Article:

Wong, CWY, Wong, CY orcid.org/0000-0002-4933-1770 and Boon-itt, S (2020) Environmental management systems, practices and outcomes: Differences in resource allocation between small and large firms. International Journal of Production Economics, 228. 107734. ISSN 0925-5273

https://doi.org/10.1016/j.ijpe.2020.107734

Environmental Management Systems, Practices and Outcomes: Differences in Resource Allocation between Small and Large Firms

Christina W.Y.Wong[1], Chee YewWong[2] and SakunBoon-itt[3]
[1]Hong Kong Polytechnic University; christina.wy.wong@polyu.edu.hk
[2]Leeds University Business school; c.y.wong@leeds.ac.uk
[3]Thammasat Business School; sakunboonitt@gimal.com

Abstract
This paper argues both small and large firms use different resource allocation patterns to benefit from implementing environmental management practices (EMPs) and environmental management systems (EMS). Results from the multi-group structural equation analyses of a survey of manufacturing firms in two countries support the resource allocation arguments - large firms use resource-demanding EMPs such as green product design and green production to improve outcomes in environmental, cost-reduction and business performance, while small firms choose resource-light EMPs such as green logistics and green packaging to gain only environmental and cost-reduction benefits. The paper advances the existing resource-advantage view by revealing different resource allocation patterns and provides meaningful recommendations through which policy makers can address various resource allocation constraints among small and large enterprises.

Keywords: Environmental management; Performance; Large firms; Small firms; Resource allocation.

1.0 Introduction

Small firms are the backbone of economic growth in many countries but their cumulative contributions to pollution are often larger than large firms (Arnold, 2019; Williamson and Lynch-Wood, 2006). However, based on the resource-advantage view, large firms are assumed to be more resourceful and proactive (Aragon-Correa et al., 2008; Russo and Fouts, 1997) and small firms lack skills, capabilities, and financial and human resources (Biondi et al., 2000; Bowen, 2000). This theoretical view implies that large firms can gain more benefits from implementing environmental management systems (EMS) such as ISO14001, EMAS, and environmental management practices (EMPs) such as green product design, procurement, production, logistics and packaging. Lacking awareness about the strategic and cost benefits of environmental management (Gadenne et al., 2009; McKeiver and Gadenne, 2005), small firms expect limited benefits from adopting EMS/EMPs (Brammer et al., 2012) and have no interest in going beyond regulatory compliance (Russo and Fouts, 1997; Sharma and Vredenburg, 1998). Thus, small firms are thought to lack proactive management concerning their environmental impacts (Aragon-Correa et al., 2008). It is thus vital to understand why small firms adopt EMS/EMPs, and whether doing so can lead to any performance outcomes.

This paper argues that an overreliance on the resource-advantage view provides an incomplete understanding of the performance outcomes of EMS/EMPs among small and large firms. Despite having cost constraints and limited resources (Biondi et al. 2000), small firms can still gain performance benefits by allocating their available resources to adopting specific EMPs. Evidence shows small firms in the wine industry have voluntarily established energy conservation and recycling practices (Cordano et al., 2010). Since small firms face fewer pressures from external stakeholders and regulators (Bowen, 2000), they have the freedom to allocate resources in specific aspects of environmental management. Small firms may not view EMPs as a strategic imperative (Gadenne et al., 2009) as they are facing an increasing number of demanding stakeholders (Biondi et al. 2000). The case studies of Baumann-Pauly et al. (2013) show that small Swiss firms are not necessarily less advanced than large multinationals in organising corporate social responsibility activities. Thus, the idea of the resource-advantage view that large firms are better at using EMS/EMPs to achieve performance is not always valid.

To compensate for the limitations of the resource-advantage view, this paper suggests using a resource allocation perspective to differentiate how differences in strategic resource allocations between small and large firms can lead to different performance benefits from adopting EMS/EMPs. The study of Cheng and Kesner (1997) reveals that firms may increase or decrease their environmental responses by allocating slack resources to specific activities. Accordingly, their environmental response is increased when more resources are allocated toward activities which enhance external market effectiveness, while environmental response is decreased by allocating more resources to activities that enhance internal efficiency (*ibid*). Market effectiveness is the main motivation for large firms while internal efficiency is usually the priority for small ones. Since small and large firms possess different enabling capabilities and constraining factors (Baumann-Pauly et al., 2013), they may selectively allocate resources to specific EMPs to achieve specific outcomes. To reveal differences in strategic resource allocation patterns between small and large firms, this study aims to reveal how different EMPs are utilised to improve specific performance outcomes.

The ways in which small and large firms allocate resources to different EMPs to achieve specific performance outcomes can be affected by the perceived cost-benefit of environmental management (Gadenne et al., 2009). From a cost-benefit perspective, there are two types of EMPs. EMPs such as green product design, sourcing and production are cost/resource demanding but their potential benefits to improve market competitiveness is attractive to large firms (Cheng and Kesner, 1997). Large firms may thus allocate their R&D capability and excess resources into green product design and production process innovation to gain cost and resource efficiency, and even develop new sustainable market segments to gain financial advantages. On the other hand, small firms rely on resource-light EMPs such as green logistics and packaging (Lai et al., 2013) to gain shorter-term cost and environmental benefits. Considering both small and large firms can use EMS as a fundamental capability (Gonzalez et al., 2008) to enhance specific EMPs, we establish a model to differentiate how small and large firms use integrated EMS to enhance two categories of EMPs (resource-demanding versus resource-light) and three performance outcomes. We expect large firms to use resource-demanding EMPs to improve environmental, cost-reduction and business performance (financial and market benefits), while small firms use resource-light EMPs to enhance only environmental and cost-reduction performance.

To test the arguments for different resource allocation and outcome approaches, new data and research designs are required. Past studies have tended to focus on either small or large firms (Aragon-Correa et al., 2008) and treat firm size as an antecedent (Bowen, 2000; Klassen, 2001), a moderator (Darnall et al., 2010; Wang et al., 2018) or a control variable (Feng et al., 2018). While Bowen (2002) tests the effect of firm size as a moderator on corporate environmental response for firms with slack resources, we argue it is important to consider that each firm may use different approaches to allocate their slack resources to corporate environmental response. Thus, this paper purposely collects data from small and large firms from the same survey. By comparing EMPs and their outcomes among small and large firms using multi-group structural equation models (SEM), this paper examines the statistical differences between them to reveal distinct resource allocation patterns. In addition to the resource-advantage argument concerning its enhanced ability to predict better performance and proactiveness for large firms, our resource allocation perspective adds new theoretical insights into differentiated performance outcomes, namely due to different resource allocation patterns among small and large firms, for advising policy makers how to specifically address resource allocation issues.

2. Literature review and hypotheses

2.1 Definitions of main constructs

Environmental management system (EMS) is "a formal system of articulating goals, making choices, gathering information, measuring progress, and improving performance" with respect to resource use, throughput and emissions (Florida and Davison, 2001: 64). EMS helps firms to established "formalized structures, procedures and processes" dedicated to reducing environment impacts (Ozusaglam et al., 2018: 112). EMS are often unregulated (Christmann and Taylor, 2006), thus firms obtain EMS certifications voluntary, although they can be costly. However, small firms often obtain EMS certifications due to mandatory requirements from customers. Other firms, often larger ones, may establish their own EMS that are more demanding than the typical EMS used in their industries. While it is used to establish and measure environmental goals, EMS is less prescriptive on the choice of EMPs and technologies (Ozusaglam et al., 2018: 112). Firms with the same EMS certification may adopt very different EMPs and associated technologies (Delmas and Montes-Sancho, 2010).

EMPs are best-practice technologies that can be incorporated into internal value-chain activities (e.g., green product design, procurement, production, logistics, packaging) to reduce a firm's environmental impacts (Christmann, 2000; Klassen & McLaughlin, 1999; Hart, 1995). Since different firms may face different market pressures and different constraints in available resources and technologies, they are likely to adopt a portfolio approach to environmental management (Nath and Ramanathan, 2016). This means there is a need to make strategic choices. Given the differences between small and large firms in terms of resources and cost-benefit rationales, we divide EMPs according to the extent of their resource demand. Green product design and green production are resource-demanding EMPs because they are technically and resource demanding, involving fundamental changes in product design, material and production technologies. However, green logistics and green packaging are resource-light EMPs that are affordable and widely available in the marketplace.

2.2 Resource-advantage hypothesis

Resource-advantage arguments have been the dominant theory when comparing small and large firms in terms of their environmental responses (Aragon-Correa et al., 2008; Russo and Fouts, 1997). Despite having more slack and financial resources, environmental issues cannot be fully resolved by only large firms. There are more studies on environmental management among large firms compared to small ones (Aragon-Correa et al., 2008; Bos-Brouwers et al., 2010; Brammer et al., 2012). Small firms receive a lower degree of public interest (Scott, 1990).

