the standard itself does not provide specific criteria for environmental performance (ISO, 2004).

The ISO 14001 standard follows a Plan-Do-Check-Act cycle which is referred to as a “process approach” (ISO, 2004). The cycle consists of:

Plan: establish the objectives and processes necessary to deliver results in accordance with the organisation's environmental policy.

Do: implement the processes (EMS).

Check: monitor and measure processes against environmental policy, objectives, targets, legal and other requirements, and report the results.

Act: take actions to continually improve the performance of the environmental management system.

Within this framework, ISO 14001 requires an organisation to (i) develop an appropriate environmental policy, (ii) identify the environmental aspects arising from the organisation's activities, products and services, (iii) identify legal requirements, (iv) identify priorities and set appropriate environmental objectives and targets, (v) adjust the structure and establish a programme(s) to implement the policy and achieve environmental objectives, (vi) facilitate control, monitoring and corrective actions, auditing and review

activities to ensure both that the policy is complied with, and (vii) be capable of adapting to changing circumstances (ISO, 2004).

In order to comply with ISO 14001, an EMS is required to be certified by registered third parties (Sheldon, 1997). Organisations are expected to have an internal assessment once a year to ensure that all requirements are being complied with. In order to maintain ISO 14001 certification, organisations are also required to complete a full recertification audit every three years to renew the certification.

EMSs can therefore comprise ISO 14001 certified and non-certified EMSs. Although environmental management systems vary across organisations, Darnall et al. (2008) and Sheldon (1997) identify specific attributes which are commonly adopted. First, both certified and non-certified EMSs involve establishing environmental goals and developing environmental policies. Secondly, employee training programs are provided to ensure that established objectives and responsibilities are clearly communicated within organisations. Thirdly, the relevant regulatory requirements imposed by governments are identified. Fourthly, monitoring and measurement procedures are in place to control and evaluate environmental impacts, and in turn, achieve environmental objectives and targets. Finally, review and audit procedures are implemented to determine the effectiveness of EMSs.

While the adoption of EMSs is widely advocated by practitioners and academics (Carruthers and Vanclay, 2012; Hertin et al., 2008), low adoption rates have been reported in studies [Delmas and Toffel, 2008 (28%); Yuksel, 2008 (36%)]. This raises concerns about whether an EMS is an effective environmental management tool to bring about improvements in environmental performance. Accordingly, this study aims to contribute to

the following two streams of literature: (i) examination of the factors influencing the adoption of environmental management practices and (ii) examination of the factors influencing the effectiveness of environmental management.

2.2 Factors influencing the adoption of Environmental Management practices

The first stream of research discusses the factors influencing the adoption of environmental management practices. These factors include regulation and legal requirements (Zailani et al., 2012; Delmas and Toffel, 2004; Quazi et al., 2001; Berry and Rondinelli, 1998; Epstein and Roy, 1998), stakeholder pressures (Sarkis et al., 2010; Delmas and Toffel, 2008; Anton et al., 2004; Foster et al., 2000), resources and capabilities (Aragon-Correa and Sharma, 2003; Sroufe, 2003) management commitment (Quazi et al., 2001; Berry and Rondinelli, 1998; Hunt and Auster, 1990) and personal attitude and experience (Klassen, 2001; Sharma, 2000).

Regulation and legal requirements

Regulations have been identified as the main drivers of environmental management practices (Jennings and Zandbergen, 1995). For example, Zailani et al. (2012) examined the influence of government regulations and incentives on proactive environmental management. The study found that government regulation encourages the adoption of environmental management practices which focus on eco-design and the use of recycled materials in production. In investigating the motivations for adopting environmental management practices, Fryxell et al. (2004) indicated that ensuring regulatory compliance was identified as the main driver for EMS adoption.

Khanna and Anton (2002) further suggested that while incentives for EMS adoption depend on the existence of a regulatory framework, the threat of stringent and high cost

regulations in the future plays an even more important role in encouraging organisations to develop a higher quality EMS. Delmas (2002) found that regulatory enforcement plays a crucial role in an organisation's decision to adopt proactive environmental management practices such as ISO 14001. Similar conclusions were reached in other studies (Delmas and Toffel, 2008; Zhu and Sarkis, 2007; Quazi et al., 2001).

Stakeholder pressures

The impact of stakeholder pressure on the adoption of environmental management practices has been widely discussed in the literature with studies suggesting that organisations that are experiencing greater pressure from government, customers, shareholders, media, local communities, environmental activist organisations and competitors are more likely to adopt environmental management practices (Sarkis et al., 2010; Delmas and Toffel, 2008; Anton et al., 2004; Foster et al., 2000; Berry and Rondinelli, 1998).

For instance, Foster et al. (2000) conducted a number of case studies in service organisations, reporting that customer demand was as an important factor in determining environmental management practices. Similarly, Anton et al. (2004) surveyed 500 firms in relation to the decision to adopt environmental management systems, and found that pressure from customers, investors and the public motivated the adoption of environmental management practices. In particular, consumer pressures were found to influence the quality of the environmental management practices adopted.

Sarkis et al. (2010) also confirmed the influence of stakeholder pressures (e.g. customers, shareholders, employees and society) on the adoption of environmental management

practices within the Spanish automotive industry, while Angell (2001) found that in addition to consumer pressures, pressure from the media, regulators, corporate headquarters and environmental activists also influenced the adoption of environmental management practices.

With respect to the pressure from competitors, Hofer et al. (2012) examined the competitive interactions among a cross-section of manufacturing organisations. They found that competition existed with the impact of a competitor's past environmental management activities on the focal organisation's environmental management activities stronger for more profitable and smaller sized organisations.

Resources and capabilities

A few studies have suggested that organisations with stronger resources and capabilities are likely to adopt environmental management practices to a greater extent (Hofmann et al., 2012; Darnall et al., 2008; Darnall and Edwards, 2006). For instance, Hofmann et al. (2012) suggested a positive association between an organisation's capabilities and environmental management practices. In particular, their study indicated that the adoption of advanced technology, experiences with inter-firm relations, and the capacity for product innovation are three key capabilities that support the adoption of environmental management practices. Similarly, Darnall et al. (2008) collected OECD survey data from manufacturing organisations operating in Canada, Germany, Hungary and the US and found that organisations with greater resources and capabilities such as export orientation, employee commitment and environmental research and development adopted more comprehensive environmental management practices.

Management commitment

Hunt and Auster (1990) and Berry and Rondinelli (1998) emphasised the need for management commitment as one of the crucial factors influencing the adoption of environmental management systems. For instance, Quazi et al. (2001) found that the genuine concern of top management for the environment is a key factor which leads organisations to adopt environmental management practices. Alternatively, Post and Altma (1994) argued that managers who are detached and lack understanding in regard to environmental and economic cost relationships create barriers for the adoption of environmental management practices.

Personal attitude and experience

Sharma (2000) investigated the association between managerial interpretations of environmental issues and organisational choice regarding environmental strategies among 99 organisations in the Canadian oil and gas industry. His study found that the adoption of environmental strategies is related to managerial interpretations of environmental issues as threats or opportunities. Specifically, the risks inherent in the adoption of environmental technologies and systems are reduced if managers interpret environmental issues as opportunities.

Klassen (2001) examined the relationship between the personal views of plant managers and a proactive environmental management orientation in the furniture industry. Managers are less likely to anticipate environmental issues and adopt environmental management initiatives when they place emphasis on short-term economic value. Alternatively, if a manager places emphasis on ethical values, a more proactive environmental management orientation is likely to be adopted.

2.3 The effectiveness of Environmental Management

Clinquini and Mitchell (2005, p. 70) define effectiveness as ‘the achievement of the objectives set for a task’ and therefore, environmental management can be described as effective when the intended environmental objectives are achieved.

According to Hamilton and Chervany (1981), one of the most cited studies illustrating different evaluation approaches to effectiveness, effectiveness can be assessed based on (i) the improvements in organisational processes and (ii) organisational performance. Applying this framework in the current context, the effectiveness of environmental management can be assessed based on (i) the improvements in environmental management processes and (ii) organisational environmental performance.

Given the literature has solely focused on the evaluation of environmental management effectiveness in terms of environmental performance, the following discussion will concentrate on environmental performance and the factors influencing environmental performance.

2.3.1 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., 2011, p. 859). Improving environmental performance can influence both the revenues and costs of a business. Revenues are influenced when an organisation adopts a ‘green strategy’ i.e. utilises clean production technologies and produces environmentally compatible products. Costs are influenced

when strategies aimed at improving environmental performance leads to less wastage and emissions, thereby reducing manufacturing and legal costs (Azzone and Manzini, 1994).

While it is important to evaluate an organisation's environmental performance, the measurement thereof is not a simple task in practice, with many different measures having been used in previous studies. For instance, environmental performance has been examined in terms of the environmental impact on specific business activities such as toxic waste generated and reductions in emissions (Clarkson et al., 2008; Al-Tuwaijri et al., 2004; Clarkson et al., 2004; Hughes et al., 2001; Freedman and Wasley, 1990; Wiseman, 1982). Previous studies have tended to proxy environmental performance using a performance index ranked by external parties (e.g. CEP (Council on Economic Priorities), Dow Jones Sustainability Index, etc) (Hughes et al., 2001; Freedman and Wasley, 1990; Wiseman, 1982; Ingram and Frazier, 1980). However, Ilinitch et al. (1998, p. 404) pointed to the risk of using external rankings arguing that 'rankings are based partly upon reputation and reputation is based partly upon rankings'. Hence, measuring environmental performance based on external rankings might not provide the objective benchmarks expected.

More recently, Al-Tuwaijri et al. (2004) employed a quantitative measure of environmental performance: the ratio of toxic waste recycled to total toxic waste generated, with a higher ratio indicative of better environmental performance. Similarly, Clarkson et al. (2004) used actual pollution discharge data from the US Environmental Protection Agency's (EPA) TRI database. In particular, the percentage of the total toxic waste generated by organisations and the ratio of TRI to total organisational sales was employed. Similar measures were also used in Patten (2002) and Clarkson et al. (2008).

While these studies have used specific environmental impacts as a proxy for environmental performance, another line of studies followed the organisational effectiveness literature to examine environmental performance. Specifically, environmental performance was assessed based on the extent to which desired environmental outcomes are achieved (Henri and Journeault, 2010; Melnyk et al., 2003; Ilinitich et al., 1998; Lober, 1996). For instance, in Melnyk et al. (2003), respondents were asked to assess the impact of environmental activities on various dimensions of the organisation: reductions in overall cost, reductions in lead times, improvements in production quality, improvements in market position, enhancing the reputation of the company, better product design, reduced waste within the production process, and reduced waste within the equipment selection process. Given these measures are more related to overall organisational performance, a set of measures which are more environmentally focused was derived from the environmental literature (Langfield-Smith et al., 2011; Henri and Journeault, 2010; Clarkson et al., 2008). Specifically, this study examines the extent to which each of fifteen desired environmental outcomes are achieved: reductions in energy consumption, reductions in water usage, reductions in material costs due to the efficient use of material, reductions in the level of emissions, reductions in the level of waste and emissions, reductions in the costs of regulatory compliance, reducing time in responding to environmental incidents and minimizing their impact, reductions in pollution incidents, reductions in the costs associated with cleaning up environmental damage, more effective and efficient decision making regarding environmental issues, reductions in the penalty and remediation costs regarding environmental damage and producing goods in a more environmentally conscious manner.

2.3.2 Factors influencing Environmental Performance

Studies examining the effectiveness of environmental management can be categorised into three groups, with the majority of studies assessing the effectiveness of environmental management in relation to environmental performance: (i) studies examining the association between organisational factors and environmental performance (ii) studies examining the link between environmental performance measures and environmental performance (iii) studies examining the impact of EMS adoption on environmental performance.

2.3.2.1 Organisational factors

This section reviews the literature in respect to the association between five organisational factors (top management support, training, employee participation, teamwork and the link of environmental performance to rewards) with the effectiveness of environmental management. Due to the limited empirical evidence supporting such associations, this study is motivated to fill this gap in the literature with Paper One empirically examining the association between the five organisational factors with the effectiveness of environmental management.

Top management support

Top management support has been identified as a crucial contingency factor in supporting various management accounting practices. For instance, in order to achieve the effectiveness of Activity Based Costing (ABC), top management must provide adequate levels of resources and facilitate effective communication to lower level employees, and use authority with caution to overcome obstacles during the implementation processes (Baird et al., 2007; Shields, 1995). Prior studies on Performance Measurement Systems

(PMSs) also identified top management support as a key success factor for PMS design and implementation (Chan, 2004; Bourne et al., 2002; Kennerly and Neely, 2003). Bourne et al. (2002) indicated that top management support is influential with respect to the successful implementation and ongoing usage of a PMS. Further, the continuous involvement by top management was invaluable in resolving problems when conflicts arose in the PMS implementation process. Similar results were found in Chan (2004) and Kennerly and Neely (2003). Tung et al. (2011) further highlighted the importance of the continued involvement and support from top management, suggesting that in order to achieve desired performance outcomes, a concentrated effort by top management aimed at continuous improvement, open communication and consistent support is crucial.

In the environmental management literature, top management support is suggested as a critical factor influencing the effectiveness of environmental management (Roonenberg et al., 2011; Ramus, 2002; Anderson and Bateman, 2000). For instance, Roonenberg et al. (2011) examined whether change management efforts improve the implementation of environmental management systems and found that change management efforts increase organisational environmental performance, primarily due to top management support efforts to institutionalize and implement environmental management initiatives.

Anderson and Bateman (2000) suggested that staff attitude and commitment in relation to environmental issues align with top management's positive attention and actions towards such issues. Similarly, the results of a survey study conducted by Ramus (2002) showed that supportive supervisory behaviour increases the likelihood that employees will try environmental initiatives. In particular, managerial behaviour which supported environmental innovation, environmental education, environmental communication from

employees, rewarding and recognizing environmental actions, and managing environmental goals and responsibilities, had a positive effect on the implementation of environmental management initiatives (Paille et al., 2014; Ramus, 2002).

Training

Previous research has highlighted the importance of investments in training in improving organisational performance (Subedi, 2006). Subedi (2006) indicated that organisations perceive the high value of training in relation to improving performance and achieving organisational goals. Studies examining the association between training and the effectiveness of performance measurement systems (PMSs) support these claims (Tung et al., 2011; Chan, 2004; Emerson, 2002). Tung et al. (2011) found that training is important in enhancing the knowledge and skills of employees in implementing the performance measurement system, with a positive association found between training and the effectiveness of PMSs. In a similar vein, Chan (2004) highlighted training as a key factor for PMSs to be effective. Emerson (2002) further argued that training is the key to sustaining the effectiveness of PMSs.

In the environmental management literature, training has been identified as an essential element in implementing environmental initiatives (Sammalisto and Brorson, 2008; Savely et al., 2007; Zeng et al., 2005; Zutshi and Sohal, 2004; Rondinelli and Vastag, 2000; Daily and Huang, 2001). Sammalisto and Brorson (2008, p. 300) suggested that training serves at least two purposes: to teach employees about company environmental policies and everyday procedures, and to change employee attitudes and create increased awareness about environmental issues. Savely et al. (2007) suggested that through training, employees gain a better understanding of the purposes of environmental management, and

the elements of environmental management processes including environmental objectives, targets and policies. Similar conclusions were found in other studies (Zeng et al., 2005; Zutshi and Sohal, 2004; Rondinelli and Vastag, 2000).

Daily and Huang (2001) point out that training is necessary to build an environmentally friendly culture in the workplace. They suggested that training not only prepares employees for potentially new environmental operations, but also assists in taking corrective action in the production process. This is in line with Hale's (1995) argument that training is necessary as the adoption of environmental objectives requires a fundamental change in organisational culture. This study further asserts that while environmental improvements depend on the adoption of environmental management initiatives, these go hand in hand with training to increase the environmental awareness of employees and to incorporate environmentally friendly practices in daily operations.

Employee participation

Employee participation has been cited as one of the critical success factors for business processes (Trkman, 2010; Yip, 2000). Yip (2000) suggested that employee participation leads to greater levels of satisfaction among staff who will then provide faster and friendlier service.

Prior research has confirmed a positive link between employee participation and the effectiveness of performance measurement systems (PMSs) (Tung et al., 2011; Kleingeld et al., 2004; Kaplan and Norton, 2001). Tung et al. (2011) suggested that employees should be encouraged to participate in the process of selecting measures and designing performance measurement systems. Kleingeld et al. (2004) found that the improvement in

performance was significantly greater for those employees in the high participation condition as opposed to those in the low participation condition. Both studies reinforce Kaplan and Norton's (2001) assertion that in order to achieve the effectiveness of PMSs, lower level employees should be involved in the establishment of performance measures.

Hanna et al. (2000) explored the association between employee involvement and environmental performance finding that employee involvement is a key source of improvement in environmental performance. Similarly, Daily and Huang (2001) posited that employee participation is a crucial factor if environmental management is to be effective. They argue that empowered employees who are able to make decisions independently, are likely to be involved in improvements in environmental performance.

Ramus (2002) concluded that it is critical for managers to listen to employees' environmental ideas, as employees are more likely to be creative when their environmental ideas, criticisms, or suggestions are heard and acknowledged (Ramus, 2002, p. 161). Goodstein and Wicks (2007) further argued that when lower level employees are empowered to take the initiative in defining their responsibilities and making decisions with respect to environmental issues, they will be more accountable, motivated and committed to environmental management.

Teamwork

Teamwork is one of the main mechanisms to generate improvements in organisational performance (Llorens Montes et al., 2005). In particular, teamwork promotes organisational learning which in turn, encourages technical and administrative innovation which facilitates improvements in performance (Palacios-Marques et al., 2013).

In the environmental management literature, Jabbour and Santos (2008) suggested that teamwork has a positive impact on environmental management processes in organisations. Specifically, team members with common values share ideas when environmental risks arise and strive to find the best practices to resolve environmental issues. This reinforces Karch's (1992, p.16) explanation that teamwork is critical due to the varying environmental knowledge and values that each member brings to the effort.

Likewise, Strachan (1996) asserted that the establishment of green teams helps bring members from different parts of the organisation together, thereby breaking down narrow departmental perspectives and improving the flow of ideas and information required to improve environmental performance. Massoud et al.'s (2010) findings support Strachan's (1996) assertion that teamwork is a critical factor in implementing environmental management initiatives.

The link of performance to rewards

The link of performance to rewards has been referred to as an important factor influencing the effectiveness of performance measurement systems (PMSs) (Tung et al., 2011; Chan 2004). Tung et al. (2011) demonstrated a positive association between the link of performance to rewards and the effectiveness of PMSs, suggesting that managers' and employees' performance should be linked to both financial and non-financial rewards to ensure the achievement of the desired performance outcomes. On the other hand, Chan (2004) pointed out that while the linkage of performance measures to compensation was uncommon, the lack of linkage of the performance measurement system to rewards was considered to be a barrier to system effectiveness.

There is a lack of empirical evidence of the association between the link of performance to rewards with the effectiveness of environmental management. The importance of the link of performance to rewards as a contingency factor in relation to environmental management was highlighted by both Daily and Huang (2001) and Jabbour and Santos (2008). Jabbour and Santos (2008) suggested that the link of performance to rewards is necessary to ensure the effectiveness of environmental management over time because the link motivates and guides employees to achieve desired environmental performance. This argument is consistent with Daily and Huang (2001) who theorised that organisations that include rewards in their performance appraisal system should achieve a higher level of implementation of environmental management initiatives. They further explained that rewards reinforce empowerment and good decision making, and motivate employees to continue good environmental practices.

