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Applying GRI reports for the investigation of environmental management practices and company performance in Sweden, China and India

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ABSTRACT

The relationship between environmental management practices (EMPs) and company performance has recently been debated in literature and is of interest for both industrial managers and political decision-makers. This paper investigates the relationship between EMPs and firm performance in manufacturing companies in Sweden, China and India. With the content analysis of Global Reporting Initiative (GRI) reports and financial reports of sample companies, the levels of EMPs and the companies' financial performances were coded. Further statistical assessment was conducted in order to identify patterns and correlations. The results indicate that only selected EMPs have been employed differently in three different countries. Most EMPs clearly do not have a positive correlation with the financial performance; i.e. employing EMPs does not necessarily improve the economic consequence of companies. Nevertheless, a number of EMPs do have a strong correlation with improving innovation performance in various companies. It is also interesting to note that a negative correlation exists between the *Environmental standard for suppliers* and *Sales growth*. This is possibly due to increasing operational costs and a delay in market acceptance. This research illustrates the possibility of using standard environmental data from GRI reports as a resource for future studies of EMPs. In order to improve long-term financial performance, this study also suggests that innovation should gain a substantial amount of attention when EMPs are employed.

1. Introduction

Literature shows that operations management are increasingly interested in a relationship between environmental management practices (EMPs) and company performance (Donnelly et al., 2006; Jabbour et al., 2008 and Walls et al., 2012). In practice, many companies attempt to include an environmental issues strategy and agenda in order to address stakeholders' needs and competitive pressures (Hofer et al., 2012). One case in point is that more manufacturing facilities introduce an Environmental Management System (EMS) with the aim of improving their performance (Johnstone and Labonne, 2009). On the other hand, companies are facing the common perception that green management will increase costs and reduce profits, which discourage green management efforts. Empirical research is relatively limited when it comes to an investigation of the economic consequences of green management at the company level.

One recent interesting study concerning this was conducted by Montabon et al. (2007). By analyzing the reports from US and non-US corporates, they investigated a link between EMPs and company performance. They concluded that a positive and significant relationship exists between them. Also, by analyzing a sample of Standard & Poor's 500 companies, Khanna and Anton (2002) explored different motivations that drive corporate environmentalism. They found that specific factors such as proxies for incentives, a desire for a competitive advantage and regulatory pressures will determine the type of EMPs to be chosen by the companies. Moreover, some recent research indicates that EMPs can lead to innovations within companies, which should have a potential to further reduce costs or increase demands (Russo and Fouts, 1997; Montabon et al., 2007; Hall and Matos, 2010; Wolf, 2011; Wu and Pagell, 2011; Hofer et al., 2012). In other words, EMPs can first improve the innovation performance and then seek to enhance the financial performance. However, the interaction between innovation performance and financial performance has not been fully investigated.

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Despite the above positive results, there are also studies showing opposite outcomes. For example, Yang et al. (2011) tested relationships between lean manufacturing practices, environmental management entities and business performances by using the existing data from the International Manufacturing Strategy Survey, collected in 2005. They find that EMPs alone are negatively related to market and financial performances. However, improved environmental performance substantially reduces the negative impact of EMPs on market and financial performance.

According to the discussion above, there is still a limited amount of research that explores the relationship between EMPs and company performance. Furthermore, the study results are controversial. Additionally, the aforementioned studies do not distinguish between sample companies with external factors. Nevertheless, nowadays there are several emerging and continuing trends including green management efforts and globalization that lead to a variety of fundamental changes in the manufacturing environment. In order to conform to these trends, the academic area and management fields need to develop a better understanding of the relationship between EMPs and company performance. This should not only be the case for their countries, but also for other parts of the world. A comparison of various industrial sectors could also be of great interest.

Motivated by this background, the current study aims to explore the link between EMPs and its company's performance. One difference compared to previous studies is that the current research attempts to investigate this link within different contexts, i.e. different industries as well as different countries. An evaluation of their performance includes financial, innovative, and environmental considerations. Additional efforts will also be given to the interaction between innovation and financial performance in order to better understand EMPs and their impact. Previous studies such as Montabon et al. (2007) indicate correlations between a company's performance and some specific EMPs and will serve as the primary focus of this investigation. In short, this research seeks to:

- Explore the relationship between environmental management practices and a firm's financial performance. More specifically, it will compare any results found against those reported in Montabon et al. (2007);
- Compare if selected industries (for example, the process industry) are employing different environmental management practices than the rest of the manufacturing industry;
- Compare the companies' environmental management practices and environmental performance in developed and developing countries.

In order to achieve the above study objectives, several hypotheses were developed using organizational theory with details that are presented and explained in Section 2. In this study, data is collected from the published annual reports of the sample companies, i.e. Global Reporting Initiative (GRI) and financial reports. The levels of EMPs and their performance are coded using content analysis.

This paper will also contribute to the development of knowledge in several ways. It adds to the current literature by introducing a coherent theory building approach to investigate any link between EMPs and a company's performance. Institutional theory, win–win principle, complexity theory and diffusion theory of innovation are applied to develop hypotheses that will explore the links. Moreover, it examines the different EMPs that are employed and reported by manufacturing companies in developed and in developing countries. In this way, it enriches a discussion about environmental management and company performance while considering a facility's location. From a practitioner's point of view, this research helps managers predict any possible interactions among EMPs and the financial performance. It will also explore how they can integrate environmental management into their strategy development process.

2. Theoretical background and research framework

A recent literature review by Sarkis et al. (2011) illustrates organizational theory and its potential for advancing emergent environmental management or anything regarding the green supply chain management field. Based on the viewpoints of these authors, organizational theory provides a solid background for developing a research hypothesis. In the following, the research hypotheses in the current study and for relevant theories will be presented.

