# Environmental management practices, operational competitiveness and environmental performance: Empirical evidence from a developing country

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## Abstract:

**Purpose:** The purpose of this paper is to examine the relationship between environmental management practices (EMP) and competitive operational performance with respect to reduced cost, improved quality, improved flexibility and improved delivery as well as overall environmental performance, of firms, using data from a developing country.
**Design/methodology/approach:** The study employed a survey approach with responses from 164 informants from different industries and used partial least squares structural equation modeling to examine the relationship between EMP and competitive operational performance and their overall impact on the environmental performance of firms. **Findings:** The results indicate that EMP by firms have a significant positive effect on firms' competitive operational performance. Again, firms' competitive operational performance has a partial positive effect on the overall environmental performance. It was also realized that the EMP initiated by a firm have a direct positive impact on the overall environmental performance of the firm. **Research limitations/implications:** There is the need for organizations to take steps to plan and implement EMP since it is likely to enhance their competitive operational performance as well as their overall environmental performance. **Practical implications:** The findings demonstrate the impact of EMP on competitive operational performance as well as on the overall environmental performance of firms. This is important as firms struggle with balancing investments in those practices against the perceived benefits that might be obtained from the practices.
**Originality/value:** The work provides insights and adds to the literature in the area of EMP and firm performance by providing evidence from a developing country environment. This study is among the few that have investigated the impact of EMP on firm performance in developing country environments.

**Keywords:** Reliability | Environmental impact | Environmental management | Quality | Green manufacturing

**Article:**

## 1. Introduction

According to Delmas and Toffel (2008), environmental issues are gradually becoming one of the most potent concerns of firms due to market pressures and the introduction of stringent environmental regulations by governments. Environmental management practices (EMP) refers to a set of skills and strategies adopted by firms with the aim of monitoring and managing the effect of their operations on the natural environment (Montabon *et al.*, 2007). These practices greatly enhance a firm's environmental performance, by minimizing the adverse effects of the firm's operations on the environment (e.g. Tyteca, 1996; Ulubeyli, 2013). Reducing ecological effects, such as reduction of pollutants, resource discount rates, a reduction in the consumption of hazardous materials, reduction of the regularity of ecological disaster, and rise in conformity with ecological requirements implies good outcomes for the ecosystem (Geyer and Jackson, 2004; Zhu and Sarkis, 2004).

Previous literature suggests that effective planning and implementation of an environmental management program in addition to an eco-design enhances environmental performance (Geyer and Jackson, 2004). In fact, several studies have tested the relationships between EMP and organizational performance (Markley and Davis, 2007; Sroufe, 2003; Kim, 2011; Lai and Wong, 2012; Montabon *et al.*, 2007; Theyel and Hofmann, 2015; Rao and Holt, 2005; Zhu and Sarkis, 2004).

Kim (2011), in his study of small and medium-sized electrical and electronic firms in Korea, found a positive relationship between EMP and operational performance. Sroufe (2003), in a study of manufacturing firms in the USA provided evidence of a positive relationship between environmental practices and operational performance measures. Montabon *et al.* (2007) used corporate reports to investigate the relationship between EMP and business performance and found a positive relationship between the two. Most of the studies on EMPs and firm performance have been done in developed or rapidly developing countries and it is unclear if the same findings can be obtained in under-developed countries where market pressures are different and governmental regulations might be less stringent.

However, investing in environmental management programs can be expensive and decision-makers need to know if those investments will yield desirable outcomes. For example, Reinhardt (1998) argued that not all firms might be able to gain competitive advantage from implementing environmentally responsible strategies and that more attention needs to be paid to the circumstances under which responsible environmental strategies contribute to operational performance. Thus, a study that provides evidence that investments in EMPs provide benefits beyond operational performance and that EMP investments also contribute to competitive advantage in the form of enhanced environmental performance should be useful to both practitioners and academics. Investments in EMPs by firms are likely to increase the cost obligations for the firms especially for those in developing countries. These firms might not have a lot of capital and thus might have to borrow or use other financing options to make the EMP investments. At the same time, if it can be demonstrated that these investments improve environmental performance in the form of waste and emission reductions, reduced energy consumption, reduced disposal costs and improved on-site waste treatment then the investment decisions might be easy to justify (Sajan *et al.*, 2017). Hence, studies that provide evidence to make decision-makers view investments in EMPs as not mere cost to be avoided but an opportunity to create and offer value are in the right direction.

Unfortunately, many studies have not focused on empirically investigating the relationship between EMP, operational and overall environmental performance of firms (Hazen *et al.*, 2011). At the same time, the literature is not uniform with regard to the proposition that the implementation of EMP always leads to improved competitive operational advantages. The findings have often been mixed. For example, Theyel and Hofmann (2015), Montabon *et al.* (2007), and Sroufe (2003) observed positive relationships in their studies, while Rao and Holt (2005) and Zhu and Sarkis (2004) found negative relationships. These conflicting results underline the need for further research on how the implementation of EMP impacts on operational performance as well as on the overall environmental performance of firms (Zhu and Sarkis, 2004; Aragon-Correa and Sharma, 2003; Lubin and Esty, 2010; Hazen *et al.*, 2011).

This study focuses on the relationship between EMP, competitive operational performance with respect to reduced cost, improved quality, improved delivery and improved flexibility and the overall environmental performance of firms. We seek to contribute to the existing literature by investigating the relationships mentioned above using data from Ghana, a developing country. Using the resource-based view (RBV) of the firm (Barney, 1991) as a referent theory, we argue and demonstrate that when organizations initiate EMP such as the implementation of environmental management system (EMS), environmental compliance and auditing programs, pollution prevention and the conservation of natural resources, the practices will enhance their competitive operational performance as well as the overall environmental performance.

