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## **ENVIRONMENTAL MANAGEMENT ACCOUNTING: THE CASE OF THE RUBBER TIRE MANUFACTURING COMPANY IN VIET NAM**

Tran Thi Nga<sup>1\*</sup>, Ho Thi Anh Dao<sup>2</sup>

<sup>1</sup> Accounting Faculty, University of Economics, The University of Danang, Vietnam  
Email: ngatt@due.udn.vn

<sup>2</sup> Accounting Department, Hi – Tech Construction Environment Limited Company, Danang City, Vietnam  
Email: hoanhdaotvk@gmail.com

\* Corresponding Author

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### **Abstract:**

In the last decades, the concept of sustainable development has been a popular subject in academic researches and the business community. To be considered as a sustainable business, becoming an environmentally friendly organization is critical. Environmental management accounting is an important tool to help enterprises to reach this goal. However, the application of environmental management accounting in Vietnam is still low in comparison to its role. The paper uses a case-study method that chooses a tire manufacturing company in central Vietnam to identify environmental cost, apply material flow accounting cost, and build criteria for environmental performance evaluation. The suggestion for the improvement of environmental management accounting implementation in Vietnam is also discussed. This study hopes to contribute to the popularization of environmental management accounting in the Vietnam business community.

### **Keywords:**

Environmental Management Accounting, Environmental Cost, Sustainable Development, Environment Performance Evaluation

### **Introduction**

Business has a responsibility to its own shareholders, employees, local community when providing products/services to customers. Of which, environment should be concerned because

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business requires the environment to achieve its objectives. The conflict between economic growth and ecological sustainability has boosted the role of environment management accounting since the 1980s. After the introduction of the Brundtland Report in 1987, the United Nations Conference on Environment and Development in 1992 has targeted the sustainable development for 21st century. “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations, 1987). The concept of sustainable development reflects a trade-off between economic growth and environmental protection through using natural resources in a rational and responsible manner. In recent years, environmental issues have become global concerns and require the responsibility of not only government and relative parties but also enterprises in the business community. In particular, manufacturing enterprises directly affect the environment. Therefore, the business community has been constantly raising awareness about the need to achieve sustainable development and reduce the environmental impact from their operation. To support enterprises’ managers in making decisions regarding the environment, management accounting system play an important role as they provide detail information and emphasize the future (Brewer et al., 2010).

According to the International Federation of Accountants (IFAC, 2005), environmental management accounting (EMA) is a management process of efficient economics and environment via developing and applying accounting systems in line with environmental problems. Environmental management accounting is a division of management accounting. It aims to collect, analyze and use monetary and physical information related to the impact of enterprises to the environment, thereby improving the performance of businesses in both financial and environmental aspects. As a result, the enterprises need to recognize the importance of connecting environmental protection to business activities as well as the accountants’ role to the environmental cost management issues that arise in operations. Especially, enterprises belong to industries that are related directly to natural environmental resource.

The paper chooses the theme of EMA for tire manufacturing industry, because this is one of the industries that consume large natural resources, potentially destroying the environment and affecting human health. However, it is a necessary product in parallel with the pace of socio-economic development in Vietnam.

The paper has six parts. The following section describes a brief literature review of environmental cost and EMA. The research problem, purpose and methodology is presented in section 3. Section 4 shows the application of EMA in the chosen company in central Vietnam. The suggestions for improvements are discussed in section 5 and conclusion is the last one.

## **Literature Review**

### ***General Information About The Environment Cost***

#### ***Definition Of Environmental Cost***

From the last half of 20<sup>th</sup> century, environmental issues have been concerned by scholars and legislators (Duma et al., 2013). In business activities, the fundamental element of environment accounting is environmental cost. Environmental cost (EC) is one of the various types of

business cost when an enterprise transfers its input resources to provide goods and services to customers. There is no generally accepted and universal definition of EC. According to United Nations Division of Sustainable Development (UNSD) (2001), "EC comprise both internal and external costs and relate to all costs occurred in relation to environmental damage and protection". Focusing on business activity, United Nations Conference on Trade and Development (1997) states that "EC comprise the costs of steps taken, or required to be taken, to manage the environmental impacts of an enterprise's activity in an environmentally responsible manner, as well as other costs driven by the environmental objectives and requirements of the enterprise". Meanwhile, Todea et al. (2011) points out that "EC is a tool for identifying and measuring ECs in order to ensure an adequate environmental performance". From these above definitions, it can be stated that ECs are those expenses for prevention, minimization or repair of environmental damages either incurred at the willingness of the company or required by regulations to reduce the negative environmental impact of the company. Nowadays, EC is accountable for a large part of operating costs in the enterprise. According to the Association of Chartered Certified Accountants (2020), EC is responsible for up to 20% of the total operating costs of the company in many cases. Information on EC is essential because it helps to reduce non-value added cost, provide more accurate costing and pricing of products as well as promote more environmentally friendly product design and finally build the company advantage (Stanciu, 2011).