2.1. Institutional theory

Institutional theory is used to justify the sample selection in this research. Institutional theory explains how external pressures influence organizational actions (Hirsch, 1975; Sarkis et al., 2011). According to institutional theory, normative, coercive and mimetic drivers act as different isomorphic forms (DiMaggio and Powell, 1983; Sarkis et al., 2011). This means that governmental agencies, laws, regulations and requirements from society (those from customers and markets) will drive manufacturers to implement environmental management practices.

In European countries, manufactures have to be environmental friendly where this concept has lasted a long time. They have normative, coercive and mimetic pressures from governments, local communities, customers and other external stakeholders. Sustainable development was introduced as a specific goal of the *European Community* in the *Single European Act* of 1987. Furthermore, the integration of environmental requirements into full community policies was further included in the *Maastricht Treaty* of 1992 (Montgomery and Sanches, 2002). Moreover, a range of environmental policies have been established by the European Union, such as the restriction of hazardous substances (RoHS). This applies to product design and a waste electrical and electronic equipment (WEEE) directive, which is directed at product life cycles (Tseng, 2013). These regulations have an impact on some specific EMPs like environmental risk analysis, the use of life cycle analysis and an environmental design. For instance, the Swedish central government has a specific environmental requirement system where local communities also have programs that focus on environmental issues. Customers, including those in business, are often green-awarded. Therefore, Swedish companies and companies originating from Sweden are often considered to have well-developed environmental programs, including well-documented reports for their programs. Thus in this study, some Swedish companies were sampled to represent the developed countries.

Conversely, the need to export to foreign countries provides a certain amount of pressure for manufactures in developing countries, such as China and India, to improve their environmental performances. In these developing countries, economic performance is typically the most influential driver for companies to implement environmental management practices (Zhu and Sarkis, 2004). It is also particularly important to understand the relationship between environmental practices and a firm's economic performance in these rapidly developing countries. China and India are good examples. Their manufacturing industries make up large portions of their economies. Thus, sample companies from India and China were selected and compared for this study.

The study also found that differences in other distinguished industries are also interesting. In Sweden, Indian and China,

process industry and the mechanical/machinery industry contribute significant economic outputs. Most of the process oriented manufacturing industries consume more energy and are resource intensive. They include the pulp and paper industry, chemical industry, food process industry and mining companies. Compared with other industries, they face relatively high regulatory pressures from an internal and external stakeholders' perspective. According to the institutional theory (Zhu and Sarkis, 2007; Sarkis et al., 2010, 2011; Tate et al., 2010; Sarkis et al., 2011; Walls et al., 2012), regulatory pressures should also motivate companies to apply specific EMPs. Therefore, a comparison between a process industry and a non-process manufacturing industry was another focus of this study. Based on the above discussion, the following hypotheses were developed.

Hypothesis 1. *There are significant differences in environmental practices employed among manufacturing companies in Sweden, India and China.*

Hypothesis 2. *There are significant differences in environmental practices employed between the process industry and other manufacturing industries.*

2.2. Win–win principle

The win–win principle is developed from an ecological modernization theory with the aim to explain the relationship between environmental performance and other performances in a firm. Researchers that support the win–win hypothesis have the following arguments: i) Environmental regulations and standards can help companies achieve innovations, which can offset regulatory costs (Montabon et al., 2007; Sarkis et al., 2011). In this way, environmental practices adopted due to regulations can have a positive impact on a company's performance. ii) Environmentally proactive manufacturers put more efforts on technological innovation, which helps them to not only decrease their operational costs (for example by recycling wastes), but also to increase a demand for eco-friendly products. In this way, manufactures can gain more opportunities in their operations and improve their company's performance (Montabon et al., 2007; Sarkis et al., 2011).

Based on the above win–win principle, the following hypothesis is developed in order to contribute to the previous debate on EMPs, a company's performance and its sustainability strategy.

Hypothesis 3. *There are correlations between environmental practices and innovation/ financial performance in the manufacturing industry.*

2.3. Complexity theory

In an organizational context, complexity theory can be explained through environmental factors such as customers, suppliers, governmental regulations, and technological advancements (Chakravarthy, 1997). Practices and performance in a firm are influenced by both internal and external factors. Some early studies indicate the importance of a supply chain environment in implementing EMPs. The implications for complexity theory in these kinds of studies state that some activities like an early supplier's involvement in new eco-product designs can influence a firm's performance. Additionally, standardizing and auditing a suppliers' environmental management system, communications with customers for eco-design, and the handling of product returns from customers can also influence a firm's performance (Koufteros et al., 2007, Sarkis et al., 2011; Vachon and Klassen, 2006). Moreover, according to Tseng (2011a, b), productivity and competitive advantage can be enhanced through a proposed framework for the assessment of Green Supply Chain Management (GSCM), since GSCM criteria can help review and improve development plans and performance evaluations strategically. Hence the following hypothesis was developed.

Hypothesis 4. *Early supplier involvement, environmental standards and audits for suppliers correlate well with a firm's performance.*

2.4. Diffusion theory of innovation

The diffusion theory of innovation claims that innovation can be communicated by social members. Early adopters of it can also often have more benefits (Sarkis et al., 2011). The diffusion of environmental friendly operations can be seen as an innovation process. According to an eco-innovation and global diffusion model by Huber (2008), a pioneering country and its rooted industries often develop regulatory and innovation technologies in a global innovative competition. Subsequently, other countries will either adopt these regulations or have the intention to do so. The pioneer adopters often gain more of an improvement in performance than later ones, namely imitative adopters. Sweden has long been credited with employing good environmental practices, whereas other countries like China and India are often considered by the rest of the world as just starting to develop environmentally friendly manufacturing practices. Thus, the last hypothesis is introduced.

Hypothesis 5. *Sweden's environmental performances in manufacturing are different compared to the similar industry in India and China.*

3. Research methodology

3.1. Sample companies

This study has a focus on the manufacturing industry with selected samples from Sweden, China and India. For each sample company, the selection criteria include:

- The company should belong to a manufacturing industry;
- The company should originate from Sweden, China or India;
- The company should have a GRI report in 2010.