2.3.2.2 Environmental Performance Measures

The majority of the studies on environmental performance measures focus on environmental disclosure practices and their relationship with environmental performance. While extensive research has examined this relationship, the results are mixed.

Clarkson et al. (2008) examined 191 firms from the five highest polluting industries in the US and found a positive association between environmental disclosure and environmental performance. Al-Tuwaijri et al. (2004) obtained similar results and concluded that the extent to which environmental performance measures are disclosed is significantly associated with environmental performance. These findings are in contrast to the majority of studies that have reported a negative relationship between environmental disclosure and

environmental performance (Cho et al., 2012; Clarkson et al., 2011; Cho and Patten, 2007; Patten, 2002; Hughes et al., 2001; Freedman and Wasley, 1990; Wiseman, 1982).

For instance, Cho et al. (2012) studied 92 US organisations from environmentally sensitive industries and found a negative association between environmental disclosure and environmental performance. Similarly, in Australia, Clarkson et al. (2011) examined 51 organisations with a negative association between environmental disclosure and environmental performance being identified. These findings are consistent with the findings of Cho and Patten (2007), Patten (2002), Hughes et al. (2001), Freedman and Wasley (1990) and Wiseman (1982) who report that poor environmental performers make more extensive environmental disclosures. Cho and Patten (2007) argued that organisations with poor environmental performance are exposed to greater political and social pressures, and therefore have a strong incentive to use disclosures to address threats to their public image. Hence, publishing environmental information could be used as a legitimising tool to manage an organisation's public image with such 'greenwashing' practices making it difficult to predict a relationship between disclosure practices and an organisation's underlying environmental performance (Clarkson et al., 2011; Adams, 2004; Deegan et al., 2002).

Therefore, rather than focusing on environmental disclosures, Paper Two aims to contribute to the literature by examining the extent to which environmental performance measures are used and the use of environmental performance measures for legitimacy, accountability and environmental decision making purposes. Specifically, Paper Two examines the association between the extent to which EPMs are used and the purpose of using EPMs with the effectiveness of environmental management.

Managing public image (Legitimacy)

While communicating favourable environmental information, through external reporting, can be used as a strategy for organisations to enhance their corporate image (Lyon and Maxwell, 2011; Adams and Frost, 2008; Wagner, 2007; Hahn and Scheermesser, 2006), this is merely a ‘green wash’ activity which is unlikely to facilitate long term improvements in environmental performance (Cho and Patten, 2007; O’Dwyer, 2002; Larrinaga-Gonzalez et al., 2001; Deegan and Gordon, 1996; Deegan and Rankin, 1996). For example, Deegan and Gordon (1996) investigated the environmental performance measures reported in the environmental reports of 197 organisations and found that only 10% of the sample organisations provided any negative environmental information. Deegan and Rankin (1996) indicated that when organisations are being prosecuted for environmental offences, they report favourable measures to deflect the attention away from their undesirable environmental management. Larrinaga-Gonzalez et al.’s (2001) study concluded that when environmental measures are used solely for legitimacy purposes, it has no genuine impact on environmental management. Similar conclusions have been reached in other studies (Cho and Patten, 2007; O’Dwyer, 2002).

Fulfilling legal requirements (Accountability)

Prior studies indicate that when environmental performance measures are used solely for fulfilling legal requirements, such measures may not be fully integrated into internal environmental management processes (Wagner, 2007; Bansal and Roth, 2000). Without going beyond legal compliance and incorporate environmental performance measures in environmental decision making processes, desired environmental objectives are unlikely to be achieved (Larrinaga-Gonzalez et al., 2001; Bansal and Roth, 2000).

Environmental decision making

When EPMs are used for environmental decision making purposes, environmental objectives and strategies are communicated across an organisation with the norms and routines that guide organisational practices gradually changing (Epstein and Roy, 2003). Anderson and Bateman (2000) suggested that the constant organisational learning and communication allows employees to gain greater knowledge of environmental issues and their environmental responsibilities, and therefore they are more committed to environmental management processes. Similarly, managers will be more motivated to devote their time to making appropriate changes in an attempt to improve environmental performance (Guest and Teplitzky, 2010).

2.3.2.3 The adoption of EMSs

A growing stream of literature has examined the relationship between the adoption of EMSs and the effectiveness of environmental management (Gomez and Rodriguez, 2011; Massoud et al., 2011; Iraldo et al., 2009; Hertin et al., 2008; Yuksel, 2008; Ann et al., 2006; Barla, 2007; Prakash and Potoski, 2005; Melnyk et al., 2003; Morrow and Rodinelli, 2002; Montabon et al., 2000) with mixed results reported.

Morrow and Rodinelli (2002) examined the impact of EMS adoption and certification on environmental performance. The findings, from five case studies of domestic energy and gas companies in Germany, showed that EMS implementation and certification assisted organisations to integrate their environmental management systems. In particular, ISO 14001 certified organisations reported improvements in environmental performance, especially in the areas of waste recycling, air and waste emissions reductions, material reuse, energy and water conservation, and environmental and safety incidence reduction.

Similarly, Melnyk et al. (2003) assessed the impact of certified EMSs and non-certified EMSs on environmental performance. They found that organisations with certified EMSs experienced higher environmental performance than organisations with a formal but non-certified EMS. Prakash and Potoski (2005) provided support for Melnyk et al. (2003) suggesting that ISO 14001 certified organisations reduce their pollution emissions more than non-certified facilities. Similar conclusions were reached in other studies (Ann et al., 2006; Iraldo et al., 2009; Yuksel, 2008; Montabon et al., 2000).

In contrast, Barla (2007) found that ISO certification did not lead to a reduction in total suspended solid emissions or in the quantity of rejected process water with most adopters either maintaining or even increasing their emissions after being ISO accredited. Given the mixed findings in relation to the association between the adoption of EMSs and environmental performance, Paper Three aims to extend this literature by empirically examining this association.

2.4 Summary

This chapter provided a review of the studies examining the factors affecting the adoption of environmental management and the factors influencing the effectiveness of environmental management.

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. Chapter Seven summarises the finding of each of the three papers, outlines the contributions of the study

to academics and practitioners, discusses 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 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. The survey questionnaire was designed in a respondent friendly manner using simple-worded questions and was printed in colour to attract respondents' attention. The survey questionnaire consisted of six pages collated in the form of a booklet (see Appendix) and included 9 questions. The contact details of the researcher were provided in case respondents required further clarification in completing the survey, thereby avoiding the non-completion of questionnaires due to misunderstanding.

The survey commenced with three simple demographic questions and ended with more complex questions designed to measure the three purposes (legitimacy, accountability and decision making) of using environmental performance measures. Multi-item scales were used to increase reliability. To ensure the validity of the survey instrument, an extensive review of the literature was conducted. All measures were adopted from prior research with a few amendments made to reflect the context of the study. The questionnaire was pilot tested by ten academics and two financial controllers to make sure the format was appropriate and the questions were not ambiguous. Amendments were then made to the questionnaire based on the feedback received.

The questionnaires were distributed to 899 senior financial officers in Australian manufacturing organisations. The manufacturing industry was selected for three reasons. The first reason is its importance to the national economy with the Manufacturing Performance Report (2014) indicating that the manufacturing industry currently contributes around \$100 billion to Australian GDP. Secondly, it is one of the ‘dirty’ industries (Cole, 2000) which attracts a higher level of public concern and is faced with more environmental regulations (Gomez and Rodriguez, 2011; Johnstone and Labonne, 2009). Finally, organisations operating in this industry are more likely to have more comprehensive environmental management initiatives in place.

Financial controllers were targeted as they are ‘information managers’ who are in contact with members across an organisation and have knowledge of the necessary technical and organisational detail required for the study (Krumwiede, 1998). In particular, they are directly involved in managing, measuring and reporting all environmental activities across organisations (Accenture, 2013; Ernst and Young 2013; Madec, 2013). Hence, they were considered to be the most appropriate respondent. The selected respondents were contacted via telephone to verify their details including their names, titles and addresses.

A total of 180 responses were received, 145 (16%) from the initial mail out and 35 (4%) from the follow up. Non-response bias was assessed by comparing the independent and dependent variable values across early and late respondents. The results revealed that there were no significant differences between the early respondents and the late respondents, hence, non-response bias was not considered to be a major concern in the study.

3.2 Data Analysis

Given the importance of mediation effects in the study, Structural Equation Modelling (SEM) was used to analyse the data collected. While SEM is widely used in examining mediation effects, it has several advantages over other techniques including Partial Least Squares (PLS) and hierarchical regression (Cheung and Lau, 2008). First, it provides a better statistical tool to examine variables with multiple indicators. Second, when relationships among variables are examined, measurement errors in the model can be controlled for, thereby providing unbiased estimates of mediation effects (Baron and Kenny, 1986). Finally, it depicts a clear model where all relevant paths can be included and examined, without omitting any variables (Baron and Kenny, 1986).

CHAPTER FOUR

PAPER ONE

The association between organisational factors and the effectiveness of environmental management

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

Tung, A., Baird, K. and Schoch, H. (2014), "The relationship between organisational factors and the effectiveness of environmental management", *Journal of Environmental Management*, Vol. 144, pp. 186-196.

Abstract

This paper examines the association between specific organisational factors (top management support, training, teamwork, employee participation and the link of performance to rewards) and the effectiveness of environmental management. The effectiveness of environmental management is measured in respect to two aspects, the effectiveness of environmental management processes and environmental performance. Data were collected by mail survey questionnaire from a random sample of 899 senior financial officers in Australian manufacturing organisations. The findings highlight the significance of the effectiveness of environmental management processes as an antecedent of environmental performance and a mediator of the association between organisational factors and environmental performance. Specifically, top management support, training and the link of performance to rewards exhibit a direct positive association with the effectiveness of environmental management processes and an indirect association with environmental performance, while teamwork exhibits a direct positive association with environmental performance. These findings provide managers with an insight into the specific organisational factors that they need to focus on to enhance the effectiveness of environmental management.

Keywords- Environmental management, top management support, training, employee participation, teamwork, the link of performance to rewards.

1. Introduction

Over the past few decades increasing industrial development has caused environmental degradation such as global warming, ozone layer depletion, air pollution and toxic waste (Zailani et al., 2012). It is widely believed that manufacturing organisations are responsible for these environmental problems (Hsu et al., 2013; Gupta, 1995). At the same time, there is increasing concern shown towards environmental issues by a variety of stakeholders including governments who impose environmental regulations, consumers who demand environmentally friendly products, and investors and shareholders who have higher expectations regarding the environmental performance of organisations. In response to the growing awareness and scrutiny from these stakeholders, many manufacturing organisations have moved beyond complying with legal requirements concerning environmental issues and have initiated a proactive environmental management approach to manage and reduce the negative impact on their business operations (Stevens et al., 2012; Wong et al., 2012; Clarkson et al., 2011; Klassen and Whybark, 1999; Porter and van der Linde, 1995). This study focuses on examining the effectiveness of environmental management and the role of organisational factors in enhancing the effectiveness of environmental management in Australian manufacturing organisations.

There is a growing stream of research examining the effectiveness of environmental management, with the majority of studies assessing the effectiveness of environmental management in respect to environmental performance (Massoud et al., 2010; Wagner, 2008; Yuksel, 2008; Savely et al., 2007; Prakash and Potoski, 2005; Anton et al., 2004; Morrow and Rondinelli, 2002; Montabon et al., 2000). This approach does not consider

Hamilton and Chervany's (1981)¹ assertion that the impact of management initiatives on organisational performance is indirectly influenced by their ability to improve organisational processes. Following Hamilton and Chervany (1981), improved environmental outcomes such as reductions in water usage and emissions, and wastage in raw material will not be realised unless process objectives such as motivating better environmental performance, enhancing staff awareness of environmental issues and providing training in relation to environmental management initiatives are achieved.

While Hamilton and Chervany (1981) emphasise the importance of organisational process effectiveness in enhancing performance, no study to date has examined the effectiveness of environmental management in respect to environmental management processes. Accordingly, this study will fill a gap in the literature by examining the effectiveness of environmental management from two perspectives, first, the effectiveness of environmental management processes and secondly environmental performance. In addition, the study explores the association between the effectiveness of environmental management processes and environmental performance.

The study also examines the association between specific organisational factors and the effectiveness of environmental management. Many manufacturing organisations have undertaken environmental management to manage their environmental performance, however the ability of these organisations to improve their environmental performance varies due to the different organisational settings (Christmann, 2000). Accordingly, it is important for managers to understand the specific organisational factors that can contribute to the achievement of environmental objectives. Daily and Huang (2001) proposed five

¹ Hamilton and Chervany (1981) is one of the most cited studies illustrating different evaluation approaches to effectiveness.

organisational factors (top management support, training, employee participation, teamwork and link of performance to rewards), theorising how each of these factors contributes to environmental performance. While prior literature has focused on these organisational factors as direct enablers of environmental performance (Daily and Bishop, 2011; Daily et al., 2007; Daily and Huang, 2001), only a few studies (Paille et al., 2014; Paille et al., 2013) have empirically examined the mechanisms through which specific organisational factors facilitate improvements in environmental performance. Consequently, it is proposed that the positive association between specific organisational factors and environmental performance is mediated by the effectiveness of environmental management processes. Hence, in addition to examining the association between the effectiveness of environmental management processes and environmental performance, the study will hypothesise the association between five specific organisational factors and the effectiveness of environmental management processes. Structural equation modelling will be used to examine these associations.

The remainder of the paper is structured as follows. Section 2 provides the literature review and develops the relevant hypotheses. Sections 3 and 4 discuss the research method and findings. Finally, Section 5 presents the conclusion and limitations of the research.

2. Literature review

2.1 Environmental Management

Environmental management involves the processes of setting '*objectives, plans and systems that determine operations' position and responsiveness to environmental issues and regulation*' (Klassen and Whybark, 1999, p. 604). Research in the field of environmental management falls into two streams. The first stream examines the

antecedents of environmental management practices maintaining that the adoption of environmental management practices is contingent upon various factors including regulation and legal requirements (Zhu and Sarkis, 2007; Delmas, 2002; Berry and Rondinelli, 1998), stakeholder pressures (Sarkis et al., 2010; Delmas and Toffel, 2008; Reed, 2008; Berry and Rondinelli, 1998), industry pressures (Hofer et al., 2012; Berry and Rondinelli, 1998), resource availability (Aragon-Correa and Sharma, 2003; Sroufe, 2003), management commitment (Gattiker and Carter, 2010; Klassen, 2001), training (Sarkis et al., 2010; Chinander, 2001) and personal attitude and experience (Pagell and Gobeli, 2009; Klassen, 2001; Sharma, 2000).

While there is extensive literature on the adoption of environmental management practices few studies have focused on the second stream of research which examines the effectiveness of environmental management. This is discussed in the following section.

2.2 The effectiveness of Environmental Management

In line with Clinquini and Mitchell's (2005, p. 70) definition, effectiveness refers to 'the achievement of the objectives set for a task' and hence, environmental management can be described as effective when the intended objectives are attained. The majority of studies assess the effectiveness of environmental management in respect to environmental outcomes (Massoud et al., 2010; Wagner, 2008; Yuksel, 2008; Savely et al., 2007; Prakash and Potoski, 2005; Anton et al., 2004; Morrow and Rondinelli, 2002; Montabon et al., 2000). However, according to Hamilton and Chervany (1981), the effectiveness of an initiative can be assessed based on (i) the usefulness of information (ii) improvements in organisational processes and (iii) improvements in organisational performance. Following this framework, the effectiveness of environmental management in this study could be

assessed on the basis of: (i) the usefulness of environmental information (ii) the improvements in environmental management processes and (iii) the improvements in organisational environmental performance. Given improvements in environmental management processes reflect the usefulness of environmental information, this study will focus on the second and third approaches. Most studies in the field have assessed the effectiveness of environmental management using the third approach, the contribution to the achievement of environmental performance (Yang et al., 2011; Johnstone and Labonne, 2009; Hertin et al., 2008; Schylander and Martinuzzi, 2007; Melnyk et al., 2003; Rondinelli and Vastag, 2000). However, in line with Hamilton and Chervany's (1981) suggestion, improvements in environmental performance do not occur directly. Rather they are the result of the effect of environmental management on organisational processes.

A process is defined as 'A related series of actions, directed to the achievement of a goal, that transforms a set of inputs into desired outputs, by adding value' (Zairi, 1997, p. 64). Hamilton and Chervany (1981) assert that irrespective of the type of management practice, process effectiveness represents an antecedent of desired performance. In the current context, this suggests that environmental performance is contingent upon the effectiveness of environmental management processes. Consequently, this study aims to contribute to the literature by examining the effectiveness of environmental management with respect to both its effect on environmental management processes and environmental performance.

The study assesses the effectiveness of environmental management processes in respect to the achievement of 11 desired objectives of environmental management. They are: (i) meeting legislative and regulatory requirements, (ii) enhancing staff awareness towards environmental issues, (iii) supporting change initiatives, (iv) ensuring staff commitment to

environmental objectives, (v) achieving environmental goals, (vi) motivating environmental performance, (vii) fostering an environmentally friendly culture, (viii) providing an accurate assessment of business unit environmental performance and managing environmental risk, (ix) managing environmental risk, (x) increasing the level of recycling and (xi) implementing an environmental strategy. These objectives facilitate a favourable operating environment which in turn, assists an organisation to achieve its environmental outcomes including reductions in energy consumption, water usage, material costs, the levels of greenhouse gas emissions, other air emissions, the levels of waste, the costs of regulatory compliance, the time taken to respond to environmental incidents and minimising their impact, the costs associated with cleaning up environmental damage and the fines paid and remediation costs regarding environmental damage, more effective and efficient decision making regarding environmental issues and producing goods in a more environmentally conscious manner. These measures were identified based on a review of the performance management and environmental performance literature (Henri and Journeault, 2010; Clarkson et al., 2008; Clarkson et al., 2004; Lawler, 2003; Melnyk et al., 2003).

2.3 The association between specific organisational factors and the effectiveness of environmental management processes

This section discusses the association between five organisational factors (top management support, training, employee participation, teamwork and the link of performance to rewards) and the effectiveness of environmental management processes with each factor examined from an environmental management perspective. While these organisational factors do not represent a complete list of all relevant factors, they were chosen because they have been widely cited as factors contributing to the effectiveness of various

management accounting practices (Tung et al., 2011; Snider et al., 2009; Baird et al., 2007; Vathanophas, 2007; Motwani et al., 2002). In addition, although the association between these factors and the effectiveness of environmental management has been discussed and theorised in Daily and Huang (2001), there is limited empirical evidence supporting such associations. Hence, this study is motivated to extend previous research by empirically examining the association between the five organisational factors and the effectiveness of environmental management processes.