#### *Classification Of Environmental Cost*

There are many ways to classify environmental costs depending on intended use of the information. It is important for managers to control the cost through selecting appropriate cost classification. In this paper, two different classification ways from IFAC and UNDSO are chosen to present. In the international guidance document on environment management accounting, IFAC (2005) divides EC into five groups: materials costs of product outputs, materials costs of non-product outputs, waste and emission control costs, prevention and other environmental management costs, research and development costs, and less tangible costs.

**Table 1. Classification environmental cost according to International Federation of Accountants**

| <b>Cost category</b>                   | <b>Content</b>  |
|--|---|
| Materials Costs of Product Outputs     | This is the purchase cost of materials that eventually are converted into product output (products, by-products and packaging). This cost measures the environmental impact of materials that used to manufacture products within the life cycle, from exploited materials, manufactured products, used by customers and finally discharged as waste in production process. |
| Materials Costs of Non-Product Outputs | These are the costs of purchasing primary and secondary materials, packaging materials, operating materials, water, energy and processing costs in non-product outputs (waste and emission).  |
| Waste and Emission Control Costs       | These are costs for controlling and treating all forms of waste and emissions. These costs are usually equipment maintenance; internal waste handling; waste and emission treatment; off-site recycling; waste disposal; remediation of   |

|   |  |
|---|--|
|   | contaminated sites and other pollution clean-up; and any environmental regulatory compliance costs related to generated waste or emissions   |
| Prevention and Other Environmental Management Costs | It contains environmental management and prevention activities such as green purchasing, supply chain environmental management, cleaner production, extended producer responsibility, etc. It also includes costs for other environmental management activities such as environmental planning and systems, environmental measurement, environmental communication and any other relevant costs. |
| Research and Development Costs                      | They include environmental costs of research and development related to operations and innovation. For example, research costs to replace hazardous materials, apply recycling processes or use renewable materials, develop energy-efficient products, and test new equipment with materials using higher efficiency, environmentally friendly.   |
| Less Tangible Costs                                 | This cost is difficult to quantify. These costs include internal cost and external cost, typically not found in an organization's information system but it can be potentially significant, for example: liability, future regulations, productivity, image and stakeholder relations and external effects on society.   |

(Source: International Guidance Document: Environmental Management Accounting, IFAC, 2005, page 38 - 40)

On the other hand, the EC is classified by four cost groups by UNDS (2001) including: waste disposal cost, environmental prevention and management cost and non-product output cost.

**Table 2. Classification environmental cost according to United Nations Division for Sustainable Development**

| Cost Category                                | Content   |
|--|---|
| Waste and emission treatment                 | Compensation cost for environmental damage and waste control cost under law commitments such as equipment depreciation, outside purchasing service for treatment waste, fees, taxes and fees, cleaning labor cost, penalties and compensation, environmental insurance...   |
| Environmental prevention and management cost | Cost for environmental prevention and management (planning, systems, equipment, communication and other management activities) such as: outside purchasing service cost for environmental management (consultancy, training, auditing, communication), labor costs related to environmental activities, costs of research and development of environmental projects, additional expenses due to cleaner production technology, and other environmental management costs, periodic environmental testing cost... |

|   |   |
|---|---|
| Material purchase value of non-product output | Cost for purchasing input for the non-product outputs, such as raw materials, packaging, auxiliary materials, energy, water |
| Processing cost of non-product output         | These are processing costs contained in non-product outputs including depreciation, labor, outside purchasing service..     |

(Source: Environmental Management Accounting Procedures and Principles, UNDSO, 2001, page 59)

### ***General Information About The Environmental Management Accounting***

#### ***The Definition And Type Of The Environmental Management Accounting***

Environmental costs may incur in or after the manufacturing process. As a result, managers need to administer to the whole value chain of the enterprise to handle and shorten these costs. The benefits of EMA application in the business have been examined recently. By grasping the material flow cost accounting in their pharmaceutical production process, Tanabe Seiyaku Company saved 60 million yen in the year 2002 as well as curtailing chloroform emission (Burritt & Saka, 2006). Despite the wide application, environmental management accounting lacks a standard definition. EMA is environmental accounting that primarily contributes information for internal decision-making purpose (United States Environmental Protection Agency, 1995). With the same point of view, Burritt (2004) indicates that EMA supports a manager's accounting information requirement about the environmental effect of the enterprise and the environmental impact on the enterprise. Emphasizing on the function of EMA, IFAC (2005) points out that "EMA is the management of environmental and economic performance through the development and implementation of appropriate environment-related accounting systems and practices". In general, it is accepted that EMA is primarily to identify, collect, record and provide environmentally driven information for managers with the aim that serving internal manager in decision-making and contributing to improving financial and environmental efficiency in the firms. The environmentally driven information of EMA in the business consists of two components: monetary EMA and physical EMA (UNDSO, 2001). Monetary EMA controls and contributes monetary information of business activities to managers. Meanwhile physical EMA concentrates on the influence of an enterprise on the natural environment in physical units such as kilograms (Burritt et al., 2002). In detail, monetary information under EMA is both environmental protections cost, and cost-efficiency manage information for environmental performance. Whereas, physical information under EMA pays special attention to the physical information of energy flows, water, materials and emissions.

