



The mediating effects of the adoption of an environmental information system on top management's commitment and environmental performance

Environmental
information
system

75

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Abstract

Purpose – This paper aims to examine the antecedent factor, top management's commitment to environmental sustainability, for the adoption of a sophisticated internal environmental information system; measured by the broad-scope, timeliness, aggregation and integration of such information. The paper also seeks to examine whether the availability of such a system would lead to improved environmental performance.

Design/methodology/approach – The paper investigates responses from a survey of Chief Financial Officers or chief management accountants in the top 200 listed companies in Australia. It uses linear regression analysis based on a multiple-mediator model with percentile-based bootstrap, bias-corrected (BC) and bias-corrected and accelerated (BCa) bootstrap confidence intervals to identify significant mediators.

Findings – It was found in this study that top management commitment to environmental sustainability was associated with the adoption of a sophisticated internal environmental information system. Further, the availability of aggregated environmental information was found to mediate the relationship between top management commitment to environmental sustainability and environmental performance. However, there was no significant relationship to other mediating variables.

Research limitations/implications – Limitations relate to the collinearity of mediators which make it difficult to identify the impact of specific mediators in a multi-mediator model. The implications are that other methods may provide further value, but these may need to be based on either different data or larger samples.

Practical implications – The findings point to the importance of aggregated environmental accounting information to organisations aiming to improve their environmental performance.

Originality/value – The study contributes to the corporate environmental accounting literature by empirically linking the top management commitment to environmental sustainability and to environmental performance through the adoption of accounting information provisions. The results of this study also provide guidance to practitioners about how to ensure their commitment to environmental sustainability will be translated to environmental performance and to some extent provide some answer to whether countries such as Australia should implement Emission Trading Scheme (ETS) to account for carbon costs.

Keywords Top management commitment, Environmental accounting information systems, Environmental performance, Mediation analysis, Senior managers, Environmental management

Paper type Research paper

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1. Introduction

Increasing pressure from stakeholders, such as government, media, consumers, investors, employees and non-government organisations, as well as the potential significant cost that may result from any catastrophic environmental disaster have prompted many organisations to consider implementing “green accounting”. The disclosure of environmental performance information to external parties is an essential step to demonstrating good corporate citizenship and gaining favour from investors and consumers. During the process of addressing ethical and ecological concerns from the public, some top managers have quickly realised that such commitment to environmental sustainability could lead to competitive advantages through cost reduction, increased market share, image improvement and technological leadership (Klassen and McLaughlin, 1996; Porter and Van der Linde, 1995; Russo and Fouts, 1997; Shrivastava, 1995).

The realisation of competitive advantage benefits, however, is often a complex process, and contingent on efficient management practices and rigorous management approaches (Roy *et al.*, 2001). In practice, most companies lack adequate systems for measuring and managing environmental costs, not to mention to coordinate environmental data collection for managerial decisions (Schaltegger and Burritt, 2000; Epstein, 1996; Joshi *et al.*, 2001). Many have invested only limited resources in developing an environmental accounting information system, and thus, organisations typically do not have a good understanding of the magnitude of those costs and hence forego many opportunities to improve their environmental and economic performance (Deegan, 2003).

This study is motivated by the lack of empirical research in the extant literature on environmental accounting information systems. The objective of this study is to contribute to a better knowledge of the relationship between top management’s commitment to environmental sustainability and management practices, in particular, the adoption of a sophisticated environmental information system. Such an information system is hypothesised to be able to translate top management’s commitment to environmental sustainability into actions resulting in optimal environmental performance for organisations. Built upon contingency theory, this study addresses the paucity of research on environmental accounting information systems and aims to fill that gap by providing empirical evidence using a mediation approach. The mediation analysis is chosen because the hypothesised mediators, the adoption of broad-scope, timely, aggregated and integrated environmental information (together representing a sophisticated environmental information system) are assumed to be theoretically related to either the independent variable (commitment) or the dependent variable (environmental performance) (Gerdin and Greve, 2004).

This study provides an opportunity to combine the perspectives of the corporate environmental accounting literature with management accounting system (MAS) literature and identify the successful actions that organisations can take to more effectively improve environmental performance throughout an organisation. The purpose of the paper is twofold. First, it examines the extent to which environmental cost information could be incorporated into MAS and the extent to which such systems could enhance performance. Second, it identifies the antecedent factors for adopting a sophisticated environmental accounting information system by organisations. Using data from a cross-section of the top 200 listed companies in Australia, this study contributes to the literature by testing these associations and shedding light on the nature of these relationships.

The remainder of the paper is organised as follows. In the next section, the relevant literature is reviewed and hypotheses are formulated. The research method and variable measurement is presented followed by an analysis of the results. Finally, important theoretical and practical implications in the area of environmental management are raised, along with limitations and suggestions for future research.

2. Theory development and hypothesis formulation

Annandale *et al.* (2004) examined the degree to which corporate environmental reporting and environmental management systems have influenced environmental reporting through a survey of 40 Western Australian companies. They reported a positive relationship between implementation of an environmental management system and environmental awareness saying that this had been achieved through proper employee training and the focus on responsibility of senior staff. However, the authors concluded that whilst EMSs are perceived to have a bigger impact than environmental reporting, both rank low on the list of drivers that influence environmental performance. More influential drivers were found to include pressure from parent companies and clients. Other drivers were public pressure, economics and corporate culture. Most often, top management's commitment to environmental sustainability can be regarded as a response to these types of external pressures (Roy *et al.*, 2001).

Gray (1993) has characterised the magnitude of organisation's commitment to environmental protection as ranging from "light green" to "dark green". "Light green" refers to the adoption of environmental practices in compliance with environmental regulations, i.e. a reactive approach. "Dark green" refers to organisations adopting a proactive approach to "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987, p. 8). Gray (1990), in his report commissioned by the Association of Chartered Certified Accountants, recognised the important role of environmental accounting information systems in helping organisations to improve their environmental performance. Environmental accounting information influences decision-makers to be more environmentally aware (Gray, 1990; Lohmann, 2009). Further, it is suggested by Lohmann (2009) that environmental accounting systems can also help translate the value of the environment into commercial "goods and services", subsequently, facilitating government environmental trading schemes and also enabling comparison. Despite the important role of the environmental accounting system, little research has been done on organisations' internal reporting on environmental performance.

We might expect "light green" organisations to have a less sophisticated environmental accounting information system, while "dark green" organisations adopt a more sophisticated system to assist in achieving their goal of improved environmental performance reflecting top management's commitment to environmental sustainability.

Prior MAS research has conceptualised the characteristics of internal management accounting information system into four dimensions: broad-scope; timeliness; aggregation; and integration. The four dimensions are often used to measure the extent of sophistication of the MAS, and they have emerged as important contextual variables in MAS research over the last two decades (Gul, 1991; Gul and Chia, 1994; Mia and Chenhall, 1994; Abernethy and Guthrie, 1994; Chia, 1995; Fisher, 1996; Chong, 1996; Chong and Chong, 1997; Chong, 1998; Bouwens and Abernethy, 2000; Moores and Yuen, 2001; Tsui, 2001; Agbejule, 2005).