2.3.1 Top management support

Top management has the authority and responsibility to direct organisations to make decisions with the support of top management considered to be crucial in the successful implementation and usage of new practices, and invaluable in identifying and resolving problems when risks and conflicts arise (Shields, 1995). Many studies have highlighted that top management support is an important factor in supporting new management initiatives including Activity Based Management (Phan et al., 2014; Baird et al., 2007), the Balanced Scorecard (Tung et al., 2011; Chan, 2004) and Enterprise Resource Planning (Motwani et al., 2002). Similarly, it is suggested that top management support is critical in enhancing the effectiveness of environmental management processes (Menguc et al., 2010; Savely et al., 2007; Zutshi and Sohal, 2004; Daily and Huang, 2001; Berry and Rondinelli, 1998). Environmental management processes follow a top-down approach whereby top managers understand and embrace the significance of applying environmental management in their organisation, initiate culture change and reinforce their managerial vision to their employees. Top management leads the processes through providing vision and guidance to employees at all levels; establishing environmental policies and objectives; encouraging communication and training; and providing timely and adequate resources for

implementation of the environmental initiatives required (Menguc et al., 2010; Zutshi and Sohal, 2004).

For the environmental management processes to be effective, it is essential that employees understand the importance of adopting environmental initiatives and commit to the environmental management processes. Anderson and Bateman (2000) noted that staff attitude and commitment in relation to environmental issues align with top management's positive attention and actions towards these issues. In other words, a more positive attitude and higher level of commitment from staff can be expected when top management demonstrate commitment towards environmental management processes (Sharma, 2000).

Top management's commitment and support for environmental management processes can have a critical impact in enhancing the environmental awareness of staff, motivating environmental performance and changing staff attitudes and behaviour towards environmental issues (Savely et al., 2007; Daily and Huang, 2001). This impact is likely to be strengthened when desired managerial behaviours, such as dedicating management time to communicating the importance of environmental management to staff, engaging with lower level employees, and providing necessary resources are demonstrated and practiced (Guest and Teplitzky, 2010).

***H1:** The extent of top management support for environmental management is positively associated with the effectiveness of environmental management processes.*

2.3.2 Training

Training is defined as 'a planned effort by an organisation to facilitate the learning of job related behaviour' (Wexley, 1984, p. 13). Many studies have highlighted the importance of

training in relation to the success of specific management accounting initiatives such as Performance Measurement Systems (Chan, 2004; Braam and Nijssen, 2004), and Enterprise Resource Planning (Snider et al., 2009; Vathanophas, 2007). Such studies indicate that training allows organisations to articulate the link between the new initiatives and organisational goals, and provides a mechanism for employees to understand, accept and feel comfortable with these initiatives.

Training in relation to environmental management has also been cited as a crucial factor in enhancing the effectiveness of environmental management (Sammalisto and Brorson, 2008; Savely et al., 2007). Savely et al. (2007) suggested that through training, employees can gain a deeper understanding of the purposes of environmental management, and the elements of environmental management processes including environmental objectives, targets and policies. Sammalisto and Brorson (2008) found that training was positively associated with employees' attitude towards environmental management and their awareness of the key elements of environmental management processes. This is in line with other studies (Jabbour and Santos, 2008; Daily and Huang, 2001) which suggest that understanding the purposes of environmental management and how to handle tasks in a more environmentally conscious manner can result in increased staff awareness and commitment to environmental issues. This can enhance the likelihood that environmental management processes will be more effective (Jabbour and Santos, 2008; Daily and Huang, 2001).

H2: The extent of training in respect to environmental management is positively associated with the effectiveness of environmental management processes.

2.3.3 Employee participation

Employee participation is ‘a process in which influence is shared among individuals’ and thus ‘balances the involvement of managers and their subordinates in information processing, decision-making, or problem solving endeavors’ (Wagner, 1994, p.312). In the performance measurement system (PMS) literature, studies have found that a higher level of employee participation contributes to the effectiveness of PMSs (Kleingeld et al., 2004; Kaplan and Norton, 2001). The findings suggest that the effectiveness of the system is assisted by two mechanisms, motivational mechanisms (including higher commitment to the system and less resistance to change) and cognitive mechanisms (such as improved communication, better understanding of the job and effective utilisation of knowledge).

Similarly, for environmental management processes to be effective there must be absolute buy-in to environmental management practices with employee involvement from the top management level to front line employees (Guest and Teplitzky, 2010; Daily and Huang, 2001; Berry and Rondinelli, 1998). In particular, employees should be involved from planning to implementation, and in the evaluation of outcomes (Reed, 2008). When lower level employees are empowered to take the initiative in defining their responsibilities and making decisions with respect to environmental issues, they will be more accountable, motivated and committed to environmental management processes (Goodstein and Wicks, 2007).

***H3:** The extent of employee participation in environmental management is positively associated with the effectiveness of environmental management processes.*

2.3.4 Team work

Teamwork refers to ‘a small number of people with complementary skills who are

committed to a common purpose, set of performance goals and approach for which they hold themselves mutually accountable' (Katzenbach and Smith, 1993, p. 112). The benefits of teamwork include the empowerment of employees, avoiding duplication of effort and obtaining collective knowledge (Matthews et al., 2004; Leitch et al., 1995).

In the environmental management literature, Beard and Rees (2000, p. 27) suggested that teams can be used to 'generate ideas, enhance learning experiences, explore issues, identify conflict and focus action to enhance understanding about why, what, how, where and when to pursue the best practicable environmental options'. Jabbour and Santos (2008) suggested that teamwork has a positive impact on environmental management processes in organisations. In particular, team members with common values share ideas when environmental risks arise and strive to find the best practices to resolve environmental issues. Massoud et al.'s (2010) findings support the Jabbour and Santos model with teamwork found to be a critical factor in implementing environmental management initiatives.

Most environmental management tasks require collective work by all employees across the various functions of an organisation. This approach ensures that all relevant functions take part in the environmental management processes, pool their knowledge and apply this in tackling environmental issues (Avadikyan et al., 2001). In particular, cross-functional teams are necessary to guarantee goal congruence and employee commitment towards environmental improvement (Jabbour and Santos, 2008; Savely et al., 2007). In such teams, the performance is collective and the skills are complementary, which assists organisations in making sure that environmental tasks are carried out in a more effective and efficient manner.

In addition, enhancing environmental management process effectiveness requires continuous learning and commitment across the organisation (Daily and Huang, 2001). ‘Teams are the key learning units which can absorb and produce novel information’ (Romme, 1996, p. 414). Team members access and gather information from different functions and share work practices and experiences with other team members. The greater sharing of knowledge and experience leads to an improved organisational environmental learning process, which in turn results in higher employee motivation and commitment towards environmental management processes (Llorens Montes et al., 2005; Avadikyan et al., 2001).

***H4:** The extent of teamwork in environmental management is positively associated with the effectiveness of environmental management processes.*

2.3.5 The link of environmental performance to rewards

The link of environmental performance to rewards is a critical factor in motivating employees’ job performance. A lack of linkage of performance to rewards is considered to be a barrier to achieving effective performance (Rynes et al., 2005; Chan, 2004; McShane and Travaglione, 2003; Bonner and Sprinkle, 2002). McShane and Travaglione (2003), for example, concluded that when employees observe a stronger link between their daily actions and rewards, they will be more motivated to improve performance. The link of performance to rewards has also been suggested as a crucial factor influencing the effectiveness of environmental management processes (Jabbour and Santos, 2008; Daily and Huang, 2001). Daily and Huang (2001) suggested that a reward system which reflects corporate commitment to the importance of environmental performance can motivate and increase the commitment by employees to be environmentally responsible. Aligning

rewards with environmental practices enables organisations to retain and motivate good employees, to initiate changes in employee attitudes, and to encourage the development of environmental knowledge and skills, which helps in achieving the environmental objectives of an organisation (Jerez-Gomez et al., 2005; Jabbour and Santos, 2008).

H5: The extent of the link of environmental performance to rewards is positively associated with the effectiveness of environmental management processes.

2.4 The association between the effectiveness of environmental management processes and environmental performance

Armistead et al. (1999, p. 105) indicated that ‘*attention to managing processes is the key to organisational effectiveness*’. Other studies also suggest that overall organisational performance can be enhanced by improving business processes (Skerlavaj et al., 2007; Hamilton and Chervany, 1981).

Processes are a generic factor in all organisations. ‘*They are the essence of change and they are the way things get done*’ (Armistead et al., 1999 p. 105). An effective business process constitutes positive changes in the way employees behave and perceive their organisations’ culture and environment (Skerlavaj et al., 2007). Consequently, this is positively reflected in the productivity of employees and in turn, facilitates improvements in overall organisational performance (Tallon et al., 2000). Similarly, it is proposed that the effectiveness of environmental management processes will affect the environmental performance of organisations.

An effective environmental management process comprises favourable organisational conditions (e.g. implementing environmental strategies, ensuring staff commitment to

environmental objectives and providing an accurate assessment of business unit environmental performance) which lead to improvements in environmental performance. For instance, implementing environmental strategies can focus employees' effort and enhance staff awareness towards environmental issues. When employees are committed to environmental objectives, genuine efforts will be made to reduce the negative environmental impact from their daily operations.

***H6:** The effectiveness of environmental management processes is positively associated with environmental performance.*

2.5 The association between organisational factors, the effectiveness of environmental management processes and environmental performance

As discussed in the previous sections, the effectiveness of environmental management processes is hypothesised to be contingent upon specific organisational factors including: top management support, training, employee participation, teamwork and the link of environmental performance to rewards. These factors create favourable process conditions (e.g. supporting change initiatives, fostering an environmentally friendly culture, and ensuring staff commitment to environmental objectives) by facilitating improvements in environmental management processes which in turn, enable improvements in environmental performance. The implication here is that the effectiveness of environmental management processes represents a mediating variable that links these organisational factors to environmental performance.

***H7:** The effectiveness of environmental management processes mediates the association between specific organisational factors and environmental performance.*

3. Method

A survey questionnaire was sent to the senior financial officer of a random sample of 899 Australian manufacturing organisations identified from the Onesource² online data base. The manufacturing industry was chosen due to its importance for the national economy. Also, it is one of the ‘dirty’ industries (Cole, 2000) which has a higher level of public concern and is faced with more environmental regulations (Gomez and Rodriguez, 2011; Johnstone and Labonne, 2009), while organisations operating in this industry are also more likely to have more comprehensive environmental management initiatives in place. Senior financial officers were chosen as they are directly involved in the management and reporting of their organisations’ environmental activities and they are accountable for their organisations’ sustainability issues (Ernst and Young, 2013). Hence, they are deemed to have relevant knowledge regarding the use of environmental management measures.

The Dillman Tailored Design Method (Dillman, 2007) was used to administer the survey. This method provides guidelines in respect to the format and style of questions, distribution procedures and follow-up communications. For instance, the questionnaire was designed to be user-friendly and presented in colour to attract respondents’ attention. Steps were also taken to make the distribution of the survey appear more personal with the addresses on the envelopes hand written. Further, in order to enhance the reliability and validity of the survey, the majority of the measures were adopted from prior research with minor adjustments made to make sure that the measures were appropriate for the current setting. The questionnaire was also pilot tested by 10 academics and two financial controllers with amendments made based on the constructive feedback received.

² The Onesource data base provides details of manufacturing organisations in Australia.

A total of 180 responses were received (20%), 145 (16%) from the initial distribution and 35 (4%) from the follow up mail out. Non-response bias was assessed by comparing the independent and dependent variable values of respondents from the initial and follow-up mailouts. This approach is consistent with Robert (1999) with the t-tests indicating that no significant differences were found in any of these comparisons. While the data are potentially subject to common method bias, the result of Harman's (1967) single-factor test suggested that the total variance (25.7%) explained by a single factor was below the 50% threshold indicative of common method bias problems (Podsakoff et al., 2003).

3.1 Variable measurement

3.1.1 The effectiveness of environmental management

The effectiveness of environmental management was assessed from two perspectives, the effectiveness of environmental management processes and environmental performance. The effectiveness of environmental management processes was measured by assessing the senior financial officer's opinion as to the extent to which 11 desired objectives of environmental management were achieved (see Appendix). These measures were developed based on Lawler (2003) with modifications made to fit the environmental context of this study. Respondents were required to indicate the extent to which their environmental management processes had achieved each of the 11 desired objectives using a five-point scale with anchors of 1 "not at all" to 5 "to a great extent". Factor analysis (varimax rotation) revealed that the eleven objectives loaded onto a single dimension which was subsequently scored as the total score of the eleven items with higher (lower) scores representing a more (less) effective environmental management process.

Environmental performance was measured in respect to the senior financial officer's opinion as to the extent to which twelve desired environmental outcomes were achieved (see Appendix). These measures were derived from the environmental performance literature and were mainly designed for manufacturing organisations (Henri and Journeault, 2010; Clarkson et al., 2008; Clarkson et al., 2004). Respondents were asked to indicate the extent to which their business unit had achieved each of the twelve perceived environmental outcomes using a seven-point scale with anchors of 1 "not at all" and 7 "to a great extent". Factor analysis (varimax rotation), using a cut-off point of 0.6³, indicated that the twelve outcomes loaded onto two dimensions (see Table 1). The first dimension included eight items which all referred to the achievement of operational aspects. Hence, this dimension was labelled "Operational environmental performance". The second dimension included four items which were more concerned with management aspects and therefore this dimension was labelled "Management environmental performance". Due to cross-loading concerns, confirmatory factor analysis (CFA) was conducted (see Appendix). The results of the CFA support the convergent validity as the standardised factor loadings of all items on each dimension exceeded the acceptable norm of 0.5 and were statistically significant (Bagozzi and Yi, 1988). The two dimensions were subsequently scored as the total score of the items loading on to each dimension with higher (lower) scores indicative of stronger (weaker) environmental performance.

³ Kline (2005) suggests that a factor loading above 0.6 is considered to be acceptable.

Table 1 Factor analysis of environmental performance measures

Items	Operational environmental performance	Management environmental performance
Reductions in energy consumption	0.85	0.14
Reductions in levels of waste	0.81	0.23
Reductions in water usage	0.80	0.28
Reductions in the levels of greenhouse gas emissions	0.79	0.35
Producing goods in a more environmentally conscious manner	0.74	0.16
Reductions in other air emissions	0.65	0.54
More effective and efficient decision making regarding environmental issues	0.63	0.59
Reductions in material costs due to the efficient use of material	0.61	0.33
Reductions in the time taken to respond to environmental incidents and minimizing their impact	0.34	0.84
Reductions in the costs of regulatory compliance	0.32	0.64
Reductions in the costs associated with cleaning up environmental damage	0.20	0.88
Reductions in the fines paid and remediation costs regarding environmental damage	0.14	0.88

3.1.2 Organisational factors

Each of the five organisational factors was measured using summated five-point scales with anchors of 1 “strongly disagree” and 5 “strongly agree”. Each factor was subsequently scored as the total score of the relevant items with higher (lower) scores indicating a higher (lower) level of each factor.

Top management support was measured using a three-item summated scale. Respondents were asked to indicate the extent to which top management provided adequate resources, communicated effectively, and exercised its authority in support of environmental management practices (Krumwiede, 1998; Grover, 1993). The extent of training was measured using two self-developed items based on a review of Shields (1995) and Krumwiede (1998), with modifications made to fit the context of the study. Respondents

were asked to indicate if adequate training had been provided to ensure employees understood the unit's environmental management policies and could implement them.

Employee participation was measured using two self-developed items based on a review of the employee participation literature (Sinclair et al., 2005; Harel and Tzafrir, 1999). Respondents were asked to indicate the extent to which lower level employees participated in selecting environmental performance measures and designing the environmental management practices. Team work was measured using two self-developed items based on a review of the teamwork literature (Matthews et al., 2004; Beard and Rees, 2000; Katzenback and Smith, 1993). Respondents were asked to indicate if teamwork was used frequently and whether employees frequently attended team meetings on environmental issues. Finally, the link of performance to rewards was measured using two self-developed items obtained from a review of the literature on performance and rewards (Rynes et al., 2005; Lawler, 2003; Huselid, 1995). Respondents were asked to indicate the extent to which environmental performance was linked to financial and non-financial rewards.

4. Results

Table 2 shows the descriptive statistics, with the actual ranges comparable with the theoretical ranges for the multi-item scales, and the Cronbach alpha scores exceeding the 0.70 threshold generally considered acceptable in regard to reliability (Nunnally, 1978, p. 245). In respect to the five organisational factors, while the mean score of top management support (10.52) lies towards the higher end of the scale, the mean values for training (5.78), teamwork (5.63), participation (4.25) and the link of performance to rewards (3.96) are below the mid-point of the range.

Table 2 Descriptive Statistics

Variables	N*	Mean	Std. Deviation	Minimum (Theoretical)	Maximum (Theoretical)	Cronbach's α
Independent variables						
Top management support	180	10.52	2.085	3.00 (3)	15.00 (15)	0.922
Training	179	5.78	1.97	2.00 (2)	10.00 (10)	0.858
Teamwork	180	5.63	1.95	2.00 (2)	10.00 (10)	0.759
Employee participation	179	4.25	1.87	2.00 (2)	9.00 (10)	0.911
Link of performance to rewards	180	3.96	1.92	2.00 (2)	9.00 (10)	0.741
Dependent Variables						
Effectiveness of environmental management processes	177	37.18	9.28	11.00 (11)	55.00 (55)	0.944
Operational environmental performance	176	32.34	10.51	8.00 (8)	56.00 (56)	0.923
Management environmental performance	161	13.53	7.63	4.00 (4)	28.00 (28)	0.884

*The number of responses (N) varies due to the fact that not all survey items were completed by respondents.

The mean score for the effectiveness of environmental management processes (37.18) is higher than the mid-point of the range, suggesting that on average the respondents assessed their environmental management processes to be moderately effective. The mean score for operational environmental performance (32.34) is slightly higher than the mid-point of the range, while the mean score for management environmental performance (13.53) is below the mid-point of the range. Hence, the operational environmental outcomes were achieved to a greater extent, with the mean score for most of the items equal to or greater than the management environmental outcomes. The operational environmental outcomes that were achieved to the greatest extent included reductions in levels of waste (mean score of 4.73), the reduction in material costs due to the efficient use of material (mean score of 4.65), more effective and efficient decision making regarding environmental issues (mean score of 4.64) and producing goods in a more environmentally conscious manner (mean score of

4.62). The management related outcomes that were achieved to the greatest extent included: reductions in the time taken to respond to environmental incidents and minimising their impact (mean score of 4.42), reductions in the fines paid and remediation costs regarding environmental damage (mean score of 4.39) and reductions in the costs associated with cleaning up environmental damage (mean score of 4.27).

4.1 Path analysis

Structural equation modelling (SEM) was used to examine the hypotheses. SEM is an efficient statistical tool in examining mediation effects (Cheung and Lau, 2008). It depicts a clear model where all relevant paths can be included and examined (Baron and Kenny, 1986). Since measurement errors in the model can be controlled for, compared with other techniques including Partial Least Squares (PLS) and hierarchical regression, SEM provides unbiased estimates of mediation effects (Baron and Kenny, 1986).

