

## The Adoption of Environmental Management Accounting: A Study on Manufacturing Firms in Malaysia

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**Abstract:** Malaysia is a primary destination for smart manufacturing and high technology activities. However, the evolving global manufacturing sector has placed pressure on Malaysian manufacturing firms to not only improve their organizational performance but to be accountable towards stakeholders and the environment. As such, Environmental Management Accounting (EMA) is an approach developed to allow for better identification, analysis, management and cost reduction that will benefit both businesses and the environment. The review of studies in the field of EMA has found that factors such as --pollution prevention activities, life cycle assessment, cost reduction and design for environment--may have an effect on the adoption of EMA. Hence, the primary aim of this study is to contribute to existing studies in the area of EMA by determining the possible relationships that may exist between these factors with the adoption of EMA on Malaysian manufacturing firms. This study received responses from 180 chartered accountants. The study found that all the factors in this study; pollution prevention activities, life cycle assessment, cost reduction and the design for environment have significant relationships with the adoption of EMA among Malaysia manufacturing firms. Implications of the research findings were discussed.

**Keywords:** *Adoption of environmental management accounting, cost reduction, design for environment, life cycle assessment, pollution prevention activities.*

### INTRODUCTION

The globalization of the world economy has had a positive impact in our lives, as it has spurred free trade, fostered economic growth, reduced poverty, generated more jobs, encouraged healthy competition among companies while reducing the monopoly of profits and at the same time, consumers have been able to purchase goods and services at a lower price. In fact, the rapid changes in technology and innovation have accelerated the manufacturing, delivery and flow of goods and services globally. Nevertheless, the rise of globalization has had its drawbacks to the environment in the form of wastage and pollution such as air, light, noise, water, soil, land

and radioactive contamination, which have contributed to global warming and the damage of earth's ecological cycle [1]. The Bhopal Chemical disaster that took place in the year, 1984 and the Exxon Valdez oil spill which occurred in the year 1989, are some of the infamous industrial disasters that have received worldwide attention and have led to the increased concern on global warming and the depletion of non-renewable resources [2]. As a result, firms are encountering ever increasing demands from shareholders, consumers and law makers to be accountable to the environment. In fact, firms that have been caught polluting the environment have had to pay hefty fines, as in the case of an Australian company that was fined \$4.5 million Aussie Dollars

for the contamination of a farmland in Chinchilla, Australia [3], while in Malaysia, 2 factory owners were detained for the illegal dumping of chemical waste into Kim Kim River in Johor, Malaysia. The toxic fumes that was released from the chemical waste dumped into Kim Kim River, left 260 people ill and resulted to the closure of 111 schools [4].

## **ENVIRONMENTAL ACCOUNTING                      MANANEGEMENT**

As firms are forced to be accountable towards the impact that their operational activities have on the environment while, protecting stakeholder interest, EMA was developed to allow firms to have a proper approach in understanding, quantifying and managing environment-related cost for better decision making [5]. Furthermore, EMA was developed to recognize the shortcomings that the conventional management accounting approach had in relation to environmental cost, consequences and impacts. According to [6], EMA is defined as a “combined formal approach which provides for the transition of data from financial accounting, cost accounting and material flow balances to increase material efficiency, reduce environmental impact and risk and reduce cost of environmental protection”. EMA has had an increased importance in the accounting for sustainable development [7]. The adoption of EMA has allowed firms to reduce cost and improve their environmental performance while playing a significant role in the long run towards sustainable development and eco-efficiency [8]. According to the environmental protection agency (EPA) in the United States of America (USA), the following benefits of EMA was identified; (1) significant reduction or elimination of environmental problems due to the effective decisions made by firms, (2) the disclosure of environmental cost (and potential savings) in overheads, (3) the revealment of environmental cost which can be offset by generating revenues through the sales of waste, by-products or recycling (4) better understanding of how environment costs can promote more accurate costing and pricing of products, (5) increased competitive advantages from processes, products and services which can be demonstrated to be environmentally friendly, and (4) accounting for environmental costs and performance which can support a company’s development and operation of an overall environmental management system (e.g. Iso 14001) [7,9,10]. In Malaysia, the fast economic development and transformation which started in the 1970s have led to the deforestation of almost 8.6% Malaysia’s natural forest within 20 years from 1990 to 2010 [11]. Furthermore, the Malaysian Department of Environment (DOE) reported that between the years of 2008 and 2013 there were major environmental offences committed by Malaysian manufacturing firms such as black smoke emission and the release of industrial effluents, open burning and water