First, a potential list that includes 109 manufacturing plants in Sweden was obtained. This is the same list that was presented in a previous study (but with different study objectives) conducted in 2006 by one of the authors (Feldmann, 2011). However, while that study focused on manufacturing plants, this one concentrates on manufacturing companies and was difficult to collect a large size of samples from. In fact, in many cases, several manufacturing plants belong to the same company. Thus, more potential sample companies from Sweden are drawn from the following sources: The Dow Jones Sustainability World Index 2010 and the sustainable operations ranking list for companies by the global investment banking and securities company Goldman Sachs as well as the financial services company UBS in 2010.

Using the selecting criteria of a manufacturing company original from Sweden, these sources provide a list of Atlas Copco, Electrolux, Sandvik, SKF, SCA, Volvo Group, Assa Abloy and ABB. Combined with a list from a previous survey study (Feldmann, 2011) and deleting duplications, finally 16 manufacturing companies that serve as research samples for Sweden were obtained. Additionally, data was collected from published sustainable reports (GRI) on the official website of the sample companies.

As stated before, the original Swedish samples can be obtained from the above lists while the Indian and Chinese ones are not listed in the Dow Jones Sustainability World Index 2010 or in the

sustainable rankings from Goldman Sachs or UBS. Thus, concerning the Chinese and Indian samples, only the manufacturing companies who are registered to the Sustainability Disclosure Database (Global Reporting Imitative, 2012) have been selected. In order to avoid non-standard environmental reporting data, only those companies that have introduced a GRI reporting system are chosen. If the GRI report in 2010 cannot be found on the official website of the company, the Sustainability Disclosure Database (Global Reporting Imitative, 2012) is used for a double check. As the result, 9 Chinese and 12 Indian companies meet the criteria.

Finally, 37 companies satisfy the selection criteria and are included as examples in this study. Recall that one research purpose is to investigate the existence of mechanisms behind the relationships between EMPs and a company's performance, especially in the manufacturing industry. As stated before, most process oriented manufacturing companies consume more energy and resources and feel more regulatory pressure. One hypothesis indicates that there are significant differences in environmental practices employed between a process industry and another manufacturing industry. Thus, the 37 selected companies are divided into two groups depending on their manufacturing branches, i.e. *Process Industry* and *Non-Process Industry*. The latter includes automotive, electronics and capital goods, etc. The samples are summarized in Table 1.

In order to evaluate the impact of EMPs on financial measures, it is also necessary to define some financial variables. According to a literature review and annual financial reports by sample companies in Sweden, China and India, a *Return on capital employed by (ROCE)* and *Sales growth* are used as financial measurements. These are the same that were used in Montabon et al. (2007) except that they also use operating earnings as a financial indicator. Since most Chinese and Indian companies do not publish operating earnings in their annual financial reports, this study's operating earnings are excluded from financial performance indicators. The information for *ROCE* and *Sales growth* can often be obtained in the annual report of the sample companies. Additionally, these measures efficiently reflect the aggregate financial performance at the company level. Details of the definition are presented below.

Table 1
Summary of the samples.

Company name	Country	Industry
BT[a]	Sweden	Automobile
Scania	Sweden	Automobile
Volvo Cars	Sweden	Automobile
ABB	Sweden	Capital goods
SKF	Sweden	Capital goods
Alfa Laval	Sweden	Capital goods
Assa Abloy	Sweden	Capital goods
Elektrolux	Sweden	Capital goods
Ericsson	Sweden	Electronics
AAK	Sweden	Process
Billerud	Sweden	Process
Holmen	Sweden	Process
Stora Enso	Sweden	Process
SCA	Sweden	Process
Sandvik	Sweden	Process
SSAB	Sweden	Process
BYD	China	Automobile
Dongfeng Peugeot	China	Automobile
Weichai Power	China	Automobile
China National Machinery Industry Corporation	China	Capital goods
China National Erzhong Group	China	Capital goods
Huawei	China	Electronics
Foxconn	China	Electronics
Alumium Corporation China	China	Process
Bao Steel group	China	Process
Tata motors	India	Automobile
Mahindra	India	Capital goods
Reliance Industries	India	Capital goods
ITC Ltd.	India	Capital goods
JSW steel	India	Process
ACC(cement and Contrete)	India	Process
Ambuja Cements	India	Process
Tata Metaliks	India	Process
Sail Mental	India	Process
Shree cements	India	Process
Chambal Fertilizers and Chemicals Limited	India	Process (chemicals)
Jubilant Life Sciences Ltd	India	Process (chemicals)

[a] Swedish origins, but currently owned by foreign company.

3.1.1. Return on capital employed (ROCE)

This is an objective financial measure, which reflects the success of a business in realizing its goal. It is often applied to indicate the overall efficiency and profitability of the business (Devinney et al., 2010).

$$\text{Return on Capital Employed} = \text{Net Operating Profit After Tax} / \text{Capital Employed}$$

3.1.2. Sales growth

This states an increase in sales over a specific period of time. In this research, we only calculated the sales growth for the 2010 fiscal year.

The financial data is collected from published 2010 annual reports of sample companies. The data for Swedish companies was also taken from Affärsdata (Business data) a database for a double check.

3.2. Content analysis

Instead of using an existing database, the data is collected from the published reports of sample companies in this study. The main methodology applied in this research is content analysis based. Content analysis has been recognized as a systematic, structural, replicable methodology for compressing long texts into fewer content categories based on an explicit coding process (Krippendorff, 2012; Shorideh et al., 2012). It is also a literature review method of a systematic, quantitative and qualitative description of a manifest content of literature in our specific area (Marasco, 2008). Moreover, research in accounting has shown the opportunity to classify disclosures as favorable or unfavorable, with quantitative measures that reflect the intensity or degree of favorableness, especially based on the published annual reports of companies (Moneva et al., 2006).