The remainder of this manuscript is structured into six sections. Next, we present the underlying theory and the development of our hypotheses. We then proceed to discuss the research method and data collection procedures. This is followed by data analysis and presentation of the results. We then present the discussion of our findings, followed by the conclusions, implications, limitations, and areas for further research.

## 2. Literature review and hypothesis formulation

### 2.1 The RBV theory

This work uses the RBV theory as the main theoretical framework (Barney, 1991; Lockett and Thompson, 2001). RBV theory is one of the most widely used theoretical perspectives applied in explaining variations in inter-firm performance (Barney and Griffin, 1992). RBV is based on the premise that organizations possess resources which can be translated into capabilities and strategic assets but, in order to gain competitive advantage from these, the resources, capabilities, and assets must be valuable, rare, inimitable and non-substitutable. RBV gives a comprehensive view on how companies use their firm-specific resources and capabilities to achieve an edge over the competition through an internally based assessment of the strength and weakness of the company (Wernerfelt, 1984). According to (Peteraf, 1993), firm-specific resources and capabilities are not easy to copy and transfer because they are distributed heterogeneously within companies. Thus, RBV seeks to demonstrate that differences in resources and capabilities account for differences in competitive advantages between different companies. Grant (1991) indicates that resources are assets that are tangible or intangible and are key inputs in the production and delivery of products and services.

Institutions that have low resources and capabilities internally generally do not have the ability to react promptly or efficiently to pressures from the external environment, whereas institution with larger resources and capabilities respond more appropriately. In relation to the natural environment, the adoption of EMSs in an organization can be complementary to the resources and capabilities of the organization (Darnall *et al.*, 2008). A resource or capability is considered very important to the progress of EMSs if it enhances the process of EMS adoption (Darnall and Edwards, 2006).

### 2.2 EMP and competitive operational performance

Two contrasting views have been presented regarding the inconclusive results that have been presented on the effect of the adoption of EMP on competitive operational performance. On one hand, some scholars have argued that EMPs increase the cost of operations, reduce quality and increase lead times (Walley and Whitehead, 1994). Klassen and McLaughlin (1996) indicated that this may be due to increased cost linked to the transference of external parameters such as polluted air back to the firm. Artiach *et al.* (2010) posited that high costs of operations may be a result of the diversion of resources away from vital business investments.

On the other hand, a number of empirical studies, though limited, have observed that achieving a competitive operational advantage, in particular, cost reduction is a prominent reason for the application of EMP (Hasan, 2013). For example, the implementation of EMPs by firms can help firms reduce their raw materials and energy consumptions, and subsequently reduce their operational cost. Tooru (2001) observed a strong positive relationship between the implementation of EMPs and operational performance. The study was based on a Japanese pulp and paper manufacturing company that implemented an EMP, conformable to ISO 14001 and established that strict adherence to internationally standardized EMPs leads to improved operational performance.

#### 2.2.1 EMP and competitive operational cost

Przychodzen and Przychodzen (2015) observed that products made using EMP tend to yield higher profits than those that do not follow EMPs. Christmann (2000), provides further evidence of a positive relationship between environmental practices and cost advantage and stresses that firms that are able to achieve this cost advantage are those that possess complementary assets in the form of process innovation and other capabilities which are not easily imitated by other firms. Porter and van der Linde (1995b) recommended that firms could enjoy first-mover advantages in the form of reduced costs that are difficult for competitors to imitate by proactively adopting EMP.

Investments in EMP lower cost. The cost might arise from a reduction in unintended environmental releases (e.g. effluents) as well as other liabilities such as required clean-ups from waste discharges. Kumar *et al.* (2012) argued that EMP provide an enabling platform that saves cost, improves efficiency and also attracts new groups of suppliers and customers. The adoption of EMPs that focus on controlling the effect of an organization's operations throughout the lifecycle of its products has been found to reduce not only manufacturing costs but also potential liability costs, legal fees, and insurance costs (Shrivastava, 1995). The use of processes that reduce the amount of energy consumed, and limits the amount of pollution will reduce costs for the firms emphasizing those techniques. Institutions that adopt EMP are very much likely to have reduced material costs because of redesigned products that might use fewer raw materials or use materials that are easy to recycle or could be reused. Based on the above arguments, the following hypothesis is proposed:

*H1a.* EMP will have a positive impact on competitive operational cost performance.

2.2.2 EMP and competitive operational quality performance

Firms are consistently finding ways to reduce the quantity of material in their products. Customers and governments are requiring producers to use processes that do not harm the environment. Manufacturers are also reaching back into their upstream supply chains to ensure the use of quality at the source practices by their suppliers. The use of materials that are not defective will enhance the quality of the finished product. Investments in EMPs such as the application of value analysis techniques that lead to a reduction in the use of materials can contribute to both design and conformance quality. EMP are a critical determinant of product quality in industrial settings (Buvik and John, 2000). Melnyk *et al.* (2003) reported significant relationships between EMP and improved quality. Firms are consistently finding ways to reduce the quantity of material in their products. Customers and governments are requiring producers to use processes that do not harm the environment. Manufacturers are also reaching back into their upstream supply chains to ensure the use of quality at the source practices by their suppliers. The use of materials that are not defective will enhance the quality of the finished product. Several researchers have reported positive relationships between EMP and product quality (Miles and Russell, 1997; Block, 1999; Caillibot, 1999; Reid, 1999; Corbett and Kirsch, 2001). Porter and van der Linde (1995a, b) posit that an industry's quest to be environmentally responsible involves the integration of environmental technologies into the operations area. Such technologies determine the type of raw materials used, waste generated and disposal treatments; which lead to efficiency in the operations function and ultimate gains in environmental performance.

