QUALITY PAPER

Environmental management accounting practices, management system, and performance

SEM approach

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Abstract

Purpose – The purpose of this paper is to examine the relationship between environmental management accounting practices (EMAP), environmental management system (EMS) and organizational performance (OPM) for Malaysian manufacturing industry by using structural equation modeling (SEM) approach.
Design/methodology/approach – The population of the Malaysian manufacturing industry comprised 2,600 manufacturing companies. The unit of analysis is the organization that participated in the survey comprised of automotive/machinery, plastics/rubber/metal, food/tobacco, electrical/electronics and chemical/woods. Out of the 2,600 questionnaires sent to the respondents, 395 were received from manufacturing companies. The collected data are analyzed with the IBM SPSS Statistics and SEM technique.
Findings – Findings found that EMS implementation as a partial mediator to improve EMAP and OPM for Malaysian manufacturing industry. Further, the implementation of EMS was found to mediate the relationship between EMAP and OPM.
Research limitations/implications – The understanding of the importance of studying the relationship between EMAP, EMS and OPM has been emphasized in the present study. In fact, the findings of this study along with its limitations have paved the way for future research in EMAP, EMS and OPM areas.
Practical implications – This research provides important guidelines for manufacturers and related companies to implement EMAP and EMS in order to improve OPM. Hence, the Malaysian manufacturing industry may need to consider the measurement of EMAP, EMS and OPM as beneficial to their manufacturing companies.
Originality/value – The research contributes to the environmental management accounting by empirically linking the relationship between EMAP, EMS and OPM for Malaysian manufacturing industry.

Keywords Performance, Manufacturing, Reliability analysis, Environmental management system, Structural equation modelling, Accounting practices, Environmental management accounting practices
Paper type Research paper

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1. Introduction

The manufacturing sector is one of the main industries in the Malaysian economy. The economic contribution of this sector is important, with significance to the manufacturing industry (Habidin, Hudin, Zabit, Fuzi and Ong, 2018; Patel and Desai, 2018). The importance of manufacturing in the Malaysian economy is to contribute to the gross domestic product (GDP). In Malaysia, the manufacturing industry contributed 22.80 percent to the GDP in 2016 (Ministry of International Trade and Industry, 2017). Regarding this, the GDP growth in Malaysian economy is essential for Malaysian manufacturing industry to increase the organizational performance (OPM). The activities of the manufacturing industry have significantly contributed toward economy development including developing countries, thus manufacturing industry plays a key role of economic growth especially in the global economy.

One of the practices that need to be considered in this study is environmental management accounting practices (EMAP). According to Jamil *et al.* (2015), there is still a lack of EMAP implementation on the environmental impact and environmental awareness within the organization. This is because the implementation of EMAP is still lacking in organization, especially in developing countries, like Malaysia. Hence, there is a significant gap in this study on EMAP for Malaysian manufacturing industry.

To meet the requirement of EMAP, the implementation of environmental management system (EMS) in the manufacturing industry can assist the organization in managing, measuring and improving the environmental management of the operations (Low *et al.*, 2015). This is because EMS is necessary for successful of environmental management accounting implementation. Furthermore, EMS provides a guideline in the manufacturing industry to manage the environment (Phan and Baird, 2015). A study by Ong *et al.* (2016) suggested that more companies in Malaysia need to adopt EMS in improving performance, especially for Malaysian manufacturing industry. Thus, the researcher chose the manufacturing industry in the study in order to improve the EMAP, EMS and OP for Malaysian manufacturing industry.

Given the implementation of EMAP for Malaysian manufacturing industry, the implementation of EMS has begun to attract the interest of researchers in this study. Previous research also suggests that the implementation of EMS can improve the EMAP in the manufacturing industry (Qian *et al.*, 2015). At the same time, EMS can improve the performance of the organization (Yang and Zhang, 2017). Thereby, EMS is one of the mediating variables that are used in this study as a guideline for Malaysian manufacturing industry in order to improve the EMAP and performance.

In relation to that, this study also focused on OPM. According to Gorane and Kant (2017), OPM refers to the measurement of outcome that influences the extent of performance measurement used in organizations. In particular, the OPM measurement is essential in the manufacturing industry, particularly for Malaysian manufacturing industry (Dubey *et al.*, 2017). By measuring OPM, the Malaysian manufacturing industry can achieve environmental objectives and this leads to improved performance.

The objectives of this study are to examine the relationship between EMAP, EMS and OPM for Malaysian manufacturing industry. In order to do this effectively, the general objective was as follows:

(1) to examine the relationship between EMAP and OPM for Malaysian manufacturing industry;

(2) to examine the relationship between EMAP and EMS for Malaysian manufacturing industry;

(3) to examine the relationship between EMS and OPM for Malaysian manufacturing industry; and

(4) to examine EMS mediates the relationship between EMAP and OPM for Malaysian manufacturing industry.

In order to provide an answer to each of the research questions, this research set out to examine the relationship between EMAP, EMS and OPM for Malaysian manufacturing industry. The detailed discussions on how the empirical results provide answers to the research questions are presented in the following sections.