#### ***Benefits Of Applying Environmental Management Accounting***

EMA helps control and save cost in enterprises: Managing environmental activities in the enterprise also raises costs and can support avoiding cost at the same time with the help of EMA (Schaltegger & Wagner, 2005). EMA information is always associated with physical information (the materials flow, energy and water), which links the production processes in the firm. Based on this, managers can detect segments, processes as well as products that consume more materials and energy. In research of the use of EMA, Jasch (2003) states that it leads to opportunities for cost saving and cost-saving calculation for enterprise's projects and investments while Doorasamy (2015) figure out that EMA traces environmental costs directly to the processes and products, thereby presenting troubles that need to be arranged. In addition,



EMA helps organize the selection of more optimal materials, innovations, cleaner production, thereby saving production costs and lowering product costs (Jovanović & Janković, 2012) and find out the chances for enhancement (Bennett et al., 2013)

EMA creates strategic benefits for businesses: Information provided by EMA is a basis to help managers have proper competitive strategy for serving environmental management requirements and making economic decisions. For example, launching environmentally friendly products into the market or performing corporate activities with less harmful effects on surrounded environment. These activities contribute to improvements incorporate reputation and attract more customers when the consumers have a trend to prefer green and clean products. In addition, incorporating EMA, managers can uncover hidden costs that help to build more competitive product price and increase shareholder value (Staniskis & Stasiskiene, 2006). The empirical research of San Ong et al. (2014) proves that environmental improvement has positively affected to the financial performance of publicly listed companies in Malaysia. Meanwhile empirical research of Ramli & Ismail (2013) EMA practices helps enterprises to achieve competitive advantage and increase their performances.

EMA evaluating the environmental performance and improve social responsibility of enterprises: EMA provides environmental data, whereby environmental performance indicators are set to help the organization get a clear picture of environmental performance and make strategic decisions (IFAC, 2005). From this comprehensive information, managers can understand the existing environmental problem. And then, they will have measures to deal with it such as implement green technology to limit wasting materials, using alternative environmentally friendly material to protect the environment. From this, administrators set the environmental goal for their enterprise as well as monitor its environmental performance. Added to this, companies are coping with environmental laws and regulations as well as pressures from a many stakeholder regarding environmental information (Mousa & Hassan, 2015). As a result, implementing EMA boosts company reputation in term of social responsibility (Jovanović & Janković, 2012) and creates a green public profile company (Wahyuni, 2009).

### ***Measuring The Enterprise's Environmental Performance***

The environmental performance is defined by ISO (1999) as the outcome of environmental aspect management of the organization. Meanwhile Schaltegger & Wagner (2005) state that “environmental performance is the change of a firm’s environmental impact over time”. In the period of sustainable development, many enterprises look about the method to grasp, prove and enhance their environmental performance. As a result, the measurement of environmental performance is important. IFAC (2005) argues that environmental performance is calculated for many different levels, depending on the purpose of information use. The information in the EC report helps to create an environmental performance indicator (EPI) to measure the result and offer the continuous advance related to established environmental target. EPIs contain process, system and ecological financial indicators. According to UNDSO (2001), EPIs provide the physical and value information for users, thereby evaluating the efficiency of resource use, which is considered a tool to help the managers to plan the environmental and financial policy. Added to this, EPI assists business’s efforts in environmental protection.

To assess the overall environmental performance, enterprises can use two types of indicators of which the contents are based on the UNDS (2001). Absolute indicators determine the amount of resource consumptions and emissions, for example tons of waste per year. Relative indicators use one criterion with environmental information (in physical or in value) and another parameter. Production volumes, production hours, sales and number of employees are the accepted denominators for relative indicators. Relative indicators depict whether or not environmental management was successful.

Based on the formulas and significance of each indicator, evaluating the environmental performance is applied through absolute indicators and relative indicators as follows:

For absolute indicators: Comparing the absolute indicator allows enterprises to determine the EC differences so that the enterprises can assess the level of completion or saving of ECs. The comparison is often carried out yearly. Absolute indicators apply to the analysis of total environmental costs and components of environmental costs. Through absolute indicator analysis, it allows businesses to assess the results of adjustments to the environmental activities they apply over the years.

For relative indicators: Comparing the relative indicators allows enterprises to assess the efficiency of resource consumption, waste reduction, cost saving and other environmental related management activities.

## **The Research Problem, Purpose and Methodology**

### ***The Research Problem***

In Vietnam, financial accounting is mandatory by law while accounting management is encouraged. To provide adequate information for managers, the accountants in the enterprises usually carry out both functions in her/his segment. That means the accounting staff of any segment usually do the financial accounting and management accounting at the same time. This situation eclipses the role of management accounting in reality recently. The chosen tire manufacturing company in this paper is not an exception. The accounting duty related to EC is currently assigned to the general accountant. Combining EMA with financial accounting could not clearly reflect the environmental impacts of the organization's operations and could not provide a full picture of using natural resource as well as providing adequate environmental cost information to help administrators control costs and make economic decisions. The paper would like to implement EMA to the tire manufacturing company to overcome the limitations of traditional accounting, which meet the information needs for environmental management and business decisions making in enterprises.