A broad-scope information system provides information relating to the external environment, the estimates of the likelihood of the future events and financial or non-financial information (Chenhall and Morris, 1986). Broad-scope environmental information can provide financial information (such as quantification of environmental costs) and non-financial information (such as reduction of spillage or wastage rates and levels of motivation among employees on environmental issues). To provide valuable support for successful decision-making, managers need a balanced set of financial and non-financial measures. Broad-scope information has thus been recognised as the main characteristic of MAS information and playing an important role in assisting managerial decision-making (Larcker, 1981; Gordon and Narayanan, 1984). Some researchers argue that the economic rationalist view of environmental performance may be lacking because the full costs of environmental activities are not being properly portrayed (Herbohn, 2005). Otherwise, the availability and use of a broad set of accounting information relative to the economic consequences of the social position (e.g. environmental management) of a company could provide a more comprehensive view of the company's cost structure (Jonson *et al.*, 1978). As suggested in the literature, a full cost reporting system is "an attempt to reform current accounting practice" (Bebbington *et al.*, 2001, p. 8) suggesting that management information systems can make a positive contribution to the sustainable or ecological debate, by reforming information systems to account for environmental and social externalities (Bebbington and Gray, 2001; Owen, 1992).

Due to the large volume of data produced by the accounting information system, aggregating information is one of the pervasive functions in accounting (Arya *et al.*, 2000a). Aggregation in MAS literature refers to the provision of information that has been accumulated by different cost pools, responsibility centres or functional areas, with an aim to calculate product cost, or facilitate formal business decision models or analytical models, such as discounted cash flow analysis; simulation and linear programming for budgeting; cost-volume-profit analysis; and, inventory management control models (Chenhall and Morris, 1986). Aggregated environmental information is reported to be used by organisations that have adopted activity based costing (ABC) to classify, analyse and report environmental costs to managers; tracking environmental cost to the responsible products; environmental costs being used for total quality management (e.g. identifying prevention costs, detection costs, internal failure costs and external failure costs); and, organisations accounting for their waste (e.g. the waste disposal costs and the cost of purchased resources that are wasted). The most cited benefit to aggregation in the literature is derived from bounded rationality, which suggests that decision-makers prefer aggregated information when there are limits on information transmission, reception and processing (Arya *et al.*, 2000a, b). A second relevant benefit is that during the process of aggregating information, managers are led to recognise the cause-and-effect relationship of changes in resources. As a result, the process itself may add information and increase managers' knowledge (Sunder, 1997). Previous research showed that aggregated information allowed decision-makers: to view the performance outcomes or results of decisions made in functional areas (Bouwens and Abernethy, 2000); reflected departmental interdependencies and organisation structure (Watson, 1975); and, helped to minimize the expected cost of misclassification (ECM) (Arya *et al.*, 2000a). Therefore, this study suggests that aggregated environmental accounting information is particularly useful for decision-makers in assessing the feasibility of technological investments aimed at improving environmental performance and in assessing organisational environmental performance.

The other two dimensions have often been considered less important in the previous literature, compared to broad scope and aggregation. Timeliness of MAS information refers to the speed of provision of information and the frequency of reporting of the collected information (Chenhall and Morris, 1986; Ansari, 1977). Integration of MAS information refers to information that assists coordination or interaction within the departments or inter-departments in the organisation or business unit (Lawrence and Lorsch, 1967; Galbraith, 1973; Chenhall and Morris, 1986). It is argued that both dimensions represent the indispensable elements of an information system and, as such, they should be included in the study. Indeed, some researchers suggested that timeliness and integration have become increasingly important as design variables of management accounting information research (Waterhouse and Tiessen, 1978; Bouwens and Abernethy, 2000; Chenhall, 2005).

The environmental information system operates with a particular focus on materials and energy flow information and environmental cost information. It can be generated through an organisation's internal MAS and cover all types of environmentally related management activities, including: product and process design; cost control and allocation; product pricing; acquisition or modification of capital equipment; supply chain management; and performance evaluation. Since environmental performance data are reported primarily for management, environmental data collection processes can be linked with management information systems (Schaltegger *et al.*, 2003) for the purposes of internal reporting. Having a full-blown environmental management system will help identify issues that need greater attention and consequently improve environmental performance (Herremens *et al.*, 1999). From a business perspective the link between environmental and economic performance is the most critical relationship in managing sustainability issues. In determining eco-efficiency measures, it is essential for the environmental information system to encompass the broad scope, aggregation, timeliness and integration characteristics, thus we contend that the four characteristics are related to perceived system success. Moreover, evidence also suggests that preparers of sustainability reports use internal management reporting systems (Adams, 1999; Ball *et al.*, 2000).

The positive impacts of a sophisticated environmental information system on an organisation's environmental performance are self-evident. The benefits range from cost reductions, better product pricing, process improvement, retention of skilled employees, and improved public image (Bennett *et al.*, 2003; Burritt *et al.*, 2002; Gibson and Martin, 2004; Hansen and Mowen, 2005; Adams and Zutshi, 2004). An increasing body of anecdotal and empirical evidence suggesting that sophisticated environmental information can help provide physical cost information on the use of materials and energy, highlight inadequacies and pinpoint environmental costs that can be reduced, allowing for better internal control and decision-making and subsequently improved economic benefits (Al-Tuwaijri *et al.*, 2004; Schmidheiny and Zorraquin, 1996; Adams and Zutshi, 2004). Companies with stronger environmental management also tend to have lower costs related to fines, penalties, and legal fees related to environmental activities. Furthermore, improved corporate reputation and better relationships with stakeholders through good citizenship behaviour and offering environmentally-friendly products tends to give companies a competitive advantage (Epstein, 1996; Adams, 2002; Adams and Zutshi, 2004). For example, Epstein (1996) reported that revenues related to environmental management initiatives are positively impacted through reputation effects as well as through "green" marketing initiatives. Customers are more likely to continue buying from companies that they perceive as being responsible and managing environmental impacts.

The aim of this study is to examine the relationship between top management's commitment to environmental sustainability and environmental performance and to test a mediational model in which the adoption of a sophisticated environmental information system is considered as a mechanism transmitting the effect of top management's commitment to environmental sustainability on improving environmental performance (Figure 1).

Thus, it is hypothesised that there is a significant indirect relationship between top management's commitment to environmental sustainability and an organisation's improved environmental performance through the adoption of a sophisticated environmental information system.

In this study, the joint and unique contribution from the four environmental accounting information dimensions is examined first to account for the link between top management's commitment to environmental sustainability and environmental performance. Each of the four dimensions is subsequently tested as an individual distinct mediator to determine whether it is a link between top management's commitment to environmental sustainability and environmental performance.

3. Research method and variable measurement

Sample selection

This section discusses the research design and the data collection procedures employed.