According to Krippendorff (2012), six questions have been addressed for content analysis:

- Which data are analyzed?
- How are they defined?
- What is the population from which they are drawn?
- What is the setting relative to which the data are analyzed?
- What are the boundaries of the analysis?
- What is the essence of the inferences?

The analysis is restricted in the following four-step framework (Gold et al., 2010):

- Material collection
- Descriptive analysis
- Category selection
- Material evaluation

In this study, the relationship between one set of independent variables and dependent variables corresponding to a company's

performance is tested. The independent variables are 33 EMPs (see the Appendix), which are the same as in Montabon et al. (2007). Some previous studies indicate that environmental regulations can lead to innovations, and that the resulting profits may offset the cost of complying with the regulation (Montabon et al., 2007; Porter and van der Linde, 1995). Thus, company performance is also measured by innovation performance in addition to the financial performance indicated previously. Furthermore, innovation performance is measured by variables of product innovation and process innovation. As was previously mentioned, *ROCE* and *Sales growth* are used as variables to measure the impact of the financial performance of EMPs. Data is collected from GRI reports and annual financial reports of the sample companies.

3.3. Data processing and validity

The company's annual GRI reports have been coded on the same time basis in 2010. Content analysis is limited as far as clarifying the reliability and validity of the information. In order to overcome this, several independent researchers should conduct the search and coding. This helps to reduce any restrictions that are found and will also serve to strengthen it scientifically (Gold et al., 2010). In this study, besides the authors, assistance was obtained from two master's degree students that conducted the content analysis in order to enhance the reliability of the study. Each report was evaluated by at least two designated raters and the coding process was finished in seven weeks.

Through a systematic approach and a structured process, research objectivity was ensured (Seuring and Müller, 2008). Hence, the researchers had a discussion in a seminar with these aims:

- To identify the objectives of this research
- To design a standard coding process
- To ensure a consistent usage of the code sheet

At the first seminar, all of the EMPs and their performances except for the financial performances are coded and tested for a sample company to establish the validity and reliability of the scales used in this analysis. The Appendix shows the coding matrix for the sample companies. The raters rated some reports as much as three times in order to understand inconsistencies. In these cases, different judgments have been accessed and resolved one at a time. With each effort, consistency is improved in the evaluation process and this further increases the reliability of the data (Kassarjian, 1977).

One of the current research's purposes is to compare the results of Montabon et al. (2007). The current study uses a standard environmental report, i.e. a GRI report, which was not used by Montabon et al. (2007) since such a standard environmental report was much less popular at the time. However, the same scales from their experiment are used in this research. These scales include EMPs and performance measurements (see the Appendix). Only one financial performance measurement, operating earnings, is excluded since annual reports of companies in China/India do not release them often. The validity of these scales has been approved by Montabon et al. (2007) in the following ways: employing a literature review, anecdotal accounts in the business press, interactions with managers from the industry by researchers and projects on environmental management.

In order to further test the validity of the data in this study, the correlations between operational, tactical, strategic, total EMPs and environmental performance have been explored. In principle, EMPs should directly improve their environment performance. A Spearman's Rho test is used here since the EMPs and the companies' environment performance both involve ranked scales. The results in Table 2 indicate a strong and positive correlation between the total number of EMPs and the environment performance. The correlation coefficient $r = .515$, ($N = 37$, $p < 0.01$) indicates that high levels of total EMPs are associated with high levels of environmental performance. Meanwhile, there are some moderate positive correlations between tactical EMPs and the environmental performance (correlation coefficient $r = .416$, $N = 37$, $p < 0.10$). We can also see that this is true for strategic EMPs and the environmental performance (correlation coefficient $r = .484$, $N = 37$, $p < 0.01$). The above test illustrates that our data supports a correlation between EMPs and the environment performance. The coded data is therefore validated.

4. Data analysis

In this section, the first hypotheses will be tested. Hypothesis 1 states that there are significant differences in EMPs employed among manufacturing companies in Sweden, China and India. Since there are three groups, a non-parametrical Kruskal–Wallis 1-way ANOVA has been applied for each of the individual practices, for the total amount of operational EMPs, total tactical EMPs, total strategic EMPs as well as for all of the EMPs. The results indicate that a majority of EMPs do not have any significant differences for all three countries. Significant differences ($p < 0.05$) are only discovered in seven specified environmental management practices when comparing companies in Sweden, China and India:

- *Waste reduction (reactive)*
- *Supply chain management*
- *Environmental standards for suppliers*
- *Environmental participation*
- *Product development and innovation*
- *Specific design targets*
- *Corporate policies and procedures*.

According to Table 3, it is interesting to see that Sweden is better than China and India when it only concerns the EMP of *Supply chain management* (SCM). Regarding the other six EMPs the only significant difference is that Sweden is worse than China or India. Additionally, the EMPs of *Environmental audits for suppliers* and *Strategic alliances* indicate a potential difference between country groups, but only on a significance level of 10% ($p < 0.10$). Again, with these two EMPs, Sweden is not better than India or China. One possible reason for this is its impact from globalization. As Christmann and Taylor (2001) indicate in their research, globalization has positive

Table 2
A Spearman' rho test for correlations between EMPs and the environmental performances.

		Environmental performance
Operational	Correlation coefficient	.220
	Sig. (2-tailed)[a]	.191
	N[b]	37
Tactical	Correlation coefficient	.416*
	Sig. (2-tailed)	.010
	N	37
Strategic	Correlation coefficient	.484**
	Sig. (2-tailed)	.002
	N	37
Total	Correlation coefficient	.515**
	Sig. (2-tailed)	.001
	N	37

*Correlation is significant at the .05 level (2-tailed).
**Correlation is significant at the .01 level (2-tailed).
[a] Two-tailed significance test is used since a difference in direction is not specified.
[b] *N* is the sample size.

Table 3
Ranks for EMPs between Sweden, China and India ($p < 0.05$).

