Doctoral Dissertation

APPLICABILITY OF JAPANESE ENVIRONMENTAL MANAGEMENT ACCOUNTING APPROACH TO VIETNAMESE COMPANIES: CASE STUDIES IN SEAFOOD PROCESSING INDUSTRY

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ABBREVIATIONS

AMDI	Asian Management and Development Institute
APO	Asian Productivity Organization
BOD	Biochemical Oxygen Demand
BRU1	First Biennial Updated Report
CFC	Chlorofluorocarbon
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
CH_4	Methane
CSRR	Corporate Sustainability Responsibility Report
CSD	Commission on Sustainable Development
EA	Environmental Accounting
EFA	Environmental Financial Accounting
EMA	Environmental Management Accounting
EPIs	Environmental Performance Indicators
ER	Environmental Reporting
ERP	Enterprise Resource Planning
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GHG	Green House Gas
GMP	Good Manufacturing Product
GMS	General Meeting of Shareholders
GNI	Gross National Income
GRI	Global Reporting Initiative

GSO	General Statistics Office
HACCP	Hazard Analysis and Control Critical Points
HCFC	Hydro Chlorofluorocarbon
HNX	Hanoi Stock Exchange
HOSE	Ho Chi Minh Stock Exchange
IDMC	International Displacement Monitoring Centre
IFAC	International Federation of Accountants
IMHEN	Institute of Meteorology, Hydrology and Environment
IQF	Individually Quick Frozen
ISO	International Standard Organization
JMA	Japan Meteorological Agency
LCA	Life-cycle Assessment
LCC	Life-cycle Costing
LOE	Law on Enterprises
LULUCF	Land Use, Land Use Change and Forestry
MFCA	Material Flow Cost Accounting
MPI	Ministry of Planning and Investment
MOF	Ministry of Finance
MOE	Ministry of Environment
METI	Ministry of Economy, Trade and Industry
N_2O	Nitrous Oxide
OPM	Oxford Policy Management
ODA	Overseas Development Administration
OECD	Organization for Economic, Cooperation and Development
PI	Production Input

PO	Production Output
PPC	Provincial People's Committee
SBV	State Bank of Vietnam
SCEM	Supply Chain Environmental Management
SD	Sustainable Development
SEC	Securities and Exchange Commission
SFP	Seafood Processing
SMCs	Small and Medium-sized Corporations
SMEs	Small and Medium-sized Enterprises
SR	Sustainability Report
SSC	State Securities Commission
TBL	Triple Bottom-Line
UN	United Nations
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate change
VND	Vietnam Dong (Current Monetary of Vietnam)
WB	World Bank

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Abstract

Recently, sustainable development becomes an emerging discussed title to many countries and companies. Due to this requirement, environmental protection is highlighted in business management policies. Although traditional management accounting mainly based on the information of material flows and production volume; this accounting method has not enough attention on analysis of material flows from the perspective of eco-efficiency. By contrast, EMA concerns this aspect. Particularly, MFCA, one of the major tools of EMA, could satisfy the information inquiry of eco-efficiency management because it may integrate the existing environmental management and management accounting practices. Additionally, conventional accounting becomes unsuitable for accounting for the environment because it hides environmental costs under overheads while the environment is one among three elements of green bottom line.

Recognition of SD of Vietnamese government also has increased clearly and sharply. There were agreements and decisions to clarify the sustainable strategies of Vietnam for the near future. For example, attending RIO+10 and RIO+20, Vietnam signed the agreement on the green economy in SD context and implemented Agenda 21 – SD strategy of Vietnam for the period of 2011-2020. As a result, Vietnamese government imposed the new environmental laws on exploring and manufacturing the natural resources. Therefore, to deal with these stricter environmental regulations, laws as well as trade pressures, Vietnamese companies should apply the higher advanced environmental management system. Nevertheless, EMA in Vietnam has not popular as it should be; compared with many years ago, from 2013, Vietnamese companies have been more interested in disclosure of social responsibility. The evidence is that "Annual Report" competition between Vietnamese firms attracts numerous attendance; for instance, the figure in 2013 was about 600; 2014 was around 700. This trend illustrated an increasing interest in accounting disclosure of Vietnamese companies. Besides the growth of environmental attention in Vietnamese companies is shown by development of Sustainable Report in some big companies such as Vinamilk Group, Bao Viet Corporation, etc; even, they also prepared the English version of this report.

However, the environmental management system of Vietnamese government and Vietnamese companies has been still weak and ineffective. Indeed, the number of cases violating environmental laws has increased in recent years in Vietnam. In 2010 there were more than 3,600 cases of Vietnamese companies that were fined for disposing of waste water into the environment without any treatment. In the first half of fiscal year 2013, there were more than 6,000 cases of violating environmental regulations and, according to the information from the Vietnamese environmental police, as high as 17,000 companies were fined for breaking the environmental laws in 2016. Furthermore, the number of Vietnamese companies obtaining ISO 14001 certificate has been increased slowly. Two first Vietnamese companies received ISO 14001 certificate in 1998 but after ten years, this figure was still low with 270 companies in 2007.

Essentially, Vietnamese company should more focus on environmental management system and environmental management accounting to develop sustainably. Additionally, due to the globalization, Vietnamese companies that plan to expand business overseas must satisfy the requirement of abroad suppliers' and customers' requirement of the Environmental Management System standard of the International Standardization Organization. The system may be supported and eased by EMA system.

By contrast, in sustainable development, Japan is a leader in environmental and climate-related technologies as well as developing green markets and employment. Meanwhile, EMA has developed and expanded sharply in Japan. From the experience of Japan, MOE guidelines significantly contributed to the improvement and expansion of environmental accounting and environment reporting of Japanese companies. Therefore, now Japanese companies take advantages of EMA and get achievements in SD. Furthermore, Environmental Accounting Guidelines of Japanese Ministry of Environment is one among two of the most widely applied framework for defining and categorizing environment-related costs for EMA purposes in organization level. Moreover, in MFCA application, Japanese companies achieved distinct advantages over German companies. Besides, Japanese practical MFCA approach indicated that MFCA can be applied without advanced information technology and in all sizes of enterprises as well as for various industries. Additionally, in greener development, Japan emphasizes the international cooperation and support to developing countries. This may support countries like Vietnam in promoting EMA application as well.

Due to the advantages of EMA application and MFCA approach of Japanese companies, the research will study on the experience of EMA application in Japanese companies and the applicability of this tool to Vietnamese enterprises with the expectation of solving environmental problems and increasing productivity. Therefore, there will be two objectives, including, (1) understanding Japanese EMA application with the aim of clarifying EMA concepts and characteristics that are generally accepted in Japanese companies and experience of EMA application in some Japanese companies; and (2) applicability of Japanese EMA approach to Vietnamese companies with the target of practical application of Japanese EMA approach to Vietnamese companies. Particularly, the research focuses on the application of MFCA tool in cases in seafood processing industry and evaluating whether this approach could enhance environmental management and material productivity management in Vietnamese seafood processing companies. Thus, there are two research questions, (1) how did Japanese companies use EMA tools and (2) is Japanese EMA approach applicable to Vietnamese seafood processing companies to improve their environmental management efficiency and economic performance.

To implement the research, two research methodologies will be used. First, the study will utilize the analyzing method to the information of EMA application of Japanese companies; the data source is secondary data from references and Corporate Social Responsibility (CSR) reports of Japanese companies. Based on this, the research is expected to indicate the characteristics and advantages of EMA application in Japanese companies. Second, to achieve the research objective of applying EMA experience of Japanese companies to Vietnamese ones, case study methodology will be used. Particularly, the most advanced tool of EMA, MFCA is adopted to two Vietnamese seafood processing companies. Seafood processing industry is chosen to do case study because it plays an important role in the national economy; however, it is causing the serious environmental problems in Vietnam. This industry contributed to 4-5% GDP; 9 -10% of total national export turn-over and ranked the fifth for export value (follow: electronics, garment, crude oil, shoes). Conversely, the pollutants from the production of seafood processing industry caused the serious problems such as high level of BOD and COD, and odor smell for surrounding area; for example, in Surimi production, the indices of BOD and COD in wastewater were up to 3,120mg/l and 4,890mg/l respectively. Especially, the solid waste from

seafood processing accounts for a large proportion of total material quantity; for example, 40-50% to Surimi production and 35-45% to Shrimp production; and this kind of waste spoils rapidly and is a rich source of protein, carotenoid, and enzymes, thus causing the sever environmental problems. In addition, according to a news about problems in seafood processing industry, the average of wastewater disposal of one seafood processing firm is around 50,000m^3/day. Moreover, waste water is a source of severe pollution due to the high indicators of Suspended Solids around 300-600mg/l, total Nitrogen: 100-150mg/l, total Phosphorus: 20-50mg/l, micro Coliforms more than 1,105 MPN/100ml. With this trend, in the near future, the polluted water may cause the serious impacts on the human life and well-being in Vietnam. Hence, the application of MFCA in Vietnamese seafood processing companies is expected to improve the financial performance and reduce the environmental impacts due to their production.

To present the information of the study, the dissertation is constructed by six chapters with Chapter 1 introduced the background information of EMA and research promotion, Chapter 2 mentioned the environmental and economic performance of Vietnam and Japan, Chapter 3 presented the reference on EMA theory and application, Chapter 4 focused on EMA application in Japanese companies and identified the approach of MFCA technique in Japanese companies, Chapter 5 described MFCA application in some Vietnamese companies in seafood processing industry and Chapter 6 for conclusion and discussion to give conclusions for all thesis and discussion about the drawbacks and implications of the research.

Regarding the theory aspect, the research could contribute to some cases of MFCA application as EMA tool in EMA research. The dissertation presents the evidence to support the findings of earlier studies on EMA application for cleaner production in developing countries. In the practical aspect, it may also promote EMA application in Vietnamese companies. Consequently, the practical adoption could improve Vietnam's environmental performance and Vietnamese companies' economic return. Potentially, MFCA application in Vietnamese companies may expand to the supply chain and Vietnamese companies could take part in the green supply chain in the global market.

Chapter 1

Introduction

This chapter aims to introduce the overview of issues that will be mentioned in the thesis. Therefore, this chapter will explain the drawbacks of conventional accounting in sustainable development that cause essential expansion of environmental accounting (EA) and environmental management accounting (EMA). Besides, the promotion of this study and other general information of research method, scope of the research and the outline for all the dissertation will be also presented in this chapter.

1.1. Overview of Environmental Accounting and Environmental Management Accounting

1.1.1. Weakness of conventional Financial Accounting and Management Accounting for environmental information

Traditional accounting has become unsuitable as accounting for profit and accounting for the environment. For example, financial accounting provides financial information for external shareholders and governmental authorities following the inflexible reporting format and schedule. However, the society, economics, and environment should take the balance in the triple bottom line under the temporary requirement of sustainable development (SD). Therefore, clarifying environmental costs and benefits is indispensable but conventional accounting and other similar information systems can become the hindrance in this situation (Schaltegger and Burritt, 2000; Jasch, 2002).

Conventional financial accounting just provides the monetary information for stakeholders about companies' financial situation in specific periods of time and physical information only including inventory system, long-term assets with the information of quality. Actually,

conventional accounting was designed to meet the demand of stakeholders who need the information of the economic performance of the company. However, recently, many stakeholders are interested in both monetary and physical environmental impacts of the enterprise's business activities with different kinds and levels. The approach of conventional accounting tends to neglect this need (Burritt, 2002) while EA could provide various information of indicators of environmentally focused management, environmental impacts of business activities, and economic and social contexts of environmentally focused management, etc.

In conventional accounting, costs are usually overestimated because all environmental costs are accumulated in the overhead costs. According to Jasch (2002), in conventional accounting, environmental costs are not recorded separately; thus, it is impossible to access information on waste and emissions as well as other environmental costs to manage and make the decision. Environment-related costs are allocated to cost centers from overhead costs in spite of what kind of environmental costs. Therefore, managers could not exactly know how much hazardous waste disposal costs or material loss occurring in production. As a result, production planning and material management could not be efficient.

Conventional accounting does not show the information of external impacts caused by degradation such as environmental pollution, excessive waste disposal or consumption of natural resources (Schaltegger and Burritt, 2000). In addition, there is no indicator to present environmental performance to stakeholders in the financial report because it is a just communication tool between managers and external parties on financial information. Regarding conventional management accounting, although this kind of management accounting includes physical and financial information, it did not separate environmental indicators as well as environmental impacts because of companies' business activities. Rather

than conventional management accounting focuses on providing information for economic decisions.

In traditional accounting, the departments of production, environment, and accounting operate following completely different principles. Consequently, due to the responsibility for loss and waste, their opinions are opposite. Waste and emission are released in production while they are resolved by the environmental department and the accounting division has no detail information about them (Jasch, 2008).

Because of all weakness above, conventional financial accounting and management accounting did not record the environmental information, environmental management and disclosure of environmental information in the context of SD. Therefore, it is necessary to have a kind of accounting that could combine approaches of financial accounting and management accounting and also reduce environmental impacts. Hence, EMA is an indispensable tool to satisfy this requirement.

1.1.2. Definition of EA and EMA

1.1.2.1. Development of Environmental Accounting and Environmental Management Accounting

In the 1970s, first researches on EA appeared and attracted interest from many researchers, managers, and accountants. Also, in this period, the EA was growing in several countries. First EA book dealing with aspects of social and EA was published; for example, “Handbook of Integrated Economic and Environmental Accounting” by UNSTAT.

From 1988 to 1994, researches on social and EA appeared on articles increasingly. Many nations already constructed their environmental accounts and green GDP such as US, Norway, Namibia, etc.

Since the 1990s, the momentous researches of environmental reporting have developed on the large scale in many developed countries with the main concern of "command-and-control" that means in compliance with environmental regulation and law without much involvement of accountants and financial analysts distinction (Bennett et al, 2002).

From 1995 to 2001, environmental accounting researchers began to be interested in building standards for environmental management. This period could be called a milestone of EA because of numerous researches and countries applying this kind of accounting in practice.

From 2002 to present, many types of researches of EA have made outstanding contributions to sustainable development; for instance, the studies of authors such as Christ, Jasch, Deegan, Gray, Schaltegger, Burritt, Kokubu and so on. Moreover, many governments published detail of guideline handbooks of environmental disclosure report and EA, for example, Australia, Japan, UK, etc., and international framework and guidelines on environmental management and EMA were also issued in this period such as International Guidance Document – Environmental Management Accounting of IFAC in 2005. As a result, EA has been accepted by more businesses.

1.1.2.2. Definition of Environmental Accounting and Environmental Management Accounting

Accounting on environment issues is still a developing research area. Up to now, there are many opinions on what is EA and EMA; these depend on its context.

According to Bennett and James (1998), EA can be separated into three distinctive meanings by its contexts and functions; consisting of EA in the context of national income accounting (environmental national accounting), EA in the context of financial accounting (environmental financial accounting) and EA for management accounting (EMA). Regarding EMA concept, they defined it is a process that records, analyses and utilizes financial and non-financial

information to improve corporate environmental and economic performance and to accomplish SD (Bennett and James, 1998).

In the EMA guidance book of IFAC (2005), EA is tool used for assessment and disclosure of environmental and economic information both in physical and monetary terms, so it is a part of sustainability accounting.

From Japanese MOE (hereafter MOE) EA guidelines perspective (2005), EA is designed for sustainable development goal by identifying and providing information of environmental conservation cost in monetary value, environmental conservation benefit in physical units and economic benefit of conservation activities in monetary value.

According to UN, EMA includes two types of information for internal decision making: "[…] physical information on the use, flow and destinies of energy, water and materials (including wastes) and […] monetary information on environment-related costs, earnings and savings." (UN, 2001). "[Physical EMA could support tracking monetary EMA information] and create environmental performance indicators (EPIs) that help an organization assess and report the materials-related aspects of its environmental performance" (IFAC, 2005). Besides, According to EMA principles and procedures (UN, 2001), EMA is combined approach of financial accounting and cost accounting for providing data for material efficiency, cost reduction and environment protection.

According to IFAC Statement Management Concepts (1998), EMA is "the management of environmental and economic performance through the development and implementation of appropriate environment-related accounting systems and practices. While this may include reporting and auditing in some companies, EMA typically involves life-cycle costing, full-costing accounting, benefits assessment, and strategic planning for environmental management".

According to Jasch (2003), "EMA […] represents a combined approach which provides for the transition of data from financial accounting, cost accounting and material flow balances to increase material efficiency, reduces environmental impact and risk and reduces costs of environmental protection. EMA is performed by private or public corporations, but not nations, and has a financial as well as physical component."

There does not remain a unique concept of EA and EMA rather various definitions of EMA and EA that are widely accepted in research and application. Overall, in the business context, EA is an advanced tool to overcome the shortcomings of conventional accounting in solving environmental issues. While EMA is an internal tool of EA but also able to combine with the external tool to disclose the environmental information. In this research, the author will focus on EMA application as a useful tool for management and use the approach of analyzing and assessing physical and monetary information to enhance economic return and to reduce the environmental impacts concurrently.