There is an assumption that small firms are only interested in regulatory compliance (Russo and Fouts, 1997; Sharma and Vredenburg, 1998). Small firms find it too expensive and time consuming to conduct environmental reviews and obtain environmental certifications (Biondi et al., 2000). Moreover, it is often more difficult to collect data from small firms (Aragon-Correa, 1998; Rutherfoord et al., 2000), whereas large firms comprise the main samples in various databases such as ESG (Environmental, Social, Governance), KLD (Kinder, Lydenburg, Domini Research & Analysis), etc. Studies investigating environmental management among small firms require new primary data collection from geographically scattered firms. However, small firms are being forced to fulfil the expectations of an increasing number of demanding stakeholders, including public opinion, consumers, customers, local communities, public authorities and environmental NGOs, etc (Biondi et al. 2000).

Small firms play an important role in environmental management because they contribute to a significant 60-70% of total global pollution (Arnold, 2019; Marshall, 1998; Smith and Kemp, 1998), which is more than all large firms combined (Hillary, 2004). Some strict environmental regulations are only applicable to large firms because they are more visible, and they are expected to afford heavy investments in environmental innovation. However, small firms have more economic significance in many countries because their contributions to employment and gross national productivity (GDP) are greater than those of large firms. Given their significant environmental impact, greater attention to small firms is required (Gadenne et al., 2009). However, there is a persistent argument that small firms lack the resources to implement proactive environmental strategies that go beyond minimum regulatory compliance (Aragon-Correa et al., 2008).

Despite this, small firms do possess certain characteristics in favour of environmental innovation. They are characterised by their entrepreneurship, flexible organisational structure, low degree of formalisation and a strong local/regional focus (Bos-Brouwers, 2009). Small firms typically have shorter lines of communication and closer interaction within firms (Aragon-Correa et al., 2008). However, small firms are poor in resources, particularly R&D capacity (del Brio and Junquera, 2003). Moreover, such firms believe they have little impact on the environment (Gadenne et al., 2009). McKeiver and Gadenne (2005) show that most manager–owners of small firms believed they were either moderately or highly orientated towards green practices. Another issue is that manager–owners find it hard to identify the economic benefits of environmental management (McKeiver and Gadenne, 2005), and are often ill-informed about these benefits (Brammer et al., 2012). They may not have enough knowledge and skills to establish the cost-benefits of environmental management, or do not bother to make such calculations or spend time on it.

Some studies have suggested reasons for why small firms investing in environmental management are distinct from those of large firms. There is an emphasis on the planet (the natural environment) and people (work conditions and productivity) rather than profits (Masurel, 2007). Small firms do not necessarily seek strategic, market and financial benefits (business performance) as a result of implementing environmental management. Environmental management may simply be driven by entrepreneurs' personal values and attitudes, rather than any strategic reasoning (McKeiver and Gadenne, 2005). Small firms may consider the environment to be important to individuals and environmental compliance as the right thing to do (Petts et al., 1999). Such evidence suggests small firms are willing to allocate more resources to achieve cost and resource efficiency, but not necessarily financial and market outcomes. This is why the natural resource-based view's expectation of sustained competitive advantage (Hart, 1995) may not be applicable to small firms (Aragon-Correa et al., 2008).

Due to differences in resource possession among small and large firms, resource advantage is an appropriate theoretical perspective for comparing the levels of EMS/EMPs adoption and performance outcomes between small and large firms. Even though the smallest firms perceived significantly less value in engaging in environmental management issues (Brammer et al., 2012), they can still gain certain benefits, in particular environmental performance and cost reduction. Small firms do engage in some environmental initiatives, but there is significant heterogeneity in their engagements (Brammer et al., 2012). Some small firms may supply to large firms with very demanding environmental requirements. However, with limited resources, small firms are not capable of achieving financial and market performance through implementing EMPs. A lack of resources can prevent small firms from adopting a proactive pollution prevention strategy and even reduce their profitability (Russo and Fouts, 1997; Rutherfoord et al., 2000). Anecdotal evidence shows it is even possible for proactive small firms to achieve significantly positive financial performance (Aragon-Correa et al., 2008). Mainly due to differences in resources, we argue that large firms with resource advantages are more capable of adopting EMS/EMPs and achieving better environmental, cost-reduction and business performance through EMS/EMPs.

H1: The levels of EMS and EMPs adoption and outcomes in environmental, cost-reduction and business performance are greater for large firms than small firms.

Next, we establish the relationship between the EMS and EMPs for small and large firms. EMS such as ISO14001 are commonly adopted by both small and large firms (Baumann-Pauly et al., 2013; Florida and Davison, 2001; Murrow and Rondinelli, 2002; Ozusaglam et al, 2018); they help to increase external legitimacy with key stakeholders (Gonzalez-Benito and Gonzalez-Benito, 2008) and improve reputation amongst regulators and insurers (Ambec and Lanoie, 2008). EMS also projects a sustainable brand image to motivate environmentally responsible attitudes among employees (Delmas and Pekovic, 2013) and increase the chances of winning contracts for the sale of products and services (Ammenberg and Hjelm, 2003). To maintain and improve environmental legitimacy, reputation and chances of winning contracts, firms will have to demonstrate that the certification of EMS has led to the adoption of the various EMPs required to reduce environmental impacts.

Moreover, small and large firms may use EMS as a resource to enable the adoption of various EMPs. Acting as a formal system, EMS certification demands that firms clearly articulate their environmental goals, decide upon EMPs to adopt, gather information, measure progress and improve environmental performance (Florida and Davison, 2001). The resource advantage of EMS comes from the structured guidance provided by the 'Plan, Do, Check, Act (PDCA)' improvement model, which focuses on identifying and minimising environmental damage and compliance with environmental regulations. The EMS acts as an antecedent of EMPs because it provides "formalized structures, procedures and processes that enable firms to manage their impact upon the environment" (Ozusaglam et al., 2018: 112). Thus, we posit:

H2: An integrated EMS is associated with EMPs for both small and large firms.

2.3 Resource allocation hypotheses

One difficulty in understanding the outcomes of environmental management for small firms over large firms is that they may adopt different EMPs, but most studies consider corporate environmental management to be a set of generic practices for both small and large firms. Even though environmental management among small firms can be divided into, for example, employee, manufacturing, corporate and marketing (Banerjee, 2001; Brammer et al., 2012), proactive versus reactive (compliance) pollution strategies (Aragon-Correa et al., 2008), and systems, conservation and support (Gadenne et al., 2008), the fact that small firms may allocate resources to different EMPs has been ignored. For example, Cordano et al. (2010) shows that small firms in the wine industry invested in, notably, energy conservation and recycling practices. Thus, we argue, to meet their strategic intentions and resource appropriateness, small and large firms may selectively allocate resources to specific EMPs.

In addition to the study of Cheng and Kesner (1997) proving the use of different resource allocation patterns, several studies support our resource allocation arguments. Del Brio et al. (2003) further argue the importance of delimiting the environmental strategies characteristic of small firms. They point out several important factors, e.g., organisational structure, financial resources, management styles, human resources, environmental management status, manufacturing activity, technological approach, innovation capacity and external cooperation (del Brio et al., 2003). Given the importance of various resources and the different strategic intents among small firms, we argue it is worth exploring the role of strategic resource allocation. Bowen (2000) argues that explaining the ambiguous relationship between firm size and environmental responsiveness depends on disaggregation. Among others, they suggest considering distinct types of environmental responsiveness. Such distinct responses can be reflected by approaches in allocating resources to different EMPs.

The consideration of resource allocation represents a perspective through which to advance the large versus small (resources-advantage) distinction. Small and large firms allocate resources in EMPs differently for various strategic reasons. Small firms may have little awareness of the benefits that might arise from cost reductions as a result of their environmentally friendly practices (Gadenne et al., 2009), but large firms are better placed to access such knowledge. Small firms may be influenced by their suppliers or customers to reduce waste, but they do not always have the ability to fully utilise the EMS or use marketing resources to promote their environmentally responsible products or services (Gadenne et al., 2009).

The realisation of strategic intent depends on a strategy process that decides resource allocation; such a strategy process often involves cost-benefit consideration (Gadenne et al., 2009). Cost is often a constraint for small firms (Biondi et al. 2000), while large firms have excess resources and are in a better position to raise funds, if required. Very few studies examine how small firms evaluate the cost benefits of environmental management. Biondi et al. (2000) note that investing in the improvement of environmental performance is not necessarily the most pressing constraint for small firms. While many small firms have already invested in the technical measures needed for environmental management, Biondi et al. (2000) reveal that initial environmental review (which involves significant time, effort and consultancy cost) is the most major expense facing small firms.