	Country	*N*	Mean rank
Waste reduction (reactive)	Sweden	16	20.50
	India	12	15.88
	China	9	20.50
	Total	37	
Supply chain management	Sweden	16	24.31
	India	12	9.58
	China	9	22.11
	Total	37	
Environmental standard for suppliers	Sweden	16	21.75
	India	12	12.29
	China	9	23.06
	Total	37	
Environmental participation	Sweden	16	19.81
	India	12	24.33
	China	9	10.44
	Total	37	
Product development and innovation	Sweden	16	15.72
	India	12	17.75
	China	9	26.50
	Total	37	
Specific design targets/goals	Sweden	16	21.31
	India	12	11.29
	China	9	25.17
	Total	37	
Corporate policy/procedure	Sweden	16	17.75
	India	12	24.88
	China	9	13.39
	Total	37	

environmental effects because global ties increase self-regulatory pressures on firms in low-regulation countries. Even though Indian and China have less strict environmental regulation than Sweden, the global tie still pushes the big manufactures to increase self-regulatory pressures and helps them to implement better environmental management practices. In this way, the large manufacturing companies in India and China may reach the same environmental standard as their international competitors.

The next analysis explores Hypothesis 2, which states: there are significant differences between process industries and the other manufacturing industries in terms of *their employment of EMPs*. All of the EMPs are on non-parametric scales where the sample company for process one is 17 and non-process ones are listed at 20. Since the sample size for both groups is less than 30, a non-parametrical Mann-Whitney-U-test is performed for each individual EMP, as well as a total number of operational EMPs, tactical EMPs, strategic EMPs and EMPs in their entirety. When a test is conducted at a significance level of 5% ($p < 0.05$), there is not a significance between these two groups. Furthermore, since the result can be caused by relative small samples, a further test at the 10% level is applied. There are minor differences between process and non-process industries at a 10% level ($p < 0.10$) in terms of the following EMPs:

- *Creating a market for waste products* which belongs to the operational EMPs. Process manufacturing companies do better with this EMP.
- *Environmental audits of suppliers* and *Use of life cycle analysis or design for environment* which belong to tactical EMPs. Non-process manufacturing companies do better in both of these two EMPs.

Corporate environmental standards and environmental auditing are often motivated by regulatory pressures (Khanna and Anton, 2002). Process industries including pulp and paper producers as well as chemical producers often face more pressures from external stakeholders and have more regulatory pressures. Moreover, the pulp and paper industry has a mature waste products market. For example, the European pulp and paper industry produces eleven million tons of waste where 70% of it is recycled (Monte et al., 2009). Additionally, Azapagic (1999) stated in her review paper that an increasing pressure on the chemical and process industries will improve their environmental performance. As a result a more acceptable life cycle analysis coupled with a multi-objective optimization as a process design tool will optimize the environmental, economic, technical and other miscellaneous aspects of this industry simultaneously. However, it is interesting to note that according to the current study, a process industry is not necessarily better in EMPs compared to a non-process manufacturing industry. Previous studies are often limited to just analyzing one individual industry rather than a comparison of one industry to another. As a result, empirical research is limited in this area and more research should concentrate on this in the future.

At the next stage of data analysis, a correlation between environmental practice, firm innovation and financial performance is investigated. For all companies, the sum of all environmental practice scores has been calculated as well as the aggregate scores for operational, tactical and strategic practices. These scores (shown in Table 4) have then been compared as far as their *ROCE* and *Sales growth* is concerned. Since EMPs are known as ranked scales, a correlation between EMPs and the financial performance is tested by Spearman's Rho test, which is a nonparametric correlation analysis that is capable of both ranked and continuous scales. Some tests have a reduced number of sample sizes due to an unavailability of certain financial performance measures. As can be seen in Table 4, neither the total amount of environmental management practices, strategic EMPs, tactical EMPs or operational EMPs have significant correlations with these two measures of financial performance – namely the *ROCE* and in their *Sales growth*.

In order to further compare the results with ones in Montabon et al. (2007), the Spearman's rho correlation tests have been applied looking at the financial performance and six other selected variables, which have been identified to be significant according to a conclusion reached by Montabon et al. (2007). These six EMPs are: *Recycling*, *Proactive waste management*, *Remanufacturing*, *Environmental design*, *Specific design targets* and *Surveillance of the market for environmental issues*. The results can be found in Table 5. According to a current study, there are not any significant correlations between these EMPs and the financial performances.

At this point, a further test between the rest of the 27 EMPs and the financial performances was conducted. Four specific EMPs have significant correlations with the financial performances and include *Environmental information*, *Supply chain management*, *Environmental statuses for suppliers* and *Environmental risk analysis*,

Table 4
Spearman's rho test for the correlations between operational, tactical, strategic and total EMPs as well as for financial Performance.

		Return on capital employed	Sales growth
Operational	Correlation coefficient	-.126	.227
	Sig. (2-tailed)	.532	.197
	Sample size *N*	27	34
Tactical	Correlation coefficient	−.031	−.256
	Sig. (2-tailed)	.879	.144
	N	27	34
Strategic	Correlation coefficient	−.118	−.076
	Sig. (2-tailed)	.558	.669
	N	27	34
Total	Correlation coefficient	.005	−.070
	Sig. (2-tailed)	.979	.694
	N	27	34

Table 5
Spearman's rho test for correlations between six specific EMPs and the financial performances.