A firm's emphasis on EMP can lead to enhanced product quality (Klassen and Whybark, 1999). This is because more firms are getting to know that consumers, lately, are interested in eco-friendly products. This provides enough incentives for firms to be innovative. For instance, Nidumolu *et al.* (2009) indicated that Procter & Gamble (P&G) conducted life-cycle assessments to estimate the amount of energy needed to use its products and found that, detergents can significantly increase US households' energy consumption. They indicated that a typical US household spends about 3 percent of its annual electricity budgets to heat water for washing clothes. Hence, P&G reckoned that, if households switched to cold-water washing, they would consume 80 billion fewer kilowatt-hours of electricity and emit 34 million fewer tons of carbon dioxide. P&G, therefore, decided to develop cold-water detergents. This led to the launch of Tide Coldwater in the USA and Ariel Cool Clean in Europe in 2005 by P&G. Nidumolu *et al.* (2009) further reported that by 2008, 21 percent of British households were washing clothes in cold water, an increase from 2 percent in 2002. The numbers in Holland also shot up from 5 to 52 percent. According to Sroufe (2003), integrated EMPs will significantly impact a firm's operational performance such as quality. The adoption of EMP can help develop organizational capabilities, which can be translated to improved product quality (Vachon and Klassen, 2008). Based on the above arguments, the following hypothesis is proposed:

*H1b.* EMP will have a positive impact on competitive operational quality performance.

2.2.3 EMP and delivery performance

According to Lambert and Cooper (2000), the essence of EMP is to ensure environmentally friendly approaches without sacrificing the traditional operational performance indicators such as delivery performance. This is because a proactive environmental policy would require that a firm acquires new technology that would improve its service delivery in terms of the quantity of goods delivered on time. For example, the use information technology and analytics can ensure that delivery trucks use the most efficient routes contributing to on-time delivery, at the same providing cost savings from fuel consumption. Investing in delivery mechanisms that rely on renewable energy and are fuel efficient can contribute to delivery reliability. It is well known that UPS minimizes the number of left turns to reduce the time it takes to make deliveries, save money on fuel consumption, and reduce environmental pollution. Again, a distribution facility that uses efficient loading and unloading docks will contribute to high delivery performance (Min and Galle, 1997). Based on the above, the following hypothesis is proposed:

*H1c.* EMP will have a positive impact on competitive operational delivery performance.

2.2.4 EMP and competitive operational flexibility

Adopting EMP as an organizational strategy complicates the supply chain process since among many other things the flexibility of both suppliers and product must be critically assessed (Handfield *et al.*, 2005). Sroufe (2003) indicates that the implementation of EMP has enhanced product flexibility. Techniques such as lean, focus on waste elimination reduce production time and enable the production of small quantities. This means an organization can respond quickly to changes in product demand volume, type, mix and delivery and thereby contribute to flexibility performance. Based on the above, the following hypothesis is proposed:

*H1d.* EMP will have a positive impact on operational flexibility performance.

2.3 Competitive operational performance and overall environmental performance

Various studies have revealed a significant relationship between operational performance outcomes such as cost, quality, delivery and flexibility and the firm's environmental performance. These results have shown that the operations function plays a crucial role in environmental performance by minimizing the impact of the firm activities on the environment (Hanna *et al.*, 2000; Bonifant, 1994; Curkovic *et al.*, 2000; Klassen and McLaughlin, 1996; Rothenberg *et al.*, 2001; Montabon *et al.*, 2000; Tibor and Feldman, 1996). Minimizing a firm's negative impact on the environment can lead to customer loyalty, given the rising consumer demand for greater accountability from firms. The effect of environmental performance on a firm competitive cost has been a point of discussion for many researchers (Sayre, 1996; Tibor and Feldman, 1996; Corbett and Kirsch, 2001). Many of these studies have found a significant relationship between competitive cost and environmental performance and various reasons has been attributed to it. A reduction in the pollution and waste systems of a firm tends to positively enhance its environmental performance. For example, if a firm produces high-quality products the first time, it will reduce the need for rework which means less energy consumed in making the product better, and less waste enhancing its overall environmental performance. Less rework also means higher productivity and profitability for the organization, increasing the availability of funds for future investments.

Delivery performance can be expressed as the extent to which products and services supplied by an organization meet customer expectations with regard to on-time delivery, delivery promises met, reduction in lead times, etc. (Rao *et al.*, 2011). Environmental safety and well-being are some of the many expectations customers have (Zeithaml *et al.*, 1990). Sroufe (2000), postulates a positive relationship between delivery performance and environmental performance. This is because firms' performance in respect of delivery is an indication of waste minimization or elimination as well as better efficiencies in their processes. Minimization or elimination of waste, as well as better efficiencies in firms' processes also means minimal use of operational resources, particularly related to delivery thereby reducing ecological footprint or impact.

Flexibility performance is usually understood as the degree of agility in respect of product type, demand volume, mix and delivery by firms. Flexibility in operational capabilities is one of the expectations of customers from firms. This study argues that operational performance of firms in terms of flexibility can potentially lead to improved environmental performance. This is because the flexibility built in the operational capabilities of firms will allow them to respond or adjust adequately to customer demands – particularly volumes – without engaging in wasteful operations which would lead to excessive resource consumption and environmental pollutions. Inflexibility in firms' operational capabilities means firms would have to deal with excessive stocks or inventory when demand drops. Energy and other resources would have to be consumed in holding the stocks and thereby increasing the ecological footprints or impacts of firms.

Shrivastava (1995) posited that environmental performance can be achieved in an organization by pursuing total quality, enhanced cost and flexibility objectives. The second objective of this research is to understand the impact of organization's competitive operational capabilities in terms of reduced cost, improved quality, delivery performance and flexibility on environmental performance. Hence, based on the above arguments, our second set of hypotheses is presented as follows:

> *H2a.* There is a positive relationship between competitive operational cost and overall environmental performance.

*H2b.* There is a positive relationship between competitive operational quality and overall environmental performance.