2. Literature review

2.1 H1: the relationship between EMAP and OPM

Previous studies stated that there is a relationship between EMAP and OPM (Rasi *et al.*, 2014; Doorasamy and Garbharran, 2015; Magara *et al.*, 2015; Qian *et al.*, 2015; Mokhtar *et al.*, 2016; Al-Mawali *et al.*, 2018; Olaoye and Adekanmbi, 2018). The authors found that EMAP leads to better OPM. Solovida and Latan (2017) mentioned that the implementation of EMAP assist the organization to improve the OPM in the manufacturing industry such as reducing environmental costs (ECs), improving the environmental management, enhancing use of renewable sources and reducing material. Furthermore, Yu and Ramanathan (2016) performed a study from manufacturing firms to assess the influence of EMAP. Results showed that EMAP is significantly and positively related to OPM. This is supported by Ghasemi *et al.* (2016) who stated that EMAP is an important tool for the organization in enhancing the OPM in order to achieve the higher performance. The implementation of EMAP can assist the organization to improve the OPM, particularly for Malaysian manufacturing industry. Based on the reviews of literature, the following hypothesis is proposed:

H1. There is a significant relationship between EMAP and OPM for Malaysian manufacturing industry.

2.2 H2: the relationship between EMAP and EMS

EMAP and EMS are closely related to improve the environmental management. The implementation of EMAP is related to the development of EMS in the manufacturing industry (Albelda, 2011). This is because EMS helps in improving EMAP to meet the objective of the company. In order to improve the EMAP, an organization can apply the EMS as a guideline for the Malaysian manufacturing industry. The effectiveness of EMS can assist an organization to manage EMAP in the manufacturing industry. Ismail *et al.* (2014) found that EMAP is positively related to the EMS in the manufacturing industry. EMS is utilized to manage the environmental management in the manufacturing industry. By implementing EMS, it leads to better compliance with environmental requirements in the manufacturing industry. In other words, the adoption of EMS is to develop and improve EMAP more efficiently and effectively (Prajogo *et al.*, 2014; Campos *et al.*, 2015). The authors stated that EMAP is positively related to EMS. These practices can improve the production process, reduce waste and reduce environmental pollution in the manufacturing industry (Gunarathne and Alahakoon, 2016). This can be achieved through the EMS to evaluate the environmental impact in the organization, especially for the Malaysian manufacturing industry. Therefore, EMS plays a vital role as a tool for EMAP to improve the procedures, legislation and structures for the Malaysian manufacturing industry. Based on the reviews of literature, the following hypothesis is formulated:

H2. There is a significant relationship between EMAP and EMS for Malaysian manufacturing industry.

2.3 H3: the relationship between EMS and OPM

Searcy *et al.* (2012) noted that EMS implementation can improve OPM such as managing environmental impacts, enhancing environmental awareness, improving operations of

company and reducing ECs. Furthermore, EMS is based on the continuous improvement to control the environmental activities and also related to the OPM (Semenova and Hassel, 2016; Zobel and Malmgren, 2016). The implementation of EMS can assist the organization in order to improve OPM, particularly for Malaysian manufacturing industry. Besides, EMS refers to the methods of the organization for managing the environment (Feng and Wang, 2016) and to enhance the OPM for Malaysian manufacturing industry. This is supported by Low *et al.* (2015) who pointed out that EMS implementation on manufacturing organizations in Malaysia had improved OPM. In this regard, EMS has the potential to improve OPM for Malaysian manufacturing industry. Therefore, this study proposes that EMS can enhance OPM for Malaysian manufacturing industry. Based on the reviews of literature on EMS and OPM, the following hypothesis is proposed:

H3. There is a significant relationship between EMS and OPM for Malaysian manufacturing industry.

2.4 H4: the relationship between EMAP, EMS and OPM

This study utilizes EMS as a mediator in the relationship between EMAP and OPM for Malaysian manufacturing industry. EMS is an important tool in managing environmental issues in the organization. Solovida *et al.* proposed that there was a positive and significant relationship between EMAP, EMS and OPM. This is because EMS helps organizations to evaluate operations of environmental management, especially for the Malaysian manufacturing industry. Hence, this study aims to examine the indirect relationship between EMAP and OPM through the use of EMS for Malaysian manufacturing industry.

Prajogo *et al.* (2014) also maintained that EMS can improve the relationship between EMAP and OPM. In other words, EMS can develop and maintain the EMAP in the organization. Thus, EMS is significant in EMAP and OPM for Malaysian manufacturing industry. Salvado *et al.* (2015) proved that there was a significant relationship to OPM. This meant that EMS was supposed to show impact on the EMAP and OPM for Malaysian manufacturing industry. Accordingly, EMS had a positive relationship between EMAP and OPM for Malaysian manufacturing industry.