pollution from raw sewage and deforestation [12,13]. As such, growing number of Malaysian manufacturing firms are voluntarily engaging in some form of EMA as they are compelled to perform sustainable practices and create strategies that would support product stewardship while conserving the environment [14].

Past studies on the adoption of EMA have found that external pressure, uncertainty in the environment, cost compliance, environmental strategies, top management commitment and financial performance were important factors affecting the adoption of EMA [15] [16]. However, there is still scarce research on the effects of factors such as pollution prevention activities, life cycle assessment, cost reduction and the design for environment in the adoption of EMA among Malaysian Manufacturing Firms [17] [18] [19]. In Malaysia, The Environmental Quality Act of 1974 (EQA) was enforced by the DOE with the primary role of “preventing, controlling and abating pollution” [20]. The Act states that in Malaysia, pollution prevention is done by enforcing firms to look into pollution control measures as early as at the pre-feasibility study stage and find possible modifications in the process line for cleaner production, to minimise waste generation and to consider recycling as an option [21]. Hence, as per the Malaysian EQA, pollution prevention activities would encouraged more firms in Malaysia to adopt EMA in their firms. Furthermore, according to the Malaysian Standard and Industrial Research Institute of Malaysia Berhad, (SIRIM) life cycle assessment (LCA) has been adopted in policy-making, business decisions, community improvements, research, technology development and innovation in Malaysia with several LCA projects undertaken by the government to help stakeholders in evaluating their environmental profiles of their product systems [22]. Hence, the adoption of LCA may encourage the adoption of EMA among Malaysian firms. Also, in Malaysia, the emphasis to reduce cost may prompt the implementation of EMA since, effective use of raw materials helps companies to minimize costs of raw materials, disposal costs and wastes generation [23]. Lastly, in order to improve the performance of an organisation, the designing environment plays an important role in the adoption of EMA since this can help reduce waste [24]. DOE Malaysia is currently working with the Japan International Cooperation Agency (JICA) to formulate a policy in managing waste in Malaysia, whereby the product has to be design to ensure that the objective is met thus, the change in the designing environment [25]. In relation to this, the study’s main objective is to examine the relationships between pollution prevention activities, life cycle assessment, cost reduction and design for environment with the adoption of EMA among Malaysian manufacturing firms.

## **LITERATURE REVIEW & HYPOTHESIS TESTING**

### **Pollution Prevention Activities**

Pollution Prevention in this study is defined as, the process of reducing or eliminating the amount of pollution generated through the implementation of pollution prevention strategies in the form of processes, practices, materials, products, substances or energy that can avoid or minimize the creation of pollutants and waste and reduce the overall risk to the environment [26]. [27] stated that there has been an increase trend in the usage of EMA as a result of pollution prevention but the meaningful disclosure has not been achieved in socially related company activities such as pollution control. [28] found that, pollution prevention is important to EMA because it brings environmental costs to the attention of corporate stakeholders who may be able to identify ways of reducing or avoiding those costs while at the same time improving environmental quality. [5] stated that when companies focus on pollution prevention activities, EMA was used as a mechanism to control the amount of toxic materials. Finally, in a study on the implementation of EMA in the hotel sector in Sri Lanka by [18], it was found that pollution prevention activities in form of waste cost identification and control, influenced the expansion of EMA practices. Hence, it is through this literature review that the following hypothesis is postulated:

H1: There is a significant positive relationship between pollution prevention activities and the adoption of EMA in Malaysian manufacturing firms.