		Return on employed capital	Sales growth
Recycling	Correlation coefficient	−.026	−.200
	Sig. (2-tailed)	.899	.256
	N	27	34
Waste reduction (proactive)	Correlation coefficient	−.022	.142
	Sig. (2-tailed)	.915	.423
	N	27	34
Remanufacturing	Correlation coefficient	.325	.209
	Sig. (2-tailed)	.098	.235
	N	27	34
Environmental design	Correlation coefficient	.246	−.091
	Sig. (2-tailed)	.217	.607
	N	27	34
Specific design targets/ goals	Correlation coefficient	.077	−.316
	Sig. (2-tailed)	.702	.068
	N	27	34
Surveillance of market	Correlation coefficient	.068	.034
	Sig. (2-tailed)	34	.847
	N	−.122	34

as seen in Table 6. Only *Environmental information* was observed to have a positive strong correlation with *Sales growth* ($r = .501$, $N = 34$, $p < 0.05$) which indicates higher levels of environmental information that was disclosed and was also associated with higher levels of *Sales growth*. Sufficient environmental disclosure can increase an external stakeholder's confidence, and thereby, increase a heightened market acceptability of the products. This can, in turn, also favor *Sales growth*. Furthermore, the three other EMPs exhibited negative correlations with regards to *Sales growth* (see Table 6). Therefore, regarding Hypothesis 3, we conclude that only specifically selected EMPs (which differ from the ones in Montabon et al., 2007) have correlations with the financial performances, and such correlations can be seen as either positive or negative.

When searching for correlations between environmental practices, the performances and the process and product innovations, again a Spearman's Rho test was applied since the EMPs and the innovation performance rankings are on both scales. As was conducted previously, the test starts with obtaining the overall scores for environmental practices (operational, tactical, strategic and total) in order to identify whether any specific level of practice seems to have a greater impact. The results in Table 7 indicated that there is not a correlation between operational EMPs and the level of innovation performance. However, there is a strong positive correlation between two other variables, i.e. a correlation coefficient of $r = .570$ ($N = 36$, $p < 0.001$) indicates that higher levels of tactical EMPs are associated with higher levels of innovation performance (products). Meanwhile, there is medium correlation between strategic EMPs and their innovation performance (products) with a correlation coefficient of $r = .489$ ($N = 36$, $p < 0.001$). A correlation between total EMPs and the innovation performance (products) are strong and positive with a correlation coefficient of $r = .556$ ($N = 36$, $p < 0.001$). One reason for this phenomena is that EMPs can be treated as an overall strategic organizational approach, which plays an important role in planning the product/process design nowadays (Tseng et al., 2008a, 2008b; Tseng, 2011a, b). An empirical research on German manufacturing companies also shows a positive correlation with the implementation level of environmental management systems and environmental product/process innovation (Wagner, 2007). In EU countries, there are unique standards for environmental management systems such as the EU Environmental Management and Auditing Scheme (EMAS). Rennings et al. (2006) conducted a study that gathered data on a set of German EMAS-validated facilities. Their research indicates that there is a positive impact on the maturity of environmental

Table 6
Spearman's rho test indicating correlations between selected EMPs and the financial performances.

		Return on capital employed	Sales growth
Environmental information	Correlation coefficient	−.287	.501**
	Sig. (2-tailed)	.147	.003
	N	27	34
Supply chain management	Correlation coefficient	−.079	−.341*
	Sig. (2-tailed)	.697	.048
	N	27	34
Environmental standard for suppliers	Correlation coefficient	−.160	−.358*
	Sig. (2-tailed)	.427	.038
	N	27	34
Environmental risk analysis	Correlation coefficient	.073	−.424*
	Sig. (2-tailed)	.718	.012
	N	27	34

*Correlation is significant at the .05 level (2-tailed).
**Correlation is significant at the .01 level (2-tailed).

Table 7
Spearman's rho test for correlations between EMPs and the innovation performances.

		Innovation performance (products)	Innovation performance (process)
Operational	Correlation coefficient	.079	.191
	Sig. (2-tailed)	.648	.265
	N	36	36
Tactical	Correlation coefficient	.570**	.046
	Sig. (2-tailed)	.000	.791
	N	36	36
Strategic	Correlation coefficient	.489**	.186
	Sig. (2-tailed)	.002	.277
	N	36	36
Total	Correlation coefficient	.556**	.098
	Sig. (2-tailed)	.000	.568
	N	36	36

*Correlation is significant at the .05 level (2-tailed).
**Correlation is significant at the .01 level (2-tailed).

Table 8
Spearman's rho test for the correlations between six specific EMPs and their innovation performances.

		Innovation performance (products)	Innovation performance (process)
Recycling	Correlation coefficient	.213	.140
	Sig. (2-tailed)	.212	.415
	N	36	36
Waste reduction (proactive)	Correlation coefficient	.073	.044
	Sig. (2-tailed)	.674	.798
	N	36	36
Remanufacturing	Correlation coefficient	−.048	−.114
	Sig. (2-tailed)	.781	.509
	N	36	36
Environmental design	Correlation coefficient	.541**	.449**
	Sig. (2-tailed)	.001	.006
	N	36	36
Specific design targets/goals	Correlation coefficient	.525**	.123
	Sig. (2-tailed)	.001	.473
	N	36	36
Surveillance of market	Correlation coefficient	.679**	.150
	Sig. (2-tailed)	.000	.381
	N	36	36

*Correlation is significant at the .05 level (2-tailed).
**Correlation is significant at the .01 level (2-tailed).

management systems as far as their environmental process innovations are concerned. Furthermore, environmental management systems have a positive impact on environmental product innovations and learning processes. Most Indian and Chinese companies do not comply with EMAs and are currently in the middle of a learning process when it comes to these standards. Due to the inclusive nature of these examples, it is reasonable to note that a significant correlation exists between innovation and performance in products rather than when it comes to process, operations, tactics, various strategies and the total amount of EMPs.

At this point, correlations between the previously selected six selected variables (identified with the financial performances in Montabon et al., 2007) and the innovation performances have been tested. From Table 8, it can be seen that *Environmental design* is positively correlated significantly to both *product and process innovation*. Additionally, *Specific design targets* and the *Surveillance of markets* are both positively correlated significantly to *product innovation*. Environmental considerations will also affect a company's research and design practices and drive them to design more eco-efficient products and create more product innovations (Noci and Verganti, 1999). This result can also be supported by an environmental modernization theory and empirical research by Rennings et al. (2006). According to their study, the implementation of environmental policies connects environmental management to technical/environmental innovations including product and process innovations.