1.1.2.3. Relationship between Environmental Accounting, Environmental Management Accounting and Environmental Reporting

At the organization level, EA system includes EMA and EFA (Herzig et al., 2012; IFAC, 2005). This can be clarified by the Figure 1.1 EMA and EFA both consist of physical and monetary elements. EMA is an internal accounting concept (Bennett and James, 1998; IFAC, 2005), so it mainly supports management decision making while environmental financial accounting mostly serves information disclosure and stakeholders' requirement of information accessibility. EMA is a managerial tool that determines, analyzes and utilizes two types of information (physical and monetary) of all materials and energy to improve environmental and economic performance of the organization (UN, 2001; Herzig et al., 2012). While environmental reporting is a tool to disclose environmental information to satisfy information

requirement of stakeholders about the environmental impacts due to business activities of the organization. Besides, EMA also provides the basic ideas for external EA by ER (Burritt, 2001). Indeed, EMA data support various environmental management activities such as assessment of annual environmental costs/expenditure, environmental performance evaluation, investments and liabilities; and also assist disclosure. For example, external disclosure of environmental expenditures, external sustainability reporting, and other reporting of environmental data to statistical agencies and local authorities use EMA data (UN, 2001). ER, meanwhile, also functions as an incentive for environmental management (Japanese Ministry of Environment, 2012).

Therefore, it could be said that EMA and ER supplement together in EA. Besides serving their main targets as management tool like EMA and disclosed means like ER, they are mutually supportive as a system.

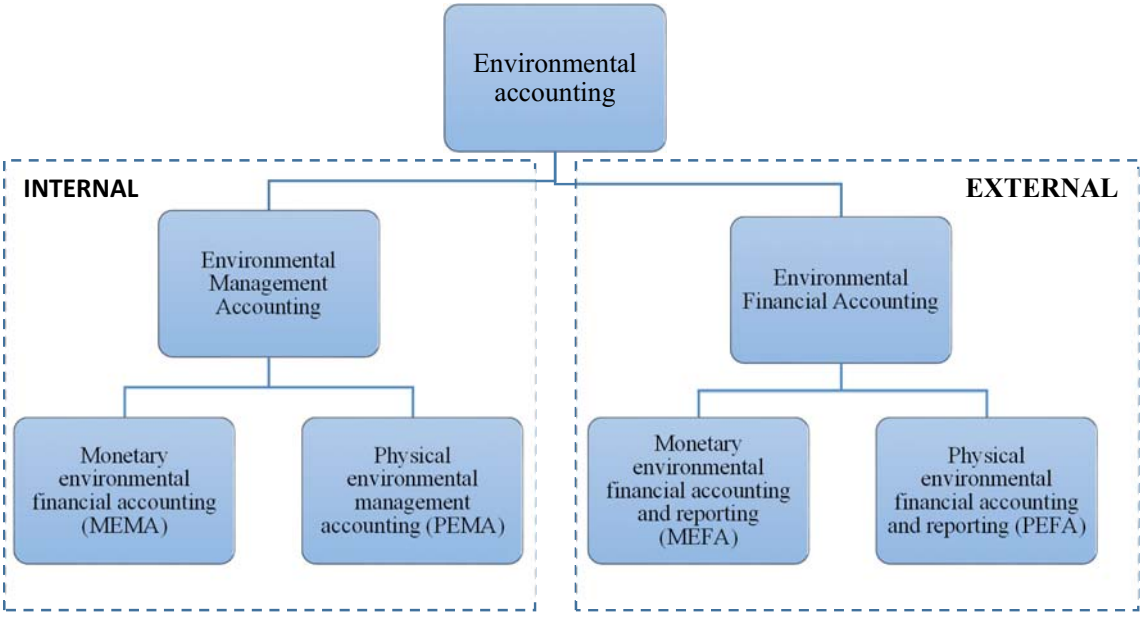

Figure 1.1. Relationship between environmental accounting and environmental management accounting (Source: Herzig, Viere, Schaltegger and Burritt, 2012)

1.1.2.4. Japanese perception of Environmental Management Accounting

According to EMA workbook of Japanese METI (2002), there are three areas of EMA methods, including (1) environmentally conscious investment appraisal, (2) environmentally conscious cost management, and (3) environmentally conscious performance evaluation. From the perspective of environmentally conscious investment appraisal, all decisions of investment are cogitated about environmental impacts. In terms of environmentally conscious cost management, there are four ranges of cost related to environmental management, consisting of (1) environmental quality cost accounting system, (2) environmental conscious target costing, (3) material flow cost accounting (MFCA), and (4) life cycle costing. MFCA is a method based on the flow of quantities and evaluates inefficiency of a manufacturing process in monetary and physical units. LCC is an approach to evaluate the environmental cost throughout life cycle of product from production, usage, recycle and disposal. Environmentally conscious performance evaluation introduces a methodology to evaluate the environmental performance of a corporation. Among of them, MFCA is the most important tool of EMA (Nakajima, 2009; METI, 2011). Thus, later in this research, the application will be focused on this tool.

1.1.3. Significance of environmental accounting

As aforementioned, traditional accounting cannot provide sufficient information on environmental issues in the context of sustainable development; whereas EA is more advanced and effective in this condition because it owns special characters.

The first advantage of EMA is that it can connect the information of environmental management and management accounting which are conventionally and historically different (Bennett et al, 2002). EMA can be used for the internal management purposes as well as the external reporting ones (IFAC, 2005). In the circumstance of increasing interest in

environmental protection and SD, EMA is becoming an essential tool for management activities than conventional management accounting or financial accounting.

EMA could improve the quality of decisions by providing decision-makers with a language, terminology, and communication format for defining, measuring and expressing the environmental performance of the organization. Indeed, EMA holds the attention of managers and it can improve and incline environmental issues rather than hide these problems as conventional management accounting does. Additionally, EMA contributes to reducing the environmental impacts of the organization. Besides, EMA identifies the issues of integration because EMA offers an answer of the integration of physical and monetary information. This derives from the interactive relationship between financial management and environmental issues. EMA is an important tool to support management of environmental performance and also raises the responsibilities of enterprises to the society and their stakeholders (Bennett, Bouma and Wolters, 2002). Environmental-focused management and green products development are parts of EMA that could bring more revenue in the period of customers' rising awareness of the environmental protection.

EMA improves the awareness of environmental protection because of its positive effects on of eco-efficiency application. EMA could support management of resource consumption and savings, so it may also reduce the costs paid for them. By EMA, managers could estimate the costs for environmental-related strategies such as green technology, green products that could bring a large amount of return for enterprises. For example, thanks to EMA information, LCA or LCC could be counted for making a decision in supply chain environmental management (SCEM). EMA could integrate environmental management and economic efficiency management with conventional economic management (MOE, 2012). Therefore, due to lack of human and financial resources, SMEs also could implement EMA to manage the

environmental impacts and address environmentally driven monetary impacts (Herzig at el., 2006).

In the context of SD, environment-related costs need to be separated to provide sufficient information for decision making; however, conventional accounting does not satisfy this requirement. By contrast, EMA could record many kinds of environmental costs and estimate future environment-related costs or potential environmental risk. This advantage of EMA could provide useful information for investment decision in the circumstance of emission reduction and environmental protection in general. In reality, companies cannot achieve SD unless they concurrently consider economic targets and environmental management. This means that either only environmental management tools or financial management are not sufficient to reach SD (METI, 2002).

In the context of cleaner production, EMA is considered as the most advanced tool because it can provide more relevant data for material efficiency that results in releasing the environmental impacts. Besides, EMA can identify, assess and allocate environmental costs properly and exactly. Thus, it can determine the opportunities for cost savings and waste reduction (UN, 2001). Consequently, the business organizations could achieve economic and environmental performance.

As a part of EA, ER supports both external communication and internal environmental initiatives in an enterprise's activities. ER is an "open-window" so that stakeholders could see how organizations' business activities affect the environment and what they should do to improve environmental performance or whether they care the environment while doing business (Japanese MOE, 2012). Therefore, stakeholders could make suitable decisions. Besides, because of this "window", the enterprises must take social responsibilities for business to keep the positive view of stakeholders on them. On the other side, ER provides important

information for management decisions and plans such as how much the company may benefit from green production or whether the investment of new green technology is efficient.

From a disclosure report of EA, Environmental Report, shows the environmental issues aggregating economic targets. Therefore, it helps to identify the firm with other firms within the industry and to indicate their stakeholders how sensitive the company is to deal with environmental issues (Deegan and Gordon, 1996). Sustainable reporting is the main factor to promote the transparency about corporate responsibilities for activities in organizations; therefore, this process also "[…] supports internal information and control processes" (Herzig and Schaltegger, 2006).

According to Japanese MOE guideline, internally, EA supports to control and analyze environmental conservation costs in order to promote effective and efficient environmental conservation activities; externally, EA provides the environmental information for stakeholders by disclosing the environmental information via ER. Corporate environmental reporting also supports social management, Trotman (1979) indicated that "[…] social responsibility reporting may contribute to public image and this, in turn, may lead to greater public acceptance, more identification and avoidance of confrontation such as strikes and boycotts […] by reporting social responsibility information companies are showing that they are acting responsibly and that there is no need for further legislation to force them to do so". This conclusion shows that disclosure brings benefits for business management and the governance administration as well.

EA is an essential tool in sustainable development because it is outstanding over the traditional accounting to further support managers and stakeholders in accounting information.

1.2. Research Background

Although in recent years EMA has attracted growing attention and research interest; the significance of EMA has not been recognized as it should be in sustainable management. Especially, in Vietnam, EMA has been recognized by a few enterprises; Vietnam may be in the first stage of EMA development. Indeed, just several Vietnamese companies established environmental management system and disclosed environmental information.

However, recognition of SD of Vietnamese government also has been increased clearly and sharply. There were agreements and decisions to clarify the sustainable strategies of Vietnam for near future. For example, in the case of attending RIO+10 and RIO+20, Vietnam signed the agreement on a green economy in SD context and Vietnam declared that the government will continue to implement Agenda 21 – SD strategy of Vietnam for the period of 2011-2020. As a result, Vietnamese government imposed new laws of environment on production and exploring natural resources. Therefore, to deal with these stricter environmental tax and regulations as well as trade pressures, Vietnamese companies should apply the higher advanced environmental management system.

Nevertheless, EMA in Vietnam has not been popular as it should be; since 2013, Vietnamese companies have been more interested in accounting disclosure and social responsibility than many years ago. The evidence is that "Annual Report" competition between Vietnamese firms attracts numerous attendance; for instance, the figure in 2013 was about 600; 2014 was around 700. This trend shows the rising interest of disclosure of Vietnamese companies. Besides the growth of environmental attention of Vietnamese companies was showed by the development sustainable report in some big companies such as Vinamilk Group[1], Bao Viet Corporation[2], etc., even they also prepared this report in English version. Essentially, they are going to require more suitable environmental management system.

[1] See Vinamilk's Sustainability report in: https://www.vinamilk.com.vn/en/phat-trien-ben-vung

[2] See Baoviet's Sustainability report in: http://baoviet.com.vn/Sustainability/AboutUs/54/

Additionally, due to globalization, Vietnamese companies that plan to expand business overseas must satisfy the abroad suppliers and customers' requirements of the Environmental Management System standard of the International Standardization Organization. The system may be supported and eased by EMA system. The empirical evidence gathered about the practice in Germany, Japan, and Australia indicates that the important role of EMA data in performance appraisal management, either for environmental managers or for other managers in the sample of examined companies (Burritt et al., 2003). Meanwhile, in sustainable development, Japan is also a leader of environmental and climate-related technologies as well as developing green markets and employment (OECD, 2010).

EMA has developed and expanded sharply in Japan. From the experience of Japan, MOE guidelines significantly contributed to the improvement and expansion of EA and environment reporting of Japanese companies (see Kokubu and Kurasaka, 2002). Therefore, now Japanese companies take advantages of EMA and get achievements in SD. EA Guidelines of Japanese Ministry of Environment is one among two of the most widely applied framework for defining and categorizing environment-related costs for EMA purposes in organization level (IFAC, 2005). Japanese companies have been promoted to apply EMA by proper policies of Japanese government; among of these is the publication of EA Guidelines and EMA workbook that is revised from experience of European firms and document of UN – Environmental Management Accounting Procedure and Principles. Furthermore, in greener development, Japan emphasizes international cooperation and support to developing countries.

Japan – Vietnam has a closed relationship in investment and supporting development. Since 1995 to now, Japan has been the largest ODA supporter to Vietnam. This endorsement accounted for 30% in total international financial support for Vietnam in 2013. Many of investment plans of Japan in Vietnam focused on improving the environment and building sustainable economy. As a result, investment of Japanese companies in Vietnam has been

increasing during last ten years. Therefore, cooperation and assistance between enterprises of two countries are potentially increasing occurrences (JICA report, 2013).

Japanese accounting is a governmental tool and has been used as a primarily governmental function, especially to political groups such as labor unions, banks, and business associations (Ho and Taylor, 2007). In addition, according to Ho and Taylor (2007), accounting and tax regulation in Japan are almost same. These characteristics are extremely similar to Vietnam's ones.

Due to the advantages of EMA application in Japan, the research will study on the experience of EMA application in Japanese companies and applicability of this tool to Vietnamese seafood processing enterprises. Particularly, two Japanese companies that were the first applicant cases and further succeeded in MFCA application and one Japanese company of food processing industry will be mentioned.

1.3. Research Objective

The thesis aims at learning the experience of EMA application in Japanese companies to apply to Vietnamese cases. Therefore, there will be two main objectives, as follows:

(1) Understanding Japanese EMA

This objective tries to reach EMA concepts and characteristics that are generally accepted in Japanese companies and ascertains the experience of EMA application in some Japanese companies. Based on this, the research will focus on the most advanced tool of EMA in Japanese companies' application that may applicable to Vietnamese companies.

(2) Applicability of Japanese EMA approach to Vietnamese companies

This objective aims at carrying out the practical application of the most advanced EMA tool, MFCA of Japanese companies to Vietnamese companies. Particularly, this research focuses on cases in seafood processing industry and evaluates whether this approach could

enhance environmental management and material productivity management in these Vietnamese companies.

Therefore, there are two research questions:

(1) How did Japanese companies use EMA tools;

(2) Whether Japanese EMA approach is applicable to Vietnamese seafood processing companies to improve their environmental management efficiency and economic performance.

1.4. Research Scope

The dissertation focuses on the practice of EA application in Japanese companies; especially, how they use the tools of EMA to improve their economic and environmental performance. Based on EMA tools that were introduced to Japanese companies in EMA workbook of METI, the research will study Japanese companies' EMA applications that may be applicable to Vietnamese companies. Particularly, the research focuses on the application of the most successful and important tool of EMA, MFCA approach in environmental cost management, environmental protection and material productivity management in Japanese companies and then, identifies MFCA approach of Japanese companies to apply to Vietnamese companies (Figure 1.2). Thus, in Chapter 4, the information of MFCA experience of Japanese companies will be explained more than other tools.

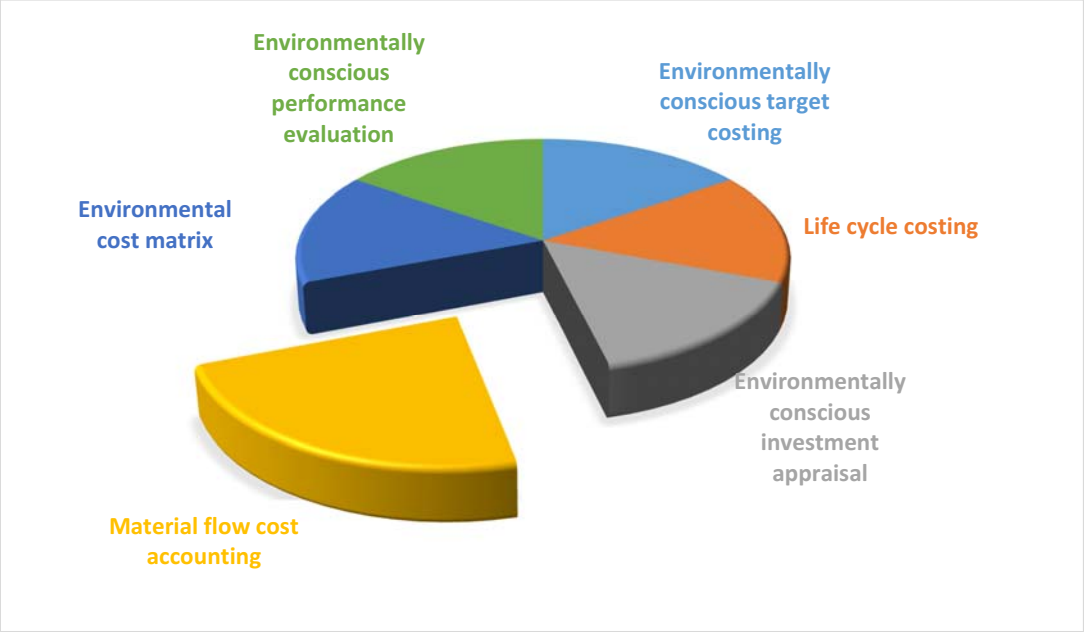

Figure 1.2. Research scope of Japanese EMA tools

Regarding the scope of application, the research will introduce MFCA analysis to two Vietnamese companies in seafood processing industry to test whether MFCA information may indicate and reduce abnormal material losses in the production process of Vietnamese seafood companies. A small-sized company and one large-sized enterprise in seafood processing industry are chosen to emphasize the applicability of MFCA technique regardless the size of the company. Seafood processing industry is collected in this research because currently, it causes serious environmental impacts to Vietnam's environment due to a large amount of disposal of waste water and solid waste. Furthermore, MFCA applications in Vietnamese seafood processing companies may be simplified by focusing on one element in three elements of MFCA (Figure 1.3). Therefore, in MFCA applications in Vietnamese seafood processing companies in Chapter 5, only the information of material will be presented.