EMS is a useful approach for improving the EMAP and OPM for Malaysian manufacturing industry. Burja (2012) pointed out that the use of EMS had a significant relationship with OPM. This is because EMS implementation has a link between OPM for monitoring and controlling the environmental impact of the organization. The implementation of EMAP and EMS is significant to improve OPM of the organization (Feng *et al.*, 2014; Jalil *et al.*, 2016; Neves *et al.*, 2017). It is necessary for organizations to implement EMS in order to enhance EMAP and OPM for manufacturing industry, such as reducing the EC, increasing the quality of environmental management, reducing materials and energy consumption and evaluating environmental impacts of the processes. Therefore, EMS implementation can be considered to improve EMAP and OPM for Malaysian manufacturing industry. Based on the reviews of literature, the following hypothesis is proposed:

H4. There is an indirect significant relationship between EMAP, EMS and OPM for Malaysian manufacturing industry.

3. Methodology

The development of questionnaire was based on the previous studies related to EMAP, EMS and OPM (Gunarathne and Lee, 2015; Ong *et al.*, 2016; Al-Mawali *et al.*, 2018). The questionnaire was designed to examine the implementation of EMAP, EMS and OPM for Malaysian manufacturing industry. This section comprises 25 questions about EMAP

(EC, environmental regulation (ER), environmental safety (ES), management commitment (MC) and customer focus (CF)).

The measurement of EMAP was divided into EC (five items), ER (five items), ES (five items), MC (five items) and CF (five items). Next, the EMS implementation comprised 20 questions (planning (PL), implementation and operation (IO), auditing and evaluation (AE) and checking and correction action (CA)). In specific, the measurement of EMS was divided into planning (five items), IO (five items), AE (five items) and CA (five items). Lastly, OPM with ten questions (financial performance (FP) and operational performance (OP) for Malaysian manufacturing industry). In the present study, there were three construct variables were examined for EMAP, EMS and OPM.

The issue of selecting the optimal number of scale points still debated. However, it has been established that seven-point scales can produce reliable results (Weijters *et al.*, 2010). In fact, Sullivan and Artino (2013) and Habidin, Hashim, Fuzi and Salleh (2018) also suggested that the seven-point scale is more appropriate and significant Likert scales. Therefore, this study used items with a seven-point Likert scales ranging from (1 = very low, 7 = very high) for measuring EMAP, EMS and OPM. The final draft of the questionnaire would be sent to the experts (local university academicians and manufacturing experts) of EMAP, EMS and OPM. Panel of experts of this study were from four local university academicians and two manufacturing experts.

Population refers to the entire group of people or areas under the investigation of the researchers in the study (Sekaran and Bougie, 2010). The population in this study focused on the manufacturing industry that was listed in the Federation of Malaysian Manufacturers Directory (2017). The data would be collected using an online survey from 2,600 manufacturing companies selected from the Federation of Malaysian Manufacturers Directory 2017. Out of the 2600 questionnaires sent to the respondents, 395 were received from manufacturing companies, and 395 valid responses were used for the final analysis. A total of 395 responses were received, which corresponds to an overall response rate of 15.19 percent. Krejcie and Morgan stated that the appropriate sample size from 2,600 population is 335. Meanwhile, as suggested by Oke *et al.*, a minimum sample size for using SEM technique is about 200–400. This is supported by Hair *et al.* who recommended that a minimum of 100–500 as a reasonable sample size is valid for research hypotheses testing by using SEM technique; thus in this study the number of 395 questionnaires were usable and more than sufficient to analyze using the SEM technique.

In this study, the unit of analysis is the organization. The manufacturing companies that participated in the survey comprised of automotive/machinery, plastics/rubber/metal, food/tobacco, electrical/electronics and chemical/woods. The researcher chose the respondents from the people who held the position in the companies such as the senior management, middle management, and others to answer questions about the EMAP, EMS and OPM of the companies.

For IBM SPSS Statistics, descriptive statistics analysis was used to determine the percentage and frequency distribution in order to analyze the data of the sample. Specifically, frequency distribution was used to summarize the respondents' profile. Next, the SEM approach refers to a statistical techniques used to analyze the data. SEM is used to test the relationships between endogenous variables and exogenous variables as proposed in the research hypotheses. SEM consists of the measurement model and structural model. In addition, SEM was chosen as statistical analysis techniques due to the applicability to test a comprehensive model. This is because SEM not only provides an assessment of the model fit in terms of the reliability and validity of each construct tested, but also performs overall model, which include the direct and indirect relationship. Therefore, this study used SEM as statistical analysis technique.

4. Results

EFA was conducted in EFA for EMAP dimensions, EFA for EMS dimensions and EFA for OPM dimensions. The EFA began with the determination of the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and the Bartlett's test of sphericity ($p < 0.001$) had been applied to check the strength of inter-correlations among the items. Second, EFA used the total variance explained to determine the number of items with Eigenvalues > 1. Lastly, rotated component matrix results were used to identify for each item factor that was sufficient for the factor loading.

EFA for EMAP, EMS and OPM was conducted ($n = 395$) for Malaysian manufacturing industry. The KMO results for EMAP (0.885), EMS (0.891) and OPM (0.918) were acceptable. According to Chawla and Saxena (2016) and Antunes *et al.* (2017), KMO results displayed values of more than 0.5 as accepting values. Meanwhile, Bartlett's test of sphericity was significant at ($p < 0.001$) for the EFA (Ho and Fan, 2014; Ho *et al.*, 2016; Fuzi *et al.*, 2017; Bhatia and Awasthi, 2018). This indicates that the KMO and Bartlett's test results for EMAP, EMS and OPM were adequate in conducting the next stage of factor analysis.