A questionnaire was designed to capture variables specified: top management's commitment to environmental sustainability, the adoption of a sophisticated environmental information system, and the organisation's environmental performance. The initial questionnaire was first sent to seven management accountants and three chief financial officers (CFOs) as a pilot study. Based on their feedback, modifications were made to improve the clarity of some questions and enhance the accuracy of the questionnaire. The questions covered in the survey about integration and aggregation are concerned with financial or other quantified data and reporting and use of information in decision-making. We chose senior accountants as respondents as being the best qualified people within an organisation to address all of these questions and have a holistic understanding of the issues involved with these matters and those of timeliness and broad-scope information. The mailed-out survey containing a covering letter, the questionnaire and a reply-paid envelope was distributed in January 2007 to the top 200 listed companies on the Australian Stock Exchange (ASX). The top 200 listed companies were chosen because small companies were thought less likely to invest in a sophisticated environmental accounting information system. The selected companies cover a range of Australian industries including mineral and exploration, chemical, oil and gas, paper and forestry (Appendix 1). The survey did not target firms in sectors that are

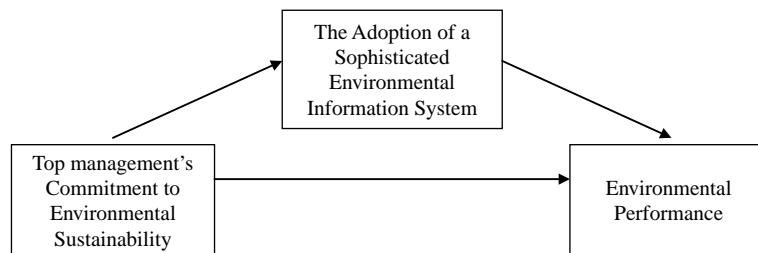


Figure 1.
Hypothesised model

sensitive to the environment, as environmental issues and risks and the prospect of further environmental regulation and a carbon price are relevant to all sectors. Furthermore, a random sample provides greater validity for the study. The survey was mainly addressed to the CFO as the most senior accountant in the company; however, the covering letter also indicated that if the CFO was not available, the survey should be redirected to the chief management accountant. CFOs and chief management accountants are deemed to be appropriate respondents as they are more likely to be involved with activities related to the organisation's long-term sustainability goals, they play an increasingly important role in deciding whether and how environmental accounting information is collected and they also have the best knowledge of an organisation's environmental performance. They are part of an organisation's senior management team and as such their views both reflect and influence the degree to which environmental thinking is embedded in the corporate psyche. A second copy of the survey was sent to companies who did not respond by the initial due date in mid March 2007. A total of 53 responses were received, 50 of which were deemed usable for data analysis, resulting in a response rate of 26 percent. The ANOVA test was undertaken to detect any late response bias, but the result revealed no significant differences in responses between the early response group and the late response group.

Variable measures

Top management's commitment to environmental sustainability. Jackson's (2004) measure of employee commitment to quality was modified and used to measure top management's commitment to environmental sustainability. This instrument was chosen not only because it can accurately capture employees' commitment to certain goals of the organisation, but also because it displayed a high level of reliability and validity in the empirical study. As a result, top management's commitment to environmental sustainability would be measured by proxy of CFO's individual perspective on this issue. By doing this, we are not suggesting that all top management necessarily share the same view, but rather that CFOs and chief management accountants are top management and that where sustainability is embedded in an organisation we would expect members of top management to share a view that sustainability goals are important. Given the seniority of the respondents we believe their "personal" views are linked to organisational commitment and would argue that, at that level, the individual and corporate are intertwined and that there is difficulty in separating the individual from their corporate role. With the survey research approach we have adopted here, there is a limit to the depth that issues can be explored, but we believe this approach does provide useful insights and that both qualitative and quantitative approaches have value in understanding these important relationships given the implications for really addressing sustainability issues.

In the survey, respondents were asked to indicate the extent to which they agreed with 12 statements concerning their environmental commitment by circling the most appropriate number, ranging from 1 (strongly disagree) to 7 (strongly agree). A factor analysis of the 12-item measure was conducted to examine its dimensionality and a single factor was extracted. The Cronbach α -coefficient (Cronbach, 1951) was 0.96, indicating satisfactory internal reliability for the scale (Nunnally, 1967). The measurement items and their factor loading are listed in details in Appendix 2. In addition, as this measure is relatively new, the correlation matrix of the measured items and the "alpha if item is deleted" are reported separately in Appendix 3, and the result showed that the instrument was robust.

The adoption of a sophisticated environmental information system. Chenhall and Morris's (1986) four dimensions of MAS information (scope, timeliness, aggregation and integration) were modified and used in this study to measure environmental information system sophistication. Respondents were provided with the definitions of information broad-scope, timeliness, aggregation and integration and were asked to indicate the extent they agreed with statements on how their organisations collect environmental information by selecting from 1 (never) to 7 (all the time). A single factor was extracted for each dimension of environmental information system in the factor analysis and high internal reliability was found for each dimension, as the Cronbach α -coefficients were showed to be 0.90 (broad-scope), 0.93 (timeliness), 0.95 (aggregation) and 0.92 (integration). The measurement items for each dimension and their factor loading are explained in details in Appendix 2.

Organisation's environmental performance. Little agreement in the current literature has been reached about what defines the environmental performance, and consequently, there are different variations on how to capture this variable (Lober, 1996; Henri and Journeault, 2010). Most studies measure environmental performance in terms of the environmental impacts, such as environmental compliance (Albelda-Pérez *et al.*, 2007; Epstein and Wisner, 2005), pollution/toxic releases (Cormier and Magnan, 1997; Patten, 2002), and waste recycled (Al-Tuwaijri *et al.*, 2004). According to Henri and Journeault (2010), such an approach has effectively limited the scope of environmental performance to one aspect, and failed to explore further about the dynamics of this concept. Ilinitch *et al.* (1998) suggested that environmental performance should be a multi-dimension concept covering the following aspects: enhancement of products and processes; relationships with the parties involved; regulatory compliance and financial impacts; and, environmental impacts and corporate image. Their framework has been applied by Henri and Giasson (2006) and also Henri and Journeault (2010) in designing an adequate and sufficient instrument to measure environmental performance. To reflect the Australian context, this study draws from Ilinitch *et al.*'s (1998) idea and combines with the findings from Deegan's (2003) *Environmental Management Accounting Report* (commissioned by Institute of Chartered Accountants in Australia), and subsequently identifies nine areas that may quantify and reflect an organisation's overall environmental performance. They are: improved environmental performance; more informed decision-making; uncovering cost cutting opportunities; improved product pricing; assisting with internal and external reporting; increased competitive advantage; improved reputation; improved staff retention and attraction; and, generating societal benefits. A seven-point Likert scale was developed to measure each dimension, in which respondents were asked to circle the most appropriate number to indicate how well their organisation performed on each area from 1 (unsatisfactory) to 7 (outstanding). The new instrument has been submitted to experts for comments and has also been pilot tested. For this study, the factor analysis was undertaken and a single factor was extracted with a Cronbach α -coefficient of 0.94, which indicates high consistency between the measured items. As the organisation's environmental performance is a new instrument, the correlation matrix of the dimensions and the "alpha if item is deleted" are reported in Appendix 3 to provide further evidence to the validity of the instrument. It is worth noting that the environmental performance measure is a self-rating measure. Issues of greater leniency and subjectivity are often raised for this type of measure, but it is also found that self-rating and independent ratings are generally consistent with each other (Heneman, 1974; Parker *et al.*, 1959). One advantage of using

self-rating performance measurement instruments over independent ratings is to prevent biased assessments and/or severely lower questionnaire response rates.

4. Results

This section reports the results of the empirical test of the hypotheses developed in this study. The descriptive statistics and correlation matrix regarding relevant variables are presented in Table I. All variables are correlated significantly with the others, in particular, between the characteristics of environmental information systems. This has raised some concern about multicollinearity. The correlation matrix was examined first to identify any collinearity and it was found none of the high correlations are above 0.90 (Hair *et al.*, 1998). Subsequently, the tolerance value and the variance inflation factor (VIF) for all variables were reviewed and the results showed that all values were within the acceptable range, therefore, multicollinearity was not severe.