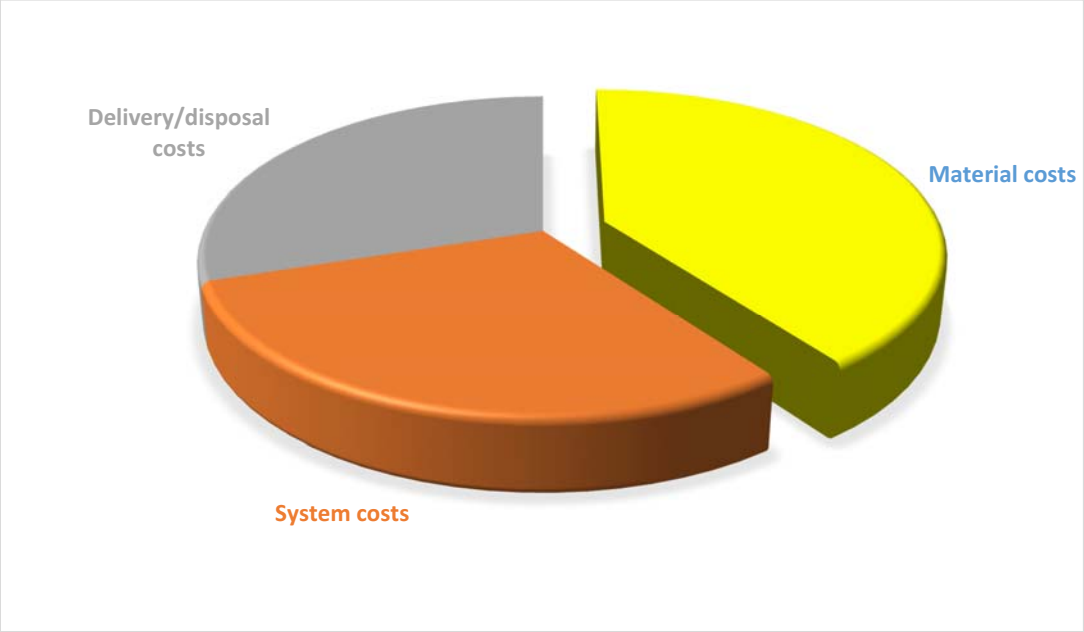

Figure 1.3. Research scope of MFCA application for Vietnamese companies

1.5. Research Contribution

According to Christ and Burritt (2015), current research of MFCA should add more knowledge of application in practice by methods of survey, interview, and statistics and broaden this adoption to more industries and firm size than manufacturing and large-sized company. This research, thus, may add actual analysis of a case of SME in seafood processing industry.

In addition, the research will be carried out in Vietnam where there have been still lacked cases of EMA application. By providing information of EMA application in some Vietnamese companies, hopefully, the study adds new evidence to temporary EMA researches on cases in developing countries. The research potentially promotes the development of EMA application in Vietnamese companies. Indeed, EMA initiative is directly affected by self-awareness of corporations and EMA projects to incentivize companies (Bennett et al., 2003). Hence, this study also brings promotion and evidence of the usefulness of EMA tool to Vietnamese firms.

There has been remained a considerable gap in studying on EMA application in SMEs compared to large-sized ones (Lee, 2009; Jamil et al., 2014). This study appends an SME case to EMA research, presenting the specific characters and context of EMA application in the small company in developing country.

Regarding the environmental issues in Vietnam, the author expects the research could help to improve the attention of environmental management in Vietnamese business organizations. Consequently, on the one hand, this reduces the pollution caused by production activities, on the other hand, EMA could enhance the competitiveness of Vietnamese companies in the global business context.

1.6. Research Methodology

In order to understand EA and environmental reporting in the Japanese company, the author analyzes the secondary data of literature and CSR reports of Japanese companies. Based on these data, the study determines the information about environmental disclosure and EMA methods of Japanese companies. To achieve the research objective of applying EMA experience of Japanese companies to Vietnamese ones, the author uses the quantitative methodology of case study approach. This method is considered a well-established approach in social sciences (Yin, 2003) and it is also a popular management accounting research (Ryan, Scapens, and Theobald 2002). Indeed, this method has been used by many researchers to study on EMA and ER such as Schaltegger and Burritt (2002, 2006); Kokubu et al. (2002, 2003, and 2006); Herzig et al. (2011, 2012); etc. Indeed, case study research in accounting brings the quality descriptions of actual situations of accounting application in different management levels (Herzig, Viere, Burritt, and Schaltegger, 2006). In addition, the author believes that case study method is a proper approach for this research because of some reasons. Firstly, the research aims to evaluate the practical application – one of the characteristics of case study has.

According to Herzig et al. (2006), case studies allow getting the target of examining social phenomena. Another factor is that the study is based on the theoretical framework and the empirical research to adopt to some practice; therefore, in this kind of research, it is difficult and not enough time to show the practical result of application to all Vietnamese cases. Hence, some of them may be sufficient to answer the research questions. In addition, the author would like to focus on some cases to display the experience of how to apply and the benefit of application to many other Vietnamese companies in the future prospect.

There are two kinds of classification of case study research designs. According to Stake (1995), this research designs may include intrinsic, instrumental and collective; while Yin (2003) classified case study research designs into three styles namely exploratory, explanatory, and descriptive (Hancock and Algozzine, 2006). According to Hancock and Algozzine (2006), intrinsic case study research can be used when the researchers want to understand more about a specific individual, group, event, or organization and do not have to develop a theory or generalize the research findings to broader populations. Instrumental case study research could be used to explore deeper insight of theoretical issues. Collective case study research tends to refine the theory and to contribute to the literature. Exploratory case study designs explore the phenomenon based on research questions of subsequent study and also test the possibility of research issues. Explanatory designs are used to explained events and their outcomes and their cause and effect relationships. Descriptive designs provide the description of a phenomenon within a particular context.

Based on the theory of case study research design and to complete research's objectives, the author would like to design the dissertation following the intrinsic and descriptive designs. MFCA will be used to show material insufficiency in Vietnamese cases based on their actual information and situation. Consequently, these companies may identify their shortcomings in

management so that they can carry out solutions to improve production management as well as to reduce environmental impacts.

The study will collect the data from various sources including (1) interviewing managers, accountants, engineers, and representatives for environmental-related issues in firms; (2) observing production operation and waste treatment by site visits; (3) collecting information from accounting records and other documents. The study will try to apply a tool of EMA method of Japanese companies to Vietnamese companies in the seafood processing industry.

1.7. Dissertation Preview

To achieve the objectives of the research and to present it clearly, the thesis will be logically structured by six chapters (Figure 1.4). Particularly, the dissertation may include main ideas as follows:

Chapter 1 Introduction

1.1. Overview of Environmental Accounting and Environmental Management accounting

1.2. Research Background

1.3. Research Objective

1.4. Research Scope

1.5. Research Contribution

1.6. Research Methodology

1.7. Dissertation Preview

1.8. Concluding Remarks

Chapter 2 Background of Economic Development and Environmental Situation in Vietnam and Japan

2.1. Overview of Vietnam and Japan Economy in Recent Years

2.2. Emissions and Environmental Management in Vietnam and Japan

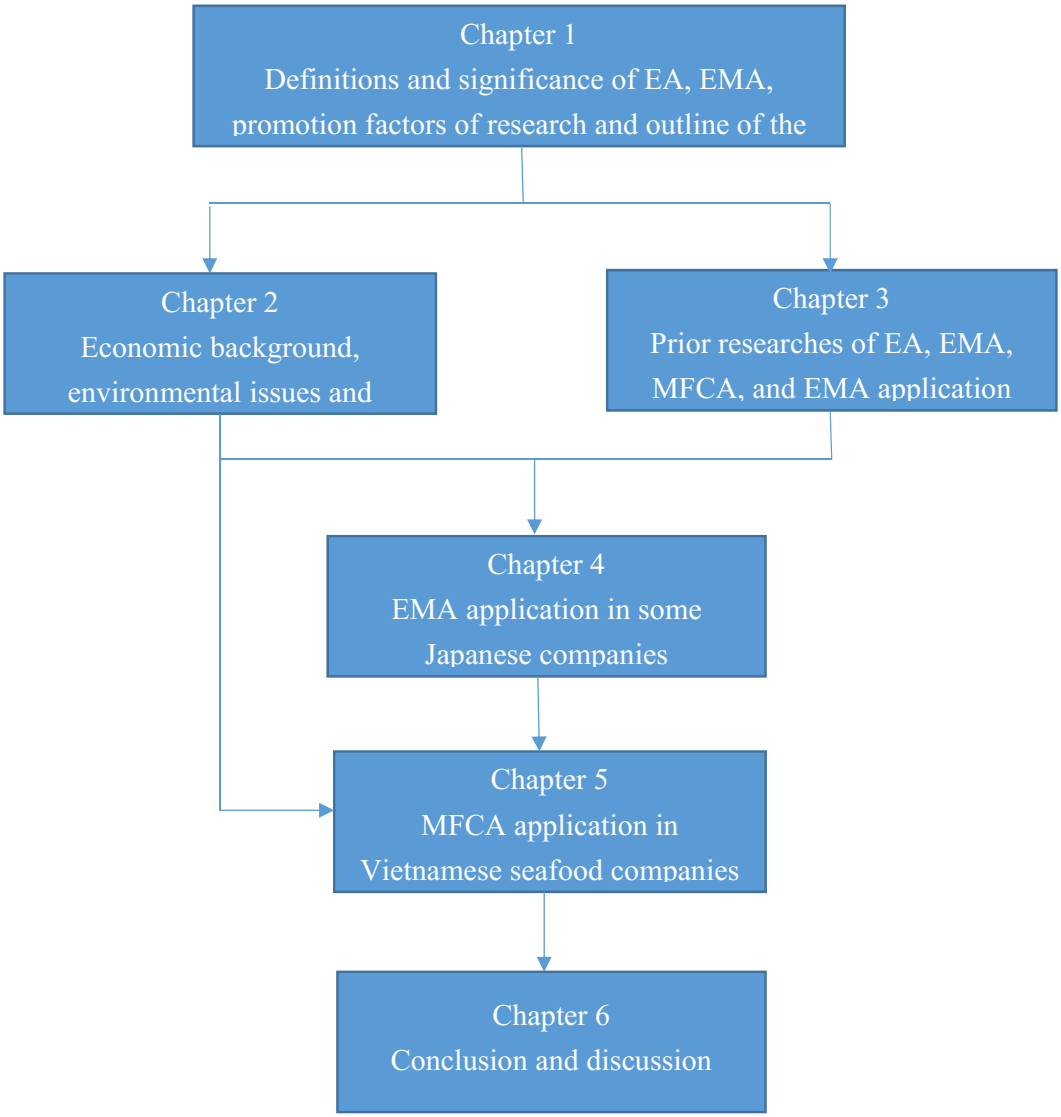

Figure 1.4. Structure of thesis

1.8. Concluding Remarks

This chapter provides an overview of EA and EMA, incentives of this study and the research methodology that will be used for this thesis. As the aforementioned in the review section, the more detail on EMA application in Japanese companies, the explanation of research methodology and the answer for the question of "whether the approach of Japanese EMA application is useful to Vietnamese companies or not?" will be presented in the later chapters.

In this dissertation, the author focuses on EMA as a tool to provide the information for management decision on environmental and economic issues. Hence, it is expected to apply EMA tools of Japanese companies to Vietnamese companies in order to solve the environmental and business problems in Vietnam.

Although EMA has been developing more than two decades in many countries around the world, EMA has been still unfamiliar and less awareness both in research and practical application in Vietnam. However, the high level of disclosure of a firm in an industry could lead to bandwagon influence on disclosing of other companies in the same industry (Wallace and Naser, 1995; Cooke, 1991). Therefore, the author anticipates that the effective applications to Vietnamese companies in these case studies may lead to dissemination to many other companies in this industry at first and hopefully other industries also. Hence, potentially the research could contribute to EMA research in Vietnam and promote EMA application in Vietnamese companies. In addition, practical adoption could improve Vietnam's environmental performance and Vietnamese companies' financial achievement. Besides, the dissertation presents the evidence to support the findings of earlier studies on EMA application for cleaner production in developing countries (e.g. Chompu-inwai et al., 2015; Schaltegger et al., 2012; Sulong et al., 2015).

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Chapter 2

Background of Economic Development and Environmental Situation in Vietnam and Japan

This chapter aims to provide the key information of economic development and environmental problems in Vietnam and Japan as well as governmental policies that aim to improve their situations. Therefore, this chapter will mention the main points of the economic and environmental situation and management of Vietnam and Japan. Besides, the information of governmental strategies to deal with environmental problems and to promote sustainable development in two countries is also presented in this chapter.

2.1. Overview of Vietnam and Japan Economy in Recent Years

2.1.1. Overview of Vietnam economy

Recently, Vietnam economy has still kept a moderate growth. The GDP trend is growing up despite of some slight fluctuation in the middle period of the year (Figure 2.1). The beginning quarter of 2016 was lower than 5.0% while the first three-quarters of this year was nearly 5.9% (Figure 2.1). Particularly, this development was mostly contributed by industry and construction, and services sectors (Figure 2.2). Such each sector may accounted for nearly 50% of Vietnam GDP. Besides, Vietnamese economy has a positive signal of export product. The export rate has been creasing continuously although the rising rate was little lower than previous years. For example, the figure of 2014 was 7.9% while 2015 was 7% (Table 2.1). In particular, the low-value manufacturing industry accounted for the highest proportion of export value in all three years from 2014, with nearly 50% in total (Table 2.1).

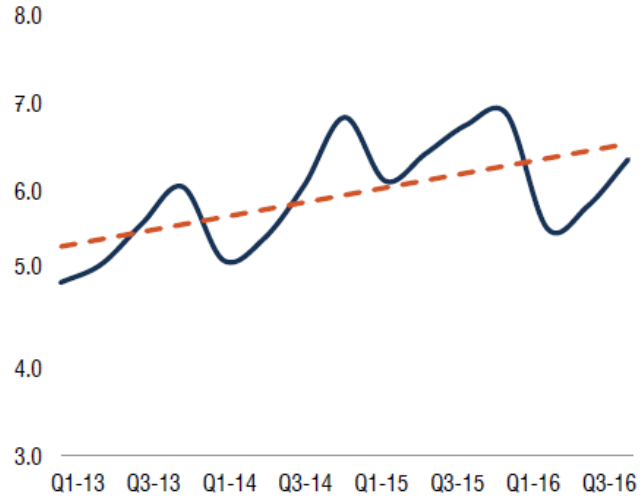

Figure 2.1. Percentage of GDP Growth of Vietnam by two quarters (Source: The World Bank, December, 2016)

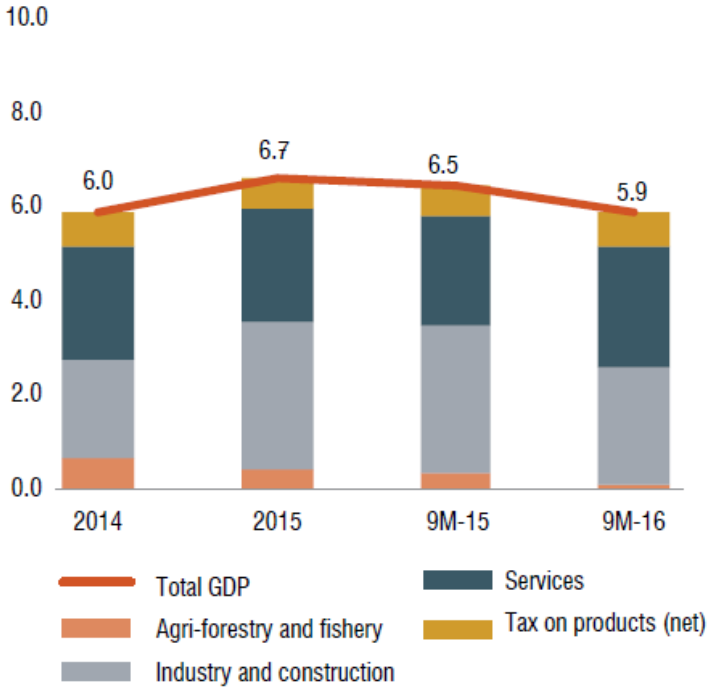

Figure 2.2. Contribution to GDP of sectors (Source: The World Bank, 2016)

Table 2.1. Vietnam's export performance

	Share of total			Growth (%, yoy)		
	2014	**2015**	**2016**	**2014**	**2015**	**2016**
Total export value	100.0	100.0	100.0	13.8	7.9	7.0
Crude oil	4.8	2.3	1.3	-0.2	-48.5	-41.2
Non-oil	95.2	97.7	98.7	14.6	10.8	8.2
Agriculture and fishery products	14.7	12.7	12.7	12.1	-6.9	7.3
Rice	2.0	1.7	1.3	0.4	-4.5	-17.4
Low value manufacturing	49.4	49.2	49.0	17.2	7.6	7.5
Garment	13.9	14.1	13.7	16.6	9.1	4.1
Footwear	6.9	7.4	7.3	22.9	16.3	7.8
Technology manufacturing	24.8	30.1	31.6	11.3	31.0	11.1
Phones and parts	15.7	18.6	19.7	11.1	27.9	10.4
Computer and electronics	7.6	9.6	10.3	7.9	36.5	15.6
Domestic sector	67.4	70.5	71.4	14.8	13.0	8.2
Foreign invested sector (excl oil and phones)	58.9	62.7	63.8	17.9	14.3	9.8

(Source: The World Bank, 2016)

2.1.2. Overview of current circumstance of Japanese economy

Japanese economy experienced a stable development with a low fluctuation of main macro-economic indicators. However, detail analysis showed that the 2016 economic growth was a little lower than the previous year. Indeed, the ratio of GDP and domestic demand reduced 0.2% (Table

2.2). Similarly, in 2016 export turnover of Japan dropped by 1.7% compared with last year (Table 2.2).