Principal component analysis using varimax rotation was conducted to test the EMAP, EMS and OPM dimensions. The total variance explained of EMAP (76.369 percent), EMS (73.070 percent) and OPM (75.250 percent) which had Eigenvalues > 1. This is supported by Williams *et al.* (2012) and Fuzi *et al.* (2018) who noted that the total variance explained which is greater than 50 percent was accepted. Based on these findings, all measures were considered reliable for further analysis in this study. The summary results of KMO, Bartlett's test and total variance explained for EMAP, EMS and OPM are shown in Table I.

The first factor of EMAP dimensions was made up of the five items from EC including EC1, EC2, EC3, EC4 and EC5. The next factor was classified as ER with five items, namely ER1, ER2, ER3, ER4 and ER5. No items were suggested to be removed. Meanwhile, there were four items for ES, namely ES1, ES2, ES3 and ES5. Item ES4 was suggested to delete. The fourth factor was grouped as MC and consisted of four items (MC1, MC2, MC4 and MC5). Item MC3 was suggested to delete. Finally, the fifth factor was CF and consisted of five items, namely CF1, CF2, CF3, CF4 and CF5. No items were suggested to be deleted. Hence, the result of EFA indicated five EMAP dimensions with 23 items from 25 items.

Next, four factors for EMS dimensions. The first factor was made up of the five items from PL including PL1, PL2, PL3, PL4 and PL5. The second factor was classified as IO with five items, namely IO1, IO2, IO3, IO4 and IO5. The third factor was AE with five items, namely AE1, AE2, AE3, AE4 and AE5. Lastly, the forth factor was classified as CA and consisted of five items (CA1, CA2, CA3, CA4 and CA5). No items were suggested to be removed. Thus, the result of EFA indicated four EMS dimensions with 20 items.

Lastly, two factors for OPM dimensions. The first factor was made up of the five items from FP including FP1, FP2, FP3, FP4 and FP5. The second factor was classified as OP with five items, namely OP1, OP2, OP3, OP4 and OP5. No items were suggested to be removed. Therefore, the result of EFA indicated two OPM dimensions with ten items. Next, internal reliability test was conducted on 23 items for EMAP dimensions, 20 items of EMS

Table I.
The summary results of KMO, Bartlett's test and total variance explained

		EMAP	EMS	OPM
KMO		0.885	0.891	0.918
Bartlett's test	Approx. χ^2	7,070.010	5,564.277	2,912.533
	df	253	190	45
	Sig.	0.000	0.000	0.000
Total variance explained (%)		76.369	73.070	75.250

dimensions and 10 items of OPM dimensions by using IBM SPSS Statistics 22. Table II shows the results of internal reliability test for EMAP, EMS and OPM.

From the results, all items are indicated as a good reliability with the Cronbach's α value exceeding 0.70 (Cronbach, 1951; Mohamad *et al.*, 2013; Tang *et al.*, 2014; Fuzi *et al.*, 2019b). The Cronbach's α showed a high reliability for each instrument.

For the EMAP (EC, ER, ES, MC and CF), EMS (planning, IO, AE and CA) and OPM (FP and OPM) displayed a good reliability analysis for Malaysian manufacturing industry. Overall, the reliability analysis is the range between 0.867 and 0.928 for all items. Accordingly, 53 out of the original 55 items were retained. The next analysis is to test the measurement model for EMAP, EMS and OPM. The researcher needed to test the measurement model by using confirmatory factor analysis based on EMAP with five dimensions, EMS with four dimensions and OPM with two dimensions. In order to achieve a model fit, fit statistics tests for this study were based on the recommended goodness-of-fit indices such as χ^2 test ($X^2/\text{df} < 3.00$); the goodness fit index (GFI $\geqslant 0.80$), the adjusted goodness-of-fit index (AGFI $\geqslant 0.80$), the comparative fit index (CFI > 0.90), the Tucker Lewis index (TLI $\geqslant 0.90$) and the root mean square error of approximation (RMSEA $\leqslant 0.08$) (Sen *et al.*, 2015). EMAP model with five dimensions, EMS with four dimensions and OPM with two dimensions was shown in Figures 1–3. For EMAP, the goodness-of-fit indices (χ^2 was 640.162 (degree of freedom = 220, $p < 0.001$), $\chi^2/\text{df} = 2.910$, p-value = < 0.001, GFI = 0.874, AGFI = 0.841, CFI = 0.934, TLI = 0.924, RMSEA = 0.070). Meanwhile, the goodness-of-fit indices for EMS (χ^2 was 479.607 (degree of freedom = 164, $p < 0.001$), $\chi^2/\text{df} = 2.924$, p-value $\leqslant 0.001$, GFI = 0.888, AGFI = 0.857, CFI = 0.941, TLI = 0.932, RMSEA = 0.070). Lastly, the goodness-of-fit indices for OPM (69.587 (degree of freedom = 34, $p < 0.001$), $\chi^2/\text{df} = 2.047$, p-value $\leqslant 0.001$, GFI = 0.966, AGFI = 0.945, CFI = 0.988, TLI = 0.984, RMSEA = 0.052). Therefore, these results for EMAP, EMS and OPM indicated good model fit for the measurement model.