At this point, correlations, between 27 other EMPs and the innovation performances were tested. They found both positive and direct connections between several different EMPs and their innovation performances both in product and in process. For example, *Product Development, Innovation*, *Design*, and *Strategic alliance* all correlate positively to their innovation performances with respect to both product and process. *Life cycle analysis*, *Specific design targets, Communication, Integration with long-term business strategy, and Surveillance of market* also correlate positively to innovation performance of product. The *Environmental mission statement* correlates positively to innovation performance of process. Again, these EMPs belong at tactical and strategic levels. The results are also in line with those of Theyel (2000), where they found that several EMPs will improve environmental innovation, performance and possibly reduce costs.

In order to test Hypothesis 4, the Spearman's Rho analysis is applied to examine *Early supplier involvement*, *Environmental standard for suppliers*, an *Environmental audit for suppliers* and their correlation with a firm's financial performances. Not every company's financial data can be obtained, thus these companies without data on *ROCE* or *Sales growth* were excluded. The results are presented in Table 9, which indicates that there are significant negative correlations between *Environmental standard for suppliers* and *Sales growth*. It also means that that higher *Environmental standard for suppliers* leads to lower *Sales growth*. These *Environmental standards for suppliers* can approve of the environmental friendly quality of the product, and thereby, meet an ever increasing market demand for environmentally friendly products. However, on the other hand, it may increase costs, not only for suppliers, but also for the company itself. Additionally, it may prolong the design and production process and further delay the time of introducing products to the market. A positive impact for markets might only be realized in the long-term as the market needs time to accept a greener product and possibly at a higher price. On a short-term scale, a stricter *Environmental standard for suppliers* will increase the purchasing cost and then increase the final price, which will be negative to *Sales growth*.

Table 9
Spearman's rho test for correlations between an early supplier's involvement, an *Environmental standard for suppliers* and an environmental audit for suppliers and the financial performance.

		Return on capital employed	Sales growth
Early supplier involvement	Correlation coefficient	−.014	.009
	Sig. (2-tailed)	.945	.958
	N	27	34
Environmental standard for suppliers	Correlation coefficient	−.160	−.358*
	Sig. (2-tailed)	.427	.038
	N	27	34
Environmental audits of suppliers	Correlation coefficient	.103	−.236
	Sig. (2-tailed)	.608	.180
	N	27	34

*Correlation is significant at the .05 level (2-tailed).
**Correlation is significant at the .01 level (2-tailed).

In order to test Hypothesis 5, the environmental performance among manufacturing companies in Sweden, India and China are compared. According to Montabon et al. (2007), the Environmental performance is measured using the following indicators: *Reduction in significant environmental incidents, Environmental certification, Continuous improvement, Recycling performance, Customer and shareholder perception of environmental performance, Independent audits of environmental performance, Waste reduction, Resource consumption (water, energy, steam, solids, fuel) and Cost savings for environmental projects and activities.* These factors are also scored based on the content analysis of a company's GRI report.

A non-parametrical Kruskal–Wallis 1-way ANOVA has been performed and the results show only two factors, *Customer and Shareholder Perception* and *Cost savings for environmental projects and activities* have a significance difference level of5% ($p < 0.05$) among manufacturing companies in Sweden, India and China for environmental performance. It is also interesting to note that in Customer and shareholder perception, India ranks highest while in *Cost savings for environmental projects and activities*, China ranks the highest. This indicates that in India, the public requirement for environment performance is high, whereas in China, recent quick economic developments, costs and profits are still the main driving forces for evaluating performance. In fact, other environment performances do not show any significant differences. As stated before, globalization creates pressure for large manufacturing companies in developing companies such as China and India to improve their environmental performance in order to catch up with their global competitors. This could be the reason for why a difference of environment performance between these countries is diminishing.

5. Results

A growing number of companies publishing GRI reports indicate an increasing engagement in standardized and effective measures for environmental practices and performance. In this study, the GRI report has been applied as an innovative approach for collecting data and comparing the EMPs between different industries and countries. A total of 37 companies were selected from Sweden, China and India in order to investigate the links between EMPs and a company's performances.

According to the results of the statistical analysis, there exists no significant difference in EMPs between a process industry versus other manufacturing industries at the 5% level ($p < 0.05$). There are seven EMPs employed differently by Sweden, China and India at the 5% level ($p < 0.05$). These seven EMPs include *Waste reduction (reactive), Supply chain management, Environmental standards for suppliers, Environmental participation, Product development and innovation, Specific design targets and Corporate policies and procedures*. One interesting finding is that in most of these EMPs, Sweden is not necessarily better than China or India except in

Supply chain management. The small and medium sized companies in Sweden, China and India still did not provide for any sustainability disclosure. Most of the sample companies in these three countries are top companies in the world or at least in their own country due to one sample selection criterion – the GRI report. Also those large companies who have standards such as EMAS and ISO 14001 often transfer their environmental management practices to other facilities worldwide. This could be one reason for explaining why there are not many significant differences concerning the performance in sample companies in these countries. Nevertheless, the study result still shows that globalization and the changing manufacturing environment have an impact on reducing the difference in the employment of EMPs in these countries, particularly with these large companies.

Furthermore, direct correlations have not been found between tactical, strategic, total EMPs and a company's financial performance according to these samples. However, when investigating the correlation between EMPs and the innovation performance, it can be found that higher levels of tactical EMPs, strategic EMPs and total EMPs are associated with higher levels of innovation performance (products). Concerning the 6 EMPs which are identified as significantly correlating to financial performance and innovation performance in Montabon et al. (2007), a significant correlation cannot be seen between these 6 EMPs and the financial performances in these 37 samples. However, *Environmental design* is positively and significantly correlated to innovation performance, both in product and in process. Additionally, some special EMPs including *Specific design targets* and *Surveillance of Markets* are both significantly correlated to product innovation in a positive way. It is interesting to note that there is a negative correlation between *Environmental standard for suppliers* and *Sales growth*. One possibility is that stricter *Environmental standards for suppliers* will increase purchasing costs, which will lead to less market acceptance. Four specific EMPs have correlations with the financial performances and these include *Environmental Information*, *Supply chain management*, *Environmental for Suppliers* and *Environmental risk analysis*. Moreover, only *Environmental Information* category was shown to have a strong and positive correlation with *Sales growth*. This shows that a sufficient and efficient environmental information disclosure to the public will have the potential to increase a market acceptance for products and then increase *Sales growth*.