### **Life Cycle Assessment**

Life cycle assessment (LCA) is defined as, a practice used in quantifying and analyzing the environmental impacts that are associated with the life cycle of products, services and process and is standardized by the ISO 14040 and ISO 14044 norms [29]. [30] found that LCA plays a very important role in EMA in identifying and assessing the aspects of the elements which are included in a planning stage that are most often carried out during a preliminary environmental review. According to [19], LCA is a tool recognised and recommended in assessing environmental projects, hence its influence to EMA. [31] stated that LCA is a proven tool essential for providing reliable comparisons between waste management technologies and encourages the use of EMA. In the study by [32] on the LCA application among medium sized coffee refining and exporting enterprises in southern Vietnam, it was found that LCA was crucial to the EMA implementation, as using LCA in the context of EMA was deemed necessary in identifying those steps within the coffee supply chain that have

highest environmental impacts and highest option for environmental improvements measures. Hence, it is hypothesised that:

H2: There is a significant positive relationship between LCA and the adoption of EMA in Malaysian manufacturing firms.

### **Cost Reduction**

Cost reduction can be defined as “the reduction of expenses that are associated with the activities of the company” [33]. Cost reduction in this study however is defined as the removal of expenses associated with the environment which involves, clean technology, substitution of material inputs and the redesign of the manufacturing process and products [34]. In the study by [35] on the EMA adopted in three hotels in South Africa, it was found that cost reduction focus was the motivating factor in the use of EMA tools by the hotel sector. This was similar among the hotel sector in Sri Lanka, where [18] found that, the cost-saving potential of EMA led to the integration of EMA into the hotel management. Lastly, [10] found that the potential savings from reduced environmental fines, fees and liabilities as a result of strict environmental regulations and enforcement was the motivating factor that encouraged the adoption of EMA. Through this literature, it is hypothesised that:

H3: There is a significant positive relationship between cost reduction and the adoption of EMA in Malaysian manufacturing firms.

### **Design for Environment**

Design for environment in EMA is defined as, the methodology, practices and principles used to assist designers to decrease or eliminate the environmental impact implicated in the whole life cycle of a product that is from the extraction of raw material until the disposal [36]. The design process of EMA involves balancing cost, performance, cultural, legal, and environmental criteria. Many companies are adopting design for the environment programs to take environmental considerations into account at an early stage. To do so, organizations need information on the environmental costs and performance of alternative product or process designs, much like the information needed in making capital budgeting decisions, hence the need for the adoption of EMA [17]. [37] found that the design for environment through green innovation had a significant positive effect on EMA adoption. The study was conducted using 277 manufacturing companies as a sample size that was listed in the stock exchange in Indonesia. As such, the following hypothesis is postulated:

H4: There is a significant positive relationship between design for environment and the adoption of EMA in Malaysian manufacturing firms

Figure 1 shows the conceptual framework based on the literature review.

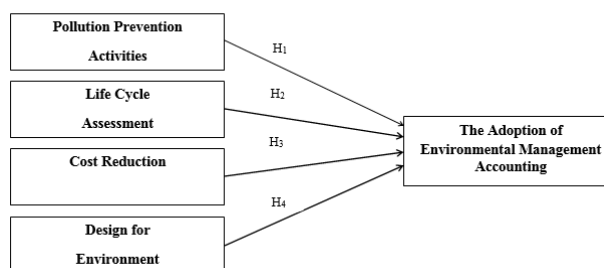


Figure 1: Conceptual Framework

## METHODOLOGY

The data collected for this study was done using a quantitative approach. Since this study was conducted on manufacturing firms, the sampling frame that was used for the study was taken from the Federation of Malaysian Manufacturers (FFM) directory 2018 [38]. The population consisted of Malaysian manufacturing firms located in the state of Selangor, Penang and Johor as (1) majority of the manufacturer's firms were located there, (2) they were preferred locations for investors and (3) these states have one of the highest gross domestic product (GDP) in Malaysia [16] [39] [40]. The sampling method applied was the simple random sampling method. Mailed questionnaires were sent to the chartered accountants of these manufacturing firms. Chartered accountants were chosen to answer the questionnaire due to their expertise regarding management accounting and the adoption of EMA [41] [42]. A total of 500 questionnaires were sent out but only 180 answered questionnaires were returned which equals to a response rate 36%.