The results for the final structural model of the relationship between EMAP, EMS and OPM (refer to Figure 4) of the hypothesized model and the mediating testing explained the findings of the research hypotheses of this study. The results for testing relationship of hypotheses *H1–H4*:

H1. There is a significant relationship between EMAP and OPM for Malaysian manufacturing industry.

Dimensions	No. of items	α values	Item for deletion	α if item is deleted
EMAP				
Environmental cost (EC)	5	0.926	None	0.926
Environmental regulation (ER)	5	0.910	None	0.910
Environmental safety (ES)	4	0.867	None	0.867
Management commitment (MC)	4	0.895	None	0.895
Customer focus (CF)	5	0.928	None	0.928
EMS				
Planning (PL)	5	0.927	None	0.927
Implementation and operation (IO)	5	0.898	None	0.898
Auditing and evaluation (AE)	5	0.870	None	0.870
Checking and correction action (CA)	5	0.917	None	0.917
OPM				
Financial performance (FP)	5	0.912	None	0.912
Operational performance (OP)	5	0.916	None	0.916
Total	53			

Table II. Results of internal reliability test for EMAP, EMS and OPM

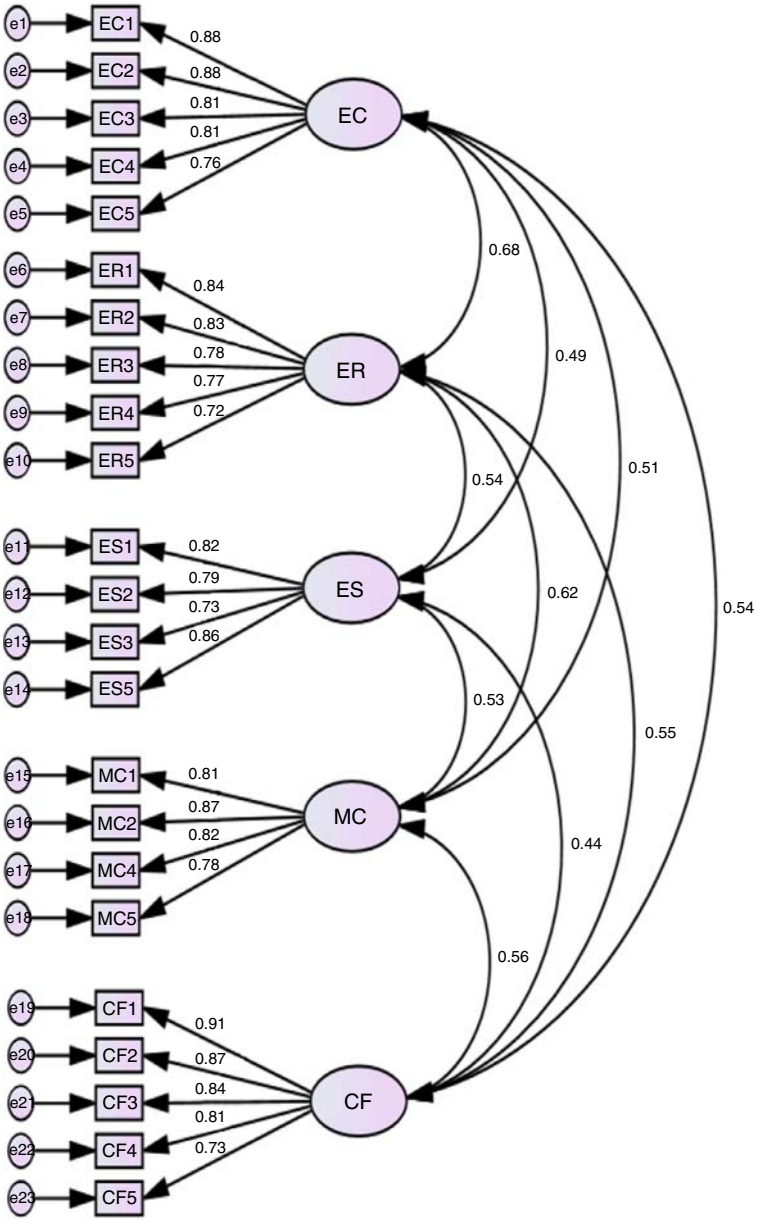

Figure 1.
Path diagram for five dimensions of EMAP model

H2. There is a significant relationship between EMAP and EMS for Malaysian manufacturing industry.

H3. There is a significant relationship between EMS and OPM for Malaysian manufacturing industry.

H4. There is an indirect significant relationship between EMAP, EMS and OPM for Malaysian manufacturing industry.