### **The Research Purpose and Research Methodology**

The research aims to

- Increase the awareness of sustainable development and environmental protection in Vietnamese business community
- Encourage the application of management accounting and EMA in Vietnamese enterprises
- Promote further research on sustainable development and EMA in Vietnam
- Boost the disclosure and exchange experience about sustainable development, EMA in detail and other management tools in general in Vietnamese business community

A case study approach is applied in this research. The figures are extracted for illustration from the year of 2019. The data were gathered from internal managerial reports and financial statements.

## **The Application Of Environmental Management Accounting In The Tire Manufacturing Company**

### ***Identifying Environment Cost in The Tire Manufacturing Company***

To illustrate the application of EMA, a tire manufacturing company in the central of Vietnam is chosen for this paper because this company has the large amount of environmental costs in its manufacturing cost, has big waste volume and has environmentally sensitive characteristic. The main business activities of this company are producing, and trading rubber tires and tubes and the main product lines of its business are bias and radial truck tires along with special tires. The tire production process consists of 5 steps that can group into 2 stages: creating semi-product and manufacturing finished good

#### ***Step 1: Preparation, Mixing and Milling Rubber***

In tire manufacturing, the two main materials of the rubber mix used are rubber and additives. They are combined in different proportions for the manufacturer's own purpose, so as to create different tires types.

+ Rubber: There are 4 types of rubber normally used, these are natural rubber and three types of synthetic rubber (styrene-butadiene (SBR), polybutadiene (BR) and butyl (or halogenated butyl - halobutyl). The first three types are often used to make tread and tire walls, while halobutyl is often used as an inner lining - a function that holds the compressed air inside the tire.

+ Additives: The most important additives are black carbon (soot/carbon black) and silicon. Many different types of additives are also selected based on the operation requirements of other parts ranging from tire tread to sidewall, bead wire. Overall, additives are used to support the manufacturing process of tires, or act as antioxidants, anti-ozone or anti-wear. In addition, there are a group of important additives for vulcanization, which helps shape and bring elasticity anise for tires. Especially, mixing formula (ratio of mixing ingredients, sequence of adding additives, temperature and time control space) play an important role in determine the quality of the finished tire.

#### ***Step 2: Prepare the Tire Components***

In this step, the tires components such as ply (casing), steel breaker, inner liner, bead wire, tread and tire walls are extruded, formed, pressed and rolled to prepare for the next step - tire formation.

#### ***Step 3: Forming the Tire***

Tires are shaped by an automated line to ensure quality and efficiency. The parts prepared from previous steps: bead wire, ply, steel breaker, inner liner, tread (cap) and sidewall, all of them will be joined together to form an unvulcanized tire (green tire).

#### ***Step 4: Vulcanizing***

This is the final step to create complete tires. During vulcanization, a series of chemical reactions will occur. Added to this, the tread face and the sidewall will be molded. Specifically, the tire will be placed into the mold and when the mold is closed, the vulcanization process

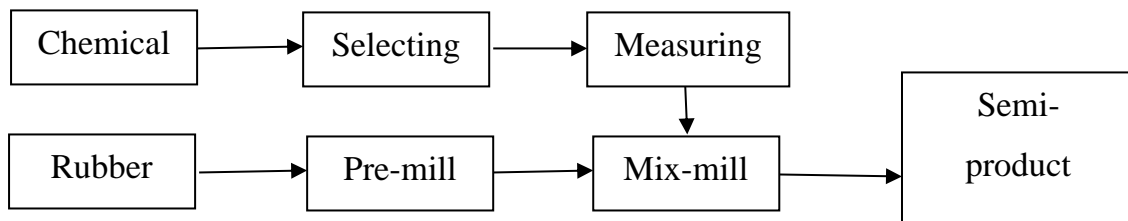


will take place at high temperatures and pressure. Chemical reactions occur, at the same time, the tread, the center groove and the sidewall are molded into the shape. Notice that the mold is closed during vulcanization.

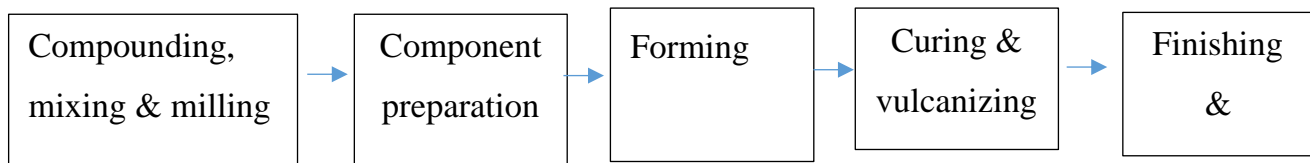
### **Step 5: Checking**

The post-inspection specialist with the automated system will detect surface defects as well as the balance of the tire. In addition, a certain number of tires will be sampled for X-rayed optics in order to detect internal defects.