The first section of questionnaire were on the respondents' demographic profile which covered age and the number of years the respondents have been working in their current manufacturing firm. This is then followed by the respondents' indicating the type of sector their manufacturing firm belongs too, their product's main market and if their firm has an environmental management systems (EMS) certification. The second section of the questionnaire were on the variables of the study. The variable pollution prevention activities utilized a five item scale which was adapted from [43]. A four item scale for life cycle assessment was adapted from [44], cost reduction was measured using a five item scale adapted from [13]. As for the designing for environment, an eight item scale was adopted from [45]. Lastly, the adoption of environmental

management accounting used a 13 item scale adapted from [42]. A 5-point likert scale ranging from (1) "Strongly Disagree" to (5) "Strongly Agree" was used to measure the variables in this study.

## Reliability Test

Firstly, the internal reliability test was conducted using SPSS for each construct [46]. The reliability test was satisfactory as each of the construct produced a reliability score of more than 0.7 (pollution prevention activities 0.928, life cycle assessment 0.908, cost reduction 0.930, design for environment 0.994 and the adoption of EMA among Malaysian manufacturing firms 0.984) [47]. In addition to this, the z-score normality test resulted to a value of -2.605 which is within the acceptable range of  $-3.29 < Z < 3.29$ .

## Exploratory Factor Analysis

The validity and dimensionalities of the constructs in this study was done using exploratory factor analysis (EFA) using the principal component analysis (PCA) [47]. The results of the EFA produced Kaiser-Meyer-Olkin (KMO) scores of; 0.776 for pollution prevention activities, 0.738 for life cycle assessment, 0.703 for cost reduction, 0.777 for design for environment and 0.726 for the adoption of EMA among Malaysian manufacturing firms. All the KMO scores obtained in this study were greater than 0.7 [47]. The Bartlett's Test of Sphericity for each construct were significant at  $p < 0.05$  and eigenvalue of greater than 1 (Hair et al., 2018). Only factors above 0.5 were retained for the study.

## Descriptive Analysis

The profile of the respondents show that majority of the respondents (39%) are within the age group of 31-40, as the respondents of this survey are chartered accountants, their experience may explain why majority are within this age group. In terms of number of years in the company, almost 39% of the respondents have been in the company between 6 to 10 years. The respondents came from a wide range of sectors whereby 9% came from chemical and wood, 24% from electrical/electronics, 22% from plastic/rubber/metal sector, 17% automotive/machinery, 17% food/tobacco and 11% from the building materials sector. 28% of manufacturing firms produce products for the domestic market, 33% produce for foreign market, while 39% produce for both local and foreign market. Lastly 44% have EMS certification, 28% have no EMS certification while the remaining 28% are planning to get the certification.

## RESULTS

### Correlation Analysis

The pearson correlation test demonstrates that pollution prevention activities was 0.508, life cycle

assessment was 0.458, cost reduction was 0.516 and design for environment was 0.442 all showing a significant positive relationship with EMA adoption among Malaysian manufacturing firms.

**Multiple Regression**

According to the model summary the R Square value was 0.482 which means that 48.2% of the total variance in the adoption of EMA among manufacturing firms are explained by pollution prevention activities, life cycle assessment, cost reduction and design for environment. There is no autocorrelation and, assumption of homoscedasticity was satisfied as the value of Durbin Watson was 1.755, which is within the required range of between 1 to 3. The ANOVA analysis produced a significant value of 0.000 hence, pollution prevention activities, life cycle assessment, cost reduction, and design for environment have significant relationships with the adoption of EMA among Malaysian manufacturing firms. The F statistics was 45.312 which means that the model of this study is strongly significant.