*H2c.* There is a positive relationship between improved delivery and overall environmental performance.

*H2d.* There is a positive relationship between operational flexibility and overall environmental performance.

2.4 EMP and environmental performance

Findings from empirical studies linking firms' EMPs to environmental performance have established that the implementation of EMPs leads to effectiveness in environmental performance. In a study by King *et al.* (2005), it was found that the adoption of EMPs led to significant enhancements in environmental performance, as measured by the toxicity of the elements present in the toxic release inventory. Kuisma *et al.* (2003) found that the adoption of EMPs in Finland has led to improvements in waste reduction by firms. In another study, Potoski and Prakash (2005) concluded, after careful observation of over 3,000 US companies that had implemented ISO 14001, that they had lowered their pollution emissions. Lee *et al.* (2012) showed that EMPs such as environmental compliance programs are improving firms' environmental performance. Companies are harvesting rainwater and air-condition vapor and recycling them for other operations within their facilities and thereby contributing to their environmental performance.

Similarly, Green *et al.* (2012) established that the implementation of environmentally friendly practices is very likely to ensure enhanced environmental performance as measured by reduction in air pollutant emissions, effluent waste, solid waste, and the consumption of toxic materials. Tung *et al.* (2014) found that Australian manufacturing companies that implemented EMPs achieved higher environmental performance than those without EMPs. Sroufe (2003) posit that an effective and efficient EMP can aid a company to sustain, and enhance the environmental aspects of its operations.

Evidence presented by Hertin *et al.* (2008) in their study of six industrial sectors within six European countries concluded that positive association exists between EMPs and environmental performance. However, the study observed that the impact of EMP on environmental performance was insignificant suggesting that EMP may not be a strong driver of environmental performance. Thus, although an EMP is a driver of environmental performance, its impact tends to be small where it is voluntarily adopted. Melnyk *et al.* (2003) observed that the impact of EMP on environmental performance tends to be insignificant where environmental practices do not follow internationally certified or standardized procedures and processes. Thus, the degree of adherence of a firm's EMPs to internationally certified or standardized procedures or processes influences the level of environmental performance achieved by the firm. Companies without any form of EMP implementation did not achieve improved environmental performance. The final aim of this study is to investigate the direct effect of a firm's EMPs on its overall environmental performance. Hence, based on the foregoing discussions, we submit the following hypothesis:

*H3.* There is a significant positive relationship between the adoption of EMP and overall environmental performance of firms.

Figure 1 summarizes the hypotheses of this study in a conceptual model. The hypothesized relationships between the constructs are all indicated as positive (+).

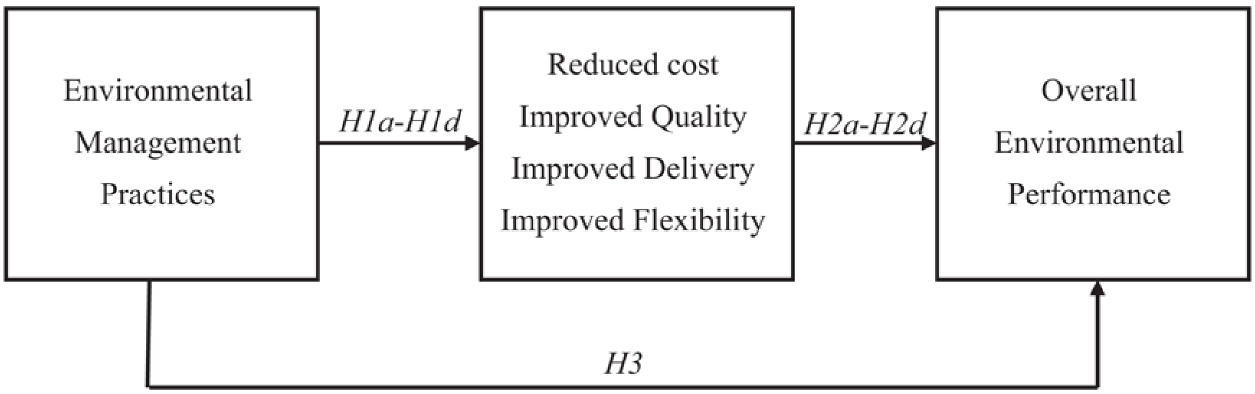


**Figure 1.** The conceptual model

**3. Research methods and measures**

3.1 Methods

Collecting data for every research is very important, as the data are intended to promote a superior knowledge of a theoretical framework (Bernard, 2002). This work, therefore, adopted the purposive sampling concept. Here the researcher knowing the type of details desired tries to identify individuals who are capable and willing to give the information sought, due to their expertise or knowledge (Bernard, 2002; Lewis and Sheppard, 2006). Purposive sampling is mainly conducted using key informant technique (Bernard, 2002). These "informants" according to Weele and Raaij (2014) are considered to be knowledgeable about EMP in their organizations and are also high up in the organizations' hierarchy to be conversant with strategic environmental issues within their organizations.

The sample composed predominantly of medium-sized and large firms operating within the Greater Accra Metropolitan Area which is considered to be home for most of the manufacturing and services activities in Ghana (Sohail *et al.*, 2004; Rankin *et al.*, 2002; Wolf, 2004). Data collection was mostly done by graduate assistants, graduates, and undergraduate students pursuing various specializations in a university in Ghana. The questionnaire was first reviewed by academics that are interested in environmental management issues at the university as well as other professionals. It was then tested through a pilot study at 17 companies that have planned and/or implemented environmental management initiatives as prescribed by the Environmental Protection Agency of Ghana, and other international environmental agencies. The survey instrument was tested for validity, coherence, clarity, quality, and reliability. Some modifications were made to the survey instrument based on the feedback obtained from the experts in these companies. The cover letter of the survey highlighted that respondents needed to be somebody in charge of environmental issues or in a top management position in the organization. Also, the organization should have been engaged in environmental management initiatives over the past three years.