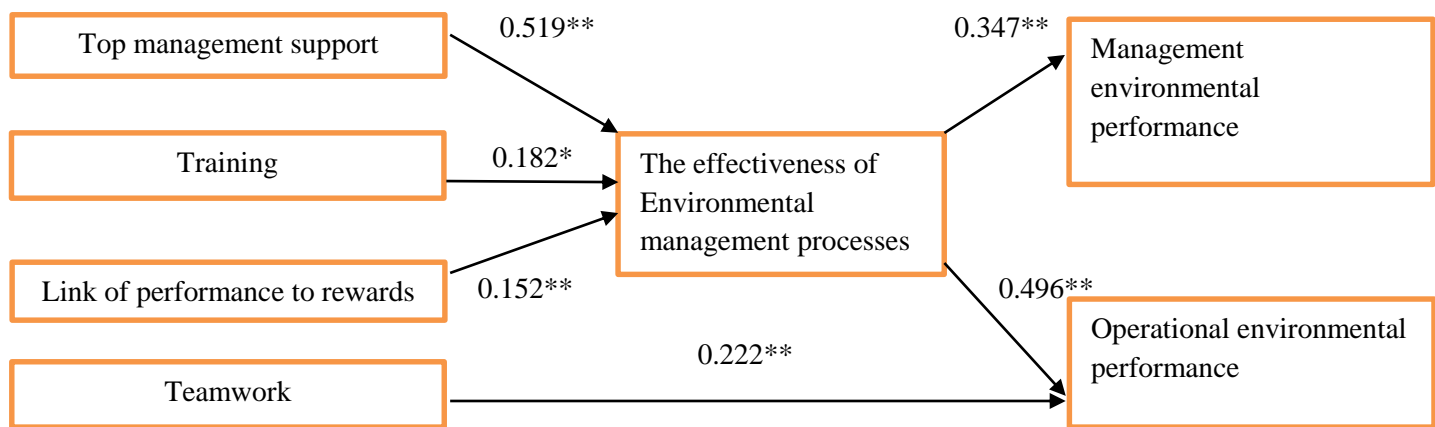
In carrying out the analysis, we added paths that the modification indices demonstrated should be examined, and sequentially removed paths that were not statistically significant until all remaining paths in the model were significant and the overall (reduced) model was a good fit. Such an approach enables a model to determine the most parsimonious explanation of variation in variables (Anderson and Gerbing, 1988). The BC bootstrap method (Cheung and Lau, 2008) was then used to examine the mediation effect.

The results of the structural equation model is shown in Figure 1 with the results of the path analysis presented in Table 3. The three benchmark fit indices ($\text{CMIN/DF}^4 = 1.38$;

⁴ The best models have values approaching 1. While some researchers have accepted models with CMIN/DF values up to 5, more conservative suggestions set the acceptable value at 2 or 3 (Ullman, 2001; Kline, 2005).

CFI⁵ = 0.990; RSMA⁶ = 0.030) indicate a good fit of the model. Among the five organisational factors, top management support ($\beta = 0.519$; $p = 0.000$), training ($\beta = 0.182$; $p = 0.022$) and the link of performance to rewards ($\beta = 0.152$; $p = 0.009$) were found to be positively related with the effectiveness of environmental management processes, supporting hypotheses 1, 2 and 5. The effectiveness of environmental management processes is positively related to both operational environmental performance ($\beta = 0.496$; $p = 0.000$) and management environmental performance ($\beta = 0.347$; $p = 0.000$), supporting hypothesis 6. In addition, Table 3 shows that teamwork ($\beta = 0.222$; $p = 0.000$) is directly related with operational environmental performance.

Figure 1 Results of the structural equation model for operational and management environmental performance



* Significant at the 5% significance level

** Significant at the 1% significance level

⁵ Values of at least 0.95 and 0.93 are indicative of “good” and “acceptable” fits (Byrne, 1994).

⁶ Values less than 0.08 and 0.05 are indicative of “acceptable” and “good” fits respectively, while values greater than 0.08 indicate that the model can be improved and values greater than 0.10 indicate “poor” fit (Schermelehn-Engel et al., 2003; Browne and Cudeck, 1993).

Table 3 Results of the path analysis for operational and management environmental performance

<u>Regression Path</u>	Standardised beta	Standardised error	Critical ratio	P-value
Top management support → the effectiveness of environmental management processes	0.519	0.245	6.869	0.000
Training → the effectiveness of environmental management processes	0.182	0.372	2.292	0.022
Link of performance to rewards → the effectiveness of environmental management processes	0.152	0.277	2.631	0.009
Teamwork → Operational environmental performance	0.222	0.347	3.397	0.000
The effectiveness of environmental management processes → Operational environmental performance	0.496	0.075	7.329	0.000
The effectiveness of environmental management processes → Management environmental performance	0.347	0.060	4.959	0.000
<u>Goodness of Fit Statistics</u>				
CMIN	48.461			
Df	35			
CMIN/DF	1.38			
CFI	0.990			
RMSEA	0.030			

Table 4 presents the evidence of mediation in the model. The results indicate that the effectiveness of environmental management processes mediates the positive relationship between the three organisational factors (top management support (CI_{LL} 0.161, CI_{UL} 0.365), training (CI_{LL} 0.020, CI_{UL} 0.143) and link of performance to rewards (CI_{LL} 0.011, CI_{UL} 0.178) with operational environmental performance as the confidence interval (CI) does not cross zero. The results also indicate that the effectiveness of environmental management processes mediates the positive relationship between top management support (CI_{LL} 0.105, CI_{UL} 0.273), training (CI_{LL} 0.009, CI_{UL} 0.125) and the link of performance to rewards (CI_{LL} 0.016, CI_{UL} 0.102) with management environmental performance. Accordingly, the finding provides partial support for Hypothesis 7.

Table 4 Bootstrapped regression analysis of mediation effects

	Operational environmental performance			Management environmental performance		
	Std Error	LL95% CI	UL95% CI	Std Error	LL95% CI	UL 95% CI
Top management support	0.197	0.161	0.365	0.120	0.105	0.273
Training	0.218	0.020	0.143	0.126	0.009	0.125
The link of performance to rewards	0.173	0.011	0.178	0.101	0.016	0.102

CI, confidence interval; LL, Lower Limit; UL, Upper Limit.

5. Discussion

This study empirically examined the relationship between five organisational factors and the effectiveness of environmental management, with the effectiveness of environmental management assessed from two perspectives: environmental management processes and environmental performance. The effectiveness of environmental management processes was evaluated based on the extent to which 11 desired objectives were achieved, with the results indicating that environmental management processes are only moderately effective in Australian manufacturing organisations. This finding highlights the importance of the organisational factors contributing to the effectiveness of environmental management. Environmental performance was evaluated based on the extent to which twelve desired environmental outcomes were achieved with factor analysis revealing two dimensions of environmental performance, operational and management environmental performance. The results show that organisations were more effective in achieving operational environmental outcomes than management environmental outcomes.

Analysis of the relationship between organisational factors and the effectiveness of environmental management processes showed that three organisational factors (top management support, training and the link of performance to rewards) were found to be

positively related with the effectiveness of environmental management processes. The findings provide managers with an insight into the specific organisational conditions that they need to concentrate on in order to enhance the effectiveness of environmental management processes. In particular, the findings highlight the importance of the involvement and support provided by top management in personally committing to environmental management and ensuring that enough resources are provided to operate and manage environmental management processes. It is crucial that top management's support and commitment are achieved and maintained during the adoption and implementation of environmental management (Wee and Quazi, 2005; Zutshi and Sohal, 2004). Top management is encouraged to understand and embrace the significance of environmental management for their organisations; set up clear environmental policies and realistic environmental objectives to ensure organisation-wide awareness of environmental issues; and communicate objectives to lower level employees to enhance staff buy-in and commitment to environmental management.

The findings suggest that organisations that provide more training are able to achieve higher effectiveness in regards to environmental management processes. This is in line with prior studies which argue that the transfer of relevant knowledge improves the overall acceptance of the processes by employees, enhances their commitment to the processes and hence, increases the likelihood that environmental management processes will be more effective (Jabbour and Santos, 2008; Sammalisto and Brorson, 2008; Savely et al., 2007). Accordingly, it is recommended that organisations provide appropriate training in relation to environmental management across different hierarchical levels to enhance the awareness and knowledge of employees in implementing new environmental management initiatives. The findings also suggest that the link of performance to rewards is another important

factor in enhancing the effectiveness of environmental management processes. This supports Daily and Huang (2001) who suggested that a reward system that aligns with environmental practices can initiate positive changes in employees' attitude and behaviour towards environmental issues. Hence, organisations may consider aligning rewards with environmental practices in order to achieve their environmental objectives.

Teamwork is found to be a direct contributing factor in enhancing operational environmental performance, suggesting that organisations aiming to improve their operational environmental performance (e.g. reducing energy consumption, reducing water usage and producing goods in a more environmentally conscious manner) are encouraged to foster a team culture. This supports Jabbour and Santos (2008) and Llorens Montes et al.'s (2005) suggestion that teamwork provides great opportunity for improving environmental performance. In line with Llorens Montes et al. (2005), it is suggested that organisations involve employees from different hierarchical levels and functions in the environmental team to promote mutual trust and co-operation in relation to environmental issues across the organisation.

Analysis of the relationship between the effectiveness of environmental management processes and environmental performance highlights the significant role of environmental management processes in improving environmental performance. It is recommended therefore that organisations seeking improvements in environmental performance focus on managing their environmental management processes. An effective environmental management process involves establishing clear environmental objectives (e.g. reduce raw material usage and emissions) which focus employees' effort and motivate environmental performance, identifying environmental performance measures (e.g. percentage of waste

material recycled and number of regulatory violations) to keep environmental performance on track, and reviewing process effectiveness to ensure improvements in environmental performance (Johnstone and Labonne, 2009; Darnall et al., 2008; Darnall and Edwards, 2006). An EMS could be used to achieve these objectives. Such a system could assist an organisation in achieving its environmental objectives through the consistent review and control of its daily operations (Zutshi and Sohal, 2004).

For organisations that are unfamiliar with the environmental management process, it is recommended that they consider obtaining advice from external environmental consultants who have the expertise in designing an EMS and managing environmental issues. External consultants could assist an organisation to streamline its environmental workflows and provide visibility through constant analysis and reporting of environmental performance across business operations (IHS, 2013). However, in the long term, organisations may consider recruiting staff with environmental management experience to strengthen its ability to manage critical environmental issues while avoiding paying high consultant fees. The results of the study also show that the effectiveness of environmental management processes mediates the effect of top management support, training and the link of performance to rewards on both operational and management environmental performance. Hence, while the presence of the three organisational factors is important to improve environmental performance, their positive impact is actualised through environmental management processes. This finding reinforces Hamilton and Chervany's (1981) claim that process effectiveness is crucial in achieving desired performance, further highlighting the need for formalised and effective environmental management processes.

5.1 Conclusion

The study contributes to the literature by examining the effectiveness of environmental management in terms of its effect on environmental management processes and environmental performance (i.e. operational performance and management performance). The identified mediating effect of the effectiveness of environmental management processes on the relationship between specific organisational factors (top management support, training and link of performance to rewards) and environmental performance highlights the need for more formalized environmental management processes in Australian manufacturing organisations. Specifically, organisations need to provide higher levels of top management support, training and align rewards with environmental performance to achieve the effectiveness of environmental management processes, and in turn improve environmental performance.

5.2 Limitations and suggestions for future research

The study is subject to the usual limitations of the mail survey approach including the inability to establish causal relationships, common method bias, and social desirability bias. In respect to common method bias, we rely on Harman's (1967) single-factor test which indicated that the total variance explained by a single factor (25.7%) was below the 50% threshold indicative of common method bias problems (Podsakoff et al., 2003). Nonetheless, future studies may combine the survey method with interviews to alleviate such concerns.

Prior research in the environmental management literature has focused primarily on environmental performance and has ignored the importance of the environmental management processes that facilitate improvements in environmental performance. The significant finding regarding the mediating role of environmental management processes

suggests that future studies consider reinforcing the approach suggested by Hamilton and Chervany (1981), by examining the effectiveness of environmental management in respect to environmental management processes. In addition, the current study provides empirical evidence with respect to the relationship between five organisational factors and the effectiveness of environmental management. Future studies may examine the relationship between other organisational factors such as strategy, structure, and the type of control, with the effectiveness of environmental management.

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Appendix : Constructs, indicator variables, Cronbach's α and standardised factor loading

Construct	Description of the item	Standardised factor loading
Top management support Cronbach's $\alpha = 0.922$	Top management exercises its authority in support of environmental management.	0.909
	Top management has effectively communicated its support for environmental management.	0.899
	Top management support has provided adequate resources to support environmental management.	0.874
Training Cronbach's $\alpha = 0.858$	Adequate training has been provided to implement the environmental management	0.865
	Adequate training has been provided to ensure employees understand the unit's environmental management policies.	0.874
Teamwork Cronbach's $\alpha = 0.759$	Employees frequently attend team meetings on environmental issues.	0.793
	Teamwork is used frequently in solving environmental issues.	0.778
Employee Participation Cronbach's $\alpha = 0.911$	Lower level employees were involved in selecting environmental performance measures.	0.853
	Lower level employees participated in designing the environmental management system.	0.977
Link of performance to rewards Cronbach's $\alpha = 0.741$	Environmental performance is linked to non-financial rewards (recognition, service awards, etc).	0.790
	Environmental performance is linked to financial rewards (pay, bonuses, etc).	0.732
The effectiveness of environmental management processes Cronbach's $\alpha = 0.944$	Meeting legislative and regulatory requirements	0.531
	Enhancing staff awareness towards environmental issues	0.832
	Supporting change initiatives	0.754
	Ensuring staff commitment to environmental Objectives	0.910
	Achieving environmental goals	0.888
	Motivating environmental performance	0.913

	Fostering an environmentally friendly culture	0.780
	Providing an accurate assessment of business unit environmental performance	0.795
	Managing environmental risk	0.729
	Increasing levels of recycling	0.824
	Implementing an environmental strategy	0.546
Operational environmental performance Cronbach's $\alpha = 0.923$	Reductions in energy consumption	0.734
	Reductions in water usage	0.758
	Reductions in material costs due to the efficient use of material	0.555
	Reductions in the levels of green house gas emissions	0.805
	Reductions in other air emissions	0.756
	Reductions in levels of waste	0.725
	More effective and efficient decision making regarding environmental issues	0.785
	Producing goods in a more environmentally conscious manner	0.622
Management environmental performance Cronbach's $\alpha = 0.923$	Reductions in the costs of regulatory Compliance	0.693
	Reductions in the time taken to respond to environmental incidents and minimizing their impact	0.875
	Reductions in the costs associated with cleaning up environmental damage	0.851
	Reductions in the fines paid and remediation costs regarding environmental damage	0.723

CHAPTER FIVE

PAPER TWO

The association between environmental performance measures (EPMs) and the effectiveness of environmental management

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

Abstract

This paper examines the association between the extent to which environmental performance measures (EPMs) (operational and management EPMs) are used and the purpose of using EPMs (for legitimacy, accountability and environmental decision making purposes) with the effectiveness of environmental management. The effectiveness of environmental management is assessed from two perspectives, the effectiveness of environmental management processes and environmental performance. Data were collected by mail survey questionnaire from a random sample of 899 senior financial officers in Australian manufacturing organisations. The findings highlight the importance of the effectiveness of environmental management processes, first as an antecedent of environmental performance and secondly, as a mediator of the association between the extent to which EPMs are used and the purpose of using EPMs with environmental performance. Specifically, the extent to which operational EPMs are used and the purpose of using EPMs for environmental decision making purposes show a direct positive association with the effectiveness of environmental management processes and an indirect association with environmental performance. The findings provide managers with an insight into how environmental performance measures can enhance the effectiveness of environmental management.

Keywords- Environmental management effectiveness, the purpose of using environmental performance measures, the extent to which environmental performance measures are used, environmental performance

1. Introduction

Environmental performance measures (EPMs) are analytical tools that provide key information relating to the environmental impact of organisations' operational processes (Tyteca, 1996). The information provided enables managers to adjust environmental actions and strategies in order to enhance the effectiveness of environmental management. While the majority of the literature on EPMs has focused on environmental disclosure and the association with environmental performance, the findings are mixed. For instance, Clarkson et al. (2008) studied 191 firms from the five most polluting industries in the US and found a positive association between EPM disclosure and environmental performance. Similar conclusions were found in Al-Tuwaijri et al. (2004) and Hughes et al. (2001). Alternatively, other studies have revealed a negative association between EPM disclosure and environmental performance (Clarkson et al., 2011; Cho et al., 2010; Cho and Patten, 2007), suggesting that poor performing organisations disclose more environmental information in an attempt to enhance public image (Font et al., 2012; Cho et al., 2010). Hence, given the environmental information disclosed by an organisation may not reveal its underlying environmental performance (Clarkson et al., 2011), this study focuses on the extent to which EPMs are used rather than disclosure practices. In addition, given the specific manner in which measures are used may influence the effectiveness of environmental management (Henri and Journeault, 2010; Failing et al., 2007; Larrinaga-Gonzales et al., 2001), this study aims to provide a further insight into the relationship between EPMs and environmental performance, by focusing on the purpose of using EPMs. For instance, Larrinaga-Gonzales et al. (2001) suggested that desired environmental outcomes are unlikely to be obtained when environmental performance measures are used for managing public image. Therefore, in addition to examining the effect of the extent to which EPMs are used, this study aims to contribute to the EPM literature by providing an

insight into the purposes of using EPMs. Specifically, with reference to Henri and Journeault (2010), the study examines the purpose of using EPMs with emphasis placed on the extent to which EPMs are used for legitimacy, accountability and environmental decision making purposes.

Accordingly, this study aims to contribute to the EPM literature in several ways. First, this study aims to extend the literature by empirically examining the association between EPMs and the effectiveness of environmental management. In particular, the study examines EPMs from two perspectives: (i) the extent to which EPMs are used and (ii) the purpose of using of EPMs. Secondly, while prior studies have used environmental performance to assess the effectiveness of environmental management, this study examines the effectiveness of environmental management with respect to both environmental performance and the effectiveness of environmental management processes. In addition, the study explores the association between the effectiveness of environmental management processes and environmental performance. Thirdly, this study aims to explore the direct and indirect effect of the extent to which EPMs are used and the purpose of using EPMs on environmental performance.

The remainder of the paper is structured as follows. Section 2 provides the literature review and develops the relevant hypotheses. Sections 3 and 4 discuss the research method and findings. Finally, Section 5 presents the conclusions, limitations and suggestions for future research.

2. Literature review

2.1 Environmental Performance Measures (EPMs)

International Standards Organisation (ISO) 14031, a subcategory of ISO 14001⁷ defines EPMs as a '*specific expression that provides information about an organisation's environmental performance*' (International Standards Organisation, 1999). A set of environmental performance measures that can simplify and communicate otherwise complex information is required to assess and to facilitate improvements in an organisation's environmental performance (Gray, 2010; Epstein and Roy, 2003; Bebbington and Gray, 2001). It is suggested that a well-developed set of environmental performance measures can serve multiple purposes for organisations: as a managerial tool for decision making with regard to environmental issues; to encourage internal communication for continuous improvements in environmental performance; to monitor compliance with environmental regulations and to establish dialogue with external stakeholders to address their environmental concerns (Epstein and Roy, 2003; Azzone et al., 1996; Tyteca, 1996).

ISO 14031 provides guidelines for an organisation on how to identify suitable environmental performance measures encompassing three categories: (i) environmental condition measures, (ii) management performance measures, and (iii) operational performance measures.