Table 2.2. Macro-Economic Indicators of Japan's Economy during 2013-2016

	2013	**2014**	**2015**	**2016**
GDP	2.0	0.3	1.2	1.0
Total domestic demand	2.4	0.4	0.7	0.5
Exports of goods and services	0.8	9.3	3.0	1.2

(Source: OECD, 2017)

All in all, according to OECD's recommendations (2015, 2017), despites of unsettled global economic, Japanese economy still keeps a reasonable growth thanks to its effective strategy of three-pillar approach – a three-arrows of "Abenomics". The strategy also supported to increase productivity and sustainable development (OECD, 2017).

2.2. Emissions and Environmental Management in Vietnam and Japan

Currently, among global environmental problems, the issue of Greenhouse gas (GHG) or CO_2 emissions was attracted the large attention because of its serious damage. Hence, in this part, the author will focus on presenting the emission in two countries.

2.2.1. Emissions and Environmental management in Vietnam

2.2.1.1. Current circumstance of Greenhouse Gas emission

According to the report of Vietnam to UN Convention Framework on Climate change, greenhouse gas emission in Vietnam soared dramatically comparing with ten years ago from 150.9

million ton in 2000 to 246.8 million ton in 2010 (Table 2.3). The number showed the down gradation of Vietnamese environment due to rising greenhouse gas emission from the economic development. Among of factors, energy caused the most amount of CO_2, with 141.1 million ton, accounting for about 50% of the total.

Table 2.3. Greenhouse gas emission in three different years 1994, 2000, 2010

Equivalent to Million ton of CO_2

Sector	1994	2000	2010
Energy	25.6	52.8	141.1
Industry	3.8	10.0	21.2
Agriculture	52.4	65.1	88.3
LULUCF	19.4	15.1	-19.2
Waste	2.6	7.9	15.4
Total	**103.8**	**150.9**	**246.8**

(Source: Vietnam's First Biennial Updated Report to UNFCCC)

Even, the scenario may become more dangerous and acute if there are no proper immediate actions. According to the forecast of UNFCCC (2013), the emission will increase double by next ten years and nearly fourfold by next 20 years (Table 2.4).

Table 2.4. Greenhouse emission expectation in 2020 and 2030

Equivalent to Million ton of CO_2

Sector	2020	2030
Energy	381.1	648.5
Agriculture	100.8	109.3
LULUCF	-42.5	-45.3
Waste	26.6	48.0
Total	**466.0**	**760.5**

(Source: Vietnam's First Biennial Updated Report to UNFCCC)

From the actual data, greenhouse gas emission was an actually severe problem to Vietnamese environment. Thus, it should put proper policies to environmental management both in macro and micro scale. Indeed Vietnamese business organizations should interest themselves in increasing the awareness and efficiency of clean production and business activities.

2.2.1.2. Current circumstance of environmental management

Although recently Vietnamese government has imposed more environmental management law such as Circular No. 35: /2015/TT-BTNMT[3] on environmental protection in economic area, industrial zone and high-tech area, Circular No. 04/2015/TT-BXD on construction of waste water treatment system[4], Decree No. 80/2014/ND-CP on the waste water drainage and treatment[5]; environmental management in Vietnam has been still not effective. The evidence is that in 2010 there were more than 3,600 cases of Vietnamese companies that were fined for disposing waste water into the environment without any treatment[6]. Moreover, this situation has been more serious in recent years. According to the information of Vietnamese environmental police, there were more than 6,000 cases of violating environmental regulations in the first half of fiscal year 2013 and as high as 17,000 companies were fined for breaking environmental laws in 2016[7].

[3] See more in: https://luatminhkhue.vn/en/circular/circular-no-35-2015-tt-btnmt-dated-june-30--2015-of-the-ministry-of-providing-for-the-environmental-protection-of-economic-zones--industrial-parks--export-processing-zones-and-hi-tech-parks.aspx

[4] See more in: http://www.moc.gov.vn/web/guest/legal-documents/-/legal/TB4r/en_US/18/259670/55213

[5] See more in: https://luatminhkhue.vn/en/decree/decree-no-80-2014-nd-cp-dated-august-06--2014-of-the-government-on-the-waste-water-drainage-and-treatment.aspx

[6] See more in: http://pnq.com.vn/news/He-thong-quan-ly-quoc-te/Moi-truong-va-ISO-14000-o-cac-doanh-nghiep-Viet-Nam-80/

[7] See more in: http://canhsatmoitruong.vn/xu-ly-nhieu-doanh-nghiep-vi-pham-moi-truong-9591.html

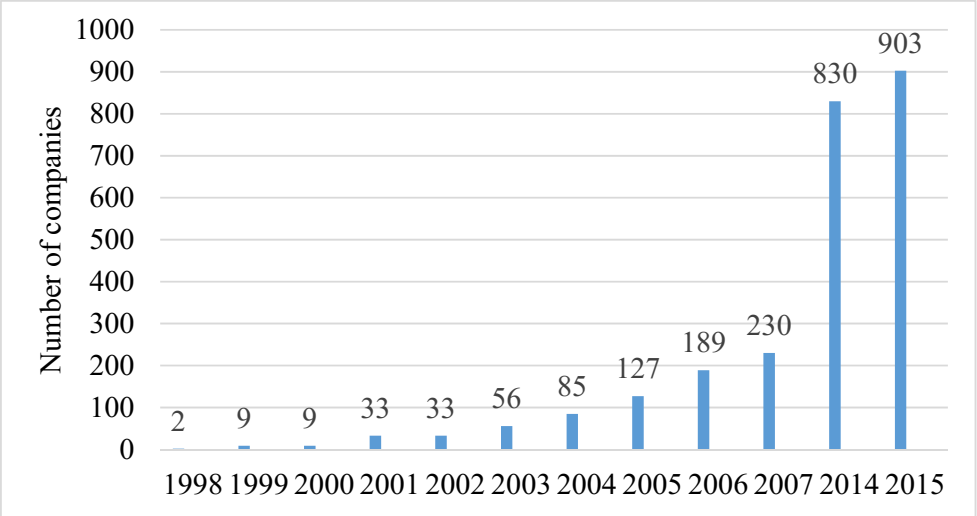

Figure 2.3. Number of Vietnamese companies obtaining ISO 14001 through the period of 1998-2015 (Source: ISO-VN, 2008[8])

Even though environmental management has been introduced into Vietnamese companies for a long time ago, environmental management systems in Vietnamese companies are still weak and inefficient. This is shown by the number of Vietnamese companies obtaining ISO 14001 certificate. Two first Vietnamese companies received ISO 14001 certificate in 1998 but after ten years, the number was still low with 270 companies in 2007 (Figure 2.3). Furthermore, most of these companies are foreign investment firms. They adopted ISO 14001 under the pressure from parent companies rather than from environmental regulations and laws of the local government (ISO-VN, 2008). According to the survey of the fiscal year 2014 of ISO organization in Vietnam, there were about 830, and the number of 2015 Vietnamese companies obtaining ISO14001 certificate was only 903. Among of them, companies of food and drink processing and tobacco production accounted for 11% only[9]. Although the number of ISO companies increased during the

[8] See more in: http://www.iso-vn.com/vi/iso-14000/126-thuc-trang-iso-14001-tai-viet-nam-sau-10-nam-trien-khai-ap-dung-nhung-thuan-loi-va-kho-khan.html

[9] See more in: http://enternews.vn/vcci-ho-tro-doanh-nghiep-huong-den-su-phat-trien-ben-vung.html

survey period, this growth is slower than the world rate (8%) (ISO, 2015).Currently, there are only 11% Vietnamese companies adopting SO 14001 (Vietnamese Ministry of Commerce, 2016).

In conclusion of environmental management of Vietnamese government and companies, it seems that environmental management policies of the government have been not effective. There remained a growing number of companies violating environmental laws. Besides, Vietnamese companies' awareness of the usefulness of environmental management was still low. Therefore, some action plans to improve environmental management in Vietnam should be done immediately.

2.2.2. Emission and Environmental management in Japan

2.2.2.1. Current circumstance of Greenhouse gas emission

According to OECD, the environmental performance of Japan has been improved dramatically thanks to the policies of sustainable development and low-carbon society. The amount of emission slightly decreased during the period of 2013 to 2015, from 1.45 billion ton to 1.321 billion ton (Table 2.5). However, this volume of greenhouse gas emission was still high and caused problems to the environment in Japan. According to the statistics of emission in 2012 (MOE, 2012), industries emitted the largest amount of CO_2 in total (34%) in Japan (Table 2.6). Besides, the commercial and other sector also exhausted a considerable proportion of emission that was contributed mainly by electricity consumption (13%). This trend was also similar to other sectors, the major proportion was caused by the electricity consumption (Table 2.6).

Table 2.5. CO_2 emission in Japan

Year	2013	2014	2015
Value (bil. Ton)	1.45	1.382	1.321

(Source: japanfs.org)

Table 2.6. CO_2 emissions by sectors

Sector	2010	2014
Waste	2%	2%
Energy conversion	7%	7%
Industries	34%	34%
(From electricity consumption)	*7%*	*7%*
Transportation	18%	17%
(From electricity consumption)	*1%*	*1%*
Commercial and other	20%	21%
(From electricity consumption)	*13%*	*14%*
Residential	16%	15%
(From electricity consumption)	*11%*	*11%*
Industrial processes	3%	4%

(Source: Japan MOE)

Note: "From electricity consumption": emissions from the use of electricity and heat which were purchased from companies such as electric companies, except for private power generation. "*Energy conversion": self-consumption at power plant, gas plants, oil refineries, etc.*

Indeed, in order to develop the economy, Japan also had to face the environmental challenges to environmental protection such as GHG emission reduction, the biodiversity conservation and the air and water pollution reduction. However, differing to other OECD countries, Japan could cut down CO_2 emission in the transportation sector sharply (OECD, 2010). Japan has also made advantages in integrating energy and climate policies by improving energy-efficient technologies in manufacturing as well as transportation (OECD, 2010).

2.2.2.2. Current circumstance of green management

According to OECD report (2017), Japan is one of countries implementing successfully its green growth strategy thanks to energy efficiency policies. The "Top Runner Program" that was carried out in manufacturers and importers helped to reduce energy consumption for many electrical and energy innovation such as household electrical applications and cars. Indeed, this results in better green indicators for Japan in comparison with the OECD average. For example, the CO_2 emission per capita from production of Japan was extremely lower than the OECD average (Figure 2.4).

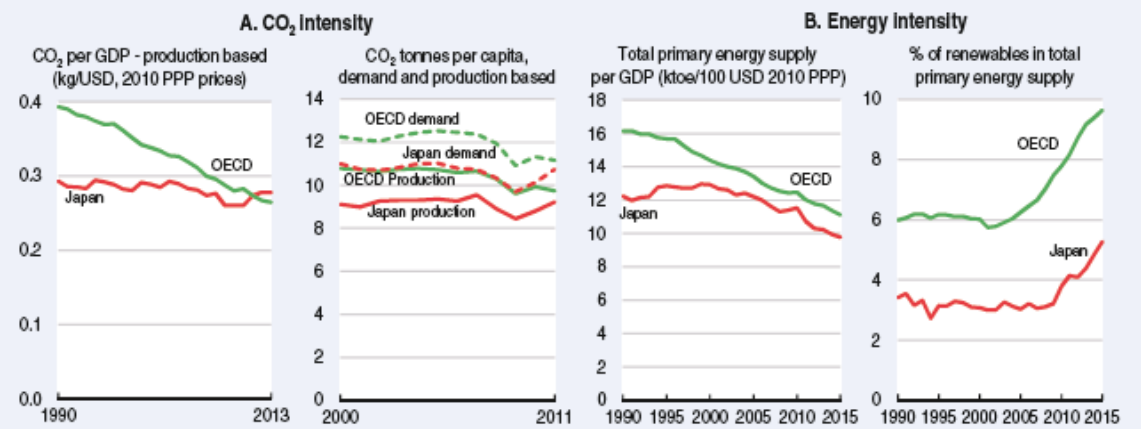

Figure 2.4. Green growth indicators of Japan in the comparison with the average of OECD countries (Source: OECD, 2017)

Additionally, Japan is one of leading countries in achieving green development such as green technologies, low-carbon energy, low-energy buildings, green materials, waste-recycling systems thanks to effort of green management of Japanese companies, for example, Toyota (Jeffrey, 2016). Indeed, according to the survey by Japanese METI (2015), most Japanese companies concerned social sustainability in their management strategy.

The efficiency of Japanese government and Japanese companies' interest in green management can be seen by the increasing figure of ISO companies in Japan. There were above 25,000 Japanese firms obtaining ISO 14001 certificates in 2015 (Figure 2.5).

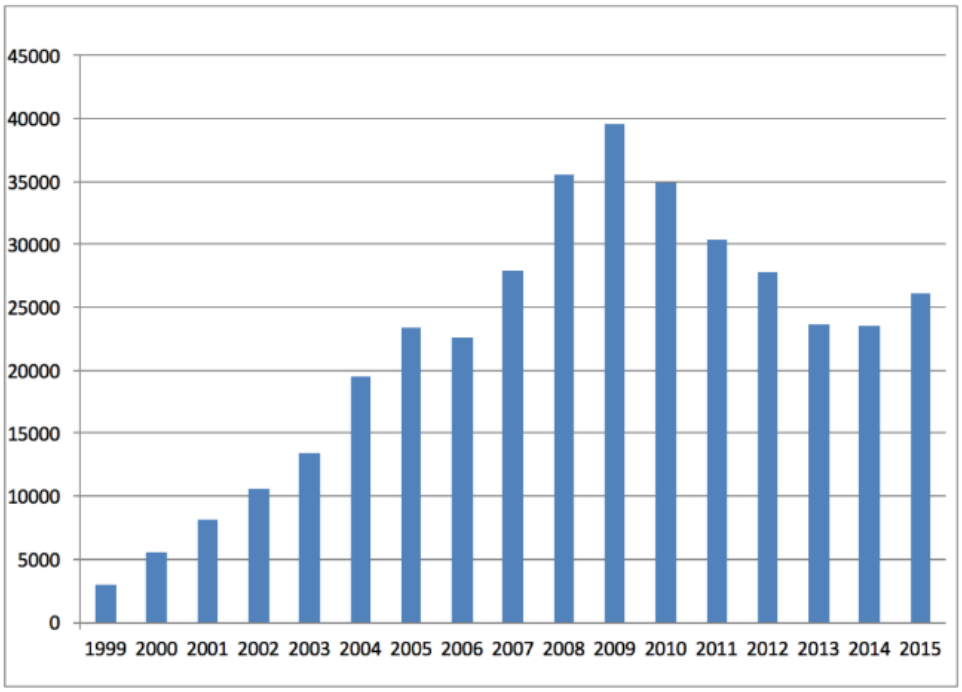

Figure 2.5. Number of organizations registered in Japan under ISO 14001 (Source: ISO.Org, 2015)

2.3. Sustainable Development Strategies of Vietnam and Japan

2.3.1. Sustainable development strategies of Vietnam

Pursuing a sustainable society, Vietnamese government informed many strategies toward sustainability for the period of 2011-2020 and with vision to 2050 including some main goals: (1) stable macroeconomics; (2) green energy and low carbon society; (3) exploring natural resources efficiently; (4) controlling and treating environment degradation; (5) keeping biodiversity; and (6) alleviating the effects of climate change, especially increasing sea level (432 QD/TTg and 1339

QD/TTg). Moreover, the governmental agencies planned to review and adjust environmental and sustainable strategies overall and frequently to ensure that all economic sectors develop towards low-affected environment and low-carbon dioxide release (Vietnamese government, Decision No. 1393/QD-TTg).