After comparing the environmental performances of Sweden, China and India, only *Customer and shareholder perception* and *Cost savings for environmental projects and activities* display a significant difference ($p < 0.05$) between these three countries. Again, according to these samples, Sweden is not necessarily doing better than China or India with respect to environmental performance.

6. Conclusion and managerial implications

The research results have managerial implications for environmental management within the field of operations management. First of all, the research findings clearly indicate that environmental management at tactical, strategic and at all levels have positive correlations with product innovations. Thus, in order to improve product innovation and keep a competitive advantage, the decision makers of companies have to consider the strategic importance of environmental friendly operations. Moreover, *Design* and *Design for Specific design targets* are strongly correlated with innovation performance (products) in a positive way. This indicates that managers must be aware that in order to achieve innovation performance, it is important to put more efforts at the early stages of a production process. For example, a company should have an environmental consideration for eco-efficiency at the research and design stage.

Regarding the 33 EMPs, only environmental information has strong and positive correlation with *Sales growth*. This shows the importance of environmental information disclosure. Managers should put more efforts into announcing environmental information that can improve their relationship to external stakeholders, including customers. In general, operational, tactical, strategic and total EMPs are statistically insignificant with regards to financial performance. This result is almost consistent with findings in Hofer et al. (2012). Therefore, companies perceiving investments in environmental management and further improving their EMPs may not immediately gain economic profit. For example, one result this study shows is that a stricter *Environmental standard for suppliers* will increase purchasing costs, which will lead to less market acceptance and reduce *Sales growth*. These potentially high upfront costs and their uncertain payoffs will discourage a company's attempt to improve their environmental practices (Hofer et al., 2012). However, according to this research, the improved EMPs can still have a positive impact on environmental performance. In this case, there are positive correlations with innovation performance, which may lead to a favorable financial performance in the future.

This research also indicates that there is a lacking of management awareness concerning environmental management performance audits and their available procedures are still uncertain. From a managerial perspective, the findings of this paper should further raise awareness of standardized formats for reporting environmental management practices like following the Global Reporting Initiative guideline. In this way, it enables companies to obtain a transparent internal and external communication system as well as a visual control of the triple bottom line on a company level (Hedberg and von Malmborg, 2003). Also, this research should further raise awareness of potential business performance improvements, especially in the manufacturing industry. This awareness should help decision makers to make better choices as far as their environmental practice strategies and implementations are concerned. In this study, the investigation is mainly based on data from GRI reports. Due to a time lag between an EMPs implementation and its effect on a company's performance, the companies who follow the GRI reporting system may not necessarily perform better than others in the short run. However, the transparency in a sustainability reporting system should enhance the opportunity to gain a potential competitive advantage and improve long term relationships with internal and external stakeholders.

7. Limitations

In this study, all of the data is collected based on GRI and financial reports in 2010. One limitation is the time lag between environmental management practice implementation and its specific effect on a company's performance. One future extension will be to investigate companies using a GRI reporting standard for several years. This should definitely be interesting, but a limitation to this is a further reduction of the potential sample, since only a limited number of companies have adopted a GRI reporting standard and have a history over several consecutive years.

In this research, the total sample consists of 37 companies, which are split into three different groups based on regions. The sample size is another limitation of this paper, since advanced statistical methods often require larger sample sizes. An increased sample size could also help achieve significant results for some of the tests that were borderline significant. Nevertheless, as a GRI report often exceed 100 pages, a large sample size increases the difficulties in the content analysis and it also requires a more rigid method for clarifying reliability and validity in the content analysis.

Appendix. List of variables for raters

This list is adopted and modified from Montabon et al., 2007. Details of the definition can be found in Montabon et al., 2007. Grading scale should follow 1: not doing it, 3: alludes to doing it… 5: quantitative measures, categories, and targets.

1. Environmental practices

1A. Operational practices

1. Recycling
2. Waste reduction (proactive)
3. Waste reduction (reactive)
4. Remanufacturing
5. Substitution
6. Consume internally
7. Packaging
8. Spreading risk
9. Creating a market for waste products
10. Energy
11. Money spent on environmental initiatives
12. Environmental information
13. Rewards as an incentive for an environmental project

1B. Tactical practices

14. Supply chain management
15. Early supplier involvement
16. Environmental standards for suppliers
17. Environmental audits of suppliers
18. Environmental awards/recognition
19. Environmental participation
20. Use of life cycle analysis or design for environment
21. Product development and innovation
22. Environmental design
23. Specific design targets
24. Environmental risk analysis
25. Environmental management systems (EMS)
26. Communication

1C. Strategic practices

27. Integration with long-term business strategy
28. Corporate policies and procedures
29. Environmental mission statement
30. Employee programs
31. Environmental department/teams (existence/extent of formal organizational structure)
32. Surveillance of the market for environmental issues
33. Strategic alliances

2. Performance measures

2A. Environmental Performance measures

34. Reduction in significant environmental incidents
35. Environmental certification
36. Continuous improvement
37. Recycling performance
38. Customer and shareholder perception of environmental performance
39. Independent audits of environmental performance
40. Waste reduction
41. Resource consumption (water, energy, steam, solids, fuel)
42. Cost savings for environmental projects and activities

2B. Financial performance measures

43. Return on capital employed (ROCE)
44. Sales growth

2C. Innovation Performance Measures

44. Innovation performance (products)
45. Innovation performance (process)

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