Environmental condition measures provide information about the local, national or global condition of the environment without considering organisational activities (e.g. biological oxygen demand, change in groundwater level). Since most of the environmental

⁷ In 1996, the International Standards Organisation released ISO 14001, an international standard for the development of an effective EMS with ISO14031 released in 1999.

performances measures in this category are out of the control of a single business, they are rarely applied to a single business (Kuhre, 1998) and hence, are not considered in the current study.

Management performance measures provide information about the management actions taken to influence organisational environmental performance. Measures in this group cover the implementation of environmental policies, community relations and environmental related financial performance (e.g. cost of pollution prevention projects, time spent responding to environmental incidents). Management performance measures are lead indicators which reflect the extent to which management addresses environmental issues and in turn, propose future improvements in environmental performance (International Standards Organisation, 1999; Kuhre, 1998).

Operational performance measures provide information about the environmental performance of an organisation's operations. Operational performance measures relate to the inputs to operations (e.g. materials, energy and services), operation of systems, and outputs from operations (product, waste, emissions) (International Standards Organisation, 1999; Kuhre, 1998). They are lag indicators which refer to past environmental performance.

The application of the ISO 14031 standard is advocated by both practitioners and academics as a means of identifying environmental performance measures (Henri and Journeault, 2008; Perotto et al., 2008; Jasch, 2000; O'Reilly et al., 2000; International Standards Organisation, 1999). Accordingly, in this study, the extent to which EPMs are used is assessed using ten EPMs which are in line with the ISO 14031 guidelines (Kuhre,

1998), and encompass both management and operational performance measures (see Appendix).

The study also investigates the manner in which EPMs are used. Previous studies have indicated that there is considerable diversity in the approach to the use of EPMs. For instance, while some organisations have used EPMs for environmental decision making (Wagner, 2007; Berry and Rondinelli, 1998), other organisations use measures to fulfill legal requirements (Bansal and Roth, 2000), and to improve external reporting and enhance their public image (Adams and Frost, 2008; Henri and Journeault, 2008; Cho and Patten, 2007; O'Dwyer, 2002; Larrinaga-Gonzalez et al., 2001; Deegan and Gordon, 1996). This study will examine three main uses of EPMs identified in the EPM literature: (i) managing public image (legitimacy) (Adams and Frost, 2008; Henri and Journeault, 2008; Cho and Patten, 2007; O'Dwyer, 2002; Larrinaga-Gonzalez et al., 2001; Deegan and Gordon, 1996), (ii) fulfilling accountability requirements to stakeholders (accountability) (Bansal and Roth, 2000), and (iii) environmental decision making (Wagner, 2007; Berry and Rondinelli, 1998).

2.2 The effectiveness of environmental management

'Effectiveness' is referred to as the achievement of the objectives set for a task (Clinquini and Mitchell, 2005). Hence environmental management is perceived to be 'effective' when its intended objectives are achieved. While the majority of studies in the field of environmental management have assessed the effectiveness of environmental management in respect to its contribution to improvements in environmental performance (Clarkson et al., 2008; Daily et al., 2007; Al-Tuwaijri et al., 2004; Hughes et al., 2001) (e.g. Daily et al. (2007) examined the mediating role of environmental management system (EMS)

teamwork on the association between HR factors and environmental performance; Clarkson et al. (2008), Al-Tuwaijri et al. (2004) and Hughes et al. (2001) examined the impact of corporate environmental disclosure on environmental performance), Tung et al. (2014) examined the effectiveness of environmental management from two perspectives, environmental performance and the effectiveness of environmental management processes. This approach is in line with Hamilton and Chervany (1981) who argue that the effectiveness of an initiative can be assessed based on its contribution to the improvements in organisational processes as well as improvements in organisational performance. They argue that improvements in organisational performance are attributed to the effect of management initiatives on organisational processes.

Accordingly, this study adopts a similar approach, examining the effectiveness of environmental management in respect to the effectiveness of environmental management processes and environmental performance. The effectiveness of environmental management processes is evaluated based on the extent to which eleven desired objectives of environmental management have been achieved: (i) meeting legislative and regulatory requirements, (ii) enhancing staff awareness towards environmental issues, (iii) supporting change initiatives, (iv) ensuring staff commitment to environmental objectives, (v) achieving environmental goals, (vi) motivating environmental performance, (vii) fostering an environmentally friendly culture, (viii) providing an accurate assessment of business unit environmental performance, (ix) managing environmental risk, (x) increasing the level of recycling and (xi) implementing an environmental strategy (Lawler, 2003).

Environmental performance is measured in respect to the achievement of twelve environmental outcomes, reductions in: (i) energy consumption, (ii) water usage, (iii)

material costs, (iv) the levels of greenhouse gas emissions, (v) other air emissions, (vi) the levels of waste, (vii) the costs of regulatory compliance, (viii) the time taken to respond to environmental incidents and minimizing their impact, (ix) the costs associated with cleaning up environmental damage, (x) the fines paid and remediation costs regarding environmental damage, (xi) more effective and efficient decision making regarding environmental issues and (xii) producing goods in a more environmentally conscious manner (Henri and Journeault, 2010; Langfield-Smith et al., 2009; Clarkson et al., 2008).

2.3 The association between the extent to which EPMs are used and the effectiveness of environmental management processes

The literature on performance measures suggests a positive relationship between the extent to which performance measures are used and the effectiveness of performance management (Crabtree and DeBusk, 2008; Davis and Albright, 2004; Braam and Nijssen, 2004; Ittner et al., 2003; Whorter, 2003; Malina and Selto, 2001; Hoque and James, 2000). These studies suggest that the use of performance measures contributes to enhancing motivation, changing behaviour and effective management control. Further, the use of performance measures is perceived to be an effective means of evaluating and achieving organisational goals (Langfield-Smith et al., 2009).

Similarly, it is expected that the extent to which EPMs are used will influence the effectiveness of environmental management processes in three ways. First, internally, the utilisation of EPMs provides a basis for communicating environmental objectives to both management and employees (Kuhre, 1998). Understanding these objectives enables employees to gain a better understanding of environmental management processes, improves staff awareness of environmental issues and enhances the likelihood of

employees being involved in environmental management (Guest and Teplitzky, 2010; Daily and Huang, 2001; Berry and Rondinelli, 1998).

Secondly, EPMs provide a basis for assessing conformance with environmental targets and objectives, and assists in identifying potential environmental risks (e.g. carbon emissions and water pollution) (Kuhre, 1998). Understanding these risks at an early stage allows managers to devote sufficient time to develop corresponding environmental strategies and allocate resources effectively and efficiently (Guest and Teplitzky, 2010) in order to reduce potential environmental risks.

Thirdly, environmental performance measures enable managers to track and evaluate employees' environmental performance in an effective and efficient manner (Kuhre, 1998). An effective performance evaluation system which reflects an organisation's commitment to the importance of environmental performance motivates employees to contribute more effectively to the attainment of the organisation's environmental objectives (Bretz et al., 1992).

***H1:** The extent to which environmental performance measures are used is positively associated with the effectiveness of environmental management processes.*

2.4 The association between the purpose of using EPMs and the effectiveness of environmental management processes

The following three subsections develop hypotheses in relation to the association between the three main purposes of using EPMs (legitimacy, accountability and environmental decision making) and the effectiveness of environmental management.

2.4.1 Managing public image (Legitimacy)

A strategy for organisations to enhance their corporate image is to communicate favourable environmental information to external stakeholders (e.g. customers, investors and communities) through external reporting (Lyon and Maxwell, 2011; Adams and Frost, 2008; Wagner, 2007; Hahn and Scheermesser, 2006). However, when EPMs are solely used for managing public image, such use is considered to be merely a ‘green wash’ activity where organisations create the impression of the company’s commitment to environmental issues without actually engaging in environmental management activities (Cho and Patten, 2007; O’Dwyer, 2002; Larrinaga-Gonzalez et al., 2001; Deegan and Gordon, 1996; Deegan and Rankin, 1996). For instance, Deegan and Gordon (1996) investigated the environmental performance measures reported in the environmental reports of 197 companies from 50 industries and found that while 71 companies measured environmental performance, only 14 companies provided any negative environmental information. Similarly, Deegan and Rankin (1996) observed that when organisations are being prosecuted for environmental offences, they report measures reflecting positive environmental information in an attempt to deflect the attention away from their undesirable environmental management.

Larrinaga-Gonzalez et al. (2001) found that environmental information was mainly used to manage the perception of their environmental management performance. Their study concluded that when environmental information is used to manage corporate reputation, it has no genuine impact on environmental management processes. Similar conclusions have been reached in other studies including Cho and Patten (2007) and O’Dwyer (2002).

H2: The extent to which EPMs are used for legitimacy purposes is not associated with the effectiveness of environmental management processes.

2.4.2 Fulfilling accountability requirements

Environmental information is also used to fulfil organisations' accountability requirements to a variety of stakeholders including regulators, customers, employees, and shareholders. In this study, accountability is concerned with the right (of the regulators) to receive information and the duty (of organisations) to supply it (Gray, 1992, p. 413).

When the use of environmental performance measures is driven by pressure from regulators, measures are likely to be used to meet standards rather than to exceed them. For instance, organisations only focus on those environmental measures whose impact is subjected to environmental regulations in order to avoid sanctions and other legal costs (Bansal and Roth, 2000). Accordingly, environmental performance measures may not be fully integrated into internal environmental management processes (Wagner, 2007). The failure to go beyond legal compliance to incorporate environmental performance measures that support environmental decision making suggests that desired environmental objectives are unlikely to be achieved (Larrinaga-Gonzalez et al., 2001; Bansal and Roth, 2000).

***H3:** The extent to which EPMs are used for accountability purposes is not associated with the effectiveness of environmental management processes.*

2.4.3 Environmental decision making

Failing et al. (2007, p. 71) indicated that the process of decision making 'consists of defining objectives and measures of performance, identifying and evaluating alternatives, and making choices based on a clear understanding of uncertainties trade off'. In an environmental context, feedback from the performance evaluation process provides managers with guidelines for environmental strategic planning and influences resource allocation by indicating which strategies are most effective in achieving desired

environmental management outcomes. Potential environmental risks (e.g. land pollution caused by raw material wastage, carbon emission) can also be identified, thereby providing managers with opportunities for planning and implementing corresponding strategies to reduce such negative environmental impacts (Berry and Rondinelli, 1998).

When EPMs are used for environmental decision making purposes, such measures will play a critical role in communicating environmental objectives and strategies to internal stakeholders, from the top management level to front line employees. Through constant organisational learning and communication, the norms and routines that guide organisational practices will gradually change (Epstein and Roy, 2003). For instance, employees will have greater knowledge of environmental issues and their environmental responsibilities and goals, and will therefore be more engaged and committed to environmental management processes (Anderson and Bateman, 2000). Managers will be motivated to devote their time to making appropriate changes, such as developing environmentally friendly products and redesigning production processes so as to reduce the negative impact on the environment and hence improve environmental performance (Guest and Teplitzky, 2010).

***H4:** The extent to which EPMs are used for environmental decision making purposes is positively associated with the effectiveness of environmental management processes.*

2.5 The association between the effectiveness of environmental management processes and environmental performance

According to Armistead et al. (1999, p. 105) ‘*attention to managing processes is the key to organisational effectiveness*’. Other studies support Armistead et al. (1999) suggesting that improvements in business processes facilitate improvements in overall organisational performance (Skerlavaj et al., 2007; Hamilton and Chervany, 1981).

'Processes are the essence of change and they are the way things get done' (Armistead et al., 1999 p. 105). An effective business process creates desirable changes in the way employees behave and perceive their organisations' environment (Skerlavaj et al., 2007). This will be positively reflected in employee productivity and in turn, potentially lead to improvements in overall organisational performance (Tallon et al., 2000; Huselid, 1995).

From this general proposition about effective processes, it is proposed that the effectiveness of environmental management processes can have a positive impact on the environmental performance of organisations. Effective environmental management processes contain desirable organisational conditions (e.g. enhancing staff awareness towards environmental issues, implementing an environmental strategy and fostering an environmental friendly culture) which facilitate improvements in organisational environmental performance (Tung et al., 2014).

***H5:** The effectiveness of environmental management processes is positively associated with environmental performance.*

2.6 The mediating role of the effectiveness of environmental management processes in the association between the extent to which EPMs are used and the purpose of using EPMs with environmental performance

As discussed in the previous sections, the effectiveness of environmental management processes is hypothesised to be contingent upon the extent to which EPMs are used and the purpose of using EPMs. In addition, the effectiveness of environmental management processes is hypothesised to affect environmental performance. This implies that the effectiveness of environmental management processes plays a mediating role which links the extent to which EPMs are used and the purpose of using EPMs to environmental

performance.

H6 a): The effectiveness of environmental management processes mediates the association between the extent to which EPMs are used and environmental performance.

b): The effectiveness of environmental management processes mediates the association between the purpose of using of EPMs and environmental performance.

3. Method

Survey questionnaires were mailed to 899 senior financial officers in Australian manufacturing organisations, with the sample chosen randomly from the OneSource⁸ online database. The manufacturing industry was chosen because it is one of the ‘dirty’ industries which has a high level of public concern and is faced with more environmental legislation than other industries (Gomez and Rodriguez, 2011; Johnstone and Labonne, 2009). In addition, organisations operating in this industry are likely to have more comprehensive environmental management initiatives in place (Cole, 2000). Senior financial officers were chosen because they are accountable for their organisations’ sustainability issues and are directly involved in the management and reporting of their organisations’ environmental activities (Ernst and Young, 2013).

The Dillman Tailored Design Method⁹ (Dillman, 2007) was adopted to administer the survey. The questionnaire was designed to be user-friendly and collated in a six page booklet. The six page questionnaire consisted of a title, a statement of appreciation for the respondent’s participation and 9 questions. The majority of the measures were adopted from prior research with minor adjustments made to make sure that the measures were appropriate for the current setting. The questionnaire was pilot tested by 10 academics and

⁸ The Onesource data base provides details of manufacturing organisations in Australia.

⁹ The Dillman (2007) Tailored Design Method provides guidelines in respect to the format and style of questions, personalisation, and distribution procedures.

two financial controllers prior to the initial mail out with subsequent amendments made based on the feedback provided. A total of 108 usable responses were received for a response rate of 20 percent, 145 (16%) from the initial mail out and 35 (4%) from the follow up mail out. Non-response bias was assessed by comparing the independent and dependent variable values across early and late respondents. No significant differences were found.

3.1 Variable measurement

3.1.1 The effectiveness of environmental management

The effectiveness of environmental management processes

The effectiveness of environmental management processes was measured by assessing the extent to which eleven desired outcomes of environmental management processes were achieved (see Appendix). Respondents were required to indicate the extent to which their environmental management processes had achieved each of the eleven desired outcomes on a five-point scale with anchors of 1 “not at all” and 5 “to a great extent”. These measures were mainly derived based on Lawler (2003). A factor analysis of the eleven outcomes was performed with the results indicating that the eleven outcomes loaded onto a single dimension. The perceived outcomes were subsequently scored as the total score of the items with higher (lower) scores indicating a more (less) effective environmental management process.

Environmental Performance

Environmental performance was measured by assessing the extent to which twelve desired environmental outcomes had been achieved (see Appendix). These measures were derived

from the environmental performance literature and were mainly designed for manufacturing organisations (Henri and Journeault, 2010; Clarkson et al., 2008; Clarkson et al., 2004; Melnyk et al., 2003). Respondents were required to indicate the extent to which their organisations had achieved each of the twelve environmental outcomes using a seven-point scale with anchors of 1 “not at all” and 7 “to a great extent”.

Factor analysis (with varimax rotation) showed that the twelve outcomes loaded onto two dimensions. The first dimension consisted of eight items: reductions in energy consumption; reductions in water usage; reductions in material costs due to the efficient use of material; reductions in the levels of greenhouse gas emissions; reductions in other air emissions; reductions in the levels of waste; more effective and efficient decision making regarding environmental issues; and producing goods in a more environmental conscious manner. This dimension was labelled “operational environmental performance”. The second dimension consisted of four items: reductions in the costs of regulatory compliance; the time taken to respond to environmental incidents and minimising their impact; the costs associated with cleaning up environmental damage; and the fines paid and remediation costs regarding environmental damage. Such items were more concerned with management aspects, and therefore, this dimension was labelled “management environmental performance”. These two dimensions were subsequently scored as the total score of the items loading on to each dimension with higher (lower) scores representing stronger (weaker) environmental performance.

3.1.2 The extent to which EPMs are used

The extent to which EPMs are used was measured by assessing the extent to which ten different EPMs were used to evaluate organisational environmental performance. The ten

EPMs encompassed the two categories (operational and management EPMs) identified in the ISO 14031 guidelines and were developed following a review of the EPM literature (Henri and Journeault, 2008; Marshall and Brown, 2003; Kolk and Mauser, 2002; Kuhre, 1998). Respondents were required to indicate the extent to which these ten EPMs were used on a five-point scale with anchors of 1 “not at all” and 5 “to a great extent”.

Factor analysis revealed that the ten items loaded onto two dimensions. The first dimension consisted of seven items (recycled materials used; the amount of energy saved due to conservation improvement and efficiency; total water used; the volume of water recycled and reused; total greenhouse gas emissions; nitric oxide, nitrogen dioxide and other significant air emissions by type and weight; total weight of waste) which all related to operational performance, hence, this dimension was labelled “operational EPMs”. The second dimension included three items (total environmental protection expenditure and investment; the time spent responding to environmental incidents; and the total number of fines and violation notices) which related to management performance. Hence, this dimension was subsequently labelled “management EPMs”. The two dimensions were subsequently scored as the total score of the items loading onto each dimension with higher (lower) scores indicating that environmental performance measures were used to a greater (less) extent.

3.1.3 The purpose of using EPMs

The purpose of using EPMs was measured by assessing the extent to which EPMs were used for legitimacy, accountability and environmental decision making purposes. Measuring the purpose of using EPMs involved two steps. First, respondents were required to indicate the extent to which the ten EPMs were used using a five-point scale with

anchors of 1 “not at all” and 5 “to a great extent”. In assessing the purpose of using EPMs, we then only focused on those EPMs where respondents had indicated 3 or above on this 5 point scale. Secondly, respondents were required to indicate the extent to which they were using each of the identified EPMs for legitimacy, accountability and environmental decision making purposes using a five-point scale with anchors of 1 “not at all” and 5 “to a great extent” with higher (lower) scores indicating that EPMs were used in a specific manner to a greater (less) extent (see Appendix). Each purpose of using EPMs was then scored as the average score of the measures with higher (lower) scores indicating that EPMs were used in a specific manner to a greater (less) extent.

4. Results

Table 1 shows summary statistics for the independent and dependent variables. The actual range was comparable with the theoretical range with the Cronbach alpha coefficients meeting or exceeding the 0.70 threshold considered acceptable in respect to the reliability test (Nunnally, 1978, p. 245). The mean score for the effectiveness of environmental management processes (37.18) is slightly higher than the mid-point of the range, suggesting that on average the respondents assessed their environmental management to be moderately effective. While the mean score for operational environmental performance (32.34) is slightly higher than the mid-point of range, the mean score for management environmental performance (13.53) is below the mid-point of the range. The mean scores of the six operational environmental performance items are equal to or greater than the four management environmental performance items, indicating that on average the respondents assessed their business units’ operational environmental performance to be moderately successful and their management environmental performance to be less successful. The operational environmental performance items that were achieved to the greatest extent

include: reductions in levels of waste (mean score of 4.73); reductions in materials cost due to the efficient use of material (mean score of 4.65); more effective and efficient decision making regarding environmental issues (mean score of 4.64); and producing goods in a more environmentally conscious manner (mean score of 4.62). The management environmental performance items that were achieved to the greatest extent include: reductions in the time taken to respond to environmental incidents and minimizing their impact (mean score of 4.42); reductions in the fines paid and remediation costs regarding environmental damage (mean score of 4.39); and reductions in the costs associated with cleaning up environmental damage (mean score of 4.27).