Given such arguments, it is logical to expect small firms lack the financial and human resources needed to develop green products, adopt green production technologies, or drive suppliers to develop green materials and solutions. The lack of specific resources, especially R&D capabilities and knowledge and skills in environmental technologies, may drive small firms to scale down their ambitions. We argue the perceived cost-benefit of environmental management influences how resources are allocated to different EMPs. What small firms can do is limited to those that require no or little R&D and new technologies. These include logistics solutions to reduce waste in empty spaces in trucks and reverse logistics (Lai et al., 2013) to reduce waste in logistics processes and packaging materials (Lai et al., 2015). Such EMPs can at least provide resource efficiency and cost-reduction.

Large firms are also more visible in society and are thus more susceptible to institutional pressure (Bowen, 2000). Large firms have a greater ability to influence environmental standards and so they might consider engaging with environmental issues as a strategic matter. Large firms are known for their possession of organisational slack. Slack is an important factor affecting environmental management implementation (Bowen, 2000). Greater slack increases the extent of their environmental response as firms distribute more resources toward activities that improve external market effectiveness (Cheng and Kesner, 1997). Large firms will have a formalised R&D department to achieve radical product and process innovation (del Brio et al., 2003). Intensity in R&D is a unique capability through which large firms can achieve radical innovation in environmental technologies. With a greater capacity in R&D and marketing, large firms may engage in developing green products and adopting green production technologies. They may also reap economies of scale in environmental technologies, as well as being better placed to influence their suppliers in developing sustainable sourcing practices.

Thus, the relationships between EMPs and performance outcomes that small and large firms can achieve depend on their allocation of strategic resources to specific EMPs. Resource-demanding EMPs are affordable for large firms to achieve environmental, cost and business performance. Large firms also apply resource-light EMPs (logistics and packaging) to improve environmental and cost performance, though their effectiveness may be lower than resource-demanding EMPs. Resource-light EMPs are applied by small firms to gain modest performance in cost and environmental performance. Small firms may also symbolically apply resource demanding EMPs, leading to small or even insignificant performance outcomes. Thus, we posit:

H3a: For large firms, resource-demanding EMPs (design, production, sourcing) and resource-light EMPs (logistics, packaging) are positively associated with environmental, cost-reduction and business performance.

H3b: For small firms, resource-light EMPs (packaging, logistics) are associated with environmental and cost-reduction performance, while resource-demanding EMPs (design, production, sourcing) are not associated with environmental, cost-reduction and business performance.

3. Research methods

3.1. Sampling and data collection

We collected data from the manufacturing firms of apparel, food, electronics and automotive products from Hong Kong and Thailand. There are both small and large firms in such sectors, all of which may face pressures from regulations and customers to address environmental issues. Due to the tightening of environmental regulations and their emphasis on export businesses, these manufacturing firms put effort into environmental management to sustain businesses while staying competitive in the international market (Luo, 2019). Collecting samples from these firms provides us with a diverse context of economic scales and environmental regulations, which improves the generalisability of the study's findings.

To collect the data, we invited the senior executive of the manufacturing firms in the functions of environmental management, supply chain management, sustainability management and operations management of the sample firms. Their duties often involve coordinating cross-functional activities that require attention to their environmental impact in various processes. We emailed the executives to explain the purpose of the study and provided them with access to our online survey system. The executives were asked to answer the questions based on their knowledge of their firm's EMPs. The main respondents were the Chief Operations Officers (COOs), Chief Executive Officers (CEOs), functional managers related to environment management, and operations, logistics and supply chain management.

In Hong Kong, a random sample of 1,000 Chinese manufacturing firms (Hong Kong) from the database of Dun & Bradstreet was drawn. These industries represent major manufacturing sectors in the country. In Thailand, a sample of 1,325 manufacturers from the Office of the Board of Investment (BOI), which operates under the Ministry of Industry, was used. In total, 192 and 203 completed the questionnaire, collected from Hong Kong and Thailand, respectively, after three rounds of mailing and follow-up calls. Thus, we achieved 395 usable responses for our hypothesis testing, which is comparable to prior studies of a similar nature (Sethi and King, 1994). Table 1 shows the demographic data for samples from both countries.

< Insert Table 1 about here >

Next, we separate our samples into small and large firms. Typically, two major dimensions are used to classify firm size – number of employees and annual revenue; although their thresholds vary among countries. Guidelines from different countries consider the maximum number of employees for small firms to be 250, 100 and 50 in the USA, Canada and EU, respectively. The EU threshold for employee number does not apply to Hong Kong and Thailand because of the significant difference in the levels of automation. While Hong Kong can be regarded as a developed country, its factories may be located in parts of China that are still developing. Similarly, Thailand is a developing country with some level of automation. To avoid allocating firms with adequate financial resources as small firms, we do not include medium-sized firms into our samples for small firms. Like large firms, medium-sized firms may have adequate resources to allocate to environmental issues. In developed countries, firms with annual sales less than or equal to US$50M are considered to be small. However, finding firms with fewer than 250 employees and annual sales higher than US$50M is likely. Thus, the use of the 250-employees limit as the threshold for small firms could lead to the inclusion of firms with adequate financial resources.

Considering the industrial structures in both Thailand and Hong Kong, we divided our samples into small and large firms based on the threshold of 100 employees. Table 1 also illustrates that there are 104 small firms and 291 large firms in our sample. There are equal splits of the number of firms in the number of employee category, both for small and large firms. These splits provided us with an equal distribution of firm size across our samples. It is worth mentioning that 78% of the small firms with fewer than 100 employees had annual sales below USD$50m. Due to the high average annual sales for our small firm sample, we would have a higher average annual sales should we move the threshold beyond 100 employees. Including firms with a considerably high annual sales into the small firm sample would have prevented us from separating the truly small firms with limited resources from the larger firms. This justifies our decision to use 100-employee as the threshold for small firms.

Commented [A1]: Why would it have gone up considerably? It's not really said.

Commented [A2R1]: The sentence could be misleading. See my revision.

3.2. Bias issues

To detect the possible problems of non-response bias following Armstrong and Overton (1977), we tested the differences between the early and late respondents by conducting a t-test on a set of randomly selected measurement items of the responses from both sets of respondents. The results show that there is no significant difference between the early and late respondents at $p > 0.05$, suggesting that response bias was not an issue for the collected data.

We took a number of measures to reduce and detect the problem of common method variance. First, in the questionnaire design, we separated the constructs in different sections of the questionnaire. Second, we detected whether common method variance posed a serious threat to our study by following Lindell and Whitney (2001) to test its potential threat. We included firm ownership type as a marker variable, which is a theoretically unrelated variable to any variable in the study. The results show that firm ownership type was not significantly related to any of our study variables, providing preliminary evidence that common method variance was not a problem in our study.

3.3. Measurement development

In the development of the measurement scales, we conducted an extensive literature review and adopted items that were used in prior studies to improve the reliability and validity of the measurement. We invited and sought comments from a panel of academics and practitioners in the area of supply chain management, environmental management and operations management to assess the comprehensiveness and appropriateness of the measurement items. For EMPs, we identified product design, sourcing, production, packaging and logistics as the critical processes by which firms might reduce their environmental impact (Klassen and McLaughlin, 1996; Shrivastava, 1995). Similarly, we identified measures from prior studies on integrating an EMS into organisational operations and decision making (Margerum and Born, 2000).

For the performance measures, we adopted measures from the relevant literature for evaluating the outcomes of the EMPs concerned with cost-reduction, environmental and business performance. To capture all possible environmental outcomes, comprehensive measures of environmental performance compared to Zhu et al. (2008) are used; the measures cover reductions in hazardous/harmful materials, use of electricity, fuel consumption, paper used, packaging materials used, air emissions and solid waste disposal. We measured cost reduction related to business transactions, as well as environment-related savings in energy and waste disposal (Christmann, 2000; Zhu et al., 2008). These cost reduction measures are particularly crucial to small firms. Large firms, on the other hand, care more about business performance in terms of increases in return on investment, market share, total profit from products/services and profit from environmentally friendly products/services (Boyer and Lewis. 2002; Wong et al., 2018; Yang et al., 2011). Table 2 displays the measurement items and their respective theoretical construct.

< Insert Table 2 about here >

We also included control variables in the studies to reflect the contextual and organisational differences of the sample firms. The control variables include industry in terms of SIC industry code, year of firm establishment and annual sales, which are secondary data extracted from the database. We ensured content validity by inviting five senior executives from the sample frame to seek opinions on the relevance of the research questions and measurement, and for how reliable and understandable the measurement items were. In addition, we conducted a pilot test with a group of 50 managers. The pilot test resulted in the slight modification of a number of measurement items based on suggestions and comments made by the managers.