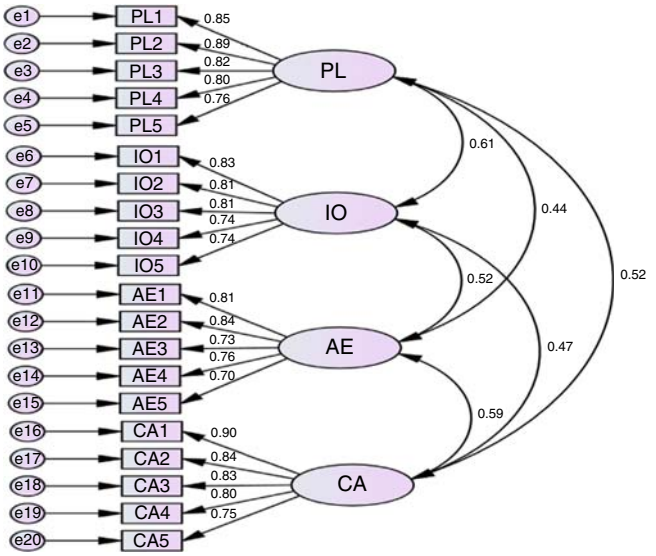

Figure 2.
Path diagram for four dimensions of EMS model

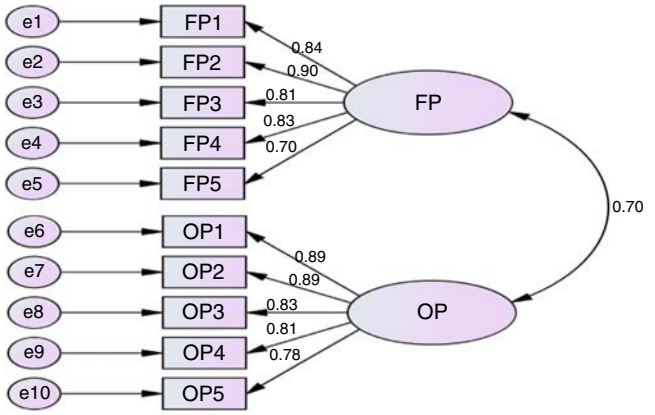

Figure 3.
Path diagram for two dimensions of OPM model

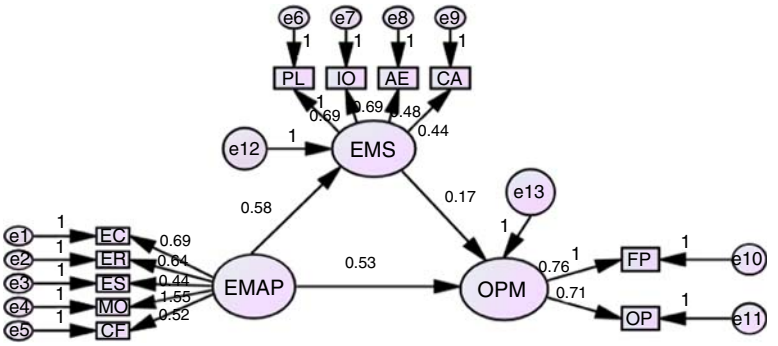

Figure 4.
The relationship between EMAP, EMS and OPM

The normality test was assessed using the skewness and kurtosis values. As shown in Table III, skewness and kurtosis were used to test the normality. According to Doane and Seward (2011), the skewness value between −1.0 and +1.0 was acceptable. Thus, the normality test for EMAP, EMS and OPM was accepted.

Similar to the measurement model, the structural model for EMAP, EMS and OPM was first checked on the goodness-of-fit. The goodness-of-fit indices for EMAP, EMS and OPM model (χ^2/df = 2.580, GFI = 0.937, AGFI = 0.905, CFI = 0.915, TLI = 0.900 and RMSEA = 0.063) indicated a good fit data. Thus, the overall model fit was adequate to test the proposed hypotheses. Figure 4 presents the structural modeling of the relationship between EMAP, EMS and OPM for Malaysian manufacturing industry.

In the present study, all the hypothesized relationships were supported based on the result of the SEM. Based on Figure 4, the standardized regression weight for *H1* was 0.530 and significant at $p < 0.001$. *H1* which stated that EMAP had positively relationship to OPM was supported. This was supported *H1* which stated that EMAP had a significant relationship on OPM for Malaysian manufacturing industry. Thus, *H1* was accepted for this study.

The standardized regression weight for *H2* was 0.583 and significant $p < 0.001$, thus *H2* EMAP gave a positive impact to EMS. Thus, *H2* was accepted. According to *H2*, the findings showed that there was a positive and significant relationship between EMAP and EMS for Malaysian manufacturing industry. *H2* was accepted because the result showed significant relationship between EMAP and EMS.

The standardized regression weight for *H3* of EMS and OPM was 0.168 and significant with *p*-value of 0.038 which less than 0.05. The result supported *H3* that EMS had a positive and direct effect on OPM. Thus, *H3* was accepted. Based on *H3*, the findings indicated that there was a significant relationship between EMS and OPM for Malaysian manufacturing industry.

To test whether EMS was a mediator of EMAP and OPM relationship, the following recommendation of effect analysis was followed (Hair *et al.*, 2011):

(1) indirect effect < 0.038 (non-mediator);

(2) 0.099 (indirect effect) > 0.038 (partial mediator (EMAP → OPM relationship, $p < 0.05$); and

(3) indirect effect > 0.038 and IE > > DE (Total Mediator (EMAP → OPM relationship, $p > 0.05$)).