Table 1 Descriptive Statistics

Variables	N*	Mean	Std. Deviation	Actual Minimum (Theoretical)	Actual Maximum (Theoretical)	Cronbach's α
Independent variables						
Operational EPMs	164	19.63	6.97	5.00(5)	35.00(35)	0.88
Management EPMs	161	7.33	3.28	5.00(3)	15.00(15)	0.77
Legitimacy	149	3.36	0.86	1.00(1)	5.00(5)	0.95
Accountability	150	3.74	0.70	2.00(1)	5.00(5)	0.92
Environmental decision making	149	3.79	0.67	2.00(1)	5.00(5)	0.93
Dependent Variables						
Effectiveness of environmental management processes	177	37.18	9.28	11.00(11)	55.00(55)	0.944
Operational environmental performance	176	32.34	10.51	8.00(8)	54.00(56)	0.923
Management environmental performance	161	13.53	7.63	4.00(4)	28.00(28)	0.884

*The number of responses (N) varies due to the fact that not all survey items were completed by respondents.

In respect to the extent to which EPMs are used, while the mean score for operational EPMs (19.63) is slightly higher than the mid-point of the range, the mean score for

management EPMs (7.33) is slightly below the mid-point of the range, indicating a moderate use of operational EPMs and low usage of management EPMs in Australian manufacturing organisations. The operational EPMs that were used to the greatest extent include: the amount of energy saved due to conservation improvement and efficiency (mean score of 3.27); recycled materials used (mean score of 3.12); total green gas emissions (mean score of 2.88); and total weight of waste (mean score of 2.86). The management EPMs that were used to the greatest extent include: total environmental protection expenditure and investment (mean score of 2.65); and the time spent responding to environmental incidents (mean score of 2.55).

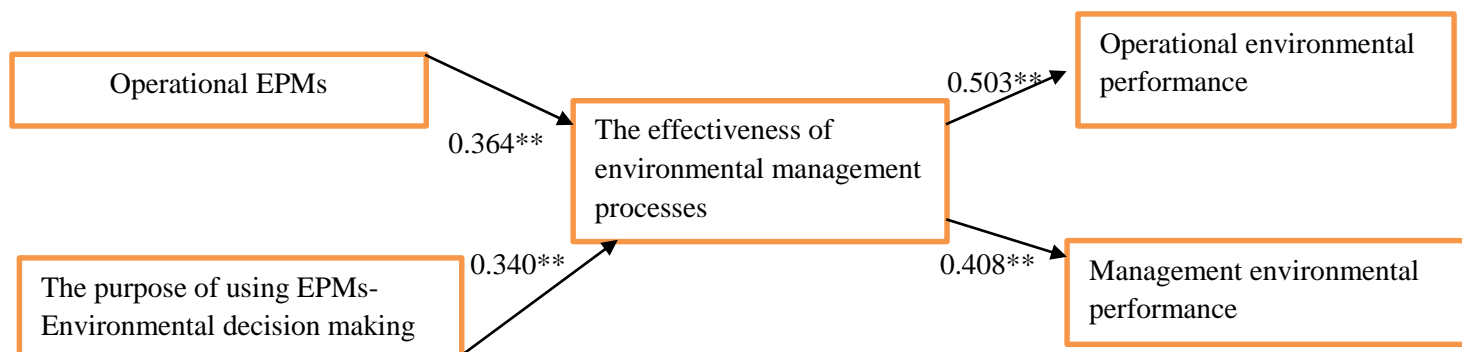
Table 1 also provides statistics regarding the extent to which EPMs were used for legitimacy, accountability and environmental decision making purposes. While the mean scores for all three types of use were above the mid-point of the range, greater emphasis was placed on using EPMs for environmental decision making (3.79), followed by accountability (3.74) and legitimacy (3.36) purposes.

4.1 Path analysis

The hypotheses were examined using Structural Equation Modeling (SEM). Additional paths were added based on the modification indices with paths that were not statistically significant removed sequentially until all remaining paths in the model were significant and the overall model was a good fit. The BC bootstrap method (Cheung and Lau, 2008) was then used to examine the mediation effect.

The results of the structural equation model is shown in Figure 1 with the results of the path analysis presented in Table 2. The three benchmark fit indices (CMIN/DF¹⁰ = 1.405; CFI¹¹ = 0.997; RSMA¹² = 0.031) indicate a good fit of the model. The extent to which operational EPMs are used ($\beta = 0.364$; $p = 0.000$) and using EPMs for environmental decision making purposes ($\beta = 0.340$; $p = 0.000$) show a positive association with the effectiveness of environmental management processes, supporting Hypotheses 1 and 4. In addition, the effectiveness of environmental management processes is positively associated with operational environmental performance ($\beta = 0.503$; $p = 0.000$) and management environmental performance ($\beta = 0.408$; $p = 0.000$), supporting Hypothesis 5.

Figure 1 Results of the mediation structural equation model of operational and management environmental performance



* Significant at the 5% significance level

** Significant at the 1% significance level

¹⁰ The best models have values approaching 1. While some researchers have accepted models with CMIN/DF values up to 5, more conservative suggestions set the acceptable value at 2 or 3 (Ullman, 2001; Kline, 2005).

¹¹ Values of at least 0.95 and 0.93 are indicative of “good” and “acceptable” fits (Byrne, 1994).

¹² Values less than 0.08 and 0.05 are indicative of “acceptable” and “good” fits respectively, while values greater than 0.08 indicate that the model can be improved and values greater than 0.10 indicate “poor” fit (Schermelleh-Engel et al., 2003; Browne and Cudeck, 1993).

Table 2 Results of the path analysis for operational and management environmental performance

Regression Path	Standardised beta	Standardised error	Critical ratio	P-value
Operational EPMs → the effectiveness of environmental management processes	0.364	0.091	5.287	0.000
Decision making → the effectiveness of environmental management processes	0.340	0.735	4.937	0.000
The effectiveness of environmental management processes → Operational environmental performance	0.503	0.073	7.656	0.000
The effectiveness of environmental management processes → Management environmental performance	0.408	0.062	5.638	0.000
Goodness of Fit Statistics				
CMIN	7.023			
Df	5			
CMIN/DF	1.405			
CFI	0.997			
RMSEA	0.031			

Table 3 presents the evidence of mediation for the model. The results indicate that the effectiveness of environmental management processes mediates the positive relationship between the extent to which operational EPMs are used (CILL 0.143, CIUL 0.439) and using EPMs for decision making (CILL 0.952, CIUL 3.316) with operational environmental performance as the confidence interval (CI) does not cross zero. The results also indicate that the effectiveness of environmental management processes mediates the positive relationship between the extent to which operational EPMs are used (CILL 0.085, CIUL 0.277) and using EPMs for decision making purposes (CILL 0.557, CIUL 2.241) with management environmental performance. Accordingly, the findings provide partial support for Hypothesis 6.

Table 3 Bootstrapped regression analysis of mediation effects

	Operational environmental performance			Management environmental performance		
	Std Error	LL95% CI	UL95% CI	Std Error	LL95% CI	UL 95% CI
Operational EPMs	0.074	0.143	0.439	0.593	0.085	0.277
Decision Making	0.593	0.952	3.316	0.421	0.557	2.241

CI, confidence interval; LL, Lower Limit; UL, Upper Limit.

5. Conclusion

5.1 Discussion

This study empirically examined the association between the extent to which EPMs are used and the purpose of using EPMs with the effectiveness of environmental management. Analysis of the association between the extent to which EPMs are used and the effectiveness of environmental management processes indicated that the use of operational EPMs was positively associated with the effectiveness of environmental management processes, suggesting that organisations are more likely to achieve higher environmental management process effectiveness when operational EPMs (e.g. recycled material used, the volume of water recycled and reused total greenhouse gas emissions) are used to a greater extent. The findings provide managers with an insight into the specific operational EPMs that should be incorporated in environmental management to achieve environmental management process effectiveness. The results of the current study are consistent with prior studies which have suggested that organisations should incorporate EPMs as part of their environmental management processes to obtain the benefits of using operational EPMs (e.g. assisting organisations to establish environmental objectives, providing information for stakeholders that relates directly to their concerns and requirements, and evaluating the environmental management process towards stated objectives) (Henri and Journeault, 2010; Iraldo et al., 2009; Clarkson et al., 2008; Henri and Journeault, 2008; Perotto et al., 2008; Al-Tuwaijri et al., 2004; Melnyk et al., 2003; Hughes et al., 2001; O'Reilly et al., 2000).

The analysis also indicated that the extent to which EPMs are used for environmental decision making purposes was found to be positively associated with the effectiveness of environmental management processes. This finding is in line with prior studies (Adams

and Frost, 2008; Henri and Journeault, 2008; Wagner, 2007) and provides managers with an insight into how specific EPMs could be used to enhance the effectiveness of environmental management processes. In particular, managers need to ensure that environmental performance measures are incorporated in environmental decision making processes in order to operationalise the benefits of EPMs and enhance the effectiveness of environmental management.

The study further indicates that the effectiveness of environmental management processes is positively associated with both operational and management environmental performance. Accordingly, it is suggested that organisations seeking improvements in environmental performance should focus on environmental management processes such as implementing an environmental strategy, enhancing staff awareness towards environmental issues, supporting change initiatives and ensuring staff commitment to environmental objectives. In addition, the results of the study show that the effectiveness of environmental management processes mediates the association between the extent to which EPMs are used and the purpose of using EPMs with environmental performance. Hence, it is suggested that the impact of EPMs is operationalised through environmental management processes. This finding reinforces Tung et al. (2014) and Hamilton and Chervany's (1981) findings that process effectiveness is critical in achieving desired environmental performance and highlights the need for formalized and effective environmental management processes in Australian manufacturing organisations.

The effectiveness of environmental management processes can be enhanced through the adoption of an environmental management system (EMS). An EMS *'is part of an organisation's management system used to develop and implement its environmental policy*

and manage its environmental aspects' (International Standards Organisation 2004, p. 2). Such a system could help an organisation to achieve its environmental objectives through the comprehensive review and control of its day to day operations (Sheldon, 1997). In addition, for organisations that are unfamiliar with their environmental management processes, they may consider obtaining assistance from external environmental consultants who have the expertise in designing EMSs and managing environmental issues (IHS, 2013). Alternatively, in order to avoid paying often high consulting fees, organisations may consider employing staff with management experience in the environmental area so as to strengthen their ability to manage environmental issues in the long term.

In conclusion, this study contributes to the literature by empirically examining the association between the extent to which EPMs are used and the purpose of using EPMs with the effectiveness of environmental management. The effectiveness of environmental management is assessed from two perspectives, environmental performance and the effectiveness of environmental management processes. The study highlights the importance of using operational EPMs in improving environmental performance. In particular, the benefits of using these measures will be realised when they are embedded in organisational decision making processes. The findings of the study provide managers with an insight into the environmental performance measures that can be used to enhance the effectiveness of environmental management.

5.2 Limitations and future research

The study is subject to the usual limitations of the mail survey approach. While the survey method is suitable for establishing associations rather than causal relationships between variables (Singleton and Straits, 2005), it is subject to potential threats because respondents

may answer questions in accordance with social desirability bias. Future studies may combine the survey method with interviews to provide in depth explanations into the association between the variables. Also, given this study only focused on Australian manufacturing organisations, the generalisability of the results may be hampered. Future studies could replicate this study in other industries including the service industry and government sectors.

The significant finding concerning the mediating role of environmental management suggests that future studies in the field of environmental management should consider incorporating Hamilton and Chervany's (1981) approach of examining the effectiveness of environmental management in respect to environmental management processes. The same associations could be tested in other industries including the service industry and not-for-profit organisations. In addition, while the current study provides empirical evidence with respect to the association between three specific uses of EPMS and the effectiveness of environmental management, future studies may examine the association between other uses of EPMS, such as motivating continuous improvement and providing data for external reporting, with the effectiveness of environmental management.

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Appendix: Variable measurement

EPMs

Please indicate whether each of the following measures is used to assess your business unit's environmental performance and to what extent this is done for the purpose of legitimacy, accountability and environmental decision making.

The extent to which EPMs are used

Operational EPMs

Recycled materials used

The amount of energy saved due to conservation improvement and efficiency

Total water used

The volume of water recycled and reused

Total greenhouse gas emissions

Nitric Oxide, Nitrogen Dioxide and other significant air emissions by type and weight

Total weight of waste

Management EPMs

Total environmental protection expenditure and investment

The time spent responding to environmental incidents

The number of fines and violation notices

The effectiveness of environmental management

Environmental performance

Please indicate the extent to which each of the following outcomes is achieved in your business unit.

Operational environmental performance:

Reductions in energy consumption

Reductions in water usage

Reductions in material costs due to the efficient use of material

Reductions in the levels of greenhouse gas emissions

Reductions in other air emissions

Reductions in the levels of waste

More effective and efficient decision making regarding environmental issues

Producing goods in a more environmentally conscious manner

Management environmental performance:

Reductions in the costs of regulatory compliance

Reductions in the time taken to respond to environmental incidents and minimizing their impact

Reductions in the costs associated with cleaning up environmental damage

Reductions in the fines paid and remediation costs regarding environmental damage

The effectiveness of environmental management processes

- Meeting legislative and regulatory requirements
- Enhancing staff awareness towards environmental issues
- Supporting change initiatives
- Ensuring staff commitment to environmental objectives
- Achieving environmental goals
- Motivating environmental performance
- Fostering an environmentally friendly culture
- Providing an accurate assessment of business unit environmental performance
- Managing environmental risk
- Increasing levels of recycling
- Implementing an environmental strategy

CHAPTER SIX

PAPER THREE

The association between the adoption of an Environmental Management System with organisational environmental performance

(A journal article based on this paper has been accepted for publication in the Australasian Journal of Environmental Management)

Tung, A., Baird, K. and Schoch, H (2014), “The association between the adoption of an environmental management system with organisational environmental performance”, *Australasian Journal of Environmental Management*, Vol. 21 No. 3, pp. 281-296.

Abstract

The purpose of this paper is to examine the association between the adoption of an Environmental Management System (EMS) with organisational Environmental Performance. Data were collected by mail survey questionnaire from a random sample of 899 senior financial officers in Australian manufacturing organisations. The findings indicate that organisations that have an EMS achieve higher environmental performance. Finally, the study identifies six specific environmental management initiatives that contribute to environmental performance. The findings reinforce the importance of EMS adoption for enhancing environmental performance, and highlight the specific environmental management initiatives that managers should focus on in order to improve their environmental performance.

Key words: Environmental management system, ISO 14001, Environmental performance, Operational environmental performance, Management environmental performance.

1. Introduction

The need to protect the environment and conserve natural resources has become a key objective embraced by most organisations who acknowledge that they have a responsibility to sustain the environment (Johnstone and Labonne, 2009). Similarly, there is increasing concern shown towards environmental issues by a variety of other stakeholders (e.g. government, consumers, and shareholders). For instance, governments regularly ratify environmental regulations aimed at mitigating the adverse effects of pollution (Berry and Rondinelli, 1998); consumers express a strong willingness to buy environmentally friendly products; and shareholders indicate that improving environmental performance is a top priority for organisations (Zutshi and Sohal, 2004a).

In order to meet the expectations from various stakeholders, and remain competitive in the ‘environmental arena’, many organisations have started to take a proactive approach to managing the environmental impact of their operations (Berry and Rondinelli, 1998). In particular, a growing number of organisations have implemented environmental management systems (EMSs) to manage their environmental performance (Daily and Huang, 2001).

An EMS assists an organisation to identify the environmental impact of business operations and to improve environmental management processes and environmental performance (Johnstone and Labonne, 2009). Prior literature has illustrated many benefits of using EMSs including improved public image, improved relations with various stakeholders, improved environmental performance and improved financial performance (Carruthers and Vanclay, 2012; Hertin et al., 2008). While these benefits have been widely advocated, there is limited empirical research examining the adoption of EMSs. Accordingly, this study is motivated to provide an insight into the adoption of EMSs and whether such systems are ISO 14001

certified.

Furthermore, given many organisations choose to focus on certain aspects of environmental management such as complying with environmental regulations and setting environmental performance measures without implementing a formal EMS, the study focuses on the extent to which nine specific environmental management initiatives were used by organisations in an attempt to provide a detailed insight into the adoption of EMSs. In summary, the adoption of an EMS will be analysed using the following three categories: (i) the adoption of an EMS in general (i.e. including both non-certified EMSs and ISO 14001 certified EMSs) (ii) the adoption of an ISO 14001 certified EMS and (iii) the use of nine specific environmental management initiatives.

In addition, while organisations are expected to use EMSs to manage their business environmental performance, the actual contribution of EMSs in improving environmental performance remains uncertain (Psomas et al., 2011; Lee, 2008; Walker et al., 2008; Epstein and Freeman, 1994). Hence it is important to examine the effectiveness of such systems and explore the association between the adoption of an EMS and environmental performance.

Prior studies examining this association have generated mixed findings, with some studies suggesting that the adoption of an EMS has a positive impact on environmental performance (Iraldo et al., 2009; Wagner, 2008; Yuksel, 2008; Anton et al., 2004; Morrow and Rondinelli, 2002) and others finding no association (Cary and Roberts, 2011; Hertin et al., 2008; Montabon et al., 2000). These mixed findings could be attributed to some extent to the alternative methods employed to measure environmental performance, with Nawrocka and Parker (2003, p. 601) concluding that *'there is no agreement on what environmental*

performance is or how to measure it'.

While previous studies have assessed environmental performance using a single item measure such as a performance index ranked by external parties (e.g. CEP [Council on Economic Priorities] and Dow Jones Sustainability Index) (Hughes et al., 2001) or the environmental impact of a single business activity (e.g. greenhouse gas emissions and toxic release) (Clarkson et al., 2008), this study attempts to provide a more detailed insight into the association between the adoption of an EMS and environmental performance by using a more complex measure of environmental performance. Specifically, following Henri and Journeault's (2010) approach, environmental performance is assessed based on the extent to which twelve desired environmental outcomes are achieved.

In summary therefore, the objectives of the study are:

1. To examine the adoption of an EMS in Australian manufacturing organisations.
2. To examine the association between the adoption of an EMS and environmental performance.

2. Literature Review

2.1 The adoption of an EMS

EMSs have been the subject of increasing interest over the last ten years with many studies examining various aspects of such systems, including the motivation for adoption (Darnall et al., 2008; Zutshi and Sohal, 2004a); benefits of adoption (Carruthers and Vanclay, 2012; Guest and Teplitzky, 2010; Johnstone and Labonne, 2009) and obstacles (Cary and Roberts, 2011; Massoud et al., 2010; Zutshi and Sohal, 2004b).