3.4. Measurement validation

We performed a confirmatory factor analysis by assessing the psychometric properties of the measurements. Table 2 summarises the goodness-of-fit measures and standard loadings of the measurements. We followed Bentler and Chou (1988) and examined the model in a nine-construct model, the CFA results of which suggested reasonable model fits (χ^2 = 720.51, df = 141, CFI = 0.91, IFI = 0.91, TLI = 0.90). All constructs were loaded significantly at $p < 0.01$ with standardised loadings greater than 0.50, indicating convergent validity of the constructs (Anderson and Gerbing, 1988). We assessed discriminant validity by evaluating the average variance extracted (AVE) of the constructs (Fornell and Larcker 1981). The AVE estimates were found to be greater than the squared correlation of any pair of constructs. This indicates that the measurement items share common variance with their respective constructs more than with the other constructs, providing evidence of discriminant validity. The Cronbach's alpha and composite reliability of all constructs are well above the criteria of 0.80 and 0.60, respectively (Nunnally, 1978). This suggests that the measurement scales possess adequate reliability and there is shared variance among the set of observed variables that measure an underlying construct's reliability (Fornell and Larcker, 1981). Table 3 summarises the correlation coefficients of the constructs.

< Insert Table 3 about here >

4. Results

4.1. Testing differences between small and large firms

< Insert Table 4 about here >

Table 4 relays the statistical differences between small and large firms. Compared to large firms, small firms have lower means (significant at the $p < 0.01$ level) for an integrated EMS, all EMPs and all three performance outcomes. These results provide support for the resource advantage hypothesis. Thus, H1 is supported.

In addition, we also compare four firm characteristics. Large firms are larger in their annual sales, with average annual sales above US$20 million. Large firms are also more likely to have formalised environmental certification. Relatively, more large firms are state-owned or collectively-owned, while small firms are predominantly private and joint-venture firms. Though not significantly different, the average stakeholder engagement is relatively higher for large firms, indicating greater pressures from stakeholders, as expected. A higher level of stakeholder engagement also indicates that large firms have higher strategic imperative and experience in dealing with environmental issues, and that they need to more heavily invest in resources for dealing with external stakeholders.

4.2. Testing the overall research model

First, we tested the research model using SEM for the combined sample (Thailand and Hong Kong) by using maximum likelihood estimation with the sample covariance matrix. The results indicated a reasonable fit of the model to the data with the goodness-of-fit indices $\chi^2 = 833.61$, df = 181, RMR = 0.08, IFI = 0.90, CFI = 0.90. As illustrated in Figure 1, an integrated EMS is positively related to all EMPs, namely green sourcing ($\beta = 0.72$, $p < 0.001$), design ($\beta = 0.58$, $p < 0.001$), production ($\beta = 0.70$, $p < 0.001$), packaging ($\beta = 0.52$, $p < 0.001$) and logistics ($\beta = 0.66$, $p < 0.001$). These results provide initial support for hypothesis H2.

< Insert Figure 1 about here >

The results also indicate that both green production ($\beta = 0.28$, $p < 0.001$) and logistics ($\beta = 0.19$, $p < 0.01$) are positively related to environmental performance. Logistics are also positively related to cost-reduction ($\beta = 0.25$, $p < 0.01$) and business performance ($\beta = 0.22$, $p < 0.01$). These results suggest that not all EMPs are beneficial to performance. These results provide initial support for the resource allocation arguments behind hypothesis H3. However, the results in Figure 1 cannot be treated as final, as we have not considered the effects of firm size. To further examine whether firm size affects the relationships between the EMS, EMPs and various performance outcomes (as suggested by our resource allocation arguments), we need to divide our samples into small and large firms.

4.3. Testing resource allocation hypotheses

As mentioned, we divided the 395 sample firms into 104 small firms and 291 large ones. We examined structural invariance by using multi-group analysis to examine the variance of the paths in the model under different levels of firm size (i.e., small vs. large firms). Multi-group analysis allows us to ascertain whether the structural relationships between an integrated EMS, EMPs and performance outcomes are variants under different firm sizes. The findings of our multi-group analysis contribute to insights on different firm sizes in achieving EMPs and performance.

In the multi-group analysis, we first allowed the structural parameter to vary freely across the two-groups to form a baseline model and obtained the path coefficients in the levels of small and medium firms, as well as large firms. The results of the two-group baseline model was $\chi^2 = 1190.54$, df = 362, RMR = 0.08, IFI = 0.90, CFI = 0.90. We then conducted a chi-square difference test between the baseline model and the constrained model, in which all the structural parameters are constrained to be equal. The constrained model has the goodness-of-fit indices of $\chi^2 = 1266.32$, df = 417, RMR = 0.09, IFI = 0.89, CFI = 0.89. There is a significant difference in the Chi-square value between the baseline and constrained models ($\Delta\chi^2 = 75.78$, Δdf = 55, $p < 0.05$), suggesting that there is a moderating effect of firm size on the relationships. The results in Table 5 suggest that different patterns of structural relationships exist between small and large firms.

< Insert Table 5 about here >

We tested the equality of the paths between small and large firms; the results in Table 5 suggest that the relationships between the integrated EMS and the various EMPs are significant for both small and large firms, providing support for H2. However, the relationships between EMPs and performance depend on firm size. As summarised in Figure 2, the relationships between design, cost and business performance vary between the two groups, and the relationships are only significant for large firms, i.e., design is positively related to cost performance ($\beta = 0.27$, $p < 0.01$), and design is positively related to business performance ($\beta = 0.16$, $p < 0.05$) for large firms, but insignificant for small firms. Similarly, production is positively related to environmental performance ($\beta = 0.30$, $p < 0.001$) for large firms. It is worth noting that only large firms can achieve business performance via green product design. Similarly, investing resources in resource-light EMPs such as logistics and packaging did not lead to significant performance improvement. These results partially support hypothesis H3a, thus suggesting that large firms allocate resources to resource-demanding EMPs (green design and production) to gain environmental, cost and business benefits. Sourcing is not significantly related to any performance for small and large firms. Thus, part of H3a (sourcing-performance, logistics-performance and packaging performance) for large firms is not supported.

< Insert Figure 2 about here >

As predicted by H3b, the results indicate that green packaging is positively related to environmental performance ($\beta = 0.27$, $p < 0.01$), and green logistics is significantly related to environmental ($\beta = 0.32$, $p < 0.05$) and cost performance ($\beta = 0.62$, $p < 0.001$) for small firms. Even though small firms have invested in those resource demanding EMPs (design, sourcing, production), they failed to gain any significant performance benefits. These results support the resource allocation hypothesis H3b for small firms.

4.4. Effect of Country

Though it is not a focus of this paper, we checked whether there were any differences between the two countries to explore potential policy implications and future research avenues. Following the same procedure, we tested the impact of country on the structural model based on the classification of the sample firms into Hong Kong (n=192) and Thailand (n=203). The results are illustrated in Table 6. The Chi-square difference test shows that the associations in the structural model are moderated by country ($\Delta\chi^2 = 271.89$, $\Delta df = 55$, $p < 0.05$). However, not all paths are different across the two groups. The different Chi-square test results indicate that the relationship between integrated EMS and production varies across the two groups ($\Delta\chi^2 = 21.75$, $\Delta df = 1$, $p < 0.05$), and the relationship is strengthened ($\beta = 0.73$, $p < 0.001$) in Hong

Kong. This apparent increased effectiveness of EMS in a more advanced country appears to suggest the potential role of country-level regulation, governmental intervention, industrial norms and culture.

Similarly, we found the relationship between design and cost performance varied across the two groups ($\Delta\chi^2 = 7.83$, $\Delta df = 1$, $p < 0.05$), and the relationship is strengthened in Thailand ($\beta = 0.29$, $p < 0.01$), but not in Hong Kong ($\beta = 0.12$, $p > 0.05$). The relationship between production and cost performance varied across Hong Kong and Thailand ($\Delta\chi^2 = 4.22$, $\Delta df = 1$, $p < 0.05$), with the relationship strengthened in Hong Kong ($\beta = 0.33$, $p < 0.01$). The different emphases in green design over production between the two countries suggest potential differences in industrial structures, or choices of resource allocation between green product and production innovation. Lastly, the relationship between logistics and cost performance is distinct across Hong Kong and Thailand ($\Delta\chi^2 = 5.96$, $\Delta df = 1$, $p < 0.05$), with the relationship being stronger in Hong Kong ($\beta = 0.43$, $p < 0.001$). These results suggest that there might be some country-specific factors that affect resource allocation and strategic intent among firms from Thailand and Hong Kong.

< Insert Table 6 about here >

5. Discussion

5.1 Discussion of findings

The analyses show that, compared to small firms, large firms in both Hong Kong and Thailand are more successful in implementing an EMS and all the five EMPs. Large firms in our samples have also achieved better performance in environmental, cost-reduction and business performance. These analyses further confirm the validity of resource advantage arguments in developing countries such as Thailand and Hong Kong. While more employees and higher revenue are an indication of resource advantages, we also have evidence that large firms are more likely to have obtained environmental certification, which can be driven by the possession of more financial and human resources. Such evidence supports the resource advantage arguments dominating the extant literature (Aragon-Correa et al., 2008; Russo and Fouts, 1997). However, our analyses suggest resource advantage is simply one of the reasons behind the differences in the EMS, EMPs and performance outcomes between small and large firms. There is a difference between possessing more resources and the intentions/processes that strategically allocate resources to specific EMPs for improving specific performance outcomes.