The questionnaires distributed were collected after one month. The data collection took place over an eight-month period. Out of the 450 questionnaires administered, a total of 227 were completed and returned resulting in a response rate of 50.4 percent, however, only 164 out of the returned responses were usable due to incomplete responses, mistakes, etc. Respondents were in the packaging (15 percent), metals (14 percent), food (13 percent), chemicals (12 percent), and roofing sheets (10 percent) sectors of the economy. As far as the positions of the respondents are concerned, 45 percent were production managers, managing directors were 27 percent, health, safety, and environmental officers were 23 percent, indicating very high-level positions of the respondents. Only 5 percent of them did not indicate their positions in their companies. The survey also indicated that most of the respondents have worked with their company for more than five years. The backgrounds of respondents are presented in Table I.

**Table I.** Background of respondents

| | **Frequency** | **%** | **Cumulative %** |
|---|---|---|---|
| *Sectors* | | | |
| Mining | 6 | 4 | 4 |
| Plastics | 14 | 9 | 12 |
| Food | 21 | 13 | 25 |
| Chemicals | 19 | 12 | 37 |
| Roofing sheets | 16 | 10 | 46 |
| Cooking pots | 14 | 9 | 55 |
| Metals | 23 | 14 | 69 |
| Packaging | 25 | 15 | 84 |
| Furniture | 15 | 9 | 93 |
| Paints | 11 | 7 | 100 |
| Total | 164 | 100 | |
| | | | |
| *Position* | | | |
| HSE managers | 38 | 23 | 23 |
| Managing directors | 44 | 27 | 50 |
| Production managers | 73 | 45 | 95 |
| Others | 9 | 5 | 100 |
| Total | 164 | 100 | |
| | | | |
| *Experience* | | | |
| Above five years | 89 | 54 | 54 |
| Two to five years | 56 | 34 | 88 |
| Less than two years | 19 | 12 | 100 |
| Total | 164 | 100 | |

3.2 Measures

The measures used to evaluate EMP were those recommended and validated by Zhu and Sarkis (2006) and Zhu *et al.* (2008). EMP were measured based on the extent to which the organization is committed to the environment by planning and implementing EMS, pollution prevention, and the conservation of natural resources (Zhu and Sarkis, 2006: Zhu *et al.*, 2008).

The competitive operational performance constructs were adapted from Fotopoulos and Psomas (2010), Swink *et al.* (2005), and Schoenherr *et al.* (2012). Competitive cost performance was measured using items like improved capacity utilization, reduction in unit labor, material, energy, and transportation cost. The competitive operational quality performance was measured using organizations' reduction in defective rates, product reliability, reduction in customer complaints and implementation of quality management systems. Flexibility was measured using the organizations' ability to change product mix, ability to offer unique products, rapid changes in design, and reduction in changeover or set up times. Delivery was measured using delivery reliability, increased delivery speed, improved production lead time and increase in the number of goods delivered on time. All these items were adapted and modified according to the suggestions of Zhu *et al.* (2008), Swink *et al.* (2005), Schoenherr *et al.* (2012). All items were measured on a five-point Likert scale with 1 indicating "not in use at all" and 5 indicating "significantly in use."

The overall environmental performance was measured using compliance with all regulations associated with environmental standards, reducing air emissions, decreased resource consumption and lower use of hazardous materials for operations (Zhu *et al.*, 2007; Rao, 2002). A five-point Likert scale (1 – "strongly disagree," 5 – "strongly agree") was used to assess perceived accomplishment on environmental performance, within the past three years.

## 4. Data analysis and results

### 4.1 Data analysis

The main analytical procedure used for the study was the partial least squares structural equation modeling (PLS-SEM 3.0) technique due to its ability to simultaneously test and estimate complex causal relationships among constructs (Williams *et al.*, 2009). Before proceeding to the analysis of the hypothesized relationships, it was imperative to analyze the validity and reliability of the items and constructs used in the study. To determine convergent validity, the outer loadings of the items as well as the average variance extracted (AVE) of the constructs were used. Figure 2 shows the loadings of all the measurement. These loadings were all higher than 0.7 on their respective constructs and thus above the acceptable convergent validity thresholds (Fornell and Larcker, 1981). The AVE values for the constructs are displayed in Table II. These values are above the recommended threshold value of 0.5 as suggested by Fornell and Larcker (1981). Discriminant validity refers to the degree to which a construct in a model is truly distinct from other constructs as assessed by empirical standards. We established this using the Fornell-Larcker criterion (Hair *et al.*, 2011). The criterion compares the square root of the AVE values with latent variable correlations (Fornell and Larcker, 1981). Our analyses indicated that the square root of all AVEs of the constructs was higher than their correlations with other constructs in the model (Chin, 1998; Fornell and Larcker, 1981). The results, as displayed in Table III provide evidence that discriminant validity was established. We calculated composite reliability (CR) and Cronbach's $\alpha$ (CA) values to provide evidence of internal consistency. The

CA values, as well as the CR values, were all greater than the recommended threshold of 0.7 (Hair *et al.*, 2014; Nunnally and Bernstein, 1994) as shown in Table II.