In particular, Vietnamese government declared a variety of strategies and action plans of green production and consumption during last years. The strategy of a "clean industrialization" was conducted by reviewing and adjusting existing industrial sectors to ensure economical and efficient use of natural resources; encouraging the development of green industry and sustainable bio-agriculture based on applying environmentally friendly structures and technologies; enhancing investment in natural capital; pro-active prevention and pollution treatment. Main targets for green production towards 2020 are building the high-value technology and green technology that may make a share of 42-45% of GDP. Especially, the rate of business organizations accrediting environmental standards was expected to be 80% and the number of companies applying clean technologies will achieve by 50%. Besides, the investment on sectors of environmental support and protection to enrich the natural capital will expectedly reach 3-4% of GDP. In addition, Vietnamese government also set the target of emission reduction by cleaner production technologies. According to this plan, it is expected that 50% of industrial production processes will be applied cleaner production technologies and 8-13% of energy consumption may be reduced by 2020.

The strategy of "greening life style and encouraging the sustainable consumption behavior" was set by following solutions: (1) combing economic development with keeping traditional customs; (2) urbanization accompanying with nature and (3) building sustainable consumption behaviors in the globalization age. The prime orientations towards 2020 include (1) 60% of large cities could have their own collection and treatment systems meeting the required standards, and

(2) 40% of small cities and rural areas could be able to treat disposed waste in their region (Vietnamese government, Decision No.2149/QD-TTg).

Furthermore, in the strategy of building renewable energy and reducing GHG emission, in 2010, Vietnamese government passed the law No.50/2010/QH12 of efficient energy usage. This law contains the detailed principles of how to use the energy efficiently, economically to secure energy security and environment protection. Besides, Vietnamese government developed the plan to restructure the power production in Vietnam for the period of 2010-2030, turning from the fossil fuel to renewable energy. Using the natural gas energy in transportation, using high efficient air conditioners, developing biomass power, enhancing small hydro power, and wind energy production are also included in this plan.

Additionally, the government aimed to build a sustainable society with organizations and individuals' involvement. In particular, the green growth action plans were considered the main part of sustainable development toward 2030 in Vietnam (Pham, H.M., 2017). There are three main tasks including reducing GHG emission by 8-10% compared with 2010 figure and emission per GDP 1-1.5% annually; promoting the environmentally friendly business organization, operation, technology, and production; encouraging green lifestyle and consumption behaviors.

Overall, Vietnamese economy has been developing towards achieving development by charging on environmental damage. Therefore, to deal with this situation, the Vietnamese government has carried out many sustainable plans and projects that are expected to bring economic benefits, to balance eco-systems and to protect natural resources. These strategies mainly focused on solving the pollutant from industrial production and improving green production and business in organizations.

2.3.2. Sustainable development strategy of Japan

Because of dramatically economic growth, the issue of environmental protection and impacts of environmental pollution have put more pressures to Japan's economy and society in the direction of sustainable development. In recent years, in Japan, the approach for sustainable development has been integrating environmental protection, economic growth, and social change. This linkage was emphasized in many environmental programs of Japan such as *2006 Third Basic Environment Plant*[10]*, 2007 Sustainable Society Strategy, 2009 New Growth Strategy to 2020*[11] (OECD, 2010), *Sustainable Development Goals* since 2016, etc. This part will refer the main policies on the sustainable development of Japanese government.

Table 2.7. CO_2 emission scheme to 2020 regarding sector

	Base year (2005)	**FY 2012**	**Estimated emissions in 2020**	
	A		**B**	**(B-A)/A**
	Million t-CO_2	**Million t-CO_2**	**Million t-CO_2**	**Compared to base year**
Energy-originated CO_2	1,203	1,207	1,208	+0.4%
Industry	459	431	484	+5.4%
Commercial and other	236	259	263	+11.4%
Residential	174	203	176	+1.1%
Transport	254	227	190	-25.2%
Energy conversion	79	86	95	+20.3%

(Source: MOE, 2014)

The long-term countermeasures to reduce the emission of Japan focus on the cooperation of government, industry and academic researches. Particularly, to reduce the emissions, usage of

[10]See content on: http://www.japanfs.org/en/news/archives/news_id026370.html

[11] See content on: http://japan.kantei.go.jp/asospeech/2009/04/09speech_e.html

energy-efficient devices has been encouraged in all business sectors and households. According to 2009 New Growth Strategy to 2020, Japan will control CO_2 emission from energy consumption, allowing just around 0.4% increase in 2020 compared with the amount in 2005 (Table 2.7). In most of sectors, the emission will slightly increase, however, in transportation industry, CO_2 emission of target year will plunge to 25.2% compared with the base year (Table 2.7). Japanese government has imposed the law of promoting low carbon cities by step by step, firstly, improving public transport; secondly, encouraging using low-carbon devices, cleaner energy and renewable power and energy-efficient and less GHG emissions technology. For example, in transportation, communal transportation system and automobile CO_2 emission control will be developed to use widely in society. In energy management, the solar power generation systems and batteries will be installed in areas adjacent to parks, ports, and harbors (MOE, 2014). These policies clearly showed a combination between serving private life, adjusting to cleaner production, satisfying the need of energy and reducing emissions.

Furthermore, Japanese government emphasized the role of environmental management, especially, in corporate management. In addition, the green policy of the government aimed to guide the business organization doing activities to meet their current targets by environmental and social management. The government has even used the interest subsidy for private companies to invest environmental friendly business. In this project, companies have also been supported the low-carbon devices by means of the lease. Another action of the government to promote environmental management in firms is encouraging environmental information disclosure by the publication of *Environmental Reporting Guideline* for Japanese companies and other action plans to increase the communication of social and environmental information between corporates and investors. For example, the Action Plan for global warming countermeasure in 2016, Japanese government promoted the infrastructure development of information disclosure using information

technology (MOE, 2016). The government provided the tool that companies and investors could publish and download information to enhance communication quality and frequency. Furthermore, Japan's CSR policy focused on changing social issues into companies management challenges and vice versa. This aims to encourage enterprises contributing to solving social problems.

2.4. Conclusion

This chapter showed the general information of economy, environmental problems, and management as well as the policy of sustainable development of two countries.

The data from this section indicated that Vietnam got the remarkable economic achievements such as GDP growth and stable high exporting index. However, referring environmental issues in Vietnam, industrial sectors caused a large amount of emission and disposal to the environment while the current environmental management seems to be not effective. By contrast, Japan is one of the countries that have implemented various efficient policies towards sustainability. Due to these strategies, the economy as well as the environment of Japan, have been improved dramatically. According to OECD (2010), Japan policies for sustainable development are well designed and eco-technology has been applied effectively to tackle the problems of environmental protection, economic growth as well as social progress.

Japan and Vietnam have different economic and environmental background and issues, therefore, they pursue no same policies and actions to develop sustainability. As a developed country, Japan has a better economic performance and environment than Vietnam. For example, there was a big gap of a number of ISO 14001 companies between Japan and Vietnam. However, it is true that both countries are pursuing sustainable development and green growth goals for enterprises by encouraging cleaner energy and production and reducing CO_2 emission. Depending

on the action plans, resources and facilities of each country, this affects how well each nation do in sustainable strategy. Nevertheless, they have to go toward less GHG emission, cleaner energy and greener technology as well as reducing the burden of global warming. According to OCED report, currently, Japan is one of leading countries of sustainable development. Thus, in the aspect of economic management and sustainable development, potentially, Vietnam could learn these valuable experiences from Japan. Indeed, to achieve the target of emission reduction and sustainable development, cleaner production of enterprises play the major role. From the achievement of Japan in SD, it inclined that Japan effectively implemented green management to the society thanks to the encouragement of Japanese enterprises' involvement. Japan's experience showed that SD was mainly contributed by clean energy and production. Japanese companies were encouraged to build environmental management system and environmental accounting system for such strategies. Thus, the management experience of Japanese companies in sustainable development may offer potentially useful lessons to Vietnamese companies in enhancing economic productivity and reducing environmental impacts.

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Chapter 3

Literature Review

EA is one of emerging research fields. There are many researches on EMA, environmental reporting, and studies on practical cases in Australia, Germany, Japan, as well as other countries. In this dissertation, some definitions, concepts, data, and conclusions from prior researches may be quoted and discussed. Therefore, the author would like to identify the main ideas in researches on EA, EMA and environmental reporting in theory and practical application that the author will employ as references for this research. Furthermore, this chapter is expected to indicate the present notions of EA, EMA, and advantages of Japanese EMA application that may promote this study. Particularly, this chapter will mention the literature following the development order of EA research in practice. Therefore, the studies of environmental disclosure and impact factors of environmental reporting will be discussed after referring general research of EA. Later on, the prior researches on the application of EMA tools in Japanese companies and MFCA approach will be presented with the aim of clarifying the widespread acceptance of notion on Japanese MFCA as a major and innovative tool of EMA among Japanese companies. Additionally, the most useful international and Japanese guidelines of EA and EMA will be summarized to ascertain the basic ideas of this field.

3.1. Prior Researches on Environmental Accounting

This part presents the information of EMA development, experience and practical application in various countries. This section also includes the discussion of definitions and circumstance of EMA development and applications, which are widely accepted and adopted.

3.1.1. Overview of environmental accounting

EA has been developed more than 30 years ago. Initially, it was established as a tool for environmental management of nation (National Environmental Accounting). Later, EA has been applying widely in management and environmental information disclosure in numerous companies, especially, in developed countries. Early concepts of EA was developed from the 1990s (Gray et al., 1993; Schaltegger and Stinson, 1994; EPA, 1995; Gray et al., 1996; Schaltegger et al., 1996; Schaltegger and Burritt, 2000). Explaining the reason for the development of EA, Herremans et al. (1999) and Schaltegger and Burritt (2000) indicated that stakeholders' concern on environmental impacts of business activities and environmental costs pushed the growth of EA among business organizations. Indeed, EA calculates economic impacts on the environment and ER presents such information, so EA strengthens the relationship and communication between the stakeholders and enterprises (Herremans et al., 1999; Schaltegger and Burritt, 2000).

EMA as an internal function of EA has been gradually developed and determined its role in sustainable development. The definition of EMA was mentioned by many researchers and organizations, for example, Bennett and James (1998), IFAC (1998), Japanese MOE (2002). According to Bennet and James (1998), EMA is a technique used for analyzing financial and non-financial information to improve environmental and economic performance of enterprises towards sustainable development while IFAC (1998) defined "Environmental Management Accounting—the management of environmental and economic performance through the development and implementation of appropriate environment-related accounting systems and practices. While this may include reporting and auditing in some companies, EMA typically involves life-cycle costing, full-cost accounting, benefits assessment, and strategic planning for environmental management". The background of EMA was continuously discussed after some years through various researches of, e.g. Bouma and Van der Veen (2002); Burritt et al. (2002); Kim (2002); Jasch (2002); Strobel and Redmann (2002). These researches added some

notions of EMA, including EMA classification, EMA framework, and EMA tools. Particularly, these researches highlighted the advanced characteristics of EMA for management in sustainable development. Similarly, Bennett et al. (2003) discussed added value of EMA that makes it distinctive from conventional management accounting and evaluated the application in practice. The paper indicated that although there was not a fundamental difference in definitions of EMA and conventional management accounting; there are three significantly different in aims and behavioral implications between these two systems. Therefore, the paper showed three value propositions of EMA for environmental and monetary management. In the part of EMA adoption, the authors mentioned the development of EMA both in research and practice in many countries such as Germany, USA, and Japan.

The literature review also focused on the distinction of traditional accounting and EA to show advantages of EA in sustainable development. Conventional accounting could not separate environmental costs from overheads costs, so it cannot provide proper information of wastes and emissions for management as EA does (Jasch, 2000; Schaltegger and Burritt, 2000; Bennett et al., 2002; Schaltegger and Wagner, 2005). Schaltegger and Burritt (2000) also indicated that the conventional accounting could not show the information of external impacts caused by degradation such as environmental pollution, excessive waste disposal or by consumption of natural resources. According to Jasch (2002) managers could not exactly know how much hazardous waste disposal costs or material loss occurring in production based on the information from the mainstream accounting system. However, EMA tool such as material flow balance can overlook production costs to improve eco-efficiency (Jasch, 2002). Similarly, Schaltegger and Wagner (2005) explained the current view of environmental costs and showed the distinction between the temporary and conventional perspective on environmental costs. The authors indicated the weakness of current environmental costing methods and proposed integrating costs of material and energy flow that were related to the environment into

environmental costs. Therefore, the conventional accounting cannot satisfy the requirement of management in environmental concern. Consequently, EMA was widely disseminated because it supported environmental reporting, cost savings, cost analysis and achieving win-win relationship (Bennett et al., 2002; Jasch, 2002).

Thanks to the advantages of EMA information, this tool may uncover proper path for sustainable development (Bennet et al., 2002; Jasch, 2002). Besides, Bouma and Van der Veen (2002) opened the way for further research on EMA adoption for sustainable development and environmental objective obtainability. The authors illustrated the positive role of EMA adoption to environmental cost management. Meanwhile, Burritt, Hahn, and Schaltegger (2002) developed EMA framework with various dimensions including monetary and physical indicators and time frame of short/long-term and past/future period. The paper presented the opinion of conventional accounting to environmental information and indicated the main differences between conventional and EA in environmental information. Finally, the authors set the general scenarios of information supply according to users and goals and proposed EMA tools from the framework for different managers and departments. Additionally, EMA can bridge the gap between environmental managers and accountants in determining environmental costs; thus, it reduces the environmental impacts and increases the material efficiency (Jasch, 2002; 2003).

Besides the individual studies, EA study has also attracted the attention of organizations. There were many EA researches conducted by organizations such as VDI Guideline 3008 (Germany), Japanese Environmental Accounting Guidelines (Environmental Agency Japan, 2000), Flow cost accounting, Materials and energy flow-orientated budgeting of researchers and application of ABC to materials and energy flows (US-EPA 2000), and EMA guidance of IFAC (2005). It seems that each document focused on a different aspect of EA. For example,

the Japanese research provided the guidelines for environmental reporting while the IFAC guidance focused on EMA methods and approaches.

Although there have been numerous EA studies, it seems that EMA researches were mainly focused on the context of developed countries such as Australia, Denmark, Germany, Japan, UK, US etc. (Burritt et al., 2002; Strobel and Redman, 2002; Thurm, 2002; Rikhardsson and Vedso, 2002; Bennett et al., 2003). In the next sections, the mainstream of EA studies will be mentioned in detail to determine the background, advantages as well as the imbalance in EA researches.

3.1.2. Impact factors of environmental accounting development

Currently, EA has been developed and expanded in many countries, especially in developed countries. Promotion factors of this technique may be the governmental incentives, research institution, enterprises' voluntary and stakeholders' concern.

ER is affected by the environmental sensitivity of industry (Deegan and Gordon, 1996; Frost and Wilmshurst, 2000; Cormier and Magnan, 2013). They examined the impacts factors of ER and EMA in some Australian companies. Particularly, Deegan and Gordon (1996) tested three factors, namely objectivity, systematization and environmental sensitivity of environmental disclosure in a sample of 197 Australian firms' annual reports. This study concluded that only in case of operating in the environmentally sensitive industries, the interrelationship between firm size and the amount of environmental disclosure existed. Moreover, the research of Frost and Wilmshurst (2000) was little more extensive because it also concluded the relationship between EMA adoption and environmental sensitivity of the company. Cormier and Magnan (2013) showed that the quality of environmental disclosure was lower in firms operating in more environmentally sensitive industries as well as having poor environmental performance. The study by Hyršlová and Hájek (2006) also indicated this application was not affected by the

company's size rather than some incentives, namely environmental protection interest, company's image, stakeholders' concern, competitiveness and improvement of community relations.

Meanwhile, the local government also plays the essential role in promoting EA and EMA application in in many countries (Jong-Dae Kim, 2002; Kokubu and Kurasaka, 2002; Kokubu et al., 2003; Thy, 2003; Brammer and Pavelin, 2006; Cormier and Magnan, 2013). Jong-Dae Kim (2002) discussed the guidelines of Korean government on environmental costing for Korean companies. According to the author, this supported environmental accounting application in Korea. Development of EA among Japanese government was also major affected by EA and ER guidelines of Japanese governmental agencies, particularly Japanese METI and MOE (Kokubu et al., 2003). To Danish companies, they were pushed to publish annual Green Account due to the legislation of the local government (Thy, 2003). Consequently, Green Account disclosure encouraged Danish companies to enhance their environmental performance and resource efficiency. Brammer and Pavelin (2006) indicated the effect of firm and industry characteristics on voluntary environmental disclosure and disclosed quality. These authors identified that the sector influenced differently on the quality and engagement of disclosure in large companies in the UK. Similarly, Cormier and Magnan (2013) examined the sensitivity of environmental information disclosure and legitimacy. The paper tested the empirical models to the sample of 550 US and Canadian firms. Consequently, this research illustrated the environmental legitimacy changed the quality of environmental disclosure and the disclosure of environmental management information.