### **Stage 1: Create Semi-Product**



### **Stage 2: Manufacture Finished Good**



**Figure 1. Production Process at The Tire Manufacturing Company**

In the chosen company, EC is now recorded mainly with the manufacturing overhead cost. In the collection and allocation cost process to calculate product cost, EC have been "hidden" completely in production costs. Although the accountant has created a detailed book, the data is not used for the purpose of determining ECs in the product cost. These ECs are calculated and allocated to the cost objects as other production costs. This is because from the managers' point of view, they think that the EC is small, insignificant. In fact, just several expenses related to environmental factors are easily recognized, the large part of ECs are often hidden in other expenses such as direct raw materials, direct labor cost and manufacturing overhead cost. The EC is shown now by the company, which is a floating number. There are many hidden ECs that the company does not recognize. Especially, these hidden costs are much larger than the amount of managers' recognition. It is popular in reality because traditional accounting system inaccurately reflect the environmental impacts of the enterprise (Duma et al., 2013)

Based on the classification of the UNDSO (2001), the EC in the tire manufacturing company in year of 2019 can be identified in three groups: waste disposal cost, environmental prevention & management cost and non – product output cost as following:

**Table 3. EC in The Tire Manufacturing Company in The Central of Vietnam**

| The cost type  | Documents   | Amount (USD) | Record in accounting book/account code                                      |
|--|---|--------------|---|
| <b>1. Waste disposal cost</b>                            |   |              |   |
| Waste disposal, collecting service charge                |   | 1,413,500    | Other cost of manufacturing overhead cost (account code 6278)               |
| - Water waste treatment cost                             |   | 530,000      | account code 6278   |
| - Domestic waste treatment and collection cost           |   | 325,000      | account code 6278   |
| - Industry waste treatment cost                          | Payment voucher /payment order,                   | 232,000      | account code 6278   |
| - Hazardous solid waste treatment cost                   | economic contract                                 | 159,000      | account code 6278   |
| Dust cleaning cost                                       |   | 79,500       | account code 6278   |
| The pits cleaning service                                |   | 49,000       | account code 6278   |
| Administrative area's kitchen cleaning services          |   | 39,000       | account code 6278   |
| Cleaning service cost                                    |   |              |   |
| - Workshop cleaning service cost                         | Payment voucher /payment order,                   | 154,000      | account code 6278   |
| - Office areas cleaning service cost                     | economic contract                                 | 35,000       | Other cost of administrative cost (account code 6428)                       |
| Planting and caring trees cost                           | Payment voucher, economic contract                | 85,000       | account code 6278   |
| Tool and equipment for treatment waste                   | Good issue, warehouse card                        | 112,500      | Fixed asset depreciation of manufacturing overhead cost (account code 6274) |
| <b>2. Environmental prevention &amp; management cost</b> |   |              |   |
| Expenses for surveying working environment               | Payment voucher /payment order, economic contract | 358,000      | account code 6278   |

|   |   |               |   |
|---|---|---------------|---|
| Insect eradication expenses                                     | Payment voucher, invoice                            | 269,500       | account code 6278   |
| Environmental monitoring cost                                   | Payment voucher /payment order, economic contract   | 92,500        | account code 6278   |
| Periodic waste testing cost                                     | Payment voucher /payment order, economic contract   | 149,000       | account code 6278   |
| Other cost: The safe nuclear radiation supporting services cost | Payment voucher /payment order, economic contract   | 499,000       | account code 6278   |
| Fee, charges and fines: Environmental forest service fee        | Payment voucher, invoice                            | 29,000        | account code 6278   |
| Environmental resource fee                                      | Payment voucher, invoice                            | 23,000        | Taxes, fees, charges of administrative cost (account code 6425) |
| <b>3. Non-product output cost</b>                               |   |               |   |
| Material purchase value of non-product output cost              | Good issue, warehouse card.                         | Not available | Not available   |
| Wasted labor cost   | Labor contract, Payroll, Timesheets, payment order. | Not available | Not available   |
| Equipment depreciation cost of non-product output               | Table of fixed asset depreciation                   | Not available | Not available   |

### Suggestion To Improve The Implementation Of EMA In The Tire Manufacturing Company

#### *Record Initial Information About EMA*

The tire manufacturing company currently records and manages the cost according to financial accounting which is regulated by the Vietnamese Ministry of Finance from the chart of accounts (account's name, account's code) to the content for recording. With the trend of connecting management accounting and financial accounting in one accounting segment, the company needs to build detailed accounts to record EC. The reason is that recording EC in general accounts will lead to difficulties in identification, measurement as well as analysis. It also makes EMA information become noncompliant for users. "The fact that EC are not fully recorded often leads to distort calculations for improvement option and achieved savings" (Jasch, 2003). Thus, the first step for implementing EMA is setting up separate account to record EC, which helps easily for EC collection, process, management and finally for preparing report. To aid the accounting system in separate EMA information from financial accounting, the accounting voucher system and cost accounts should be amended as follows.