Therefore, Table IV presents the results for indirect effect was 0.099 which *p*-value was less than 0.05. Regarding this, EMS partially mediates the relationship between EMAP and OPM. This finding supports *H4*, which stated that there was an indirect significant relationship between EMAP, EMS and OPM for Malaysian manufacturing industry.

5. Discussion

The result for *H1* was 0.530 and significant at $p < 0.001$. This hypothesis was accepted. According to *H1*, there was a positive and direct significant relationship between EMAP and OPM for Malaysian manufacturing industry. This is supported by previous studies on the significant relationship between EMAP and OPM (Gunarathne and Lee, 2015;

Table III. Normality test

	Skewness	Kurtosis
EMAP	0.441	0.071
EMS	0.659	0.811
OPM	0.307	−0.415

Qian *et al.*, 2015; Semenova and Hassel, 2016; Yu and Ramanathan, 2016). Similarly, recent research also conducted by Salem *et al.* in the Libyan industrial sector indicated that there was a significant relationship between these variables. Thus, this study contributes to examine the relationship between EMAP and OPM for Malaysian manufacturing industry.

The result for *H2* was 0.583 and significant at $p < 0.001$, thus *H2* was accepted. According to *H2*, the findings showed that there was a positive and direct significant relationship between EMAP and EMS for the Malaysian manufacturing industry. Accordingly, in this research, it is hypothesized that EMAP gave a positive impact to EMS for Malaysian manufacturing industry. To a certain extent, the results support the previous research (Searcy *et al.*, 2012; Hariz and Bahmed, 2013; Prajogo *et al.*, 2014; Fuzi *et al.*, 2019a) by demonstrating a direct relationship between EMAP and EMS. In order to improve the EMAP, an organization can apply the EMS as a guideline for Malaysian manufacturing industry. EMS helps the organization to evaluate the effectiveness of EMAP such as environmental activities, operations, ECs and ERs. Hence, EMAP is an important determinant of EMS for Malaysian manufacturing industry.

The result for *H3* of EMS and OPM was 0.168 and this was significant with *p*-value less than 0.05. Thus, *H3* was accepted. According to *H3*, the findings showed a positive and significant relationship between EMS and OPM for Malaysian manufacturing industry. Thus, in this research, it is hypothesized that EMS gave a positive and significant relationship to OPM for Malaysian manufacturing industry. The results of EMS and OPM in this study displayed a significant relationship between these variables. This result was supported by the findings (Low *et al.*, 2015; Zobel and Malmgren, 2016) which stated that EMS had a positive relationship on OPM. This study concluded that EMS implementation could be positively to OPM for Malaysian manufacturing industry. Hence, the results indicated that the implementation of the EMS can lead to better OPM for the organization, mainly for Malaysian manufacturing industry.

Finally, the result of EMAP, EMS and OPM was 0.099 and significant at $p < 0.05$. Since *p*-value between EMAP and OPM was less than 0.05, EMS could be considered as a partial mediator. Therefore, EMS partially mediates the relationship between EMAP and OPM. The implementation of EMAP and EMS is significant to improve OPM (Prajogo *et al.*, 2014; Salvado *et al.*, 2015; Jalil *et al.*, 2016; Neves *et al.*, 2017). Regarding this, the implementation of EMS as a guideline can assist organizations to improve the EMAP and OPM, particularly for Malaysian manufacturing industry.

Regarding this result, EMS implementation is a partial mediator to improve EMAP and OPM for Malaysian manufacturing industry. Thus, the present study has provided a better understanding of the relationship between EMAP, EMS and OPM for Malaysian manufacturing industry. In conclusion, EMS partially mediates the relationship between EMAP and OPM. Hence, this finding supports *H4*, which stated that there was an indirect significant relationship between EMAP, EMS and OPM.

6. Conclusion

The findings of the present study contribute to a growing body of knowledge on EMAP, EMS and OPM. The contributions of the research are not only limited for academic purposes

	Direct effect			Indirect effect			Total effect		
Factors	EMAP	EMS	OPM	EMAP	EMS	OPM	EMAP	EMS	OPM
EMS	0.583	0.000	0.000	0.000	0.000	0.000	0.583	0.000	0.000
OPM	0.530	0.168	0.000	0.099	0.000	0.000	0.629	0.168	0.000

Note: Direct effect + indirect effect = total effect

Table IV. The results of direct effect and indirect effect analysis

but also for practitioners as well, especially for Malaysian manufacturing industry. In addition, this study confirmed that the SEM technique was suitable and reliable to test the fit model and to explore the relationship between the EMAP, EMS and OPM model. The main contributions of this research are the development and verification of five EMAP dimensions, four EMS dimensions and two OPM dimensions by using the SEM technique. This study aimed to provide reliable and valid instrument and the relationship model for EMAP, EMS and OPM. The empirical test result showed that EMS was partially mediated of EMAP and OPM relationships.

The empirical implications of this study explores the direct and indirect effects of EMAP on OPM. At the same time, this study also tested the mediating effect of EMS. This study was used to test the hypothesized relationships (*H1–H4*) and it can examine of the direct and indirect effects between these variables. In this regard, the research findings confirmed that the mediating effect occurred in the relationship of EMAP and OPM via EMS. Thus, the relationship of EMAP, EMS and OPM may assist the Malaysian manufacturing industry to improve the environmental management accounting.