Mediation analysis

Evidence for mediation was established by applying the criteria described by Judd and Kenny (1981) and further elaborated by MacKinnon (1994). According to their work, four conditions must be satisfied to establish mediation. They are:

- (1) the independent variable must be significantly associated with the dependent variable;
- (2) the independent variable must be significantly associated with the hypothesised mediator;
- (3) the mediator must be significantly associated with the dependent variable when controlling the effects of the independent variable; and
- (4) the mediated effect is statistically significant.

| | Commitment (X _i) | Broad-scope (M ₁) | Timeliness (M ₂) | Aggregation (M ₃) | Integration (M ₄) | Environmental performance (Y) |
|-------------------------------|---------------------------------|----------------------------------|---------------------------------|----------------------------------|----------------------------------|-------------------------------------|
| <i>Descriptive statistics</i> | | | | | | |
| Theoretical range | 1-7 | 1-7 | 1-7 | 1-7 | 1-7 | 1-7 |
| Observed range | 2-7 | 1-6 | 1-7 | 1-6 | 1-7 | 3-7 |
| Mean | 5.18 | 4.76 | 4.55 | 4.35 | 4.55 | 5.07 |
| Std. deviation | 1.143 | 1.131 | 1.306 | 1.320 | 1.386 | 0.921 |
| Cronbach α | 0.96 | 0.90 | 0.93 | 0.95 | 0.92 | 0.94 |
| <i>Correlation matrix</i> | | | | | | |
| X _i | 1.00 | | | | | |
| M ₁ | 0.740* | 1.00 | | | | |
| M ₂ | 0.750* | 0.762* | 1.00 | | | |
| M ₃ | 0.654* | 0.704* | 0.814* | 1.00 | | |
| M ₄ | 0.838* | 0.721* | 0.807* | 0.738* | 1.00 | |
| Y | 0.721* | 0.574* | 0.636* | 0.645* | 0.595* | 1.00 |

Note: Correlation is significant at: *0.01 level (one-tailed)

Table I.
Descriptive statistics
and correlation matrix

The technique, which can be expanded for more than one potential mediator (i.e. k), uses the following three multiple-regressions analyse:

$$Y = \beta_0 + \gamma X_i + \varepsilon \quad (1)$$

$$M_i = \beta_0 + a_i X_i + \varepsilon \quad (2)$$

$$Y = \beta_0 + \gamma' X_i + \beta_i M_i + \varepsilon \quad (\text{single mediator}) \quad (3)$$

or:

$$Y = \beta_0 + \gamma' X_i + \beta_1 M_1 + \dots + \beta_i M_i + \dots + \beta_k M_k + \varepsilon \quad (\text{multiple mediators})$$

In these equations, Y is the dependent variable, X_i is the independent variable, and M_i is the mediator.

Condition (1) for establishing mediation is supported by a test of statistical significance of γ in equation (1). Condition (2) is supported when α_i is significant in equation (2). Condition (3) is supported when β_i is significant in equation (3) and when $\gamma' < \gamma$, which provides evidence for mediation. Condition (4) was tested for the variables that satisfied the first three conclusions for mediation. To satisfy the condition (4), the mediated effect must be statistically significant. Baron and Kenny (1986) described a procedure developed by Sobel (1982) to provide a more direct test of an indirect effect. This is called the product of coefficient approach, also known as the Sobel test, and it is used as to supplement, rather than replace, the Baron and Kenny method. The significance of the mediation effect is determined by interval estimation of the mediated effect ($\alpha_i \beta_i$) using the asymptotic variance derivation, in which the estimate of the

standard deviation of $\alpha_i \beta_i$ is equal to $\sigma_{\alpha\beta} = \sqrt{\alpha_i^2 \sigma_\beta^2 + \beta_i^2 \sigma_\alpha^2}$. This method assumes a normal sample distribution of the total and specific indirect effects *ab*, however, such assumption of normality is often questionable, particularly in small samples (MacKinnon *et al.*, 2002; Preacher and Hayes, 2004; Shrout and Bolger, 2002). Thus, such a method is not recommended.

Baron and Kenny (1986) is the seminal article on using the mediation approach. By May 2012, Google Scholars search engine has showed it is the most referenced paper in social science research, totalling 32,004 citations. Ironically, as knowledge of mediation analysis grows, the evidence points to Baron and Kenny's approach being the less effective than other available methods to detect mediation.

Baron and Kenny's well known causal steps approach suffers from low statistical power in most situations (Fritz and MacKinnon, 2007; MacKinnon *et al.*, 2002). This means that if X imparts its influence on Y partly through M, this approach is least likely among the tested methods to be able to detect the effect (Hayes, 2009). Another criticism of this approach is that it is not based on quantification of the very thing it tries to test – the mediating effect. Rather, it nests in a series of tests based on inferring each path in the hypothesis diagram and a failure to establish one leads one to claim an absence of evidence of mediation effect (Hayes *et al.*, 2011). It makes more sense to minimize the number of tests to support a claim.

If following causal steps criteria, one may not be able to detect the inconsistent mediation model (Kenny *et al.*, 1998; MacKinnon *et al.*, 2002). There is clear evidence that it does not have to be a statistically significant relation between X and Y even for a consistent mediation model. In some cases, the direct test on mediation has more power

than the test of the total effect between X and Y. Also the test of the X to Y relation in the sample is a test in a sample just like any other statistical test, thus, it can contain sample error (Hayes, 2009). Therefore, it does not have to have the effect to be mediated.

Finally, the Baron and Kenny method over emphasizes the importance of an effect existing before being mediated, resulting in its limited application to a multi-mediators model (Hayes, 2009). For a multi-mediator model, there could be more than one mediation effect with the same direction or opposite directions. As the number of mediators increase, the different types of effects become more complicated and difficult to interpret. Specific indirect effects can have opposite signs and reduce the total effect or the total indirect effect. Consequently, the total effect and the total indirect effect are not particularly meaningful in a multi-mediator model unless all specific indirect effects are of the same sign (Figure 2).

An alternative approach, bootstrapping, is a non-parametric resampling procedure that involves repeatedly sampling from the data set and estimating the indirect effect in each resampled data set (Efron and Tibshirani, 1993; Hayes, 2009; MacKinnon, 2008; Preacher and Hayes, 2008b). By repeating this process thousands of times, say 5,000, an empirical approximation of the sampling distribution of ab is built and used to construct confidence intervals (CI) for the indirect effect. If zero is not within the CI, it can be claimed that the indirect effect is not zero with a certain percentage of confidence.