- Regarding the accounting voucher system: when cost items incur related to environmental activities, the accounting voucher should have the signal to emphasize that the cost of the economic transactions in the voucher is EC. In addition, for the voucher number in general journal, the accountant may be inscribed with the symbol EC as the basis for recording in the relevant accounting account.

-About the accounts: The accounts regarding product cost need to be detailed for the environmental cost content. The method of detailed account coding is setting up on accounting software shown as table 3. The principle of recording detailed accounts is still based on the general cost accounts which are set out by the law for enterprise's accounting policy.

**Table 4. Organize Accounting Accounts to Collect Environmental Costs**

| Account level 1                            | Account level 2                               | Account level 3                               | Account level 4    |
|--|---|---|--------------------|
| Direct raw materials cost                  | Details of locations where costs are incurred | Environmental cost                            |                    |
| Direct labor cost                          | Details of locations where costs are incurred | Environmental cost                            |                    |
| Manufacturing overhead cost                | Details by cost content                       | Details of locations where costs are incurred | Environmental cost |
| Selling expenses & administrative expenses | Details by cost content                       | Environmental cost                            |                    |
| Work in progress, finished goods           | Product details                               | Environmental cost                            |                    |

For example: To record labor cost of EC in the factory 1, the detailed account of manufacturing overhead cost account (account code 627) that can be coded as 62711-EC

#### ***Applying Material Flow Cost Accounting in Determining Environmental Cost***

According to classification of UNDS (2001), environmental cost includes waste disposal cost, the environmental prevention and management, the non-product output cost. However, the traditional environmental cost accounting only identifies waste disposal cost, the environmental prevention and management cost, it does not concern about the hidden cost – the materials cost waste in the product process. Therefore, to serve the purpose of managing EC, this paper recommends the material flow cost accounting (MFCA) method to calculate this hidden cost in the production.

MFCA is one of the primary tools for EMA and furthers the “transparency of material use practices through the development of a material flow model that traces and quantifies the flows and stocks of materials within an organization in physical and monetary units” (Asian Productivity Organization, 2014). MFCA was developed in Germany in 1991 and outspreaded in Japan from 2000s (Schmidt & Nakajima, 2013). With this methodology, environmental cost are determined by the balance flow of the material from the beginning until removing from the manufacturing process in which the word "material" is used for both energy and materials. The material flow system in this company includes the conventional material flows along the value chain from the time of inputting materials at different production stages to create product until distributing products to customers and the flow of materials lost in different stages of the manufacturing process (such as debris, damaged products, etc...) leaves the company due to

the create of non-product output that are undesirable waste in both economically and environmentally. To extract non-product output cost from product output cost, it needs to carry out 5 steps as follows:

**Step 1:** Understand the production process of the enterprise

From the production process of tires, the first step needs to be to prepare the semi-product, which is created from rubber and chemical. Then they are milled via automatic and close production technology. Next, semi-product is mixed with components through the line of model technology to make tire.

**Step 2:** Gather information about the types of materials input and the waste output that can be caused by production process and business activities of the enterprise. For example, the materials for non-product output of the tire manufacturing company is presented in the following table.

**Table 5. Information About Types of Materials Input and Non-Product Output**

| No | Input                 | Unit | Non-product output |
|----|-----------------------|------|--------------------|
| 1  | Natural rubber        | Kg   | Rubber crumb       |
| 2  | Synthetic rubber      | Kg   |                    |
| 3  | Carbon black, Silicon | Kg   | Carbon dust        |
| 4  | Metal (Steel, copper) | Kg   | Metal crumb        |
| 5  | Fabric blind          | met  | Fabric yarns       |
|    | ...                   |      |                    |

**Step 3:** Determine the amount of material for the non-product output.

From the conservation law, it can be stated that:

Amount of material input = Amount of material output = Amount of material for finished goods  
+ Amount of material for non-product output

**Step 4:** Determine the material cost of non-product output.

The material cost of non-product output is determined through production efficiency as follow:

*Quantity of material for non-product output = Quantity of material put into production X (1-  
production efficiency ratio)*

*Material cost for non-product output = Material cost put into production X (1- production  
efficiency ratio)*

The product efficiency in the above formula is determined by the ratio of positive product weight and the amount of material input of production process. In the case of the tire



manufacturing company, the related information is provided that: “According to production division estimates, production efficiency ratio of milling and liquefying workshop is 91.94% (interview)”. From this, the material cost of non-product output is calculated as follow:

The material cost of non-product output = \$112,282,900 \* (1 – 91.94%) = \$9,050,000

According to Jasch (2003) in terms of economy and finance, this method is suitable for a company with a high proportion of material costs. This method is appropriate for the chosen tire manufacturing company because its materials cost accounts for 70% of total manufacturing cost. This method helps to separate the main non-product output costs that are currently hidden in the cost of finished goods which is important to help manager to recognize the environmental costs level and polluted impact of the company. MFCA in this case provides sufficient information for managers to govern material cost of the company.