Our resource-allocation analyses indicate that resource advantage arguments can be complemented by an understanding of strategic intent, which can further affect the strategic allocation of resources. Such strategic intentions may be driven by external pressures. Internally, we find EMS particularly useful for both small and large firms to support the implementation of all five EMPs. This is encouraging evidence demonstrating that small and large firms are leveraging their EMS as a resource for adopting EMPs. As shown in our analyses, another reason for large firms to allocate resources in integrating an EMS and implementing EMPs is that they face higher stakeholder pressures. As is typical in Hong Kong and Thailand, many large firms are state-owned or subsidised by the government, so they may be the first group of firms facing governmental pressures, and their engagement in environmental management may also be encouraged or subsidised by the government. In Thailand, larger firms with more community concerns make more environmental disclosures than smaller firms. The previous study identified that small firms do not believe they can make a difference (Brammer et al., 2012), which could be caused by a lower level of stakeholder pressures, as shown by our analyses. This is especially relevant to small firms in regions such as Thailand and Hong Kong (China) with less government and social pressures (He et al., 2018). As both Thailand and Hong Kong are export economies, the firms in these two areas are likely to serve international customers that demand information about their environmental performance. The finding that EMS helps facilitates the adoption of EMPs that lead to performance outcomes encourages firms in Thailand and Hong Kong to adopt EMS and EMPs.

While our data do not provide a full account of strategic intent among small and large firms, we focus on identifying how certain performance outcomes are created by specific EMPs as an indication of strategic resource allocation patterns. Our analyses show that small and large firms attempted to improve environmental and cost-reduction performance using different EMPs. Our idea of dividing EMPs according to resource demand and cost-benefits seems to apply to firms from Thailand and Hong Kong. The analyses revealed that large firms relied on resource-demanding EMPs such as green product design and production, while small firms emphasised resource-light green EMPs such as green logistics and packaging. Small firms seem to view resource-light EMPs that reduce cost and environmental impacts as the best cost-effective strategies, but large firms need to address a significantly challenging task, i.e., improve business performance through investing in resource-demanding EMPs.

As expected, a crucial difference in terms of resource allocation relates to the emphasis on business performance. Both small and large firms achieved environmental and cost-reduction, but only large firms managed to improve business performance, which is a more difficult performance objective to achieve through implementing EMS and EMPs (Ozusaglam et al., 2018). Past research shows small firms are often ill-informed about the benefits and they have inadequate skills in assessing the cost-benefit of environmental management (Brammer et al., 2012; Gadenne et al., 2009; McKeiver and Gadenne, 2005). Our analyses suggest an alternative resource-allocation explanation. Furthermore, it suggested that small firms are likely to be able to afford an improvement in environmental and cost-reduction performance through implementing resource-light EMPs, rather than wasting resources to improve business performance. This is because investing in resource-light EMPs such as green logistics and packaging (Lai et al., 2013) better fits the resource profiles of small firms. In contrast, large firms may decide to utilise their R&D particularly, in addition to more excess to design green products and change their production to greener production technologies.

Surprisingly, unlike small firms, our analyses show that large firms will not be able to achieve any performance outcomes through investing in resource-light EMPs such as green logistics and packaging, even though they have implemented them. Another observation is that small and large firms do not all rely on EMPs to improve performance. This indicates the use of a purposive resource allocation strategy, which reflects how firms address attention allocation problems – instead of spreading all of their resources across the EMPs, they focus on a few selected ones. Perhaps mastering skills such that all EMPs can lead to performance takes time, for both small and large firms. We regard this anomaly as an opportunity for future research.

5.2 Theoretical implications

Resource-advantage has been a central theory in comparing the environmental management of small and large firms. While our analyses support this theory, we argue that a deeper understanding of how small and large firms respond to environmental issues and achieve performance requires an alternate theory. Our analyses show that small and large firms can achieve both environmental and cost-reduction performance but through implementing different EMPs, supported by the EMS. While the EMS provides a structured management system and processes, small and large firms ended up using different EMPs to achieve the same performance. This is evidence of the use of a purposive or strategic resource allocation strategy, which reflects strategic intent with regard to which performance objectives to prioritise, and the allocation of resources as to which EMPs achieve those intended outcomes.

There are some implications of our resource allocation arguments to the debate surrounding large firms versus small firms. Our resource allocation arguments suggest a theoretical framework that establishes connections between drivers and strategic intent (of which performance outcomes are chosen to be improved), and between intent and resource allocations (to understand how firms address cost-benefits and allocate resources to specific EMPs for the targeted performance outcome). A unique problem facing both small and large firms when addressing cost-benefits assessment is how they view specific EMPs, whether resource-demanding or resource-light. By establishing these connections among small and large firms and how they view resource demands, the field can advance the simplistic resource-advantage argument towards a more nuanced understanding of resource allocation patterns.

5.3 Practical implications

The findings of this paper suggest that managers in large and small firms should be aware of how they establish which performance outcomes to target, and how their perceptions of resource demands can affect the ways they assess the cost-benefits of and allocate resources to specific EMPs. While our analyses show small firms can only achieve environmental and cost-reduction through EMPs that emphasise logistics and packaging, we argue that learning how large firms utilise resource-demanding EMPs can help them become more ambitious. However, our analyses suggest the need to be cautious about spreading resources too thin across different EMPs. For Hong Kong, where competition in the logistics industry is high, resulting in low logistics service charges and high-quality service, small firms in Hong Kong may take advantage of the low cost of logistics and invest in logistics EMP implementation to achieve environmental and cost-reduction performance.

For policy makers, past research based on resource-advantage suggests the need to provide resources to small firms. Such a recommendation is, perhaps, not specific enough. Instead, our analyses discovered that small firms already use resource-light EMPs to achieve cost-reduction and environmental performance. Thus, small firms need support (finance, human resources, sales) to implement resource-demanding EMPs, as well as an increase in ambition that they can, indeed, achieve business performance by learning from large firms. We also observed differences between countries. For example, firms in Hong Kong emphasised green production while firms in Thailand used green design to reduce cost. This suggests the roles of national level environmental policy and governmental intervention. Studies that compare regulatory and industrial policies, as well as governmental support structures across countries, could be used to explain differences in resource allocation patterns and the effectiveness of EMPs among small and large firms.

6. Conclusion and future research

This paper compares EMS, EMPs and performance outcomes between small and large firms in Thailand and Hong Kong. Instead of a reliance on resource-advantage arguments to expect large firms to implement EMS/EMPs more successfully and achieve better performance than small firms, we argue a more subtle understanding can be gained by assessing the allocation of resources to specific EMPs to improve specific performance outcomes. The analyses show that large firms can achieve environmental, cost-reduction and business performance by purposely allocating resources in resource-demanding EMPs, while small firms use resource-light EMPs to achieve only environmental and cost-reduction performance. Such resource allocation arguments lead to the suggestion of future research to establish connections among drives, strategic intent and resource allocation, as a way to expand the current theoretical explanations.

This paper has several limitations. First, the paper uses the performance outcomes of EMPs as an indirect indication of resource allocation. However, this approach serves as a platform for future research to directly collect data on drivers, strategic intent and resource allocation. Second, the paper relies on cross-sectional data, while performance outcomes may take time to realise; finally, strategic intent and resource allocation may change over time. Thus, longitudinal studies, though significantly more difficult to conduct, may provide greater insights and more reliable data. Third, the samples from Hong Kong and Thailand may not be representative of other countries. Moreover, we realise it was harder to collect data from small firms that have limited human and financial resources. As shown in our data, we have used a threshold of 100 employees to obtain a sample of small firms; however, some of these firms had annual sales the size of medium firms. This weakness can be addressed by working closely with small business associations under the support of the government.

References

Anderson, J.C. and Gerbing, D.W. (1988). Structural equation modeling in practices: a review and recommended two-step approach. *Psychology Bulletin*, 103, 411-423

Aragon-Correa, J.A., Hurtado-Torres, N., Sharma, S. and Garcia-Morales, V.J. (2008). Environmental strategy and performance in SMEs: A resource-based perspective. *Journal of Environmental Management*, 86, 88-103.

Armstrong, J. S., and Overton, R. S. (1977). Estimating nonresponse bias in mail surveys. *Journal of Marketing Research*, 14(4), 396-402.

Arnold, C. (2019). Foundation for Economies Worldwide = Small Business. International Federation of Accountants. (https://www.ifac.org/global-knowledge-gateway/finance-leadership-development/discussion/foundation-economies-worldwide)

Banerjee S. (2001). Corporate environmental strategies and actions. *Management Decision*, 39(1), 36-44.

Baumann-Pauly, D., Wickert, C., Spence, L.J. and Sherer, A.G. (2013). Organizing corporate social responsibility in small and large firms: size matters. *Journal of Business Ethics*, 115, 693-705.