**Table II.** AVE, composite reliability Cronbach's $\alpha$, and $R^2$ measures

| Constructs | AVE | Composite reliability | $R^2$ | Cronbach's $\alpha$ |
|---|---|---|---|---|
| COST | 0.781 | 0.934 | 0.062 | 0.907 |
| DELIVERY | 0.586 | 0.849 | 0.521 | 0.761 |
| ENV MGT PRACT | 0.692 | 0.871 | 0 | 0.777 |
| OVERALL ENV PERF | 0.767 | 0.929 | 0.722 | 0.898 |
| FLEXIBILITY | 0.745 | 0.898 | 0.123 | 0.830 |
| QUALITY | 0.707 | 0.906 | 0.114 | 0.861 |

**Table III.** Discriminant validity-Fornell-Larcker criterion

| Constructs | COST | DELIVERY | ENV MGT PRACT | OVERALL ENV PERF | FLEXIBILITY | QUALITY |
|---|---|---|---|---|---|---|
| COST | *0.883* | | | | | |
| DELIVERY | 0.288 | *0.765* | | | | |
| ENV MGT PRACT | 0.250 | 0.722 | *0.832* | | | |
| OVERALL ENV PERF | 0.656 | 0.448 | 0.453 | *0.876* | | |
| FLEXIBILITY | 0.606 | 0.435 | 0.350 | 0.761 | *0.863* | |
| QUALITY | 0.506 | 0.436 | 0.338 | 0.749 | 0.749 | *0.841* |

**Note:** The italic numbers on the diagonal are the square root of the AVEs

## 4.2 Model predictive relevance ($Q^2$) and effect size ($f^2$)

In evaluating the research model, $R^2$ values of the endogenous constructs, $f^2$, and $Q^2$ values were considered. The $f^2$, the effect size, is the change in $R^2$ values when a specified exogenous construct is omitted from the model (Cohen, 1988). This was used to evaluate if the omitted construct had an appreciable impact on the endogenous constructs. The effect is measured using the following equation:

$$f^2 = \frac{R^2_{\text{included}} - R^2_{\text{excluded}}}{1 - R^2_{\text{included}}}$$

where $R^2_{\text{included}}$ and $R^2_{\text{excluded}}$ represent the $R^2$ values of the endogenous latent variable when a selected exogenous latent variable is included and excluded from the model, respectively. The guiding principles for evaluating $f^2$ are that values of 0.02, 0.15 and 0.35, respectively, represent small, medium and large effects of the exogenous latent variable (Cohen, 1988). Hence from Table IV, all the exogenous latent variables seem to have some effect on the endogenous latent variables in the model. Surprisingly, delivery seems to have no effect on overall environmental performance.

To further examine the accuracy of our model, we examined the Stone-Geisser's $Q^2$ value (Geisser, 1974; Stone, 1974). This evaluation shows the model's predictive relevance. For a given structural model, $Q^2$ values larger than zero for a certain reflective endogenous latent variable indicate the path model's predictive relevance for that specific construct (Chin, 1998; Henseler *et al.*, 2009; Tenenhaus and Esposito Vinzi (2005). The $Q^2$ value in Table IV was obtained using the blindfolding procedure in PLS 3.0. The same guidelines recommended by Cohen (1988) were used to evaluate the $Q^2$ value. The results in Table IV, $Q^2$ value of 0.504 for overall environmental performance as shown in Table IV, provides evidence of the very large predictive relevance of the endogenous construct in the model.

**Table IV.** Pearson's coefficients ($R^2$), predictive relevance ($Q^2$) and effect size ($f^2$)

| Constructs | $R^2$ | $Q^2$ | Environmental performance ($f^2$) |
|---|---|---|---|
| *Endogenous latent variables* | | | |
| Cost | 0.062 | | |
| Quality | 0.114 | | |
| Delivery | 0.521 | | |
| Flexibility | 0.123 | | |
| Environmental performance | 0.722 | 0.504 | |
| *Exogenous latent variables* | | | |
| Cost | | | 0.095 |
| Quality | | | 0.242 |
| Delivery | | | 0.000 |
| Flexibility | | | 0.095 |
| Environmental management practices | | | 0.043 |