### ***Building The Criterion For Environmental Performance Evaluation***

Identifying, recording and providing all related ECs for managers is part of the function of EMA in the enterprise. To serve EC analysis, the managers need to base on the criterion system of environmental performance evaluation (EPE). Defined by ISO 14031, EPE is “an internal process and management tool designed to provide management with reliable and verifiable information on an ongoing basis to determine whether an organization’s environmental performance is meeting the criteria set by the management of the organization” (cited in Jasch, 2000). Building the relevant indicators of EPE assists managers to self-evaluate the enterprise’s environmental affect and find the suitable environmental protection methods. Environmental performance indicators can be absolute figures, relative figures, percentages or other forms. In the case of the tire manufacturing company, the below indicators are used for environmental performance evaluation.

Firstly, together with the absolute indicators in the table 4, the company can use the absolute indicator in the analysis of environmental savings costs between yearly by the following formula: (assumed that the operating level is the same in three years)

| Year                               | 2017      | 2018      | 2019      |
|------------------------------------|-----------|-----------|-----------|
| Amount of environmental cost (USD) | 8,150,000 | 8,770,000 | 9,350,000 |

Environmental cost saving of the year 2018 compared to 2017 = Environmental costs in the reporting period (2018) - Environmental costs in the base period (2017) = 8,770.000 - 8,150.000 = \$620,000

Environmental cost saving of the year 2018 compared to 2017 = Environmental costs in the reporting period (2019) - Environmental costs in the base period (2018) = 9,350,000 - 8,770,000 = \$580,000

The result of absolute indicator shows that EC of this company increases over the three years from 2017 to 2019. This result proves that EC is important in cost control of the chosen tire manufacturing company and the managers have to pay attention on this. However, when applying the above formula, it needs to adjust the operating volume between the base period and the reporting period. This adjustment is to accurately reflect the costs saving in the reporting period. The adjusted formula will be:

Environmental cost saving = Environmental cost incurred in the reporting period - Environmental cost incurred in the base period \* (Level of operation in the reporting period/ Operation level in the base period)

Secondly, the company can use relative indicators to evaluate ecological efficiency. Relative indicators can also be compared between years to help businesses assess the effectiveness of the applicable environmental activities. The company can use the criterion system for environmental performance evaluation under UNDSO (2001) guidelines including:

$$\text{Efficiency of material} = \frac{\text{Total volume of material in output}}{\text{Total volume of input material}} = 91.94 \%$$

This indicator shows that a unit of input material can be converted 91.94% into output or 1kg of material input delivers 0.9194kg to production output. The larger the indicator value is, the higher the company's production efficiency is. Instead of material efficiency, the waste input resource coefficient can be used:

$$\begin{aligned} \text{Waste of material input ratio} &= \frac{\text{Total waste of material in volume}}{\text{Total input material in volume}} \\ &= 1 - \text{Efficiency of using input resources coefficient} = 1 - 91.94 \% = 9.06\% \end{aligned}$$

$$\text{Waste water per unit of product value} = \frac{\text{Total waste water in m}^3}{\text{Production output in pcs}} = \frac{80,000}{19,500,000} = 0.0041 \text{ m}^3/\text{pcs}$$

This coefficient points out that the production process of this chosen company is efficient because the waste level still belongs to the permission level. This value also reflects the environmental impact of this company. To know about the specific consumption, the eco-intensity indicators for energy and water can be used for the tire manufacturing company

$$\begin{aligned} \text{Specific energy input} &= \frac{\text{Energy input in kwh}}{\text{Production output in pcs}} = \frac{64,000,000}{19,500,000} = 3,28 \text{ kwh/pcs} \\ \text{Specific water input} &= \frac{\text{Water input in m}^3}{\text{Production output in pcs}} = \frac{105,000}{19,500,000} = 0,0054 \text{ m}^3/\text{pcs} \end{aligned}$$

The calculated results let us know about the consumption of two important input resources of this company. The consumption of energy in a tire unit is high while the consumption of water in a tire unit is low. Add to this, the purchasing cost of energy is higher in comparison to water input in Vietnam. As a result, the company should be aware of this energy consumption in EC management.