Bentler, P. M., & Chou, C.-P. (Eds.). (1988). *Practical issues in structural modeling*. Newbury Park, CA: Sage.

Biondi V., Frey M. and Iraldo F. (2000). Environmental management systems and SMEs. *Greener Management International*, 29, 55-69.

Bowen, F. (2000). Does size matter? Organizational slack and visibility as alternative explanations for environmental responsiveness. PhD dissertation, Business and Society, 41(1), 118-124.

Bowen, F. (2002). Organizational slack and corporate greening: Broadening the debate. *British Journal of Management*, 13, 305-316.

Boyer, K.K. and Lewis, M.W. (2002). Competitive priorities: investigating the need for trade-offs in operations strategy. *Production and Operations Management*, 11(1), 9-19.

Brammer, S., Hoejmose, S., Marchant, K. (2012). Environmental management in SMEs in the UK: Practices, pressures and perceived benefits. *Business Strategy and the Environment*, 21, 423-434.

Cheng, J.L.C., and Kesner, I. (1997). Organizational slack and response to environmental shifts: The impact of resource allocation patterns. *Journal of Management*, 23(1), 1-18.

Christmann, P. (2000). Effects of “best practices” of environmental management on cost advantage: the role of complementary assets. *Academy of Management Journal*, 43(4), 663-680.

Christmann, P., Taylor, G. (2006). Firm self-regulation through international certifiable standards: Determinants of symbolic versus substantive implementation. *Journal of International Business Studies*, 37(6), 863-878.

Cordano, M., Marshall, R.S. and Silverman, M. (2010). How do small and medium enterprises go “Green”? A study of environmental management programs in the U.S. wine industry. *Journal of Business Ethics*, 92, 463-468.

Darnall, N., Henriques, I., Sadorsky, P. (2010). Adopting proactive environmental strategy: The influence of stakeholders and firm size. *Journal of Management Studies*, 47(6), 1072-1094.

Del Brio J. and Junquera B. (2003). A review of the literature on environmental innovation management in SMEs: implications for public policies. *Technovation*, 23(12), 939-948.

Delmas, M., Montes-Sancho, M.J. (2010). Voluntary agreements to improve environmental quality: Symbolic and substantive cooperation. *Strategic Management Journal*, 31(6), 575-601.

Feng, M., Yu, W., Wang, X., Wong, C.Y. (2018). Green supply chain management and financial performance: The mediating roles of operational and environmental performance. *Business Strategy and the Environment*, 27(1), 811-824.

Florida, R. and Davison, D. (2001). Gaining from green management. *California Management Review*, 43(3), 63-84.

Fornell, C. and Larcker, D.F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research,* 18(1), 39-50.

Gadenne D., Kennedy J. and McKeiver C. (2009). An empirical study of environmental awareness and practices in SMEs. *Journal of Business Ethics*, 84(1), 45-63.

Gonzalez, P., Sarkis, J., Adenso-Diaz, B. (2008). Environmental management system certification and its influence on corporate practices: Evidence from the automotive industry. *International Journal of Operations and Production Management*, 28(1), 1021-1041

Hart, S.L. (1995). A natural-resource-based view of the firm. *Academy of Management Review*, 20(4), 986-1014.

He, Z. X., Shen, W. X., Li, Q. B., Xu, S. C., Zhao, B., Long, R. Y., & Chen, H. (2018). Investigating external and internal pressures on corporate environmental behavior in papermaking enterprises of China. *Journal of Cleaner Production*, 172, 1193-1211.

Hillary R. (2004). Environmental management systems and the smaller enterprise. *Journal of Cleaner Production*, 12(6), 561-569.

Julian, C.C. (2003). Export marketing performance: a study of Thailand firms. *Journal of Small Business Management*, 41(2), 213.

Klassen, R.D. (2001). Plant-level environmental management orientation: The influence of management views and plant characteristics. *Production and Operations Management*, 10(3), 257-275.

Klassen, R.D. and McLaughlin, C.P. (1996). The impact of environmental management on firm performance. *Management Science*, 42(8), 1199-1214.

Lai, K.H., Wong, C.W.Y., Lam, J.S.L. (2015). Sharing environmental management information with supply chain partners and the performance contingencies on environmental performance. *International Journal of Production Economics*, 164(June), 445-453.

Lai, K.H., Wu, S.J., Wong, C.W.Y. (2013). Did reverse logistics practices hit the triple bottom line of Chinese manufacturers? *International Journal of Production Economics*, 146(1), 106-117.

Lindell, M. K., & Whitney, D. J. (2001). Accounting for common method variance in cross-sectional designs. *Journal of Applied Psychology*, 86(1), 114-121.

Luo, W. (2019). Sustainability the rallying cry in tough times. *China Daily*, August 26, 2019.

Marshall, C. L. (1998). *Economic Instruments and the Business Use of Energy*. London: Stationery Office.

Commented [A3]: This author is missing an initial.

Commented [A4R3]: It is Colin Marshall, I added the initial.

Masurel E. (2007). Why SMEs invest in environmental measures: Sustainability evidence from small and medium-sized printing firms. *Business Strategy and the Environment*, 16, 190-201.

McKeiver C. and Gadenne D. (2005). Environmental management systems in small and medium businesses. *International Small Business Journal*, 23(5), 513-537.

Margerum R.D. and Born, S.M. (2000). A co-ordination diagnostic for improving integrated environmental management. *Journal of Environmental Planning and Management*, 43(1), 5-21.

Murrow, D., and Rondinelli, D. (2002). Adopting corporate environmental management systems: Motivations and results of ISO 14001 and EMAS certification. *European Management Journal*, 20(2), 159-171.

Nath, P. and Ramanathan, R. (2016). Environmental management practices, environmental technology portfolio, and environmental commitment: a content analysis approach for UK manufacturing firms. *International Journal of Production Economics*, 171, 427-437.

Nunnally, J. (1978). *Psychometric Theory*. New York, NY: McGraw-Hill.

Ozusaglam, S., Kesidou, E., Wong, C.Y. (2018). Performance effects of complementarity between environmental management systems and environmental technologies. *International Journal of Production Economics*, 197, 112-132.

Petts J., Herd A., Gerrad S., Horne C. (1999). The climate culture of environmental compliance within SMEs. *Business Strategy and the Environment*, 8, 14-30.

Russo M. and Fouts P. (1997). A resource-based perspective on corporate environmental performance and profitability. *Academy of Management Journal*, 40(3), 534-559.

Rutherfoord, R., Blackburn, R.A. and Spence, L.J. (2000). Environmental management and the small firm: an international comparison. *International Journal of Entrepreneurial Behaviour and Research*, 6, 310-325.

Scott, W.R. (1990). *Ideology and the New Social Movements*. London: Unwin Hyman.

Sethi, V., & King, W. R. (1994). Development of measures to assess the extent to which an information technology application provides competitive advantage. *Management Science*, 40(12), 1601-1627.

Sharma, S. and Vredenburg, H. (1998). Proactive corporate environmental strategy and the development of competitively valuable organizational capabilities. *Strategic Management Journal*, 19, 729-753.

Shrivastava, P. (1995). Environmental technologies and competitive advantage. *Strategic Management Journal*, 16, 183-200.

Smith, M.A. and Kemp, R. (1998). SMEs and the Environment 1998: A Grounded Report. Birmingham: Groundwork.

Wang, J., Zhang, Y., and Goh, M. (2018). Moderating the role of firm size in sustainable performance improvement through sustainable supply chain management. *Sustainability*, 10, 1-14.

Williamson, D. Lynch-Wood, G. (2006). Drivers of environmental behaviour in manufacturing SMEs and implications for CSR. *Journal of Business Ethics*, 6(3), 317-330.

Wong, C.W.Y., Wong, C.Y. and Boon-itt, S. (2018). How does sustainable development of supply chains make firms lean, green and profitable? A resource orchestration perspective. *Business Strategy and the Environment*, 27(3), 375-388.

Yang, M.G., Hong, P., Modi, S.B. (2011). Impact of lean manufacturing and environmental management on business performance: An empirical study of manufacturing firms. *International Journal of Production Economics*, 129(2), 251-261.

Zhu, Q., Sarkis, J. and Lai, K. (2008). Confirmation of a measurement model for green supply chain management practices implementation. *International Journal of Production Economics*, 111(2), 261-273.