Organisations are motivated to adopt an EMS due to the significant benefits they provide. First, at the most basic level, an EMS can help organisations assure that their operational practices comply with environmental regulations. The system requires detailed documentation which enables organisations to identify and resolve environmental problems at an early stage and in turn, reduce the likelihood of being subjected to legal penalties (Johnstone and Labonne, 2009; Zutshi and Sohal, 2004b). Secondly, implementing an EMS requires intensive employee participation and teamwork, and when employees are empowered to take the initiative in defining their responsibilities and in making suggestions with respect to an EMS, they become more accountable, motivated and committed to the system (Guest and Teplitzky, 2010; Zutshi and Sohal, 2004b). This enables organisations to implement sophisticated environmental strategies in a more effective manner in an attempt to improve environmental performance. Finally, an EMS assists organisations to improve their corporate image through the perception of being ‘environmentally friendly’. This can lead to improved relationships with various parties including customers, suppliers, communities and other stakeholders (Zutshi and Sohal, 2004a; Morrow and Rondinelli, 2002).

There are also obstacles in adopting an EMS. For instance, high implementation costs and the time involved in developing and maintaining the system have been identified as the main barriers to adopting an EMS (Massoud et al., 2010). EMSs utilize significant resources due to the constant preparation and updating of the extensive documentation required (Daily and Huang, 2001). A considerable amount of resources are also required for administration, marketing and external auditing. Despite the significant resources employed there is no guarantee of improved environmental performance or a better corporate image (Zutshi and Sohal, 2004b).

Despite the wide advocacy for EMSs, some studies have reported low adoption rates, [Delmas and Toffel (2008) (28%) and Yuksel (2008) (36%)]. Johnstone and Labonne (2009) reported the EMS adoption rate in seven OECD countries with the rate varying across countries, from over 70% in Germany and Hungary to 43% in the United States. These varying adoption rates raise concerns as to whether the presence of an EMS has a positive effect on an organisation's environmental performance as suggested in the literature. Accordingly, this study will re-examine the association between the adoption of an EMS and environmental performance. The relevant hypotheses are developed in Sections 2.1.1 and 2.1.2.

2.1.1 The association between the adoption of an EMS and environmental performance

The adoption of an EMS involves implementing a set of attributes which allow organisations to identify, control and reduce the negative environmental impact of their organisations' operations (Bansal and Hunter, 2003). Comprehensive documentation enables organisations to utilize a wide range of information to identify potential environmental impacts from operations, and to address those imposing the most significant risk immediately (Carruthers and Vanclay, 2012). In addition, on-the-job training and communication allows organisations to articulate the link between green production and environmental objectives, and provides a mechanism for employees to understand, accept and feel comfortable with the assigned targets and responsibilities in relation to environmental issues. Knowing the purposes of environmental control and how to handle tasks in a more environmentally conscious manner can also result in increased staff awareness and commitment towards environmental issues (Jabbour and Santos, 2008; Daily and Huang, 2001), thereby enhancing the likelihood that desired environmental performance is achieved. Finally, the performance evaluation and monitoring attributes of an EMS provide organisations with the information they need to indicate the effectiveness of actions taken and to facilitate continual improvement in

environmental performance.

Some previous studies have demonstrated a positive association between EMS adoption and environmental performance. For instance, Yuksel (2008) found that an EMS enhanced environmental performance by encouraging organisations to use resources for pollution prevention and the application of cleaner practices (e.g. reducing the usage of natural resources, using energy efficient technologies and using non-toxic materials in production). Similarly, Anton et al. (2004) found that an EMS leads to lower toxic emissions with the effect magnified for those organisations with a more comprehensive EMS. Wagner (2008) indicated that the adoption of an EMS promotes environmental process innovations, with the development of new ideas and processes contributing to the improvement in the achievement of environmental targets in combination with reduced costs. Other studies have found that organisations with an EMS demonstrated improvements in environmental performance, especially in the areas of air and waste emission reductions, energy and water conservation, waste recycling and environmental incidence reduction (Iraldo et al., 2009; Zutshi and Sohal, 2004b; Morrow and Rondinelli, 2002).

In contrast to the above findings, Montabon et al. (2000) concluded that the adoption of an EMS did not assist organisations in reducing environmental costs. Hertin et al. (2008) commented that although the adoption of an EMS appeared to have a minor positive impact on a small number of performance measures, there was no evidence of a consistent and significant positive impact on environmental performance. Similar conclusions were reached in Cary and Roberts (2011). Despite the findings in these studies that there was no association between the adoption of an EMS and environmental performance, on balance, there are more

findings which suggest a positive association between the two variables. Accordingly, the following hypothesis is developed.

H1: Organisations with an EMS will achieve higher environmental performance than organisations without an EMS.

2.1.2 The association between ISO 14001 certification and environmental performance

The accredited third party certification requirement distinguishes an ISO 14001 certified EMS from a non-certified EMS (Sheldon, 1997). This certification requires an independent appraisal of an environmental management system to ensure that all requirements of the ISO 14001 standard have been met and are applied in a manner that facilitates continual improvement in environmental performance. The third party audit process examines the extent to which the organisation has set environmental objectives and policies and how well they are linked to improvements in environmental performance. Accordingly, organisations are more likely to take their EMS more seriously (Morrow and Rondinelli, 2002), identifying clear environmental objectives, changing underlying operating processes and enhancing the opportunity for improvements in environmental performance.

Obtaining ISO 14001 certification demonstrates an ongoing commitment by an organisation to improve its environmental performance. Furthermore, since senior managers are actively involved in reviewing information for annual internal review/audits and ISO 14001 recertification audits, they are more likely to see environmental obligations as a long-term commitment. Such commitment by senior managers will have a positive impact by enhancing staff environmental awareness and changing organisational behaviour in relation to environmental issues, thereby increasing the likelihood of achieving desired environmental performance (Savely et al., 2007; Daily and Huang, 2001).

Alternatively, organisations with a non-certified EMS are not subject to third party certification. Without surveillance and an objective assessment from an external party, organisations are expected to place less emphasis on implementing and managing the system. For example, organisations may not implement all of the attributes required by the ISO 14001 standard. This can be problematic given the attributes required by the standard are interrelated, and continual environmental performance improvement can only be achieved when all elements are in place and applied in a proper manner (Sheldon, 1997).

While some studies have reported no association between ISO 14001 certification and environmental performance (Gomez and Rodriguez, 2011), the majority of studies have found that organisations with an ISO 14001 certified EMS are likely to achieve higher environmental performance (Massoud et al., 2011; Prakash and Potoski, 2005; Montabon et al., 2000).

Hence, the second hypothesis is derived as follows:

H2: Of those organisations adopting an EMS, organisations with a certified EMS will achieve higher environmental performance than organisations with a non-certified EMS.

3. Method

A survey questionnaire was mailed to the senior financial officer of a random sample of 899 Australian manufacturing organisations identified from the Onesource online data base¹. The manufacturing industry was chosen due to its importance to the national economy and because it is a dirty industry (Cole, 2000) that is subjected to more environmental regulations. Senior

¹ The Onesource data base provides details of manufacturing organisations in Australia.

financial officers were chosen due to their increasing role in measuring, managing, and reporting environmental activities across organisations (Accenture, 2013; Ernst and Young, 2013; Madec, 2013).

The Dillman Tailored Design Method (Dillman, 2007)² was used to administer the survey. In total, 180 responses were received, 145 (16%) from the initial distribution and 35 (4%) from the follow up. Non response bias was assessed by comparing the independent and dependent variable values across early and late respondents with no significant differences detected.

3.1 Variable measurement

3.1.1 The adoption of an EMS

The adoption of an EMS was measured by requiring respondents to indicate if they were using an EMS (“Yes” or “No”). Respondents who answered “yes” were further required to indicate if the EMS was ISO 14001 certified (“Yes” or “No”). This study also applied a more comprehensive approach, which focuses on the specific environmental management initiatives employed by organisations. This required respondents to indicate (“Yes” or “No”) if they were using the nine identified environmental management initiatives (see Table 3) to manage the business unit’s environmental performance.

3.1.2 Environmental performance

Environmental performance was measured using two approaches. The first approach required respondents to indicate the “overall environmental performance” of their organisation using a seven-point scale with anchors of 1 “Very Poor” and 7 “Excellent”. A more comprehensive

² The Dillman (2007) Tailored Design Method provides guidelines in respect to the format and style of questions, personalisation, and distribution procedures.

approach was used to assess the extent to which 12 desired environmental outcomes had been achieved by organisations. These 12 outcomes (see Table 1) were derived from the environmental performance literature and were designed for manufacturing organisations (Henri and Journeault, 2010; Clarkson et al., 2008). Respondents were required to indicate the extent to which their organisation had achieved each of the 12 perceived environmental outcomes, using a seven-point scale with anchors of 1 “not at all” and 7 “to a great extent”.

Table 1 Environmental outcomes

Items	Relevant literature
Reductions in energy consumption	Langfield-Smith et al., 2009; Clarkson et al., 2008
Reductions in water usage	Clarkson et al., 2008
Reductions in material costs due to the efficient use of material	Henri and Journeault, 2010; Langfield-Smith et al., 2009
Reductions in the levels of greenhouse gas emissions	Henri and Journeault, 2010; Clarkson et al., 2008
Reductions in other air emissions	Langfield-Smith et al., 2009; Clarkson et al., 2008
Reductions in levels of waste	Langfield-Smith et al., 2009; Clarkson et al., 2008
Reductions in the costs of regulatory compliance	Clarkson et al., 2008
Reductions in the time taken to respond to environmental incidents and minimizing their impact	Deegan et al., 2002
Reductions in the costs associated with cleaning up environmental damage	Langfield-Smith et al., 2009
Reductions in the fines paid and remediation costs regarding environmental damage	Henri and Journeault, 2010; Clarkson et al., 2008
More effective and efficient decision making regarding environmental issues	Henri and Journeault, 2010
Producing goods in a more environmentally conscious manner	Henri and Journeault, 2010; Langfield Smith et al., 2011; Clarkson et al., 2008

4. Results

4.1 The adoption of environmental management initiatives

Of the respondents, 74 (43%) had adopted an EMS (Table 2). The rate of adoption of EMSs was more prevalent in the construction, food and beverage, chemical, and energy sectors, although the number of respondents in the latter two sectors was quite small. An ANOVA analysis showed that those organisations adopting EMSs were larger in size (based on the number of employees).

Of those organisations adopting an EMS, 37 (51%) indicated that they had adopted an ISO14001 certified EMS (Table 2). The rate of ISO14001 certified adoption was quite low in the chemical and food and beverage sectors. An ANOVA analysis revealed that organisational size was not associated with the adoption of certified EMSs.

Table 2 EMS and ISO 14001 Certified adoption

EMS adoption	Frequency (%)	Chemical	Construction	Engineering	Energy	Food and Beverage	Media	Consumer product	Other
Yes	74 (43)	9 (60)	17 (49)	19 (40)	5 (71)	16 (53)	3 (20)	4 (21)	1 (17)
No	100 (57)	6 (40)	18 (51)	28 (60)	2 (29)	14 (47)	12 (80)	15 (79)	5 (83)
ISO 14001 Certified*	Frequency (%)**								
Yes	37 (51)	3 (33)	10 (59)	13 (68)	3 (60)	3 (19)	2 (67)	3 (75)	0 (0)
No	36 (49)	6 (67)	7 (41)	6 (32)	2 (40)	13 (81)	1 (33)	1 (25)	0 (0)

*This question relates to those respondents who indicated they had an EMS. ** One EMS user did not indicate whether their EMS was certified.

A separate analysis was undertaken to observe the extent to which organisations were adopting specific environmental management initiatives. The most commonly used environmental management initiatives are communicating documented procedures to employees (65%) followed by monitoring the environmental impact of operations (61%) and having a documented plan of action for complying with the relevant regulations (61%) (Table 3). A higher percentage of organisations from the energy, food and beverage, and chemical industries are using such initiatives (Table 3).

Table 3 The use of environmental management initiatives

	All Respondents	Chemical	Construction	Engineering	Energy	Food and Beverage	Media	Consumer product	Other
EMS initiatives	Frequency (Percentage)								
Has a documented environmental policy statement	104 (60)	11 (73)	21 (60)	28 (60)	7 (100)	19 (63)	7 (47)	9 (47)	2 (33)
Has a documented plan of action for complying with the relevant regulations	106 (61)	13 (87)	23 (66)	28 (60)	6 (86)	22 (73)	5 (33)	8 (42)	1 (17)
Has documented procedures in place for reducing the impact of operation's on the environment	90 (52)	5 (33)	20 (57)	22 (47)	6 (86)	19 (63)	6 (40)	10 (53)	2 (33)
Communicates documented procedures to employees	113 (65)	12 (80)	21 (60)	33 (70)	6 (86)	22 (73)	8 (53)	9 (47)	2 (33)
Has an environment management team	73 (42)	7 (47)	17 (49)	20 (43)	3 (43)	15 (50)	4 (27)	5 (26)	2 (33)
Has targeted environmental performance measure	77 (44)	6 (40)	18 (51)	17 (36)	5 (71)	14 (47)	6 (40)	7 (37)	4 (67)
Trains employees to implement the environmental procedures	88 (51)	8 (53)	21 (60)	19 (40)	5 (71)	17 (57)	8 (53)	9 (47)	1 (17)
Monitors the environmental impact of operations	107 (61)	10 (67)	23 (66)	27 (57)	6 (86)	17 (57)	8 (53)	12 (63)	4 (67)
Conducts internal/external audits to monitor the impact of operations on the environment	88 (51)	7 (47)	19 (54)	26 (55)	4 (57)	13 (43)	6 (40)	10 (53)	3 (50)

*The number of responses (N) varies due to the fact that not all survey items were completed by respondents

4.2 Environmental performance

Factor analysis (principle components with varimax rotation) using a cut-off point of 0.6 was performed on the twelve item measure of environmental performance. Table 4 shows the twelve outcomes loaded onto two dimensions. The first dimension included eight items, which all referred to the achievement of operational aspects. This was labelled “Operational environmental performance”. The second dimension included four items that are more concerned with management aspects and was labelled “Management environmental performance”. These two dimensions were subsequently scored as the total score of the items loading on to each dimension with higher (lower) scores representing higher (lower) environmental performance.

Table 4 Factor analysis of the environmental performance measures

Items	Operational environmental performance	Management environmental performance
Reductions in energy consumption	0.85	0.14
Reductions in levels of waste	0.81	0.23
Reductions in water usage	0.80	0.28
Reductions in the levels of greenhouse gas emissions	0.79	0.35
Producing goods in a more environmentally conscious manner	0.74	0.16
Reductions in other air emissions	0.65	0.54
More effective and efficient decision making regarding environmental issues	0.63	0.59
Reductions in material costs due to the efficient use of material	0.61	0.33
Reductions in the time taken to respond to environmental incidents and minimizing their impact	0.34	0.84
Reductions in the costs of regulatory compliance	0.32	0.64
Reductions in the costs associated with cleaning up environmental damage	0.20	0.88
Reductions in the fines paid and remediation costs regarding environmental damage	0.14	0.88

Table 5 shows summary statistics for the environmental performance measures with the Cronbach alpha scores shown to exceed the 0.70 threshold generally considered acceptable in regard to the reliability test (Nunnally, 1978, p. 245). The mean score for operational (management) environmental performance is slightly higher (lower) than the mid-point of the range, indicating that, on average, the respondents assessed their operational environmental performance to be moderately strong and the management environmental performance to be relatively weak. The majority of the eight operational environmental outcomes were achieved to a greater extent than the four management environmental outcomes.

Table 5 Descriptive statistics for the environmental performance measures

Variables	N*	Mean	Std. Deviation	Minimum (Theoretical)	Maximum (Theoretical)	Cronbach α
Operational environmental performance	176	32.34	10.51	8.00(8)	56.00(56)	0.923
Management environmental performance	161	13.53	7.63	4.00(4)	28.00(28)	0.884

*The number of responses (N) varies due to the fact that not all survey items were completed by respondents.

4.3 The association between the adoption of environmental management systems and environmental performance

Organisations with an EMS achieved a higher level of operational environmental performance ($F = 19.35$, $p = 0.00$) (Table 6). However, no significant difference was found in respect to management environmental performance ($F = 1.58$, $p = 0.21$). These results provide support for Hypothesis 1.

Table 6 Results of the One-way ANOVA comparing environmental performance based on the adoption of an EMS

Environmental Performance	Yes – currently using an EMS			No – not using an EMS			F-statistic	Significance
	N*	Mean	Std Dev	N	Mean	Std Dev		
Operational	75	36.19	9.46	101	29.49	10.37	19.35	0.00
Management	73	14.36	7.46	88	12.84	7.75	1.58	0.21

*The number of responses (N) varies due to the fact that not all survey items were completed by respondents.

Organisations with a certified EMS did not report a significantly higher level of either operational ($F = 0.18$, $p = 0.67$) or management environmental performance ($F = 0.13$, $p = 0.73$) (Table 7). Therefore, the results support Hypothesis 2 and allow us to conclude that certification has no effect on environmental performance.

Table 7 Results of the One-way ANOVA comparing environmental performance based on ISO 14001 Certification

Environmental Performance	ISO 14001 Certified			Non-Certified			F-statistic	Significance
	N	Mean	Std Dev	N	Mean	Std Dev		
Operational	37	36.62	10.75	37	35.68	8.24	0.18	0.67
Management	35	14.57	7.21	37	13.95	7.78	0.13	0.73

*The number of responses (N) varies due to the fact that not all survey items were completed by respondents.

Additional analysis was conducted to examine the association between the use of each of the nine environmental management initiatives with operational and management environmental performance (Table 8). In respect to operational environmental performance, the model was statistically significant ($F = 19.44$, $p = 0.00$) with three initiatives found to be associated with operational environmental performance (i.e., ‘have a documented plan of action for complying

with the relevant regulations’ ($p = 0.01$), ‘train employees to implement the environmental procedures’ ($p = 0.00$) and ‘conduct internal/external audits to monitor the impact of operations on the environment’ ($p = 0.01$)). The model relating to management environmental performance is also statistically significant ($F = 11.22$, $p = 0.00$) with ‘communicate documented procedures to employees’ ($p = 0.00$) found to be positively associated with management environmental performance.

Table 8 Results of stepwise regression analysis of the association between each of the nine environmental management initiatives and environmental performance

Variables	Operational performance			Management performance		
	Coefficient	T-Statistics	Significance	Coefficient	T-Statistics	Significance
Have a documented plan of action for complying with the relevant regulations	0.21	2.74	0.01			
Communicate documented procedures to employees				0.26	3.35	0.00
Train employees to implement the environmental procedures	0.22	2.97	0.00			
Conduct internal/external audits to monitor the impact of operations on the environment	0.21	2.82	0.01			
F-Value	19.44			11.22		
P-Value	0.00			0.00		
R square	0.25			0.07		
Adjusted R square	0.24			0.06		
N	175			160		

5. Conclusion

5.1 Discussion

The first objective of the study was to examine the adoption of an EMS in Australian manufacturing organisations. The results indicate that 43% of the sample organisations were using an EMS, of which only 49% had an ISO14001 certified EMS in place. The low adoption rate may be attributed to the ‘*uncertainty of outcomes and benefits*’ (Massoud et al., 2010, p. 206) associated with an EMS. Specifically, organisations may be willing to go beyond legal compliance and invest in new initiatives if the benefits exceed the costs. However, adopting an EMS, especially a certified EMS, requires time and continuous effort with the positive

environmental outcomes and market returns often realised over a long period of time. Hence, when the achievement of positive environmental outcomes are uncertain, organisations are more likely to perceive an EMS as a cost undermining their bottom line performance, and thus may be more reluctant to adopt such a system and pursue certification. To address this situation, it is recommended that academics, industry and the government should work in partnership in promoting the benefits of EMSs and provide adequate support for the implementation of EMSs in the Australian manufacturing industry (Cary and Roberts, 2011; Massoud et al., 2010).