Research shows that bootstrapping provides the most powerful and reasonable method of obtaining confidence limits for specific effects under most conditions

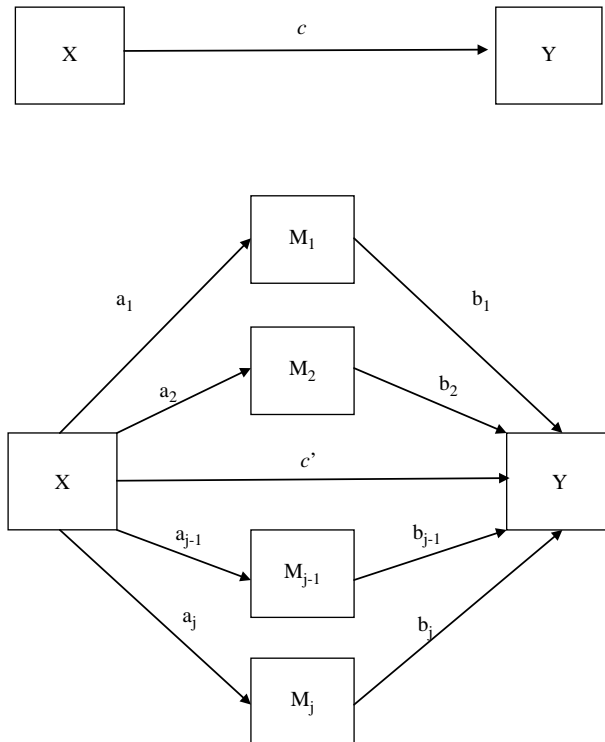


Figure 2.
A multiple
mediator model

(Hayes, 2009; Lockwood and MacKinnon, 1998; MacKinnon *et al.*, 2004; Preacher and Hayes, 2008b; Shrout and Bolger, 2002). Thus, in this study, we adopted the bootstrap method to examine the indirect effects of top management's commitment to sustainability on environmental performance. The macro developed by Preacher and Hayes (2008a), also known as the indirect macro, was employed in conjunction with SPSS to generate estimates for indirect effects in a multiple-mediator model as shown in Figure 1, where c is the total effect of X on Y , c' is the direct effect of X on Y , and the specific indirect effect of X on Y through mediator M_i is defined as $a_i b_i$. This macro not only allows for multiple mediators, statistical control of covariates, all possible pairwise comparisons between indirect effects, but also produces bias-corrected (BC) and bias-corrected and accelerated bootstrap (BCa) CI in addition to percentile-based bootstrap CI. Hence, it is the most sophisticated macro program that is available.

The results of the hypothesised multi-mediator model, including the point estimates of the indirect effects and the pairwise comparisons between the indirect effects are reported in Table II. All the point estimates were calculated based on 5,000 bootstrap samples, and the 95 percent CI were constructed by using three different methods. They are the percentile-based bootstrap, BC and BCa CI. Studies have been conducted to determine which resampling method would produce the most reliable results, and it is found that the BC bootstrap and BCa are the best methods overall (MacKinnon *et al.*, 2004). Hence, the result analysis of the multiple-mediator model is preferred and based on the bias corrected and accelerated bootstrap, although all of the three methods consistently conclude the same findings in this study (Figure 3).

Taken as a set, the adoption of a broad scoped, timely, aggregated and integrated environmental information system does not mediate the effect of top management's commitment to sustainability on the organisation's environmental performance. As can be seen in Table II, the total indirect effect through the three mediators has a point estimate of 0.0342 and a 95 percent BCa bootstrap CI of -1.1073 and 1.3304 . As the CI contains zero, we cannot claim that the total indirect effect is different from zero. The insignificant total indirect effect is caused by the opposite directions of the indirect effect of each mediator. The directions of the indirect paths through timeliness and aggregation are consistent with the interpretation that greater top management's commitment to sustainability leads to the adoption of the timely and aggregated environmental information, which in turn leads to greater environmental performance. However, the indirect paths through broad scope and integration are negative in direction. Therefore, indirect paths with opposite directions have cancelled each other out, resulting in an insignificant total indirect relationship.

In a multiple mediation model, one should be concerned not only with the total indirect effect of X on Y , but also with specific indirect effects. An examination of the specific indirect effects indicates that only aggregation is the mediator, since its BCa 95 percent CI ranging from 0.1770 to 1.2441 does not contain zero. None of broad scope, timeliness or integration contributes to the indirect effect above and beyond aggregation. It may be of interest to see whether these three indirect effects are significantly different from aggregation. Examination of the pairwise contrasts of the indirect effects shows that the specific indirect effect through aggregation is significantly different from the specific indirect effect through broad scope and integration, with a BCa 95 percent CI of -1.7350 and -0.0687 with broad scope and 0.1126 and 2.6143 with integration. However, when comparing the specific indirect effects between aggregation and timeliness, they cannot be distinguished in terms of magnitude, despite the fact that one is significantly different from zero and the

| | Point estimate | Product of coefficients | | Percentile 95 percent CI | | Bootstrapping BC 95 percent CI | | BCa 95 percent CI | |
|----------------------------|----------------|-------------------------|---------|--------------------------|---------|--------------------------------|---------|-------------------|---------|
| | | SE | Z | Lower | Upper | Lower | Upper | Lower | Upper |
| <i>Indirect effects</i> | | | | | | | | | |
| Broad scope | -0.1466 | 0.3254 | -0.4504 | -0.7401 | 0.4075 | -0.7150 | 0.3944 | -0.7706 | 0.3918 |
| Timeliness | 0.2151 | 0.4128 | 0.5211 | -0.6586 | 0.8974 | -0.5553 | 0.9892 | -0.4372 | 1.2880 |
| Aggregation | 0.6893 | 0.3236 | 2.1303 | 0.2083 | 1.2739 | 0.2290 | 1.2688 | 0.1770 | 1.2441 |
| Integration | -0.7237 | 0.4695 | -1.5415 | -1.7003 | 0.2659 | -1.6507 | 0.3196 | -1.7445 | 0.2838 |
| Total | 0.0342 | -0.4516 | 0.0757 | -1.2871 | 1.1286 | -1.2661 | 1.1435 | -1.1073 | 1.3304 |
| <i>Contrasts</i> | | | | | | | | | |
| Broad scope vs timeliness | -0.3617 | 0.5938 | -0.6092 | -1.2477 | 0.4870 | -1.3723 | 0.3280 | -1.5626 | 0.3261 |
| Broad scope vs aggregation | -0.8359 | 0.5036 | -1.6597 | -1.7750 | -0.0498 | -1.7470 | -0.0983 | -1.7350 | -0.0687 |
| Broad scope vs integration | 0.5771 | 0.5755 | 1.0028 | -0.6179 | 1.7073 | -0.6756 | 1.6635 | -0.7413 | 1.6813 |
| Timeliness vs aggregation | -0.4741 | 0.6332 | -0.7488 | -1.7794 | 0.5210 | -1.6535 | 0.5887 | -1.5251 | 0.9163 |
| Timeliness vs integration | 0.9388 | 0.7157 | 1.3118 | -0.3756 | 2.1160 | -0.2640 | 2.2296 | -0.2441 | 2.3494 |
| Aggregation vs integration | 1.4130 | 0.6290 | 2.2464 | 0.1959 | 2.6564 | 0.1816 | 2.6678 | 0.1126 | 2.6143 |

Notes: BC – bias corrected; BCa – bias corrected and accelerated; 5,000 bootstrap samples