Table 1. Respondent demographic

Demographic characteristics	Hong Kong (n = 192) Percentage of samples (%)	Thailand (n = 203) Percentage of samples (%)
Certification		
Environmental certifications	24.4	88.2
Uncertified	75.6	11.8
Annual Sales		
<US$10M	28.5	14.3
US$10M-20M	16.9	17.7
>US$20M-$50M	16.3	22.7
>US$50M-$100M	14.5	25.6
>US$100M	23.8	19.7
Number of employees		
1-10	19.4	0.5
11-50	20.6	0.5
51-100	11.4	5.6
101-500	26.3	42.9
>500	22.3	50.2
Demographic characteristics	**Small firms (n = 104) Percentage of samples (%)**	**Large firms (n = 291) Percentage of samples (%)**
Certification		
Environmental certifications	17.3	70.4
Uncertified	82.7	29.3
Annual Sales		
<US$10M	45.2	14.3
US$10M-20M	20.2	17.7
>US$20M-$50M	12.5	22.7
>US$50M-$100M	12.5	25.6
>US$100M	9.5	19.5
Number of employees		
1-10	34.0	-
11-50	35.0	-
51-100	31.1	-
101-500	-	51.5
>500	-	48.5

Note: SMEs threshold is 100 employees.

Table 2. Measurement Model

Construct *[Goodness-of-fit indices]*	**Loading**	**t-value**
Integrated environmental management system EMS *[χ2 (df)= 43.47 (9); CFI = .98; IFI = .98; RMR = .03; Cronbach alpha = .95; Composite reliability = .94; AVE = .73]*		
Environmental management system integrates environmental responsibility into employee codes of conduct	.88	-
Environmental management system includes environmental criteria into commercial decisions	.86	24.13
Environmental management system integrates environmental criteria into resource management decisions	.90	26.11
Integrate environmental, quality and other standards into one management systems	.85	23.34
Environmental management system based on life-cycle approach	.84	22.57
Environmental management system supported by an integrated information system	.79	20.46
EMP - Sourcing *[χ2 (df)= n/a; CFI = n/a; IFI = n/a; RMR = n/a; Cronbach alpha = .85; Composite reliability = .85; AVE =.65]*		
Sources non-hazardous/toxic materials	.71	-
Sources from suppliers who comply with environmental regulations, e.g., REACH	.84	14.63
Sources environmental-friendly raw materials	.87	14.63
EMP - Design *[χ2 (df)= n/a; CFI = n/a; IFI = n/a; RMR = n/a; α = .86; Cronbach alpha = .89; Composite reliability = .89; AVE =.74]*		
Designs products to reduce consumption of materials	.86	-
Designs products to reduce consumption of energy	.95	22.04
Designs products to reuse, recycle, and recovery	.76	17.97
EMP - Production *[χ2 (df)= 20.06 (2); CFI = .99; IFI = .99; RMR = .04; Cronbach alpha = .92; Composite reliability = .92; AVE =.74]*		
Controls operations process to reduce waste from all sources	.91	-
Monitors operations process to reduce waste from all sources	.97	34.58
Audits operations process to reduce waste from all sources	.88	27.33
Uses cleaner technology to reduce waste from all sources	.65	15.33
EMP - Packaging *[χ2 (df)= n/a; CFI = n/a; IFI = n/a; RMR = n/a; Cronbach alpha = .88; Composite reliability = .88; AVE =.70]*		
Recycles packaging	.84	-
Reuses packaging	.90	18.69
Reduces packaging	.77	16.88
EMP - Logistics *[χ2 (df)= 22.34 (2); CFI = .97; IFI = .97; RMR = .04; Cronbach alpha = .87; Composite reliability = .87; AVE =.62]*		
Utilizes cleaner transportation modes	.77	-
Improves vehicle fill	.79	15.49
Careful schedule transportation routes to reduce emission	.84	16.21
Compact packaging the reduces space requirement	.75	14.61

Cost-Reduction Performance *[χ2 (df)= n/a; CFI = n/a; IFI = n/a; RMR = n/a; Cronbach alpha = .87; Composite reliability = .86; AVE =.68]*		
Cost reduction per business transaction	.72	-
Cost reduction on energy savings	.90	15.60
Cost reduction on waste disposal	.84	15.50
Environmental Performance *[χ2 (df)= 162.64 (14); CFI = .93; IFI = .93; RMR = .03; Cronbach alpha = .92; Composite reliability = .92; AVE =.59]*		
Reduction in hazardous/harmful materials used in manufacturing product/service delivery	.83	-
Reduction in the use of electricity	.84	16.24
Reduction in total fuel consumption used in transportation of products/services	.86	16.31
Reduction in total paper used	.82	16.78
Reduction in total packaging materials used	.88	16.06
Reduction in air emissions	.82	17.14
Reduction in solid waste disposal	.72	16.05
Business Performance *[χ2 (df)= 20.84 (2); CFI = .98; IFI = .98; RMR = .02; Cronbach alpha = .89; Composite reliability = .90; AVE =.71]*		
Increase in return on investment	.75	-
Increase in market share	.90	18.28
Increase in total profit from products/services	.87	17.72
Increase in profit from environmentally friendly products/services	.84	17.00

Note: The respondents were asked to indicate their extent of implementation on a five-point Likert scale with 1 = almost never and 5 = almost always

Table 3. Correlations table (combined samples)

Variables	*1*	2	3	4	5	6	7	8	9
1. Integrated EMS	*.85*								
2. EMP - Sourcing	.503**	*.81*							
3. EMP - Design	.584**	*.562***	*.86*						
4. EMP - Production	.701**	.634**	.764**	*.86*					
5. EMP - Packaging	.520**	.459**	.555**	.643**	*.84*				
6. EMP - Logistics	.660**	.528**	.679**	.732**	.681**	*.82*			
7. Environmental Performance	.512**	.452**	.507**	.563**	.450**	.524**	*.77*		
8. Cost-reduction Performance	.487**	.350**	.470**	.496**	.411**	.501**	.660**	*.82*	
9. Business Performance	.474**	.364**	.448**	.487**	.378**	.478**	.571**	.690**	*.77*
10. Marker variable	-.127*	-.031	-.075	-.126*	-.071	-.036	-.017	-.042	.005

*Note: square root of AVE is depicted italic; ** p<0.01; *p<0.05.*

Table 4. Differences between large and small firms

Variable	All firms [n=395]				Small firms (=<100 employees) [n = 104]				Large firms (>100 employees) [n = 291]				F-value
	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	
Integrated EMS[1]	1	5	3.42	1.07	1	5	2.73	1.10	1	5	3.66	.95	67.07***
EMPs													
Sourcing[1]	1	5	3.94	.94	1	5	3.61	1.07	1	5	4.05	.86	18.32***
Design[1]	1	5	3.58	1.10	1	5	2.97	1.24	1	5	3.80	.96	47.77***
Production[1]	1	5	3.80	1.02	1	5	3.15	1.14	1	5	4.02	.86	65.51***
Packaging[1]	1	5	3.62	1.01	1	5	3.25	1.06	1	5	3.75	.95	19.26***
Logistics[1]	1	5	3.45	.96	1	5	2.99	1.08	1	5	3.62	.85	34.96***
Performance													
Environmental performance[1]	1	5	3.31	.75	1	5	2.98	.75	1	5	3.42	.72	22.57***
Cost Reduction[1]	1	5	3.09	.74	1	5	2.71	.65	1	5	3.22	.77	39.97***
Business performance[1]	1	5	3.07	.72	1	5	2.78	.78	1	5	3.17	.68	26.97***
Firm characteristics													
Annual Sales	1	5	3.05	1.40	1	5	2.21	1.38	1	5	3.34	1.28	12.32***
Environmental Certificate	1	2	1.41	.48	1	2	1.83	.37	1	2	1.26	.43	13.35***
Ownership	1	6	2.63	.95	1	6	3.04	.98	1	6	2.48	.90	5.82*
Stakeholder engagement[1]	1	5	2.88	1.16	1	5	2.18	1.09	1	5	3.11	1.08	.09

*Note: [1]Likert scale: 1 (low) to 5 (high); Annual sales (1=<US$10m; 2=US$10m-20m, 3=US$21m-50m; 4= US$51m-100m; 5> US$100m); Environmental certificate (1 = certification; 2 = no certification); Ownership. (1. State-owed; 2. Collectively-owned (subsidized by government); 3. Privately owned; 4. International JVs; 5. Listed; 6. Others). ***p < 0.001; **p < 0.01; * p < 0.05*