While many organisations focus on implementing specific environmental management initiatives rather than implementing a formal EMS, the maximum percentage of business units implementing any one specific initiative was 65%, suggesting that there is room for organisations to adopt a more proactive approach to managing their environmental performance. In particular, organisations are recommended to establish an environmental team (42%), use environmental performance measures (44%) and focus on training their employees (51%) in an attempt to obtain desired environmental outcomes.

The second objective of the study was to examine the association between the adoption of an EMS and environmental performance. The results indicate that those organisations adopting an EMS have higher operational environmental performance than non-adopters. This supports previous studies which have demonstrated a positive association between EMS adoption and improvements in operational environmental measures, such as reductions in energy consumption (Yuksel, 2008; Anton et al., 2004; Morrow and Rondinelli, 2002) and reductions in water usage (Yuksel, 2008; Morrow and Rondinelli, 2002). However, no significant difference was found in respect to management environmental performance. This is not

unexpected, given that improving efficiency is a common objective shared by all manufacturing organisations (Appelbaum, 2000). Accordingly, irrespective of the presence of an EMS, all organisations would be expected to make a continuous effort to reduce their environmental costs. Hence, it is not surprising that non-EMS users achieve reductions in the costs of regulatory compliance and the fines paid regarding environmental damage to the same extent as organisations that have an EMS.

Analysis of the effect of ISO14001 certification on environmental performance indicates that there were no significant differences between the two groups. We provide two possible explanations for such results. First, organisations may perceive certification as a marketing tool (Gomez and Rodriguez, 2011) to promote their social legitimacy rather than a management tool to improve environmental performance. If actual changes in business practices and behaviour do not occur, the benefits from a certified EMS are unlikely to be obtained. Secondly, given ISO 14001 does not contain any specific environmental performance standards/benchmarks, this may eventually lead to process standardization rather than performance excellence (Comogilo and Botta, 2012). As a result, apart from its legitimization value, ISO 14001 certification may not offer any additional benefits to a non-certified EMS (Jiang and Bansal, 2003). In order to reduce this problem and maximize the benefits of complying with ISO 14001, it is recommended that specific environmental performance measures, which take into account industry types, should be included. This would not only help organisations to identify risk areas in operations, but also assist them in monitoring overall environmental performance and achieving desired environmental outcomes.

Further exploratory analysis suggests that in order to improve operational environmental performance, organisations need to have a documented plan of action for complying with the relevant regulations and provide relevant employee training. Improvements in management environmental performance rely on sufficient communications across the various functions within an organisation. These results provide managers with an insight into the specific initiatives which they should focus on to enhance environmental performance. For organisations that want to improve their environmental performance, but do not have the knowledge and experience in managing environmental issues, it is recommended that they obtain reliable and quality advice from external environmental consultants who have the expertise in implementing an EMS.

5.2 Limitations and future research

The study is subject to the usual limitations of the survey method including the inability to assert causality and social desirability bias (Singleton and Straits, 2005). Future studies may incorporate face-to-face interviews in order to provide richer descriptions into the hypothesised associations.

The growing stringency of legal requirements is expected to shape organisational attitudes and behaviour towards environmental issues and hence future studies may focus on capturing the changes that occur following the introduction of certain regulatory pressures. In particular, future research could consider the adoption rate of EMSs and whether there will be more organisations employing an ISO14001 certified EMS in order to reduce legal liabilities and improve environmental performance.

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CHAPTER SEVEN

CONCLUSION

This aim of this study was to fill a number of important gaps in the environmental management literature. The first gap related to the limited empirical evidence examining the association between specific organisational factors and the effectiveness of environmental management. In particular, Paper One examined this association with the effectiveness of environmental management examined from two perspectives: the effectiveness of environmental management processes and environmental performance. Hypotheses were developed in regard to the association between five organisational factors (top management support, training, employee participation, teamwork and the link of environmental performance to rewards) with the effectiveness of environmental management processes. The direct and indirect effects of the organisational factors on environmental performance were explored.

The second gap addressed related to the limited empirical evidence examining the association between environmental performance measures (EPMs) with the effectiveness of environmental management. Paper Two examined this association. In particular, EPMs were examined from two perspectives: (i) the extent to which EPMs are used and (ii) the purpose of using EPMs. Similar to Paper One, the effectiveness of environmental management was assessed with regard to both environmental performance and the effectiveness of environmental management processes. The paper also explored the direct and indirect effect of the extent to which EPMs are used and the purpose of using EPMs on environmental performance.

Paper Three was aimed at addressing the mixed findings in relation to the link between the adoption of EMSs (i.e. adoption of an EMS in general, adoption of an ISO certified EMS and the use of nine specific initiatives developed and based on the requirements listed in ISO 14001) with environmental performance.

The remainder of this chapter is structured as follows: Section 7.1 outlines the findings of the research. Section 7.2 then discusses the contributions and implications of the thesis.

7.1 Summary of findings

Analysis of the relationship between organisational factors and the effectiveness of environmental management shows that three organisational factors (top management support, training and the link of environmental performance to rewards) were found to be positively related to the effectiveness of environmental management processes. Teamwork, on the other hand, was found to be a direct contributing factor in enhancing operational environmental performance.

Analysis of the association between the extent to which EPMs are used and the purpose of using EPMs and the effectiveness of environmental management processes leads to two significant findings. First, the use of operational EPMs is positively related to the effectiveness of environmental management processes. Secondly, the extent to which EPMs are used for environmental decision making purposes is positively related to the effectiveness of environmental management processes. Such results are in line with prior studies (Adams and Frost, 2008; Henri and Journeault, 2008; Wagner, 2007) and provide managers with an

insight into how specific EPMs could be used to enhance the effectiveness of environmental management processes.

The results of both Paper One and Two indicated that the effectiveness of environmental management processes is positively associated with both operational and management environmental performance, and mediates the associations between the examined factors with environmental performance. Specifically, in Paper One, the effectiveness of environmental management processes mediates the association of top management support, training and the link of environmental performance to rewards with environmental performance. In Paper Two, it is indicated that the effectiveness of environmental management processes mediates the association between the extent to which EPMs are used and the purpose of using EPMs with environmental performance.

Given that Paper One and Paper Two both highlight the significant impact of environmental management processes on environmental performance, Paper Three attempted to provide an insight into the adoption of EMSs and its association with environmental performance. It was found that 43% of the sample organisations were using an EMS, of which only 49.3% had an ISO 14001 certified EMS. Organisations adopting an EMS achieved a higher level of operational environmental performance. These findings are in line with prior studies, which have also reported a positive relationship between EMS adoption and improvements in operational environmental measures (Yuksel, 2008; Anton et al., 2004; Morrow and Rondinelli, 2002). However, no significant difference was found between adopters and non-adopters in respect to management environmental performance. Further, organisations with an ISO 14001 certified EMS did not report a significantly higher level of either operational or management environmental performance compared to those without certification. Additional

exploratory analysis revealed that in order to improve environmental performance, organisations need to have a documented plan of action for complying with relevant regulations, provide relevant employee training and ensure sufficient communications about environmental issues across the various functions within an organisation.

7.2 Contribution and implications

The study contributes to the environmental management literature in several ways. First, while the majority of studies in the field of environmental management have focused on the factors influencing the adoption of environmental initiatives, this study fills a gap in the literature by examining the various factors that lead to greater effectiveness of environmental management. Secondly, the few studies that have examined the effectiveness of environmental management, have mainly focused on assessing the outcome of environmental management (i.e. environmental performance). Accordingly, this study fills a gap in the literature by examining and providing evidence of the effectiveness of environmental management from two perspectives, the effectiveness of environmental management processes and environmental performance.

In addition, this study uses a contingency approach to investigate how multiple contingent factors affect the effectiveness of environmental management. Specifically, this study examines the association between five organisational factors (top management support, training, teamwork, employee participation, and the link of performance to rewards) and environmental performance measures (EPMs) with the effectiveness of environmental management. The empirical evidence in respect to the association between these factors and the two perspective of the effectiveness of environmental management provides managers

with an insight into the specific factors that they need to focus on to enhance the effectiveness of environmental management.

In regard to the association between specific organisational factors and the effectiveness of environmental management, it is suggested that organisations provide higher levels of top management support and training, and link environmental performance to rewards in order to enhance the effectiveness of environmental management processes, and in turn improve environmental performance. In order to obtain desired environmental outcomes, continuous support from top management is crucial (Zutshi and Sohal, 2004). Therefore, top management is encouraged to personally commit to environmental management and to ensure that enough resources are provided during the adoption and implementation of environmental management initiatives.

It is also recommended that organisations provide appropriate environmental training across business levels to enhance the awareness and skills of employees in adopting and implementing new environmental management initiatives. In relation to this, Wehrmeyer (1996) recommended that environmental training programs should be kept simple, relevant and for small groups with the leaders of the environmental management teams participating in each training session.

Aligning rewards with environmental management goals is another important factor that contributes to the effectiveness of environmental management. Hence, it is recommended that organisations align rewards with environmental performance that is within the control of employees (McShane and Travaglione, 2003) in an attempt to motivate employees and encourage the development of the knowledge and skills required to achieve desired environmental outcomes. Finally, organisations should utilise a team approach to improve

operational environmental performance. For example, the use of a 'green' team could involve employees from different business levels to promote mutual trust and co-operation in relation to environmental issues in the organisation (Llorens Montes et al., 2005).

In relation to the use of EPMs, it is recommended that organisations use specific operational EPMs (e.g. recycled materials used, the volume of water recycled and reused, and total greenhouse gas emissions) in their environmental management processes to a greater extent to enhance environmental management process effectiveness (Henri and Journeault, 2010; Iraldo et al., 2009; Clarkson et al., 2008). In particular, organisations need to ensure that these measures are incorporated in environmental decision making processes in order to obtain the benefits of EPMs and enhance the effectiveness of environmental management.

The identified mediating effect of the effectiveness of environmental management processes on the relationship between the examined factors with environmental performance suggests that while the presence of these factors is crucial in improving environmental performance, their positive impact is actualised through environmental management processes. This finding not only reinforces Hamilton and Chervany's (1981) assertion that process effectiveness is important in achieving desired outcomes, but also highlights the need for Australian manufacturing organisations to have a formalised and effective environmental management system.

Effective environmental management processes can be enhanced with the adoption of an environmental management system (EMS). The finding of the association between the adoption of EMSs and environmental performance suggests that organisations that do not yet have an EMS should consider adopting such a system to improve their environmental performance. In particular, the findings indicate that providing relevant employee training, having documented

plans of action for complying with relevant regulations, and conducting internal/external audits to monitor the impact of operations on the environment are of particular importance in enhancing environmental performance. In addition, sufficient communication across different levels within an organisation is needed to obtain improvements in management environmental performance.

While the study points to the benefits of adopting an EMS, many organisations are reluctant to adopt such a system, perhaps due to the high costs and continuous effort involved in adopting and maintaining the system. To address this situation, academics, practitioners and the governments could work in partnership to promote the benefits of EMSs and provide adequate support for the adoption and implementation of EMSs in the Australian manufacturing industry (Cary and Roberts, 2011; Massoud et al., 2010). The benefits of EMSs can be advocated extensively through publications, conferences and workshops to ensure that practitioners are aware of and most importantly, understand the positive environmental outcomes associated with adopting an EMS. In addition, the government could offer financial incentives such as tax relief and business grants (Cary and Roberts, 2011) to organisations that have adopted an EMS as a reward for their effort and commitment to the environment. Benchmarked organisations could be encouraged to share their success in achieving positive environmental outcomes to lift user confidence and encourage non-EMS users to adopt an EMS. Finally, to further encourage EMS adoption in Australia, additional support from industry associations (e.g. funding to support the implementation of EMSs and environmental training) should be provided. This is particularly important for small to medium enterprises (SMEs) which often lack sufficient capacity and resources (Hitchens et al., 2003) in employing new initiatives in relation to environmental management.

Appendix: Questionnaire



Thank you for taking the time to complete this survey. Your assistance in providing this information is very much appreciated. Please indicate the charity to which you would like me to make a \$5 donation as a result of your participation in this survey.

The Smith Family..... ☐ The Fred Hollows Foundation..... ☐

World Vision..... ☐ Mission Australia ☐

The Salvation Army..... ☐ The Cancer Council Australia..... ☐

If you wish to enquire about the survey or if you need any assistance in completing the survey, please contact Amy Tung at the Department of Accounting and Corporate Governance, Macquarie University, Sydney on (02) 98508478 or email manamy.tung@mq.edu.au

Environmental Performance Survey

1 How many years have you worked in your current business unit? _____ (Years)

2 What is the approximate number of employees within your business unit? _____

3 Which industry does your business unit operate in?

4 Does your business unit have an environmental management system (EMS)?

(Note: An environmental management system (EMS) refers to the management of an organisation's environmental programs in a comprehensive, systematic, planned and documented manner.)

Yes..... ☐ No ☐

If yes:

a) How long has the EMS been in place? _____ (Years) or _____ (Months)

b) Is the system ISO14000 certified? Yes.....☐ No.....☐

5 Below is a list of perceived desired environmental outcomes. Please indicate the extent to which each of the following outcomes is achieved in your business unit.

Not at all

**To a great
extent**

**Not
Applicable**

(i)	Reductions in energy consumption	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7	<input type="checkbox"/>
(ii)	Reductions in water usage	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7	<input type="checkbox"/>
(iii)	Reductions in material costs due to the efficient use of material	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7	<input type="checkbox"/>
(iv)	Reductions in the levels of green house gas emissions	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7	<input type="checkbox"/>
(v)	Reductions in other air emissions	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7	<input type="checkbox"/>
(vi)	Reductions in levels of waste	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7	<input type="checkbox"/>
(vii)	Reductions in the costs of regulatory compliance	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7	<input type="checkbox"/>
(viii)	Reductions in the time taken to respond to environmental incidents and minimising their impact	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7	<input type="checkbox"/>
(ix)	Reductions in the costs associated with cleaning up environmental damage	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7	<input type="checkbox"/>
(x)	Reductions in the fines paid and remediation costs regarding environmental damage	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7	<input type="checkbox"/>
(xi)	More effective and efficient decision making regarding environmental issues	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7	<input type="checkbox"/>
(xii)	Producing goods in a more environmentally conscious manner	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7	<input type="checkbox"/>

6 Please indicate which of the following steps have been taken to manage your business unit's environmental performance

	Yes	No
My business unit:		
(i) has a documented environmental policy statement	<input type="checkbox"/>	<input type="checkbox"/>
(ii) has a documented plan of action for complying with the relevant regulations	<input type="checkbox"/>	<input type="checkbox"/>
(iii) has documented procedures in place for reducing the impact of operation's on the environment	<input type="checkbox"/>	<input type="checkbox"/>
(iv) communicates documented procedures to employees	<input type="checkbox"/>	<input type="checkbox"/>
(v) has an environment management team	<input type="checkbox"/>	<input type="checkbox"/>
(vi) has targeted environmental performance measures	<input type="checkbox"/>	<input type="checkbox"/>
(vii) trains employees to implement the environmental procedures	<input type="checkbox"/>	<input type="checkbox"/>
(viii) monitors the environmental impact of operations	<input type="checkbox"/>	<input type="checkbox"/>
(ix) conducts internal/external audits to monitor the impact of operations on the environment	<input type="checkbox"/>	<input type="checkbox"/>

7 Below is a list of perceived outcomes of environmental management. Please indicate the extent to which your business unit's focus on environmental issues results in achievement of each of the following outcomes.

		Not at all			To a great extent
(i) Meeting legislative and regulatory requirements	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(ii) Enhancing staff awareness towards environmental issues	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(iii) Supporting change initiatives	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(iv) Ensuring staff commitment to environmental objectives	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(v) Achieving environmental goals	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(vi) Motivating environmental performance	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(vii) Fostering an environmentally friendly culture	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(viii) Providing an accurate assessment of business unit environmental performance	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(ix) Managing environmental risk	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(x) Increasing levels of recycling	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(xi) Implementing an environmental strategy	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

8 Please indicate the extent to which you agree that the following statements represent current practices within your business unit.

		Strongly Disagree		Neutral		Strongly Agree
(i)	Top management has provided adequate resources to support environmental management.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(ii)	Top management has effectively communicated its support for environmental management.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(iii)	Top management exercises its authority in support of environmental management.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(iv)	Adequate training has been provided to ensure employees understand the unit's environmental management policies.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(v)	Teamwork is used frequently in solving environmental issues.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(vi)	Employees frequently attend team meetings on environmental issues.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(vii)	Adequate training has been provided to implement the environmental management system.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(viii)	Lower level employees participate in designing the environmental management system.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(ix)	Lower level employees were involved in electing environmental performance measures.	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(x)	Environmental performance is linked to financial rewards (pay, bonuses, etc).	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
(xi)	Environmental performance is linked to non-financial rewards (recognition, service awards, etc).	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

9

Please indicate the extent to which each of the following measures is used to assess your business unit's environmental performance and to what extent this is done for the purposes of (a) managing public image, (b) accountability (legal compliance), and (c) environmental decision making.

		Not at all					To a great extent				
(i)	Recycled materials used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	a) Public image	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b) Accountability (Legal Compliance)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	c) Environmental decision making	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(ii)	The amount of energy saved due to conservation improvement and efficiency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	a) Public image	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b) Accountability (Legal Compliance)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	c) Environmental decision making	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(iii)	Total water used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	a) Public image	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b) Accountability (Legal Compliance)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	c) Environmental decision making	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(iv)	The volume of water recycled and reused	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	a) Public image	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b) Accountability (Legal Compliance)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	c) Environmental decision making	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(v)	Total greenhouse gas emissions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	a) Public image	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b) Accountability (Legal Compliance)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	c) Environmental decision making	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(vi)	Nitric Oxide, Nitrogen Dioxide and other significant air emissions by type and weight	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	a) Public image	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b) Accountability (Legal Compliance)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	c) Environmental decision making	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(vii)	Total weight of waste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	a) Public image	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b) Accountability (Legal Compliance)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Not at all					To a great extent				
c) Environmental decision making	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5					
(viii) Total environmental protection expenditure and investment	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5					
a) Public image	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5					
b) Accountability (Legal Compliance)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5					
c) Environmental decision making	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5					
(ix) The time spent responding to environmental Incidents	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5					
a) Public image	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5					
b) Accountability (Legal Compliance)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5					
c) Environmental decision making	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5					
(x) The number of fines and violation notices	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5					
a) Public image	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5					
b) Accountability (Legal Compliance)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5					
c) Environmental decision making	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5					

Please return your completed survey in the enclosed envelope to:

Ms Amy Tung

Department of Accounting and Corporate Governance

Faculty of Business and Economics

Macquarie University, NSW 2109.

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