Table II.
Results of regression –
multi-mediator model

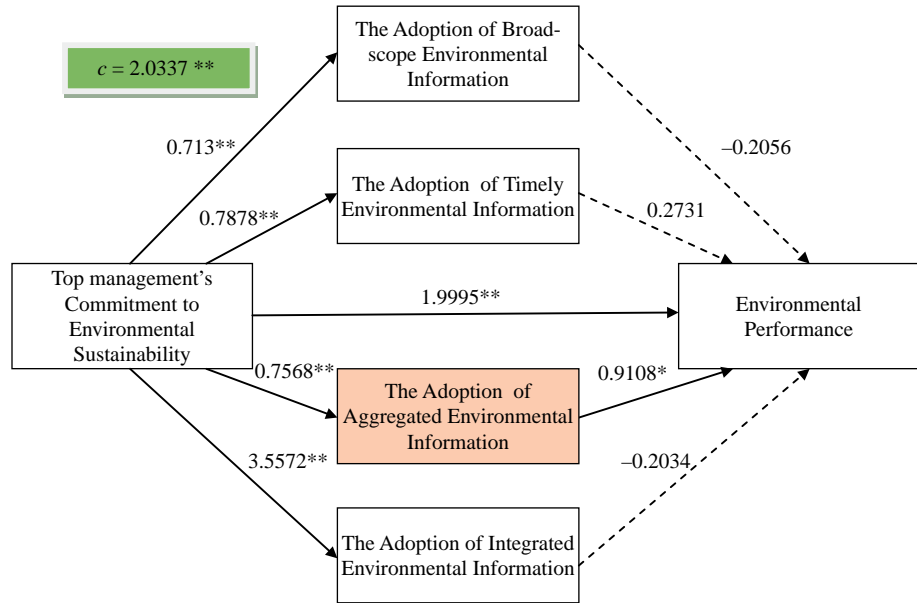


Figure 3.
The hypothesised multiple mediator model

Note: Significant at: *0.05 and **0.01 levels

other is not. Such a paradox can occur when one of the specific indirect effects involved in the contrast is not sufficiently far from zero. It is also worth noting that the direct relationship between top management's commitment to environmental sustainability and organisation's environmental performance is 1.9995, significant at the 0.01 level. The existence of a strong direct relationship between the independent and dependent variables provides directions for future research, which will be discussed in the last section of this paper.

Single mediator model

As three out of four mediators identified above failed to be established as the mediators in the multiple-mediator model, the mediated effect of each individual variable for the dependent variable was subsequently tested in a single mediator model to compare with the alternative multiple-mediator model. This is considered a necessary step, as the single mediator model will reveal whether the variable is a significant mediator on its own and whether its effect has been accounted for by other potential mediators which render its insignificance in the multiple-mediator model.

Table III shows that the point estimates of the indirect effects through broad scope, timeliness and integration are 0.1870, 0.4631 and -0.0724 , respectively, with BCa 95 percent CI from -0.4935 to 0.8547 for broad scope, -0.1620 and 1.0887 for timeliness, and -1.0531 to 0.9759 for integration. Since zero is included between the upper and lower bounds of the 95 percent CI, the mediation effect through individual mediators cannot be established. The result indicated that the availability of broad-scope environmental information itself does not transmit the effect of top management's commitment to change environmental performance, and the same conclusions can be drawn for the availability of timely environmental information and the integrated environmental information.

In contrast, the point estimate of the indirect path through aggregation is 0.5584 with 95 percent CI from 0.1640 to 1.1558, indicating that this indirect effect can be deemed different from zero, and the availability of aggregated environmental information can be established as a single mediator, passing the effect of top management’s commitment to environmental sustainability to an organisation’s environmental performance.

To sum up, the results from the single mediator models show that the availability of broad-scope, timely and integrated environmental information on their own are not significant mediators for top management’s commitment to environmental sustainability and environmental performance, therefore, it is safe to conclude that their effects have not been accounted for by aggregated environmental information, which would otherwise render their insignificance in the multiple-mediator model (Figure 4).

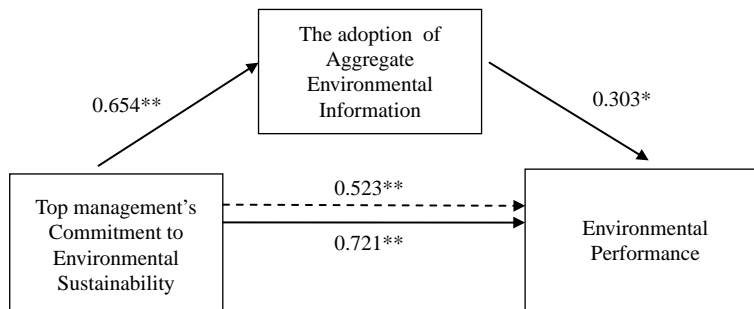
5. Discussion and conclusions

In general, our study of data from a cross-section of industries in Australia found that top management’s commitment to environmental sustainability is a strong driving force for improving environmental performance. Further, our study suggested that top management’s commitment to environmental sustainability is highly associated with the adoption of a sophisticated environmental information system. That is, organisations with strong commitment to environmental sustainability tend to adopt a more sophisticated environmental information system characterised by broader-scope, timeliness, aggregation and integration. The result revealed that environmental accounting has taken a more sophisticated form in providing environmental information than found in earlier studies by

| | Product of coefficients Point estimate | SE | Z-value | Bootstrapping BCa 95 percent CI | |
|-------------|---|---------------|---------------|------------------------------------|---------------|
| | | | | Lower | Upper |
| Broad scope | 0.1870 | 0.3066 | 0.6101 | -0.4935 | 0.8547 |
| Timeliness | 0.4631 | 0.3146 | 1.4720 | -0.1620 | 1.0887 |
| Aggregation | <i>0.5584</i> | <i>0.2459</i> | <i>2.2707</i> | <i>0.1640</i> | <i>1.1558</i> |
| Integration | -0.0724 | 0.4289 | -0.1689 | -1.0531 | 0.9759 |

Table III.
Results of regression – single-mediator model

Notes: BCa – bias corrected and accelerated method; 5,000 bootstrap samples



Note: Significant at: *0.05 and ** 0.01 level

Figure 4.
Single mediator model – aggregation

Bebbington *et al.* (1994) and Gray *et al.* (1995) who found that the accounting functions had limited involvement in corporate responses to the environmental agenda.

With regard to top management's commitment, our findings are consistent with other recent studies. For example, Albelda-Pérez *et al.* (2007) found that the commitment of managers defined the characteristics of an environmental management system which acted as catalysts for change whilst Lee and Ball (2003) found that top management's commitment had a direct impact on how organisations respond to corporate environmental issues and strategy formulation. Wee and Quazi (2005) identified top management's commitment to the environment as a critical factor in assessing and improving environmental management practices. When top management understands the potential benefits which may result from certain environment initiatives, they will be motivated to commit to environmental sustainability. As a result, more resources will be used to develop a comprehensive environmental information system to capture broad-scope, aggregated and integrated environmental information in a timely fashion.

In regards to the hypothesised mediation model, the availability of aggregated environmental information is found to partially transmit the effect of top management's commitment to environmental sustainability to environmental performance. This result is consistent with those reported by Otley and Dias (1982), Arya *et al.* (2004) and Gigler and Hemmer (2002). Particularly, Otley and Dias (1982) noted that there were two types of information aggregation. The first type reduces the amount of information but not the value of that information and the second type reduces both the content and the value of the information. Although this study did not explicitly consider the level of aggregation, the instrument (Appendix 2) is more likely to measure the first type of aggregation, that is, data reduction without information value being lost. This result proves that there is benefit associated with using aggregated environmental accounting information, and this has practical implications. In today's working environment, decision-makers are facing a multiplicity of difficult tasks, maintaining good relationships with different stakeholders and managing their often-conflicting interests about the means and ends, especially the conflict between short-term profitability requested by the shareholders and long-term sustainability by the community and government. Contrary to the common intuition that aggregation destroys information, employing aggregate data may prove adequate for decision-makers to translate their commitment to environmental sustainability into actions to improve the efficiency of control system and achieve satisfactory environmental performance when they juggle those different demands.