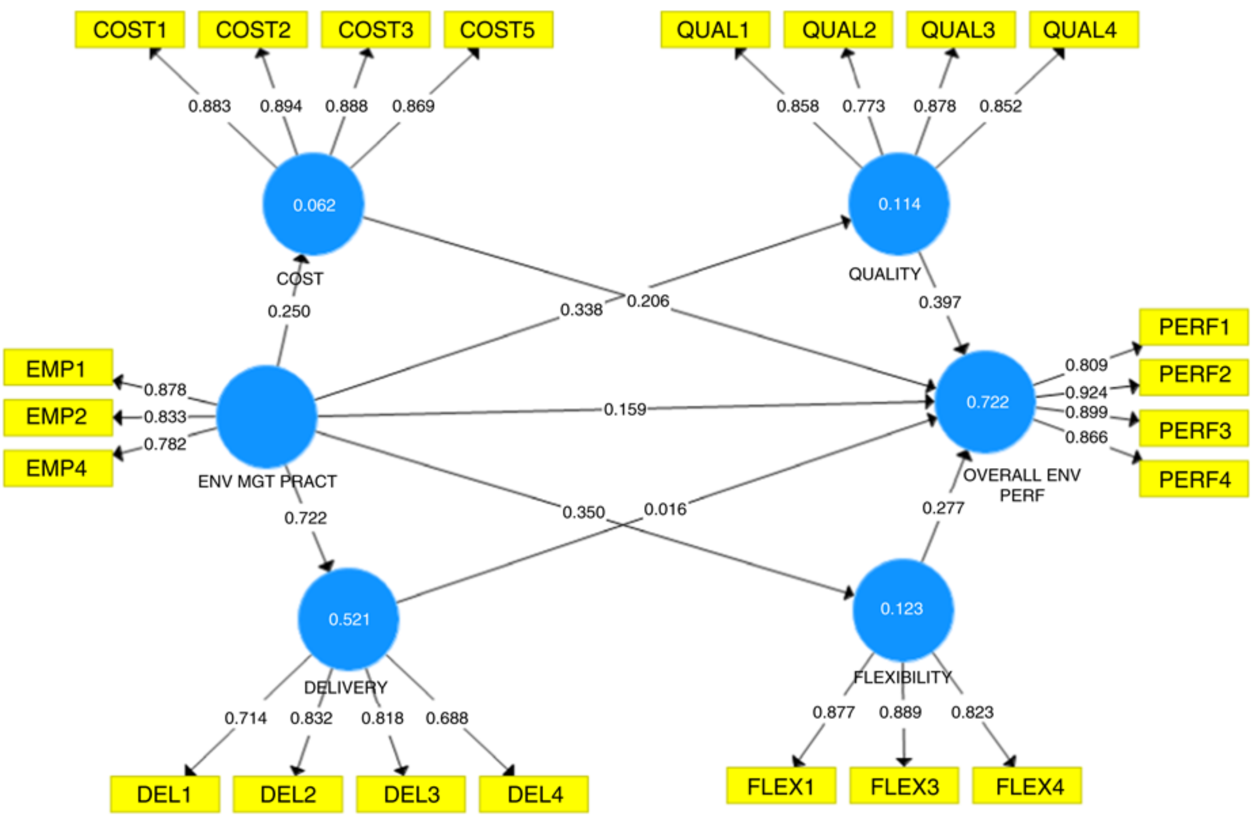

**Figure 2.** Results of the measurements and structural model

4.3 Results

The analysis of the structural model begins by evaluating the Pearson's coefficients ($R^2$). This $R^2$ indicates the portion of the variance of the endogenous variables, cost, quality, delivery, flexibility and overall environmental performance which is explained by the structural model. It also indicates the quality of the adjusted model. According to the Cohen (1988), an $R^2$=2 percent is classified as having a small effect, $R^2$=13 percent is classified as having a medium effect, and $R^2$=26 percent is classified as having a large effect. Thus, the results in Figure 2 and Table IV, indicate that the research model explained 6.2, 11.4, 52.1, 12.3 and 72.2 percent of the variance in cost, quality, delivery, flexibility, and overall environmental performance, respectively. This implies the model explained relatively small effects in cost, quality, and flexibility. However, the model explained large effects in delivery and overall environmental performance.

The bootstrapping procedure in SmartPLS 3.0 using re-samples of 5,000 (Hair *et al.*, 2011) was used to determine the significance of the path coefficients in the model. The bootstrap results are shown in Table V. As far as the hypothesized relationships are concerned, the results indicate that EMP by firms has a significant relationship with cost ($\beta$=0.250, $p$=0.002), quality ($\beta$=0.338, $p$=0.000), delivery ($\beta$=0.722, $p$=0.000), and flexibility performance ($\beta$=0.350, $p$=0.000), providing support for *H1a*-*H1d* in the model.

**Table V.** Hypothesis tests, path coefficients and significance levels from bootstrapping

| Hypothesized relationships | Original sample (*O*) | Sample mean (*M*) | SD | *t*-statistics | *p*-value |
|---|---|---|---|---|---|
| COST → OVERALL ENV PERF | 0.206 | 0.208 | 0.055 | 3.371 | 0.000 |
| DELIVERY → OVERLL ENV PERF | 0.016 | 0.018 | 0.069 | 0.229 | 0.819 |
| ENV MGT PRACT → COST | 0.250 | 0.255 | 0.081 | 3.084 | 0.002 |
| ENV MGT PRACT → DELIVERY | 0.722 | 0.726 | 0.034 | 21.152 | 0.000 |
| ENV MGT PRACT → OVERALL ENV PERF | 0.159 | 0.162 | 0.072 | 4.832 | 0.009 |
| ENV MGT PRACT → FLEXIBILITY | 0.350 | 0.355 | 0.061 | 2.626 | 0.000 |
| ENV MGT PRACT → QUALITY | 0.338 | 0.341 | 0.077 | 4.399 | 0.000 |
| FLEXIBILITY → OVERALL ENV PERF | 0.159 | 0.278 | 0.095 | 2.903 | 0.004 |
| QUALITY → OVERALL ENV PERF | 0.397 | 0.388 | 0.077 | 5.163 | 0.000 |

**Table VI.** Summary of hypothesis tested, path coefficients and significance levels

| Hypothesis | Exogenous variable | Path | Endogenous variable | Path estimate | *p*-value | Supported? |
|---|---|---|---|---|---|---|
| *H1a* | Env Mgt Practices | → | Reduced Cost | 0.250** | 0.002 | Yes |
| *H1b* | Env Mgt Practices | → | Improved Quality | 0.338*** | 0.000 | Yes |
| *H1c* | Env Mgt Practices | → | Delivery Time | 0.722*** | 0.000 | Yes |
| *H1d* | Env Mgt Practices | → | Flexibility | 0.350*** | 0.000 | Yes |
| *H2a* | Reduced Cost | → | Overall Env Performance | 0.206*** | 0.000 | Yes |
| *H2b* | Improved Quality | → | Overall Env Performance | 0.397*** | 0.000 | Yes |
| *H2c* | Delivery Time | → | Overall Env Performance | 0.016 | 0.819 | No |
| *H2d* | Flexibility | → | Overall Env Performance | 0.277** | 0.004 | Yes |
| *H3* | Env Mgt Practices | → | Overall Env Performance | 0.159* | 0.009 | Yes |

**Notes:** *$p$<0.1; **$p$<0.05; ***$p$<0.01

The results also indicate that cost ($\beta$=0.206, $p$=0.000), quality ($\beta$=0.397, $p$=0.000), and flexibility ($\beta$=0.277, $p$=0.004) performance firms, have significant positive relationships with overall environmental performance. However, operational competitiveness in terms of delivery does not appear to have a significant relationship with overall environmental performance ($\beta$=0.016, $p$=0.819).Thus, we found support for *H2a*-*H2d* but no support was found for *H2c*. The results also indicate that EMP initiated by firms have a direct positive relationship with overall environmental performance ($\beta$=0.159, $p$=0.009), also satisfying *H3*. A summary of the hypotheses tested, and the results obtained are presented in Table VI.