Development of EMA was also incentivized by the international organizations (Jasch and Savage, 2008; Thurm, 2006). For instance, UNDSD (2001) published "Environmental Management Accounting: Procedures and Principles" and IFAC (2005) provided

"International Guidance Document, Environmental Management Accounting"[12], etc. The guidance of IFAC indicated the potential functions and benefits of EMA that the business organizations may adopt in their cleaner production management (Jasch and Savage, 2008).

In conclusion, the literature review showed that EA development has been promoted mainly by the governmental policies such as guidelines publication, training and even by the laws and regulations. Besides, the concern of partners and awareness of business organizations were also fairly important. Indeed, in order to promote EMA implementation, it should have both external and internal involvement (Burritt, 2004).

3.1.3. Relationship between environmental accounting application and corporation performance

EA though does not guarantee the certain level of financial or environmental performance, it provides more factual and detailed information for decision making (Bennett et al., 2002; Vasile and Man, 2012). Therefore, EA implementation can improve the organizations' performance (Jasch, 2002; Thy, 2003; Wagner, 2005). Thy (2003) and Wagner (2005) indicated that EA application may improve the environmental performance of organization. Thy (2003) explained this situation in Danish companies and the paper showed financial and environmental achievements of such companies thanks to Green Account application. Wagner (2005) examined the correlation between the quality of environmental report and the environmental performance, particularly, focusing on the cases of Germany and United Kingdom companies. In addition, the author stated the indispensable role of EMA tools to improve the quality of environmental reporting as well as environmental performance and their mutual relationship.

[12] The content of these documents will be summarized later in this chapter to show how these guidelines benefit EMA application in companies

Also, Herzig and Schaltegger (2006) identified the most important goals and benefits of sustainability reporting including the legitimation of corporate activities; reputation and brand value; competitive advantage; internal transparency and accountability; and internal communication. The paper also provided the information of current development of SR and its potential growth in the future in the perspective of professional communication and the link to accounting.

Overall, the literature review presented that environmental disclosure affected positively to not only environmental performance but also the economic one. Whereas, environmental disclosure was affected by the environmental sensitivity of industry and the environmentally legal system of countries that organizations operate.

3.1.4. Environmental accounting application

This section introduces the prior researches on EA including EMA application and environmental disclosure in various companies, industries, and countries. This provides the experience of actual applications of EA and EMA tools for management and environmental conservation.

EA literature more focused on environmental reporting and disclosing and environmental costing in early years of its development. For example, Jong-Dae Kim (2002) introduced the practical environmental costing based on the case of LG Chemical Ltd. in Korea and Gale (2005) examined EMA application in Canadian paper mill in the fiscal year of 2000, especially focusing on analyzing environmental cost categories. Another research by Hyršlová and Hájek (2006) examined the temporary situation of EMA in the Czech Republic, especially, focusing on the stages to track and evaluate environmental costs in such companies. Likewise, Jennifer Ho and Taylor (2007) analyzed the triple bottom line (TBL) disclosure in 50 US and Japanese companies. The authors focused on five relationships between, namely (1) disclosure and firm

size; (2) corporate profitability and dimension of TBL reporting; (3) financial leverage and level of TBL reporting; (4) firm liquidity and dimension of TBL reporting; (5) industrial membership and dimension of TBL reporting.

EA and EMA studies and practical applications were implemented more widely in developed countries than developing countries. There were many EA researches for developed countries' cases from the early years such as Czech, Danish, Germany, Japan, Korean, UK, US, etc. For example, Thy (2003) introduced the progress of application of green accounts in Danish companies. The Danish government imposed the Green Accounts Act and enforced companies to oblige. For example, Bennett et al (2003) and Schaltegger and Wagner (2005) studied practical development of EMS in some countries, namely Australia, Germany, and Japan; Gale (2005) examined EMA application in Canadian paper mill in the fiscal year of 2000 or Hyršlová and Hájek (2006) examined the temporary situation of EMA in Czech Republic. Likewise, Jennifer Ho and Taylor (2007) analyzed triple bottom-line (TBL) disclosure in 50 US and Japanese companies.

However, studies on EA application in developing countries' cases have just appeared recent years. While the abovementioned researches in this section mainly focused on EMA application in developed countries, Herzig et al. (2012) provided various samples of EMA application in four developing Asian countries. This book illustrated the benefit of EMA application to all kinds of enterprises from small and medium size to large and multinational companies in various countries with different environmental laws and institutions. Based on 12 case studies of 12 companies in four South-East Asian countries, the study concluded that economic rationality was the main incentive of EMA application in these South-East Asian companies while the enforcement of environmental regulation was weak. Subsequently, the study clarified that EMA could support managers in various approaches due to different rationales and requirements. Similarly, Jamil et al. (2015) tested the impact factors and

obstacles to EMA application in SMEs in developing country, particularly Malaysian manufacturing industry. By the survey methodology, the paper revealed that majority of Malaysian manufacturing SMEs were interested in environmental and sustainable activities. In EMA application, Malaysian companies were favor of physical EMA than monetary EMA. However, the factors of deficiency of resources, the efficiency of financial attention and the shortage of interest in environmental costs were major hurdles of EMA adoption in Malaysian manufacturing SMEs. Finally, the paper proposed the solutions for developing EMA application in Malaysia based on the results of this survey.

The literature was also interested in differences of practical EA application between different countries (e.g. Burritt et al., 2003; Loew, 2003; Jennifer Ho and Taylor, 2007). Buritt et al (2003) made a comparison of EMA applications between Australia, Germany, and Japan, especially focusing on the term EMA information for staff appraisal. While environmental accounting approach of Japan and Germany focused on the external communication, US one aimed to support environmental management and protection (Loew, 2003). Although flow cost accounting of Germany was a cost accounting approach and green supply chain management of US was an approach of supply chain management; they were both based on the principles of material and energy flows (Loew, 2003). Besides, Wagner (2005) added that the choice of physical indicators affected the quality of environmental reports could be different and the significant difference only occurred in two different sectors rather than two countries. The paper by Jennifer Ho and Taylor (2007) also clarified the difference in TBL disclosure between US and Japan. The results showed that the most overriding of the difference of US-Japan TBL disclosure was while Japanese companies focused on disclosing environmental issues and US firms concentrated on environmental liabilities.

In addition, the prior researches on EMA application aimed to provide the practical experience as a guidance to other companies (Bennett et al., 2003). Such studies indicated the

experience of successful EMA companies as examples to support the wider adoption of EMA. For example, Thurm (2002) explained the experience of EMA application in a multinational company – Siemens. The author indicated the promotion factor of sustainable development in this company as well as policies that Siemens implemented. Similarly, Jasch (2003) provided a pilot of EMA application in 12 companies as a "best-practice" example for others. Burritt et al. (2009) indicated EMA tools providing useful information for corporate decision-making, especially the long-term decision such as investment by examining the process of carbonization and cogeneration in a rice milling company in the Philippines. The paper showed the practical experience of EMA knowledge for the long-term decisions in the context of ecological and sustainable development. The paper also opened the directions for future research and application of EMA to cleaner development mechanism and emission reductions.

Another trend of EA study was preferring to large-sized companies more than to SMEs (Bennet et al., 2003; Lee, 2009). For instance, Kokubu et al. (2003) examined ER of Japanese companies that listed in Tokyo Stock Exchange. Likewise, Thy (2003) provided the application of Green Accounts in Danish companies that listed in the stock market. Similarly, Collison (2003) discussed the practical EA application based on the survey carried out in top 200 UK companies and top 500 Scotland companies. Burritt and Saka (2006) also took an example from a large company – Toyota Corporation for their analysis.

Currently, the ideas, notions, and techniques of EMA are continuously studied and developed. From first definitions, presently, EMA principles, framework, and techniques are widely accepted in many countries. EMA has been adopted and accepted in many companies and various countries. This trend may continue in the future because it is compatible with sustainable development tendency. However, it seems that the growth of this trend is stronger and quicker in developed countries than developing countries (Burritt, 2004). By this study, the author expects to add more cases of EMA application in developing countries.

Otherwise, the literature review stated that EMA system can benefit the business management in the context of sustainable development and cleaner production regardless of countries where organizations do their business. Additionally, EA application was motivated mainly by the governmental promotion; however, its application procedure was not influenced by the legislation and industrial characteristics. Thus, potentially, EMA application may implement effectively in Vietnamese companies. Besides, the literature clarified EA and EMA application may financial benefits and environmental advantages to organizations. Hence, possibly, EMA application may offer positive changes to the environmental and economic performance of Vietnamese companies. Therefore, this thesis is expected to show the benefit of EMA application in Vietnamese companies.

3.2. Researches on Environmental Accounting Application in Cases of Japanese Companies

This part presents the information of studying on EA application and development in Japan. It shows the experience of Japanese companies in adopting EA as well as considers the impact factors of EA development in Japan. The information from this section will be used as the background for analyzing the experience of EA application in Japanese companies in Chapter 4.

The early researches of EA in Japan mainly focused on the status of EA development and environmental disclosure, EA guidelines of Japanese governmental agencies and the impact factors of EA development in Japanese companies. For instance, in the year of 2000 when EA had been first introduced in Japan, Miyazaki (2000) indicated the current status of EA, how EA was introduced and implemented in Japan. This study indicated that Japanese companies have been eager to apply and some of them surpassed the European and North American companies in disclosing EA information to the external reports. Besides, the author suggested

Japanese companies needed to develop two sets of EA both for internal and external communication purposes and matching the decision making of internal and external stakeholders. Also mentioned on EA development in Japan, Saka and Burritt (2003) analyzed some features of EA in Japanese companies during the period of 1998 to 2002. The paper showed a dramatically upward trend in the number of Japanese companies reporting environmental information over the period.

Studying on EA guidelines by Japanese governmental agencies also attracted attention from many researchers. For instance, Kokubu and Nashioka (2001) discussed the ER guidelines of Japanese MOE in 2000. The authors summarized the environmental cost classifications and environmental reporting formats of the guidelines. The paper examined that the format C was considered as the most far-reaching EA report among three provided formats in the guidelines. The paper also mentioned the sharply positive impact of the guideline to the development of ER and EA in Japan. The disclosure was analyzed to determine the progress of environmental publication among Japanese companies. Likewise, Kokubu and Kurasaka (2002) explained the guidelines and referred to the strategic plan of MOE and METI to improve such guidelines on encourage EA application in Japan in the near future after discussing the environmental disclosures of Japanese companies.

Besides, the impact factors on EA development in Japanese companies were studied by many researchers. Kokubu et al. (2001) examined the impact factors of the engagement of Japanese enterprises in disclosing the corporate environmental information. The aspects were considered including company size, financial performance, consumers' strength, the capital market, and the type of industry. Based on the sample of 1203 Japanese firms, the study showed that profitability and debt equity ratio did not affect the corporate environmental disclosure while the company size and type of industry significantly positively influenced by this activity of enterprises. By contrast, floating stock ratio of the company seemed to have the negative

trend with the engagement of environmental report and the relationship with the customers did not have great influence on the publication of the corporate environmental report. This research was continued by Kokubu et al. in the next year. The authors concluded that in Japan, two main governmental initiatives on EA were taken by MOE and METI (Kokubu et al, 2002). Kokubu and Kurasaka (2002) explained the MOE guidelines and studied the temporary EA application of Japanese companies to clarify the role of Japanese MOE and METI in EA development in Japan. The study also found that most of Japanese companies applying EA based on the MOE guidelines and stated the important role of MOE guidelines in EA development in Japan. Hirayama et al. (2001) also indicated that MOE Environmental Reporting Guidelines disseminated environmental reporting in Japanese companies. Likely, Saka and Burritt (2003) examined the influenced factors of Japanese companies' EA applications. This study found seven main impacts, namely (1) MOE guidelines, (2) ISO 14001 certification, (3) increasing credibility of environmental information, (4) environmental reporting award systems, (5) establishment of eco-funds and socially responsible investment, (6) rating in environmental management, and (7) pressure of social responsibility. In another study, Kokubu and Nashioka (2008) explained the impact factors of EA application in Japanese manufacturing sites. The paper concluded that the effectiveness of EA application was considerably affected by the awareness of EA's benefit of applied sites. Similarly, Saka and Noda (2013) discussed the role of stakeholders in disclosing environmental information in Japanese companies. By analyzing CSR reports of 236 listed Japanese companies, the result showed that most of the Japanese enterprises issued CSR report based on Japanese MOE Environmental Reporting guidelines and different kinds of stakeholders influenced differently on CSR reporting of Japanese companies but employees and shareholders seemed not to have an effect on this disclosure.

In the early period of EA development in Japan, studies and applications of EA in Japan mentioned on ER more than EMA (Kokubu and Kurasaka, 2002; Kokubu and Nakajima, 2004;

METI, 2002). For example, Saka and Burritt (2005) analyzed EA information of two Japanese companies – Canon and Ricoh during 1999 to 2003 with the main focus on environmental disclosure of such companies. The paper was aimed to conclude three main limitations of EA information in SR/ER of Japanese companies. Likewise, Hirayama et al. (2001) studied EA disclosure practices in listed Japanese companies in the first section of the Tokyo Stock Exchange Market and suggested solutions that made ER more meaningful. The study presented the reporting companies in the number and the percentage grouping into the industry. The authors also carried out the survey and analyzed the contents of the report and how they changed during two years 2000 and 2001 according to company's size, industry, and first-timer companies and experienced companies. Also mentioning on environmental disclosure of Japanese companies, Kitamura et al. (2002) compared the numerical data from the ER between Japanese companies in three industries, namely automobile, beer brewery, and chemicals. Based on these analyses, the authors concluded that the automobile industry was one of the front runners in environmental disclosure in Japan because these companies disclosed a wide range environment-related data while the beer brewery companies were still trying to reduce emission and tackling the environmental issues and the chemical companies caused the high emissions and consumed the largest energy among three industries. Besides, the paper mentioned that Japanese companies did not disclose the environmental information in a standardized style format. By contrast, the study of Kokubu and Nashioka (2003) indicated that there was no major difference between information disclosures of companies in different industries; whereas, the significant difference was found in companies which published the advanced EA reports based on some sort of guidelines in terms of the median of sales, total assets and operating profits.

EA application of Japanese companies became more focusing on the internal function for management since 2002 since METI guideline for EMA was published (Kokubu and Nashioka,

2005; Kokubu and Nashioka, 2008). Kokubu and Nashioka indicated that the number of Japanese listed companies that recognized the importance of internal EA was increasing and EMA brought more benefits than ER in such practical applications. Regarding EMA application in Japanese companies, Burritt and Saka (2006) indicated the links between EMA and eco-efficiency in the practical cases in Japan. The paper introduced the overview of EMA development in Japan and referred to EMA and eco-efficiency relationship. Based on the analysis of the case studies of six Japanese companies, namely Tanabe Seiyaku, Nippon Oil, Ricoh, Canon, Hitachi, and Fujitsu, the paper showed how these companies evaluated the environmental impacts of their business activities and indicated a link between eco-efficiency measurement and EMA information in Japanese companies' management. Studying on EMA application at Japanese manufacturing sites, Kokubu and Nashioka (2008) concluded that most of such sites adopted EA to collect environmental data for the headquarters. Besides, this study discovered that the EMA was highly appreciated in Japanese manufacturing companies and MFCA tool was more popular to these Japanese firms than other EMA tools (Kokubu and Nashioka, 2008).

Overall, the experience of EA and EMA application in Japan displayed the essential role of MOE's and METI's guidelines in promoting these tools in Japanese companies. In the first years of application, Japanese companies focused more on disclosing environmental information than applying EA tools for decision-making (Kokubu and Nakajima, 2004). However, presently, there are numerous researches on EMA application in Japanese companies, mostly on MFCA tool, so they will be mentioned in the later section of this chapter.

3.3. Opinions on Material Flow Cost Accounting

This section introduces the prior researches on MFCA as various aspects including numerous benefits of MFCA, the applicability of MFCA in many kinds of companies and

countries as well as the integration of MFCA with environmental management and other EMA tools.

The MFCA approach was introduced as one of the tools of EMA. The idea of MFCA was firstly developed by Strobel and Redmann (2002). These authors formed the new opinion on management looking throughout the organization by the material flow. This study explained flow cost accounting and its advantages to the environmental issues over the traditional cost management. The paper was written as the first guidance for material flow cost application. Indeed, the elements of material flow cost, implementation steps of material flow cost and information reported by material flow cost were also introduced. After that, the idea of material flow cost had been developed by Jasch (2009). This research defined as the principles and procedures for EMA with a focus on the techniques of environmental and material flow costs. This book indicated the advanced approach of MFCA towards sustainability, focusing on waste material value to reduce the cost of wastes and emissions and to protect the environment as well. Based on this background, ISO 1405 (2011) explained the main ideas of MFCA and introduced the implementation steps for MFCA application. This document was stated the most important signal for ascertaining the essential role of MFCA in SD (Christ and Burritt, 2016; Kokubu and Kitada, 2012; Schmidt and Nakajima, 2013). Christ and Burritt (2016) asserted that the release of ISO 14051 might create the greater attention to MFCA than ever seen before within the area of EMA. This standard also incentivized the MFCA adoption because of availability of detail principles, implementation steps and successful examples of adopted cases.