On the other hand, it is surprising that our results do not support the hypotheses of broad-scope, timeliness and integration as mediators for the relationship between top management's commitment and organisation's environmental performance. It is speculated that the time lag between collecting and using broad-scope, timely and integrated information and realisation of the benefit of using such information is one of the possible reasons. This simply cannot be captured by a one-point survey, and suggests the need for a longitudinal, qualitative study. In addition, broad-scope information carries numerous individual signals and it may easily result in information overload for top management. Environmental accounting currently focuses primarily on providing internal or external environmental reports at a corporate level. Consequently, broad-scope information may not be so useful for monitoring and improving performance. Regarding the result for integration, previous research has already noted the inadequacy in the coordination arising from managing corporate environmental data (Schaltegger and

Burritt, 2000). Due to the complexity (Daft and Lengel, 1990) and the variety of ways in which integrated information might be drawn on in practice, Chapman and Kihn (2009) argue that a system of integration provides no strong basis for predicting a link to business unit performance.

Overall, it is worth noting that the environmental performance in this study was represented by the firms' performance in aspects of environmental impact, stakeholder relationships, financial impact and productivity. The failure to find a significant relationship between the adoption of a sophisticated environmental information system (particularly in aspects of broad-scope, timeliness and integration) and environmental performance may be due to a lack of appreciation of the business case for reducing environmental impacts. Senior accountants appear to equate reducing environmental impacts with raising costs and reducing productivity (Porter, 1991), and any spending on environmental issues is often considered as a means of correcting market failures while increasing companies' burden (Wagner and Schaltegger, 2003). Unfortunately, such a view of neoclassical environmental economics is mainstream thinking among top management who focus on financial returns and economic growth (Lamberton, 2005). Indeed, the current accounting system is built on "entity" focus, and it may never be able to address the real sustainability issues, such as building a fairer and more equitable society. Although Burnett and Hansen (2008) provided some empirical evidence of ecoefficiency in the US electric utility industry, it is also possible the ecoefficiency paradigm may not be valid if cross-sectional data is examined or a different country studied. Adam and Frost (2006) noted that businesses do not feel responsible for the kind of societal shift that would move today's society to the one that is consuming less. Thus, hoping businesses will become ecologically conscientious is misplaced and there is a call for a radical reform in accounting to incorporate environmental and social impacts by Adams (2002), Bebbington *et al.* (1999) and Gray (1992). This cannot be achieved without strong government policies and pressing public opinion (Adam and Whelan, 2009). The Porter hypothesis (guided ecoefficiency hypothesis) has also suggested that the win-win paradigm (achieving both environmental and economic objectives) needs to be stimulated or encouraged by carefully crafted regulatory intervention to induce ecoefficient behaviour (Porter and Van der Linde, 1995).

The finding of our study may provide some answers to current debate regarding emissions trading and carbon pricing. Since organisations perceive that sustainable outcomes can only be achieved at the expense of economic performance, they are unlikely to voluntarily engage in proactive environmental behaviour and self-regulation to become "clean and green" or consider accounting's potential role in improving environmental performance. Without any mandatory emission reduction targets set nor any financial mechanisms, such as carbon price, in place, most firms will only respond to environmental challenges with as little effort as they can get away with, as bounded rationality thinking dominates (Porter, 1991; Burnett and Hansen, 2008). Hence, implementing carbon taxes may become one of the possible solutions so long as businesses uphold their win-lose paradigm.

Several limitations should be noted when interpreting the results of this study. First, high correlations between four mediators may lead to inflated standard errors and a resulting decrease in power to detect significant mediators (MacKinnon, 1994). Second, measurement error in the mediators might have contributed to decreased power to detect associations with environmental performance and with top management's commitment to environmental sustainability. One solution to reduce the effects of measurement error

is to use latent constructs and structural equation modelling techniques (Judd and Kenny, 1981; MacKinnon, 1994). However, the sample size in our study was insufficient to undertake covariance-based structural equation modelling techniques (e.g. LISREL, EQS); Partial least squares modelling, on the other hand, has rarely been recommended for mediation analysis in social science research as its effectiveness in terms of mediation analysis has not been validated yet. Third, our study assumes that all the relationships are unidirectional. Our approach neglects the potential for environmental performance to influence the EIS and either directly or indirectly impact back on commitment. It is possible that feedback and learning are playing a part in this dynamic process. Unfortunately, this is a limitation of a quantified survey approach and further qualitative case study work could be conducted to more fully explore these relationships. Fourth, there may be other potential mediators that this study has neglected. The existence of a significant positive direct relationship between the independent and dependent variables indicates the likelihood of such mediators, and future research should look for a positive indirect relationship rather than a negative one. However, caution should be taken when selecting and testing additional mediators to replicate and extend the findings. The selection of any mediator has to be theory-driven, with an aim to increase our understanding on environmental accounting information systems. Finally, there is still room for improvement on the environmental performance measure. The key question is how to preserve the dynamics of the concept while recognising the potential conflicting natures of the dimensions.

Notwithstanding the limitations described above, this paper sheds some light on the relationship between top management's commitment to environmental sustainability and environmental performance through the adoption of a sophisticated environmental information system. In particular, the availability of an aggregated environmental information system was identified as mediating the relationship between top management's commitment to environmental sustainability and environmental performance. Organisations with high commitment to environmental sustainability tend to adopt an aggregated environmental information system, and the adoption of such a system is more likely to lead to high environmental performance. However, this study fails to find similar effects for a broad-scope, timely and integrated environmental information system. The findings of this study have both academic and practical relevance. The study contributes to the corporate environmental accounting literature by empirically linking the top management's commitment to environmental sustainability and to environmental performance through the adoption of accounting information provisions (mainly aggregation). Although in a strict sense, the presence of such an environmental accounting system does not equate to usage of the system by the respondents, we strongly believe that the existence, or at least the knowledge of the existence, implies that the respondent is using it. If the information were not used, it is less likely that senior accountants would be aware of its existence. In addition, our study also extends academic research in this area from predominantly European or US-based research to Australia to enable better benchmarking among developed countries. By identifying that aggregated environmental accounting information improves environmental performance, the result of this study also provides guidance to practitioners about how to ensure their commitment to environmental sustainability will be translated to environmental performance. Finally, the finding of this study to some extent provides some answer to whether countries such as Australia should implement emission trading scheme (ETS) to account for the carbon costs.

Future research could consider whether environmental accounting information systems can play a more vital role in managing environmental sustainability.