**5. Discussion**

One of the principal aims of this research was to ascertain if EMPs impact competitive operational performance in terms of reduced cost, improved quality, delivery and operational flexibility. We were also interested in knowing if EMP has a significant effect on overall environmental performance. The empirical results indicate some important findings that contribute to the literature as well as providing an enhanced understanding of the relationship between EMP, operational performance, and overall environmental performance. The results indicate that EMP initiated by firms have a significant positive effect on cost, quality, delivery and flexibility performance of those firms supporting our first four hypotheses. This finding seems to be consistent with the findings of Hasan (2013), Sroufe (2003) and Tooru (2001), particularly with regard to the implementation of EMP and its ability to reduce cost (Christmann, 2000; Porter and Van der Linde, 1995b; Kumar *et al.*, 2012), improve quality (Sroufe, 2003; Vachon and Klassen, 2008), improved delivery performance (Szwilski, 2000; Vijayvargy *et al.*, 2017) and enhance flexibility performance of firms (Handfield *et al.*, 2005; Sroufe, 2003). Our study advances the green supply chain literature by contributing to the debate that EMP are significant to improving the competitive operational performance of firms. Firms might implement EMPs in response to governmental regulations or community pressures, but they also stand to gain competitive performance improvements from those practices.

The second objective of this research was to understand the impact of a firm's competitive operational capabilities in the form of cost, quality, delivery, and flexibility on the firm's overall environmental performance. Our results indicate significant positive relationships between competitive operational cost, quality, flexibility and overall environmental performance of firms. However, improvements in delivery performance do not necessarily lead to improvements in overall environmental performance. This finding seems to contradict the work of Sroufe (2000) who postulate that there is a positive relationship between delivery performance and environmental performance. The lack of support for a positive effect of improved delivery on overall environmental performance, in Ghana, is perhaps explained by the inadequate transportation and logistics infrastructure in the country. It is also possible that customers and other stakeholders do not necessarily see improved delivery performance as an environmental issue.

Finally, the results revealed that EMP initiated by firms have a direct positive relationship with overall environmental performance. In fact, previous empirical studies on EMPs and environmental performance have established that the implementation of EMPs leads to high levels of environmental performance among firms. This finding is consistent with that of King *et al.* (2005) and Kuisma *et al.* (2003). King *et al.* (2005) found that the implementation of EMPs led to high standards in environmental performance. Kuisma *et al.* (2003) reported that the adoption of EMS in Finland has led to improvements in waste and risk management. The results from our study are consistent with the findings of Potoski and Prakash (2005), Lee *et al.* (2012), Tung *et al.* (2014) and Hertin *et al.* (2008). Our findings also indicate that competitive operational capability appears to mediate the relationships between EMP and overall environmental performance. In other words, investments in EMPs improve the overall environmental performance of firms because EMPs improve the competitive operational performance of the firms. This is a significant theoretical insight that has not received much attention.

The above findings are significant given that this study was conducted in Ghana, a developing country, where environmental practices are not likely to receive much attention due to the relatively lower incomes of consumers as compared to developed countries. Investments in EMPs by a firm are likely driven by three main forces: governmental regulations or mandates, pressure from customers and populace and as a response to a firm's own strategic initiatives. Despite the benefits that EMPs provide, they also have cost implications and thus in a country like Ghana, where governmental regulations might be less stringent and consumer and community activism might not be strong, the main impetus for implementing these practices might be the competitive benefits that they provide to firms. By demonstrating that EMPs contribute significantly to improvements in operational capabilities as well as in environmental performance, managers in Ghana and similar environments can have more backing for their decisions regarding EMP investments. Managers can be assured that EMP investments can yield benefits that can be translated into overall firm competitive performance.

We have also shown that the same results obtained from studies carried out in more developed countries where awareness of the need for preservation of the natural environment might be higher than can be expected from less developed countries.

## 6. Conclusions, implications, limitations and areas for future research

Environmental issues are gradually receiving much attention from firms due to market pressures and the introduction of stringent environmental regulations. The effects of EMP on operational performance (Hasan, 2013; Tooru, 2001; Theyel and Hofmann, 2015; Sroufe, 2003) and overall environmental performance (King *et al.*, 2005; Kuisma *et al.*, 2003; Potoski and Prakash, 2005) have been documented in the literature. The present study explores the relationship between the implementation of EMP and competitive operational performance with respect to cost, quality, delivery, and flexibility as well as the overall environmental performance of firms using data from a low-developed country. In doing so, this study contributes to the literature on green supply chain management, especially how investments in EMPs must not be necessarily seen as a cost to avoid but rather an opportunity to create value for firms and their customers.

This is actually one of the few studies that have attempted to understand the effect of EMPs on competitive operational performance and how competitive operational performance also impacts on the overall environmental performance of firms using data from a developing economy environment as well as employing the PLS-SEM technique. The results reemphasize the relevance of environmental practices and its ability to reduce cost, improve quality, increase operational flexibility, improve delivery as well as enhance overall environmental performance.

The results indicate that when organizations invest in EMP, they are likely to achieve cost reductions, improved quality, improved delivery, and flexibility. For managers of firms, it indicates that it is important to invest in EMP since these investments are likely to enhance the competitive operational capabilities in terms of cost, quality, delivery, and flexibility. Such enhanced operational capabilities are also likely to improve the overall environmental performance in terms of conformity with environmental standards, minimal air pollution, reduced resource input, and minimal intake of toxic raw materials. One limitation of this work is the use of data from Ghana. It is important for other researchers to also assess these relationships using data from a wider geographical area. Future studies can also consider the impact of EMP on a firm's reputation. This was also a cross-sectional study and future research should look at whether or not the relationships change over time and how these changes occur.

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