**Hypothesis Testing**

Table 1 shows the results of the coefficients. The results show that H1 ( $\beta = 0.337$ ;  $p = 0.000$ ), H2 ( $\beta = 0.175$ ;  $p = 0.009$ ), H3 ( $\beta = 0.305$ ;  $p = 0.000$ ), and H4 ( $\beta = 0.243$ ;  $p = 0.000$ ) were supported by the data. This study found that pollution prevention activities, life cycle assessment, cost reduction, design for environment were significant predictors of the adoption of EMA on Malaysian manufacturing firms.

**Table 1.** Results of the coefficients

Coefficient*		Unstandardized Coefficients		Standardized Coefficients		Collinearity Statistics	
Model		B	Std. Error	Beta	T	Sig.	Tolerance
1	(Constant)	-.254	.261		-.973	.332	
	PPA	.337	.057	.340	5.922	.000	.808
	LCA	.175	.067	.157	2.635	.009	.744
	CR	.305	.069	.268	4.412	.000	.722
	DfE	.243	.064	.224	3.812	.000	.767

**DISCUSSION**

Based on the results of this study, pollution prevention activities have been found to have a significant positive association with the adoption of EMA in Malaysian manufacturing firms similar with past studies [5] [18] [28]. For this reason, more concentration has to be given by the Ministry of Natural Resources & Environment of Malaysia (NRE) together with the Department of Environment (DOE) and accounting bodies in working towards developing policies and procedures that will promote and facilitate the adoption of EMA among manufacturing firms in Malaysia. There must be training given to the respective employees involved to allow for better assessment of pollution prevention, management and

disclosure of activities and cost using appropriate EMA techniques such as the environmental cost reporting, activity based management and the inclusion of the environmental perspective into the balanced scorecard [35].

Next, similar to past research, LCA was also found to have a significant positive relationship with EMA adoption among Malaysian manufacturing firms [19] [31] [32]. LCA must be incorporated into an organization’s corporate strategy towards sustainable development which can be done through the enforcement of the Malaysian government and collaboration with accounting bodies towards the adoption and usage of appropriate EMA techniques. SIRIM must be involved with accounting bodies and manufacturing firms to educate and promote the importance and usage of LCA in EMA. Next, this study has also revealed that cost reduction has a significant positive affect in the adoption of EMA in Malaysian manufacturing firms [10, 18, 35]. Manufacturing firms should be given training on EMA techniques such as activity based management which can be used to identify and estimate environmental cost related activities for cost control purposes. Value added and non-value added environmental activities can be identified for improvement and cost control purposes as well. EMA tools involving material and process flow accounting will allow for better distinction and comparison of alternatives in environmental spending [38]. Lastly, design for the environment has a significant positive relationship with EMA in Malaysian manufacturing firms [17] [37]. Engineers must work together with with accounting bodies to advise on the design and usage of proper tools in the adoption of EMA. Once again, training must be provided covering strategies, practices, guidelines and tools to allow for better enforcement of the design for environment [35]. There are a few limitations in this study, one of which is the inclusion of other states in Malaysia especially Sarawak, Malacca and Negeri Sembilan as these states had an increase in GDP per capita and an increase share of the manufacturing sector [39]. As such, it is suggested that future research should have a broader based population that includes other states in Malaysia. Also factors such as culture and competitive advantage should be included as these factors may also have an effect of the adoption of EMA [49].

**CONCLUSION**

The results of this research has provided empirical knowledge on the adoption of EMA in Malaysia which will contribute to existing research on the adoption of EMA. EMA has to be integrated into the manufacturer’s corporate business process and information system. Tackling environmental issues are important towards eco-efficiency and sustainable

development hence, government support, the involvement of accounting bodies, management's commitment and regulatory compliances is needed to enforce the adoption of EMA among Malaysia manufacturing firms.

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