MFCA was illustrated to be not only a management tool for material efficiency and cleaner production, but also an approach for decision making of investment and energy management (Jasch, 2009; Kokubu and Kitada, 2009; ISO, 2011; Sygulla et al., 2011; Schaltegger et al., 2008; Schaltegger and Zvezdov, 2015). Indeed, Sygulla et al. (2011) discussed the extension

of MFCA for providing further information on manufacturing process and technology improvement. The paper analyzed the benefit of the separation between energy flows and energy loss flows in the recognition of potential energy savings. By this approach, the paper concluded MFCA could provide the detailed information about the loss and consumption of material, energy and other system costs; thus, it could improve the productivity and opportunities to promote green technology. Besides, Sygulla et al. (2014) mentioned supportive approach of MFCA in the context of ecological and economic goals. Especially, the paper discussed the extension of MFCA to combine with life cycle costing and life cycle assessment in order to calculate the energy and material loops and evaluate the efficiency of alternative processes. Finally, the paper concluded MFCA was not only useful for short-term management decisions but also relevant to long-term decisions and MFCA tool could maximize its usability by integrating with existing cost accounting system and management systems.

The researches and application of MFCA from Western countries, especially German researchers' opinion usually mentioned the support of ERP for information collection. For instance, Fakoya and van der Poll (2013) indicated the combination of EFP and MFCA was essential for making management decisions of waste reduction. By case study methodology, the paper showed an example of the South African company that had not obtained accurate data for decision-making, especially in waste management. It presented the shortcomings of using ERP data solely and explained how ERP and MFCA system could be integrated to support management. Finally, the article concluded integrating ERP and MFCA system provided full physical and monetary information of waste because this combination could not only provide higher precise information but also require less time for data collection. Similarly, Schmidt (2015) illustrated integration MFCA and ERP could provide the most exact information of waste losses effectively by an experiment in a South African company. The paper indicated that the advantages of MFCA calculation could overcome the shortcomings of

conventional accounting by various formulae for different information such as material losses, saving of treatment costs thanks to material losses reduction. These formulae could solve a variety of management situations, including allocating material costs, energy costs and system costs for products and non-products, and measure potential savings of eliminating the internal recycle of residual materials. Finally, this article concluded that MFCA not only was essential tool providing the accurate data for management but also enabled to connect with various management tools and systems for higher valuable and effective information system.

By contrast, the researches on MFCA application of Japanese companies were stated the minor role of information technology (Christ and Burritt, 2015; Kokubu and Tachikawa, 2013; Kokubu and Kitada, 2015). These authors indicated that Japanese companies could adopt MFCA with the manual information system and MS Excel. Regarding information technology support for MFCA implementation, Christ and Burritt (2015) stated that while ERP systems were recognized as a supportive tool to European companies, it was not so popular to Japanese companies.

Researches of MFCA in Japan clearly explained the difference between traditional accounting and MFCA approach (e.g. Nakajima, 2003; Kokubu and Nakajima, 2004; Kokubu and Kitada, 2010). Moreover, Kokubu and Kitada (2010) indicated the potential confrontations between traditional management methods and management opinion following MFCA. The paper contributed the ideas of practical challenges of continuous MFCA application to the temporary MFCA researches. The study discovered that the confrontations may be caused by the new definitions of waste and stronger internal cooperation of MFCA perspective; however, these challenges may be solved by the involvement of external stakeholders.

Besides, MFCA researches on Japanese companies usually discussed the experience of the most successful cases as examples (e.g. Kokubu and Nakajima, 2004; Kokubu and Kitada, 2010; METI, 2011; Nakajima, 2009; Nakajima, 2011; Nakajima, 2013; Onishi et al., 2008;

Schmidt and Nakajima, 2013). In these researches, the case studies were frequently concerned, including Nitto Denko, Tanabe Seiyaku, and Canon. Besides, these cases were used to show experience in overcoming the potential confrontations to achieve advanced MFCA application (Kokubu and Kitada, 2010). Furthermore, sample cases of Japanese METI illustrated that MFCA might be the effective management tool for all companies regardless their size.

Discussing on Japanese MFCA, the combination between MFCA analysis and PDCA cycle were also mentioned frequently (Nakajima, 2009; Nakajima, 2011). All four companies (Nitto Denko, Tanabe Seiyaku, Canon and Shimizu Printing Inc.) adopted the result of MFCA analysis for PDCA management to implement environmental goals (Nakajima, 2009). This combination was identified one of the distinctive characteristics of Japanese MFCA approach (Nakajima, 2011). Furthermore, the literature of MFCA application in Japanese companies showed that Japanese companies usually began to adopt MFCA to one product or process and then, expanded to the whole corporation. For example, Nitto Denko started to implement MFCA in Toyohashi plant with *adhesive tapes for electronics* product and Canon started with *lens* product. Additionally, MFCA applications in Japanese companies exhibited the experience of application in SMEs and throughout the supply chain (METI, 2011).

Although most of the researches on MFCA focused on its application in large companies in developed countries (Christ and Burritt, 2015), there were some studies in developing countries (e.g. Schaltegger et al., 2012; Chaiwan et al., 2015; Chompu-inwai et al., 2015; Sulong et al., 2015). For instance, Schaltegger et al. (2012) introduced a Vietnamese case study applying MFCA for material and energy management. Particularly, the approach of material and energy flow accounting was applied to provide decision-making information for cleaner production with the lowest cost. The paper resolved environmental and economic issues of a case study by its environmental management system running parallel to already existing management system. More importantly, the paper produced an example of material, energy flow accounting

application on regular basis. This study also illustrated the adaptability of EMA application in a developing country. Chaiwan et al. (2015) discussed the MFCA application in a Thailand company in the food industry. Especially, the author focused on analyzing MFCA adoption to identify material waste in the case study production. The paper showed step-by-step implementation of MFCA in the case study. Likewise, Chompu-inwai et al. (2015) carried out a research in a Thailand company on combing MFCA tool and Design of Experiments (DOE) techniques to reduce the materials inputs and waste disposal. It designed two steps for achieving the research purposes. The paper concluded the positive effects of applying MFCA and DOE for management decisions of various departments and discussed the applicability of this model to other Thai SMEs with the involvement of research institutions and government agencies. Another similar research was carried by Sulong et al. (2015). The paper introduced the experience of a Malaysian SME in MFCA application, potential obstacles and challenges were discussed. Especially, the paper was expected to show the impact factors and barriers as the real experience to other firms to follow. In the paper, the diffusion of innovations theory was used to resolve the hurdles in MFCA implementation in a Malaysia manufacturing company.

Overall, the prior researches showed the concepts and issues of MFCA in theory as well as practical application. In SD era, MFCA is an essential tool (Schmidt and Nakajima, 2013; Schaltegger and Zvezdov, 2015). Its applicability is not only in one production process or one company but also in the supply chain. MFCA was developed and applied widely around the world, particularly more in many developed countries and recently has been adopted in some developing countries such as Thailand, Malaysia, etc. The literature review showed that although MFCA was found in Germany but its breakthrough was implemented in Japan (Christ and Burritt, 2015). Japanese companies' application indicated MFCA could be applied successfully both in SMEs and large-sized companies in various industries, for short-term or

long-term decisions, and for inner management or through a supply chain. Japanese companies' experience, additionally, showed how to use PDCA cycle in MFCA implementation from establishing the goal to assessing the result. Based on this section, the thesis will present the main ideas of MFCA and distinctive characteristics of MFCA application in Japanese companies in Chapter 4. Another illustration from the literature review was that MFCA application in Vietnamese companies was less common compared with others from counterpart countries in the area.

3.4. Environmental Accounting and Environmental Management Accounting Guidelines

This section aims to present the main ideas of EMA guidelines that are broadly accepted in many countries and Japan. These documents were illustrated the crucial guidance of EA and EMA application (Jasch, 2006; Kokubu and Nashioka, 2002; Kokubu and Nashioka, 2003) because they provided the background knowledge and incentives for EMA application in many companies and for EMA researches as well. Furthermore, these guidelines played the major role in promoting EA application in international scale (like IFAC guidance) and in Japan (like EA and EMA guidelines of Japanese MOE and METI) (Schaltegger et al., 2008; Kokubu and Nashioka, 2002; Kokubu and Nashioka, 2003).

3.4.1. IFAC, 2005. International guidance document: Environmental Management Accounting

This document aimed to provide an international guidance of EMA theory and application, so it was a collection of advanced knowledge of EMA from various researches and a revision of EMA theory. This guidance document included six chapters concerning definitions, principles as well as practical applications of EMA. This document; however, did not focus on how to implement EMA as well as its various tools as other documents of ISO (such as ISO

14051) or Japanese guidelines (Environmental Accounting Guidelines and Environmental Reporting Guidelines). The contents of this guidance were structured as follows,

Chapter one explained the growth of EA definitions and incentive factors of its development. In this chapter, EA adoption for various context was also introduced.

Chapter two focused on EMA and provided its definitions, feasible practices, advantages as well as challenges. Particularly, broadly applied techniques of EMA were explained by the introduction of physical and monetary information of EMA. According to this guidance, from EMA perspective, physical information was a driven factor because the volume of material consumption and energy emission significantly affects the level of environmental pollution. This chapter described the benefits of EMA belonging to three spheres, namely regulation compliance, win-win achievement, and vision position. Finally, major obstacles to implement EMA in existing conventional accounting system were analyzed and potential solutions were proposed.

Chapter three and four discussed in detail the physical and monetary information of EMA respectively. Chapter three presented the information of materials balances, materials flow accounting, and physical environmental performance indicators. Especially, materials mass balances (or material balances) were discussed further as a useful tool to determine the non-product output. In Chapter four of this guideline, environmental costs include the material cost of product outputs, the material cost of non-product outputs, waste and emission controls, prevention and other environmental management costs, research and development costs, less tangible costs. This approach was also used in EA Guideline of Japanese governmental agency. In the later sections, information of eco-efficiency indicators, descriptive environmental cost forms, environmental-related earnings, and expected benefits of allocation of environmental-related by environmental domains were mentioned.

Chapter five and six showed the practical illustrations of EMA application for internal management and external disclosure respectively. Examples of EMA adoption for managerial functions indicated that EMA could be implemented with the different boundary of an organization such as separated factories or production process or material level or the whole corporation; EMA information may be supportive of various management decisions, for instance, logistics management, investment appraisal, environmental impact reduction, etc. Cases in Chapter six illustrated the external function of EMA as a mean of communication in the combination with the national accounting and reporting, the financial accounting and reporting, and environmental performance report.

3.4.2. Japanese MOE, Environmental Accounting Guidelines, 2005 version

The MOE guidelines[13] intended to provide guides for companies and organizations to implement EA. Particularly, it presented EA information for environmental information disclosure satisfying stakeholders' requirement and for internal management. From MOE's perspective, EA pursues the sustainable development, building the positive relationship between companies and community, and constructing effective and efficient conservation business.

The boundary of these guidelines was EA for companies and organizations with the components, namely environmental conservative cost (monetary value), environmental conservative benefit (physical units), and economic benefit of environmental conservation activities (monetary value).

Table 3.1. Environmental conservation cost category

Category	Content

[13] The newest version of these guideline is 2005 edition

Business area cost	Environmental conservation cost to control environmental impacts resulting from main business operations within a business area
Upstream/downstream cost	Environmental conservation cost to control environmental impacts resulting from upstream/downstream operation of business activities
Administration cost	Environmental conservation cost caused by administration activity
R&D cost	Environmental conservation cost ensuing from R&D activity
Social activity cost	Environmental conservation cost resulting from R&D activity
Environmental remediation cost	Cost incurred for dealing with environmental degradation
Other cost	Other costs related to environmental conservation activities

(Source: MOE, 2012)

This document was structured by ten sections regarding the overview of EA and its components, analysis of EA information, and the guidance for practical application to internal management decision-making and environmental information disclosure. The detailed explanation of the meaning of items in EA was presented in section one. Section two mentioned the structural elements of EMA consisting of target period, the scope of calculation, environmental conservation costs and its measurement, environmental conservation benefit and its measurement, economic benefit related to environmental conservation activities and its measurement. Section three, four, and five explained the elements of EA and classification of each element.

Categorizing environmental conservation cost in relation to business activities, there are seven kinds of cost, namely business area cost, upstream/downstream cost, administration cost,

R&D cost, social activity cost, environmental remediation cost, and other cost related to environmental conservation (Table 3.1).

Environmental conservation benefit is measured in physical units gaining from the prevention, reduction, and/or avoidance of environmental impact, removal of such impact, restoration following the occurrence of a disaster, and other activities. Information of environmental conservation benefit is performed in indicators. Corresponding to business activities, environmental conservation benefit is divided into four groups, as follows:

(1) Benefit corresponding to key business area cost and upstream/downstream costs, presenting environmental conservation benefit related to resources input into business activities;

(2) Benefit corresponding to key business area cost, applying to the environmental conservation benefit related to waste or environmental impact originating from business activities.

(3) Benefit corresponding to key business area cost and upstream/downstream costs for environmental conservation benefit related to goods and services produced from business activities.

(4) Administration cost, R&D cost, social activity cost, and others referring to other types of environmental conservation benefit, depending upon the details.

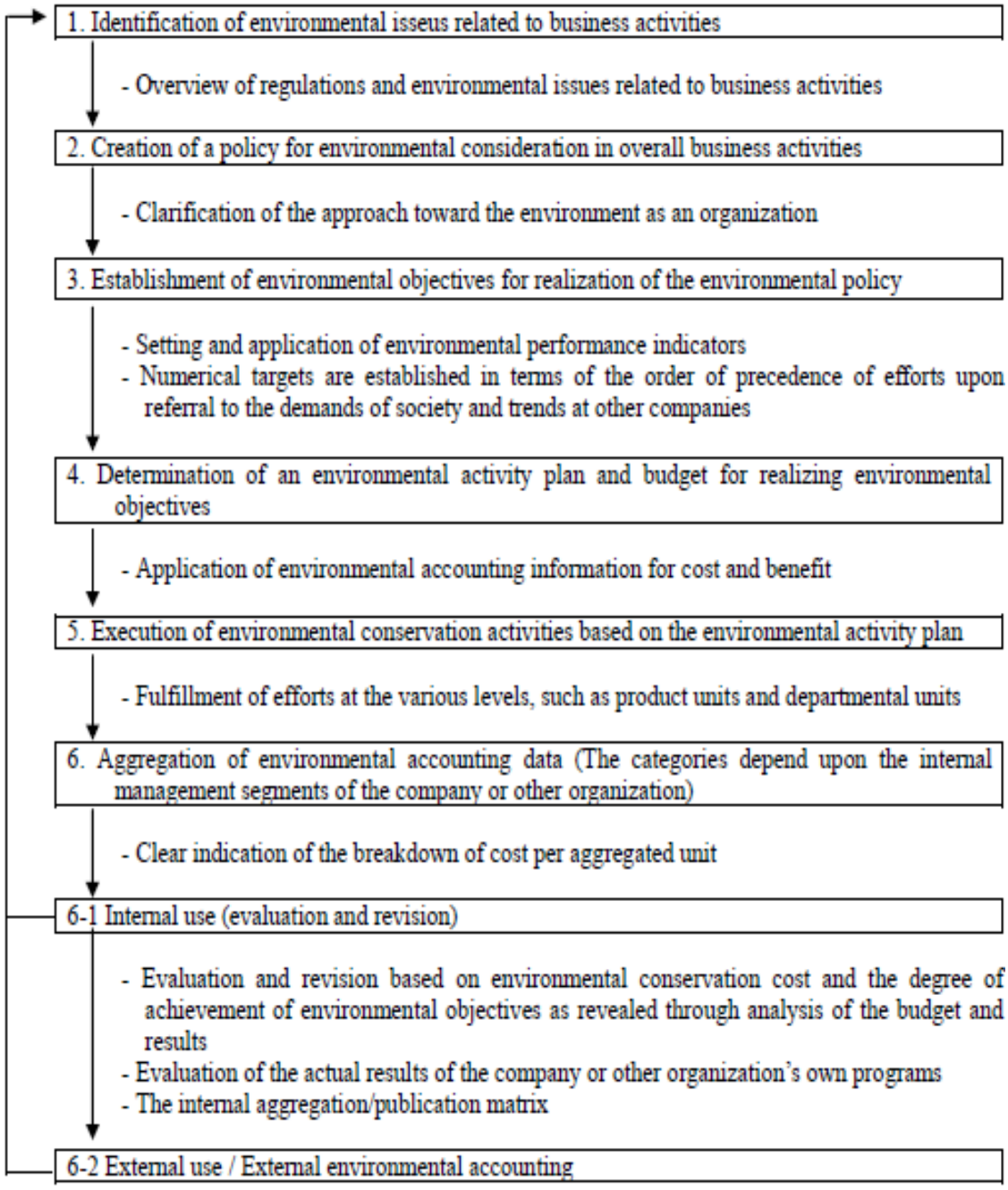

Figure 3.1. Diagram of Environmental Accounting data (Source: MOE, 2012)

The Section four also explained how to calculate the environmental conservation benefit to adjust the change of business activity results in order to ensure the comparability between different periods. Section five mentioned the economic benefits of environmental conservation

activities and measurement of these benefits. Referring to the disclosure of environmental information, the Part seven listed three disclosed issues consisting of processes and results of environmental conservation activities, the major factors (target period and scope) of EA, and combined results of EA. Section eight presented EA application for internal management. EA information for internal and external function had the same source. This section introduced step diagram for collecting the environmental information for internal management and external disclosure (Figure. 3.1). In this section, various tools of EMA were also listed and classified by the target of application (Table 3. 2).