Thirdly, the share percentage is used to reflect the weight of the sub-group to the total, for example the water recycling rate and environmental cost density

$$\text{Water recycling rate} = \frac{\text{Quantity of recycled wastewater in m}^3}{\text{Quantity of total wastewater in m}^3} = \frac{55,000}{80,000} = 69\%$$

The value of water recycling rate is high. It shows that the company has made efforts in the reduction the wastewater to the environment by reusing. This not only helps the tire manufacturing company save on costs but also save resources as well as protect the environment.

$$\text{The environmental cost ratio} = \frac{\text{Total environmental cost}}{\text{Total operation cost}} = 30\%$$

The result indicates that in \$100 of cost incurred of this company, the EC cost is \$30. This ratio figures out that the company's investment and involvement for the environment is high. The EC of the tire manufacturing includes the waste disposal cost, preventing & environmental management and non-product output cost. The percentage of each component of EC can be presented to understand clearly about the contribution of each element.

$$\text{The waste disposal cost density} = \frac{\text{Total environmental cost to waste disposal cost}}{\text{Total environmental cost}} = 15\%$$

$$\text{The environmental prevention \& management cost density} = \frac{\text{Total environmental cost to prevention \& management cost}}{\text{Total environmental cost}} = 12\%$$

$$\text{The non-product output cost density} = \frac{\text{Total environmental cost to non-product output cost}}{\text{Total environmental cost}} = 73\%$$

These ratios demonstrate the density of each factor in the total environmental cost of the tire manufacturing company. From the calculated value, it is revealed that the non-product output cost account for the highest proportion while the percentage of environmental prevention & management cost is the least. The non-product output cost is significant in the EC of this company. In other words, the managers need to be concerned about the non-product output cost to reduce cost, increase the production efficiency and decrease the environmental impact.

In analysis of environmental impacts, both absolute indicators and relative indicators are essential because "absolute indicators describe the total environmental burden, relative indicators allow monitoring of efficiency improvements" (UNSD, 2001). As well as for comparison of the values of one company over the time, these indicators can also be used to compare between company units or companies.

### ***Suggestions For Improving The Application Of Environmental Management Accounting In Vietnam***

EMA brings great benefits to company. Cost saving, efficient use of resources, better product pricing, innovation, cleaner production, shareholder value and reputation improving are potential advantages for implemented company (Jovanović & Janković, 2012). Recognizing the importance of EMA, the companies in the Vietnam have awareness to the trend of environmentally friendly development. In order to boost the EMA application, it needs to coordinate among the related parties. Of which the role of government, professional bodies and enterprise is critical.

Regarding the government: research of Muhammad Jamil et al. (2015) indicates that coercion is a principle influent factor for practicing EMA, therefore, the government plays a decisive role in implementing EMA. Until now, there are not any regulations and guidelines for implementing the EMA in Vietnam (Le & Dang, 2020). To help the enterprises be familiar with EMA, the guidance for EMA based on the publications of prestigious international organizations like UNDSO and IFAC should be issued at the earliest. EMA is also promoted by governmental rules which require enterprises to collect and submit data which is assumed mandatory to supervise and maintain oversight of their operations (Schaltegger et al., 2008). In Vietnam, EMA practices are insufficiently considered because the government has not strongly executed policies boost the accountability involved to environmental information (Le, 2019). Promoting the environmental audit is one way to improve the function of EM. The most important thing is ensuring the enforcement of the environmental protection law that issued in 2014. This raises the responsibility of enterprises about their environmental impacts.

Regarding the professional associations: Vietnam Accounting Association (VAA) and Vietnam Association of Certified Public Accountants (VACPA) are the main professional associations for accountants in Vietnam, as a result, they should contribute to raising the environmental awareness for businesses. The training courses organized by these professional associations will help to promulgate the national and international environmental regulations and standards as well as the importance and benefits from environmental protection for business community.

Regarding the enterprise: When managers are aware of the benefits and role of EMA for their long-term development, they will proactively make objectives and commitment to implementation. In addition, to ensure the succeed of EMA system, all units in the company must have a common understanding of the importance and usefulness of EMA (Le & Nguyen, 2018). As a result, improving the qualifications of accountants and other staffs about EMA and establishing a system for exchanging environmental information in the company are essential. From that, the enterprises can be actively engaged in organizing the implementation of EMA in their units. Finally, knowledge and experience sharing about EMA should be encouraged in the business community to boost its implementation.

### **Conclusion**

Accounting is generally accepted as a wide system which is related to not only the economic issues but also the social and environment issues of the company. The traditional accounting system has some cognitive limitations related to operational improvement through cost management. One such limitation is that environmental costs are being gathered into a general

account (UNSD, 2001). This system only focuses on financial activities; it does not give a specific view on environmental impacts and related costs (IFAC, 2005). The fact that most companies do not recognize the significance of their environmental costs and undervalue them will cause the miscalculation of improvement opportunities (Kamruzzaman, 2012). Thus, the application of EMA contributes to ensuring the environmental information is provided in a complete and comprehensive way for administrators. EMA is evaluated as a tool for effective environmental management. According to Yakhou and Dorweiler (2004), environmental accounting may be sub-section of cost accounting or a separate section in accounting system. The application of EMA is becoming more and more popular, however, the application of ECMA in developing countries such as Southeast Asia is at an early stage and there is little literature on EMA in these countries (Herzig et al., 2012). Vietnam is no exception; EMA is considered a new field in both research and practice. This paper of a tire manufacturing enterprise helps guide the application steps from account setting to recognition, methods of calculating environmental costs and provides insights on evaluating the performance environment. Moreover, it is an illustration for companies to demonstrate the responsibility to the environment and gradually towards sustainable development in Vietnam.

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