Table 5. Invariance tests for large versus small firms

Hypothesis description	χ^2	df	RMR	IFI	TLI	CFI	$\Delta\chi^2$	Δdf	*p*	Small firms	Large firms
Baseline model	1190.54	362	.08	.90	.90	.90					
Constrained model[a]	1266.32	417	.09	.89	.90	.89	75.78	55	<.05		
Integrated EMS → Sourcing	1190.54	363	.09	.90	.90	.90	0	1	<.05	**.72*****	**.70*****
Integrated EMS → Design	1114.30	363	.08	.90	.90	.90	76.24	1	<.05	**.62*****	**.48*****
Integrated EMS → Production	1112.77	363	.08	.90	.90	.90	77.77	1	<.05	**.69*****	**.62*****
Integrated EMS → Packaging	1109.54	363	.08	.90	.90	.90	81.00	1	<.05	**.50*****	**.47*****
Integrated EMS → Logistics	1112.82	363	.08	.90	.90	.90	77.72	1	<.05	**.69*****	**.58*****
Sourcing → Environmental Performance	1109.85	363	.08	.90	.90	.90	80.69	1	<.05	.22	.13
Sourcing → Cost performance	1109.92	363	.08	.90	.90	.90	80.62	1	<.05	.11	.01
Sourcing → Business performance	1110.91	363	.08	.90	.90	.90	79.63	1	<.05	.09	.16
Design → Environmental Performance	1110.35	363	.08	.90	.90	.90	80.19	1	<.05	.24	.08
Design → Cost performance	1118.45	363	.08	.90	.90	.90	72.09	1	<.05	.20	**.27****
Design → Business performance	1110.67	363	.08	.90	.90	.90	79.87	1	<.05	.03	**.16***
Production → Environmental Performance	1113.47	363	.08	.90	.90	.90	77.07	1	<.05	.06	**.30*****
Production → Cost performance	1111.06	363	.08	.90	.90	.90	79.48	1	<.05	.11	.16
Production → Business performance	1111.93	363	.08	.90	.90	.90	78.61	1	<.05	.21	.15
Packaging → Environmental Performance	1110.52	363	.08	.90	.90	.90	80.02	1	<.05	**.27***	.01
Packaging → Cost performance	1116.55	363	.08	.90	.90	.90	73.99	1	<.05	.19	.01
Packaging → Business performance	1110.05	363	.08	.90	.90	.90	80.49	1	<.05	.20	.04
Logistics → Environmental Performance	1110.52	363	.08	.90	.90	.90	80.02	1	<.05	**.32***	.15
Logistics → Cost performance	1116.55	363	.08	.90	.90	.90	73.99	1	<.05	**.62*****	.11
Logistics → Business performance	1110.52	363	.08	.90	.90	.90	80.02	1	<.05	.30	.15

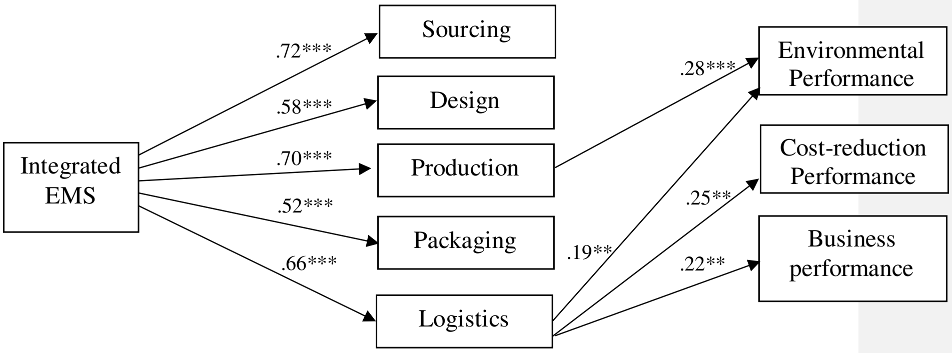
****p < 0.001; **p < 0.01; * p < 0.05*; n.s. = Not significance

Table 6. Invariance tests for Thailand versus Hong Kong samples

Hypothesis description	χ^2	df	RMR	IFI	TLI	CFI	$\Delta\chi^2$	Δdf	*p*	Hong Kong	Thailand
Baseline model	1085.90	362	.08	.90	.90	.90					
Constrained model[a]	1357.79	417	.10	.89	.89	.89	271.89	55	<.05		
Integrated EMS → Sourcing	1086.50	363	.80	.90	.90	.90	0.6	1	n.s	.70***	.63***
Integrated EMS → Design	1088.24	363	.80	.90	.90	.90	2.34	1	n.s.	.59***	.41***
Integrated EMS → Production	1107.06	363	.80	.90	.90	.90	21.75	1	<.05	**.73*** **	**.42*** **
Integrated EMS → Packaging	1087.32	363	.80	.90	.90	.90	1.42	1	n.s.	.56***	.33***
Integrated EMS → Logistics	1086.05	363	.80	.90	.90	.90	.15	1	n.s.	.67***	.54***
Sourcing → Environmental Performance	1086.52	363	.80	.90	.90	.90	.62	1	n.s.	.21	.08
Sourcing → Cost performance	1088.84	363	.80	.90	.90	.90	2.94	1	n.s.	.18*	.09
Sourcing → Business performance	1085.90	363	.80	.90	.90	.90	0	1	n.s.	.09	.08
Design → Environmental Performance	1085.91	363	.80	.90	.90	.90	0.01	1	n.s.	.97	.11
Design → Cost performance	1093.73	363	.80	.90	.90	.90	7.83	1	<.05	.12	**.29** **
Design → Business performance	1086.86	363	.80	.90	.90	.90	.96	1	n.s.	.06	.19*
Production → Environmental Performance	1086.71	363	.80	.90	.90	.90	.81	1	n.s.	.31**	.13
Production → Cost performance	1090.12	363	.80	.90	.90	.90	4.22	1	<.05	**.33** **	.04
Production → Business performance	1086.16	363	.80	.90	.90	.90	.26	1	n.s.	.18	.06
Packaging → Environmental Performance	1089.35	363	.80	.90	.90	.90	3.45	1	n.s.	.18*	.05
Packaging → Cost performance	1085.94	363	.80	.90	.90	.90	.04	1	n.s.	.02	.07
Packaging → Business performance	1090.80	363	.80	.90	.90	.90	4.90	1	<.05	.19	.10
Logistics → Environmental Performance	1086.72	363	.80	.90	.90	.90	.82	1	n.s.	.23*	.12
Logistics → Cost performance	1091.86	363	.80	.90	.90	.90	5.96	1	<.05	**.43*** **	.06
Logistics → Business performance	1086.11	363	.80	.90	.90	.90	.21	1	n.s.	.22	.14

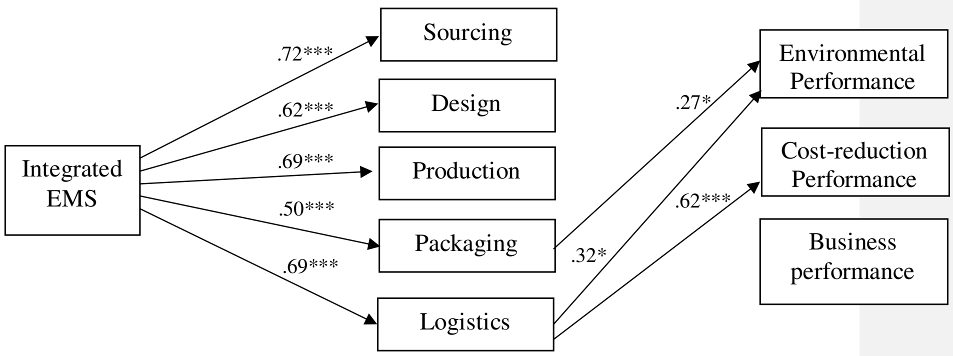
****p < 0.001; **p < 0.01; * p < 0.05*; n.s. = Not significance

Figure 1. Structural model for the combined sample



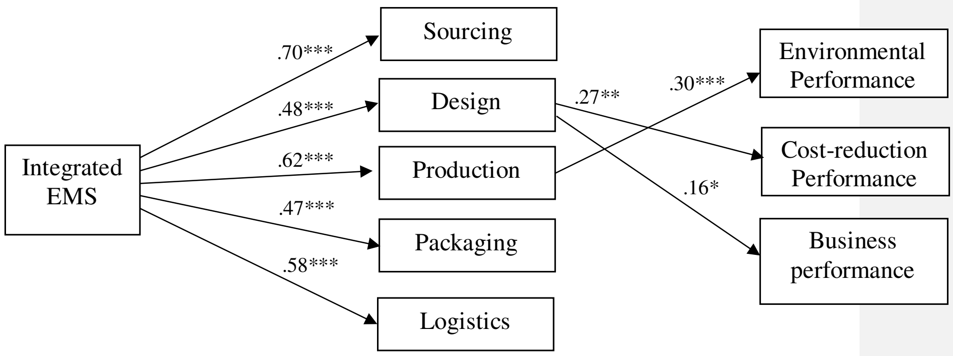
*Note: goodness-of-fit indices $\chi 2$ = 833.61, df = 181, RMR = 0.08, IFI = 0.90, CFI = 0.90. *** P < .001, ** P < 0.01, * P < .05. Non-significant paths are not shown.*

Figure 2. Sub-group structural models for small and large firms



*Note: *** P < .001, ** P < 0.01, * P < .05. Non-significant paths are not shown.*

Sub-group structural model for small firms (see Table 4 for full result)



*Note: *** P < .001, ** P < 0.01, * P < .05. Non-significant paths are not shown.*

Sub-group structural model for large firms (see Table 4 for full result)