For practical implications, this research provides important guidelines for manufacturers and related companies to implement EMAP and EMS in order to improve OPM. The findings from this research also provide a useful guideline for Malaysian manufacturing industry, specifically in implementing EMS. Hence, the Malaysian manufacturing industry may need to consider the measurement of EMAP, EMS and OPM as beneficial to their manufacturing companies.

To the policy makers and government, this research will be of enormous benefit as it would serve as a guideline for making polices relating to Malaysian manufacturing industry to enhance the EMAP, EMS and OPM. The EMAP, EMS and OPM model proposed in this study would be a roadmap for the government and policy makers in knowing those important and relevant factors to be considered toward improving the OPM for Malaysian manufacturing industry. This result could be used as a specific reference for policy making to continuously improve the OPM. These findings suggest that policy makers and government need specifically emphasize the implementation of EMAP, EMS and OPM to encourage the integration of environmental issues into decision making.

In this study, we studied how implementation of EMAP affects OPM, through EMS implementation. Empirical evidence is found regarding direct and indirect effect of implementation of EMAP and EMS on OPM. This research also provides a unique contribution to the SEM approach and assessing their direct and indirect impact of EMAP and EMS on OPM for Malaysian manufacturing industry, emphasizing not only the importance of the concepts studied, but also on relevant factors of EMAP, EMS and OPM. These findings indicate that the practitioners also can recognize that the implementation of EMAP, EMS and OPM is important to the Malaysian manufacturing industry. EMS provides many positive outcomes in terms of increasing environmental management accounting, reducing cost and enhancing environmental improvement of the organization in order to achieve environmental objectives and goals for Malaysian manufacturing industry. Malaysian manufacturing industry can improve the EMAP and OPM by implementing EMS in order to achieve the organization's goal. It is hoped that this study can be utilized by academicians and practitioners to increase their knowledge of EMAP, EMS and OPM which in turn would enable them to assist the Malaysian manufacturing industry to improve environmental management accounting. Based on the findings, Malaysian manufacturing industry can apply the EMS as the guideline for EMAP in order to increase the OPM. This study emphasized that the implementation of EMAP, EMS and OPM could help in making effective decision making, thus this results provide the higher performance for Malaysian manufacturing industry. Therefore, this research makes a new contribution to EMS between EMAP and OPM, particularly for Malaysian manufacturing industry by using the SEM approach.

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Appendix. Survey instrument

Environmental management accounting practices

Extent to which your organization uses:

(1) Environmental cost:

- Organization identifies environment related costs.
- Organization allocates environment related costs to production processes.
- Organization allocates environment related costs to products.
- Organization creates and uses environment related costs accounts.
- Organization improves the environment related costs management.

(2) Environmental regulation:

- Organization addresses environmental issues.
- Organization complies with the regulations.
- Organization monitors the environmental regulation.
- Organization complies with the environmental procedures.
- Organization is committed to environmental regulation.

(3) Environmental safety:

- Organization considers environmental safety.
- Organization improves safety awareness.
- Organization complies with the environmental safety.
- Organization provides safety requirement.
- Organization understands the procedures for environmental safety.

(4) Management commitment:

- Employees consider environmental issues.
- Employees are committed with the environmental activities.

- Management commitment supports environmental management.
- Management commitment encourages environmental programs.
- Management commitment involves environmental decision making.

(5) Customer focus:

- Organization is committed to create customer satisfied.
- Organization is committed to provide value to customers.
- Organization meets customer requirements.
- Organization encourages environmentally friendly practices to customers.
- Customers give feedback on quality and delivery of performance.

Environmental management system

(1) Extent to which your organization use these during planning?

- Determine the impact and regulatory requirements.
- Determine the environmental policies in the organization.
- Identify environmental aspects in the organization.
- Consider continuous environmental improvement in the organization.
- Achieve the objectives and targets in the organization.

(2) Extent to which your organization performs the following during implementation and operation?

- Determine the proper procedures of environmental activities.
- Organization prepares EMS documentation.
- Organization identifies the document control.
- Organization monitors the operations based on environmental policy.
- Organization is concerned about environmental awareness.

(3) Extent to which your organization use these during auditing and evaluation?

- Organization provides environmental auditing.
- Organization provides audit evidence.
- Organization provides systematic process of auditing.
- Organization evaluates the environmental issues.
- Organization makes changes in EMS documentation.

(4) Extent to which your organization use these during checking and correction action?

- Organization can resolve environmental issues.
- Organization complies with the procedures.
- Organization reviews the correction action.
- Organization can address the environmental impacts.
- Organization can improve on the corrective and prevention.

Organizational performance

(1) Financial performance:

- Increased sales growth.

- Improved profit growth.
- Increased operating income.
- Increased return on investment.
- Reduced costs.

(2) Operational performance:

- Increased product quality.
- Improved operational processes.
- Increased operational efficiency.
- Increased amount of goods delivered on time.
- Reduced operational costs.

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