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Appendix 1

| Industry classification | No. of responses | Percentage |
|-------------------------|------------------|------------|
| Mining and chemical | 5 | 10 |
| Food and household | 3 | 6 |
| Industrial | 14 | 28 |
| Trade and services | 10 | 20 |
| Financial services | 7 | 14 |
| Paper and packaging | 3 | 6 |
| Oil and gas | 8 | 16 |
| Total | 50 | 100 |

Table AI.
Industry classification

| | Factor loadings |
|--|-----------------|
| Top management's environmental commitment | |
| It pleases me to know that my own work has made a contribution to the environmental performance of the company's products/services/operations | 0.681 |
| A major source of satisfaction from my job comes from producing accurate environmental cost information | 0.762 |
| It is important to me that my company continues to put an emphasis on environmental performance | 0.720 |
| I am continually taking action to improve my company's environmental management system | 0.897 |
| Even if my work was never checked, I would continue to treat environmental performance as being important | 0.870 |
| I do not mind spending more time on developing an effective environmental management information system in order to assist decision-making, even if I get no credit for it | 0.832 |
| I am prepared to put in extra effort to meet environmental performance goals | 0.812 |
| In my job, environmental performance is one of the most important targets to achieve | 0.893 |
| I feel that providing accurate information on company's environmental performance is the most important aspect of my job | 0.767 |
| I take personal responsibility for the quality of my own work on the company's environmental performance | 0.855 |
| Each individual has an important part to play in increasing the environmental performance of my company's products | 0.789 |
| I feel I share a responsibility for the environmental performance of my company's products | 0.804 |
| The adoption of environmental information systems | |
| <i>1. Broad-scope</i> | |
| Information which relates to possible future environmental events is available in our organisation | 0.812 |
| Our organisation quantifies the likelihood of future environmental events occurring, such as probability estimates | 0.812 |
| Non-economic information, such as stakeholder opinion, employee attitudes, government regulations on environmental issues, is collected in our organisation | 0.775 |
| Information on broad factors external to our organisation, such as green house effect, global warming, pollution, is gathered in our organisation | 0.863 |
| Non-financial information that relates to the production, such as waste production, gas emission, is recorded in our organisation | 0.813 |
| <i>2. Timeliness</i> | |
| Environmental accounting information can be obtained immediately upon request in our organization | 0.880 |
| Environmental information will be supplied to us automatically upon its receipt into our organisation's information system or as soon as processing is completed | 0.895 |
| Environmental information reports are provided to us frequently on a systematic, regularly basis -, e.g. daily reports, weekly reports (for less frequent reporting mark lower end of scale) | 0.818 |

(continued)

Table AII.
Constructs and items

SAMPJ
4,1

100

| | Factor loadings |
|--|-----------------|
| There is no delay between environmental event occurring and relevant information being reported to me | 0.928 |
| <i>3. Aggregation</i> | |
| Environmental accounting information is provided on the different sections or functional areas in our organisation, such as production, marketing, sales | 0.789 |
| Environmental accounting information on the effect of events on particular time periods (e.g. monthly/quarterly/annual summaries, trends, comparisons, etc) is available to me | 0.830 |
| Environmental accounting information which has been processed to show the influence of events on different functions, such as production, marketing associated with particular activities or tasks is provided to me | 0.883 |
| Environmental accounting information on the effect of different sections' activities on summary reports such as profit, cost, and revenue reports for the overall organisation is available to me | 0.883 |
| Environmental accounting information is in the forms which enable me to conduct "what-if" analysis | 0.858 |
| We use environmental accounting information in the formats that are suitable for input into decision models such as incremental or marginal analysis | 0.892 |
| Environmental costs are separated into fixed and variable components in our organization | 0.874 |
| <i>4. Integration</i> | |
| Information on the environmental impact resulting from decisions of different sections/business units is available to us | 0.813 |
| Targets for the environmental protection activities are specified for all sections/business units in our organization | 0.879 |
| Information that relates to the impact that the decisions of different sections/business units have on the environmental performance is provided to us | 0.997 |
| Organisation's environmental performance | |
| Improved environmental performance | 0.714 |
| More informed decision-making | 0.826 |
| Uncovering cost cutting opportunities | 0.687 |
| Improved product pricing | 0.721 |
| Assisting with internal and external reporting | 0.867 |
| Increased competitive advantage | 0.827 |
| Improved reputation | 0.881 |
| Improved staff retention and attraction | 0.848 |
| Generating societal benefits | 0.827 |

Table AII.

| | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | Cronbach's α if item is deleted |
|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|---|
| C1 | 1.00 | | | | | | | | | | | | 0.954 |
| C2 | 0.557** | 1.00 | | | | | | | | | | | 0.953 |
| C3 | 0.665** | 0.463** | 1.00 | | | | | | | | | | 0.954 |
| C4 | 0.497* | 0.705** | 0.615** | 1.00 | | | | | | | | | 0.949 |
| C5 | 0.618** | 0.573** | 0.678** | 0.715** | 1.00 | | | | | | | | 0.950 |
| C6 | 0.519** | 0.548** | 0.543** | 0.737** | 0.811** | 1.00 | | | | | | | 0.951 |
| C7 | 0.568** | 0.547** | 0.602** | 0.695** | 0.777** | 0.873** | 1.00 | | | | | | 0.951 |
| C8 | 0.641** | 0.703** | 0.619** | 0.767** | 0.698** | 0.761** | 0.695** | 1.00 | | | | | 0.949 |
| C9 | 0.476** | 0.697** | 0.423** | 0.747** | 0.566** | 0.642** | 0.639** | 0.752** | 1.00 | | | | 0.952 |
| C10 | 0.504** | 0.674** | 0.544** | 0.798** | 0.700** | 0.623** | 0.630** | 0.754** | 0.750** | 1.00 | | | 0.950 |
| C11 | 0.577** | 0.549** | 0.591** | 0.683** | 0.743** | 0.609** | 0.586** | 0.600** | 0.474** | 0.763** | 1.00 | | 0.952 |
| C12 | 0.505** | 0.604** | 0.627** | 0.766** | 0.714** | 0.568** | 0.540** | 0.708** | 0.595** | 0.701** | 0.718** | 1.00 | 0.951 |

Note: Correlation is significant at: *0.05 and **0.01 level (one-tailed)

Table AIII.
Correlation matrix
and Cronbach's
(α for commitment

Table AIV.
Correlation matrix
and Cronbach's
 α for environmental
performance

| | EP1 | EP2 | EP3 | EP4 | EP5 | EP6 | EP7 | EP8 | EP9 | Cronbach's α if item is deleted |
|-----|---------|---------|---------|---------|---------|---------|---------|---------|------|--|
| EP1 | 1.00 | | | | | | | | | 0.938 |
| EP2 | 0.736** | 1.00 | | | | | | | | 0.931 |
| EP3 | 0.391** | 0.597** | 1.00 | | | | | | | 0.939 |
| EP4 | 0.384* | 0.663** | 0.647** | 1.00 | | | | | | 0.937 |
| EP5 | 0.616** | 0.646** | 0.669** | 0.677** | 1.00 | | | | | 0.929 |
| EP6 | 0.574** | 0.702** | 0.559** | 0.592** | 0.692** | 1.00 | | | | 0.931 |
| EP7 | 0.645** | 0.695** | 0.550** | 0.637** | 0.754** | 0.798** | 1.00 | | | 0.929 |
| EP8 | 0.630** | 0.635** | 0.495** | 0.548** | 0.703** | 0.709** | 0.797** | 1.00 | | 0.930 |
| EP9 | 0.620** | 0.629** | 0.570** | 0.530** | 0.752** | 0.634** | 0.681** | 0.847** | 1.00 | 0.932 |

Note: Correlation is significant at: *0.05 and **0.01 level (one-tailed)

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