Table 3.2. Environmental management accounting methods corresponding to targeted application

Target area	Methods		
By product	Cost planning system takes the investment into consideration	Environmental cost matrix	Business results evaluation system that takes the environment into consideration
	Life cycle costing		
Facility investment	Facility investment decision-making methodology		
Production and distribution processes	Material flow cost accounting		

(Source: METI, 2002; MOE, 2012)

The Section nine provided indicators from EA data for internal management. These indicators illustrated how much the company made progress and affected the environment, and the interaction between economic efficiency and environmental impact. The Section ten introduced presentation of information of environmental business activities for both external

disclosure and internal management. For external function, three applicable formats could be chosen depending on the period goal of companies or organizations. For internal function, the guidelines indicated various forms for recording EA information depending on the management requirement and the actual situation of companies.

All in all, Japanese EA guidelines provided not only the theory of EA but also implementation steps. Besides this document ascertained detailed guidance for both internal management and external disclosure. Therefore, it could be said that it is a useful and supportive document for companies that begin to apply EA.

3.4.3. Japanese METI, Environmental Management Accounting workbook, 2002 version

EMA workbook of Japanese METI is the document that led the turning point of EMA application in Japanese companies (Kokubu and Nashioka, 2005; Kokubu and Nashioka, 2008). The English version of this handbook only provided two chapters among all seven chapters[14]. This document did not referred to all methods of EMA, rather focused on the application techniques for environmental conservation costs management, environmental cost-benefit analysis, efficient environmental investment and environmental consciousness. As the aforementioned in Chapter 1 of this thesis, the thesis focuses on EMA application into production process, so the relevant EMA tool is MFCA. Hence, herein, the contents of Chapter 4 on MFCA approach will be discussed.

This part discussed MFCA definition; structured elements including material costs, system costs and delivery/disposal costs; MFCA measurement method and examples of MFCA applications in three Japanese companies, namely Nitto Denko, Tanabe Seiyaku, and Canon. The trial application was started with Nitto Denko into its material costs in 2000. The success

[14] The research focuses on MFCA ideas, so the author presents the main idea based on the English version. The full version was written in Japanese only.

of Nitto Denko in MFCA application resulted in the expansion of this tool in Japanese companies. The practical applications also disclosed the implementation steps consisting of determining target scope and period, identifying input and output of each quantity centers, calculating material costs, and presenting information of MFCA by a flow chart. The document indicated that MFCA enabled to provide the actual inside information of costs for management by the new perspective of loss and waste.

Overall, EMA principles, techniques and implementation steps were presented in many documents. Among of them, Japanese guidelines for EA and EMA provided the detailed and sound implementation steps as well as samples for EA and EMA application.

3.5. Conclusion

In conclusion, there are numerous researches on EA and EMA. The framework of EMA tools for decision-making was created and recognized widely. EMA application had rapidly and greatly expanded in developed countries while this has been emerging in developing countries. Although common definitions of EMA and classification of EMA were generated and accepted widely; this research area has been still attractive and latent.

The literature review showed that EMA application achieved many advantages in sustainable development and green productivity. Particularly, although MFCA as a tool of EMA was founded in Germany, Japanese companies have developed and applied it more effectively. The literature review also illustrated that there was a gap in research and practical implementation of EMA between developed countries and developing ones. This is one of promotion factors of this study. Whereas, the previous researches illustrated that the success of EMA implementation was affected by the choice of EMA tool rather than the legal system (Bennett et al., 2003). Hence, this research is expected to take advantages of Japanese MFCA application's experience to apply to Vietnamese cases.

Thus, these researches of EMA and MFCA application will become a major background for developing Chapter 4 and Chapter 5 of this thesis.

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Chapter 4

Environmental Management Accounting Application in Japanese Companies

This chapter aims to present the general information of development of EA and EMA in Japanese companies as well as the detailed experience of EMA application in Japanese companies. Especially, the characteristics and approach of the most advanced tool of EMA, MFCA approach in Japanese companies will be clarified by practical applications of some Japanese companies that achieved various advantages of EMA application and were mentioned as examples in many EMA researches.

4.1. Overview of Environmental Accounting in Japanese Companies

Development of EA in Japan could be realized by EA projects and the growth of guidelines on EA, EMA and environmental reporting of Japanese governmental agencies, particularly, MOE and METI as well as a number of Japanese companies disclosing environmental information and applying EMA tools. Therefore, to understand the overview of EA and EMA application in Japanese companies, the issues of development of Japanese MOE guidelines on EA and its influence on Japanese companies will be presented before mentioning on environmental disclosure and EMA application in Japanese companies.

4.1.1. Environmental Accounting Guidelines of Japan

To promote EA in Japan, Japanese government published many versions of guidelines on EA, ER, and EMA. The timeline of the EA development can be presented, as follows:

- 1997: MOE implemented the first project of EA;

- March 2000: MOE published the Guidelines for introducing an Environmental Accounting System (EMS) (2000 version, MOE) that was revised the interim report of last year. This guideline focused on promoting environmental disclosure;
- March 2002: MOE revised the Environmental Accounting Guidelines (2002 version, MOE). The new version aimed to improve classification and measurement of environmental benefits. This document also provided three kinds of format to disclose environmental information consisting of format A: environmental cost only, format B: environmental cost and environmental conservation benefits, and format C: environmental cost, environmental conservation benefits, and economic benefits;
- June 2002: METI introduced the first version of Environmental Management Accounting Workbook in order to encourage Japanese companies using EMA tools for management. In accordance with this workbook, a project was carried out to promote five tools of EMA in Japanese companies namely environmental capital investment appraisal, environmental cost management, MFCA, environmental corporate performance evaluation, and LCC;
- 2003: MOE revised the 2002 version to encourage internal communication of environmental reporting;
- 2005: MOE published the new version of Environmental Accounting Guidelines (2005 version, MOE);
- 2007: MOE published the new version of Environmental Reporting Guidelines towards a Sustainable Society (2007 version, MOE);
- 2012: MOE published the new version of Environmental Reporting Guidelines with the aim to build a sustainable society.

Essentially, MOE's guideline had a strong influence on the disclosure of EA in Japan (Kokubu et al., 2003). According to the survey of Kokubu and Nashioka (2003), among listed

companies in Japan, more companies chose MOE's guidelines for their environmental disclosure, 62 companies compared with 42 companies of non-based on MOE's guidelines (Table 4.1) and 62 compared with 42 (Table 4.2).

Furthermore, the promotion factor of Japanese government to disclosure was also confirmed by the research of Saka and Burritt (2005). This study stated that "first and main driver of environmental reporting and EA disclosure is government initiatives". This report also listed the number of factors affecting environmental reporting and EA development in Japanese companies in the order of importance (Table 4.3).

Table 4.1. Influence of the MOE's guideline on the disclosure of environmental conservation effects

	Disclosure of environmental effects	**Non-Disclosure of environmental effects**	**Total**
Based on MOE's guideline	62	16	78
Not-based on MOE's guideline	42	64	106
Total	104	84	184

(Source: Kokubu and Nashioka, 2003)

Table 4.2. Influence of the MOE's guideline on the disclosure of substantive economic effects

	Disclosure of economic effects	**Non-disclosure of Economic effects**	**Total**
Based on MOE's guideline	59	19	78
Not-based on MOE's guideline	26	80	106
Total	85	99	184

(Source: Kokubu and Nashioka, 2003)

Japanese government has made a large effort for EA expansion in Japanese companies. This encouragement was showed clearly through frequent publications of EA guidelines and workbooks of Japanese governmental agencies. Consequently, the number of Japanese companies applying EA increased dramatically.

Table 4.3. Major impact factors on EA development in Japan in importance order

In the order of importance	Factors
First	Government initiatives – MOE guidelines
Second	The increase in ISO 14001 certification
Third	Higher numbers of third party reviews
Fourth	Environmental reporting award systems
Fifth	Growth of eco-funds and socially responsible investments
Sixth	Environmental ratings
Seventh	Pressure for corporate social responsibility

(Source: Saka and Burritt, 2005)

4.1.2. Environmental disclosure in Japanese companies

Environmental disclosure has been started in Japanese companies since 1998, as an external function of EA. From the first years of disclosing environmental information, there were a large number of Japanese companies reporting environmental information. Besides, their disclosure increased in number and quality annual. For example, in 2000, 236 companies disclosed environmental information and presented 51% environmental information in their annual report while in 2001, the number was 297 companies with 57% of information transparency (Table 4.4).

A growing number of firms and facilities introduced environmental management system, most of which follow ISO 14001, an environmental management system was certified

by the International Standardization Organization (ISO). Besides, these ISO 14001 companies tended to publish environmental information more than the non-ISO companies (Saka and Burritt, 2003). In 2003, 63.1% ISO 14001 companies applied EA while this figure was 36.9% to non-ISO companies (Table 4.5). Possibly, the number of environmental reports were also related to the number of companies that obtained ISO 14001 certificate. This was presented by the same trend of Japanese companies obtaining ISO 14001 certificate and disclosing environmental information (Figure 4.1). In 2008 and 2009, the number of Japanese firms obtaining ISO certificate and the figure of firms issuing environmental report was both highest (more than 1,100 corporations) (Figure 4.1).

Table 4.4. Number of companies disclosing information and how much they report

	Number of companies issuing report	**Degree of disclosure**
FY 2000	236	51%
FY 2001	297	57%

(Source: Hirayama et al survey, 2003)

Table 4.5. Percentage of ISO 14001 companies using environmental accounting in 2003

	Introduction of EA	**Non-introduction of ER**
Acquisition of ISO14001 certification	63.1%	36.9%
Non-acquisition of ISO14001 certification	11.1%	88.9%

(Source: Saka and Burritt, 2003)

Another survey of the environmental report in Japanese companies also showed an upward trend in environmental disclosure. The percentage of publishing companies has gone up gradually in Japan; the number of 2005 was 34.7% and 35.9% in 2009 (Figure 4.2.). Especially, the survey detected the information that among 455 publishing companies with revenues over

¥100 billion, more than 83% of such companies issued environmental reports (Figure 4.2). This figure showed that the adoption of EMA in Japan increased sharply year by year. However, this trend was not same to all industries in Japan. At early years of EA application, environmental reporting attracted the attention of some particular industries such as chemicals, steel and metal, machinery and electric (Kokubu and Nashioka, 2001).

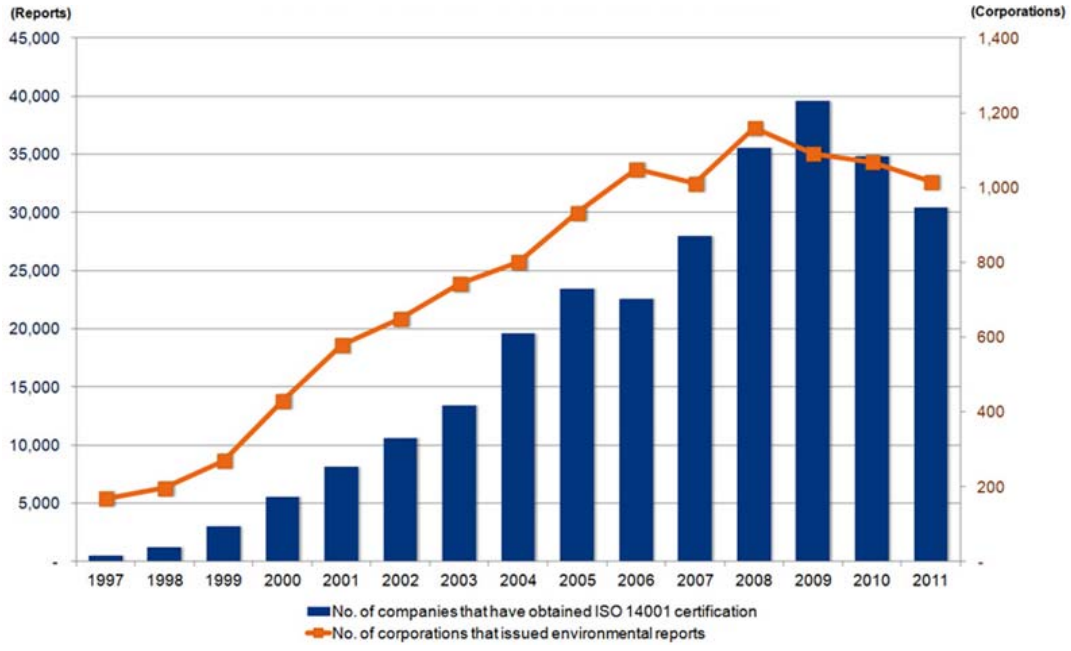


Figure 4.1. Trend of companies published ER and obtained ISO 14001 certificate (Source: https://www.ecosearch.jp/en/csr_history02.html)

Another characteristic of EA development in Japanese companies is that the most important internal promoting factors of environmental disclosure is improving the business image. More than 73% of companies in this survey considered that EA was an opportunity to improve their business image and 45% of firms answered that EA information also supported for their technology development (Figure 4.3).

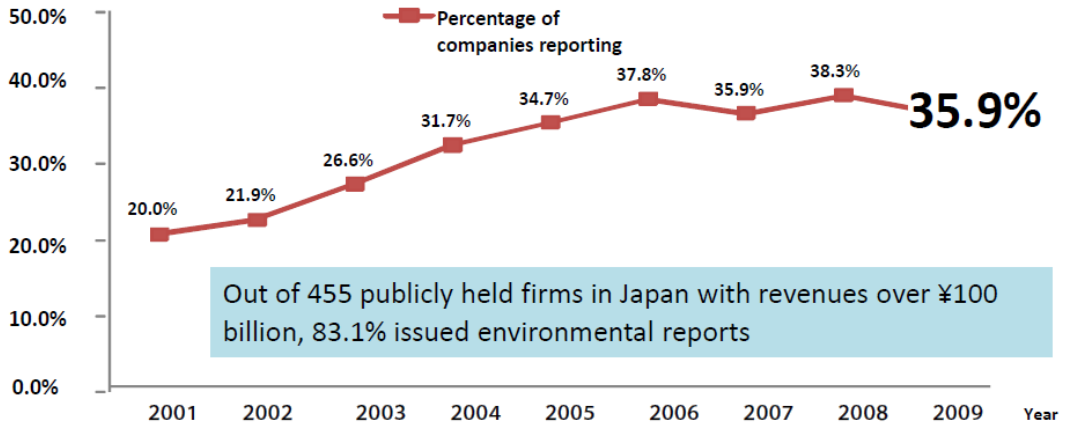


Figure 4.2. Proportion of corporations publishing environmental reports (Source: 2010 MOE survey of Environmental actions by corporations)

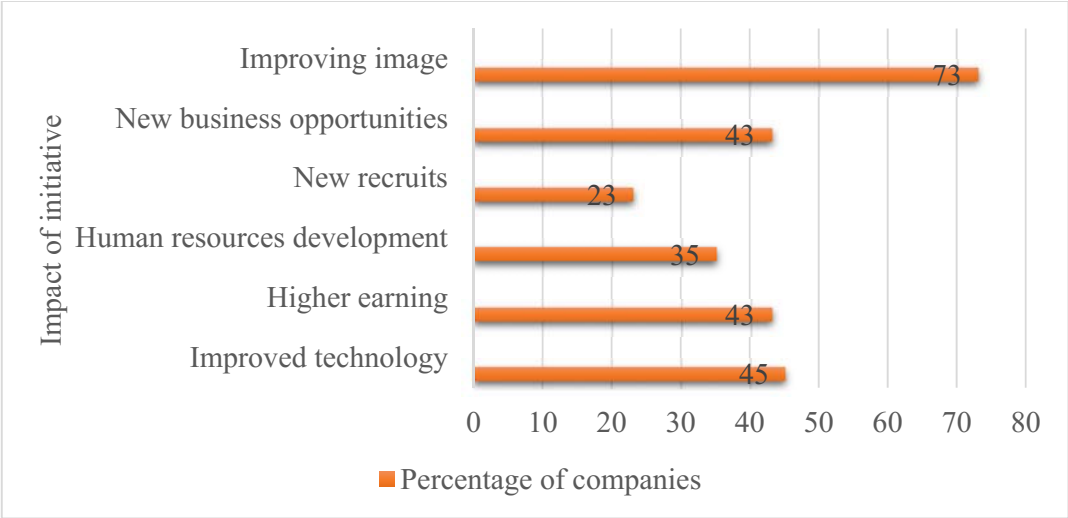


Figure 4.3. Initiatives impacting companies to publish environmental information in Japan (Source: Zentaro and Taku, 2015)

Currently, according to the report of Japan MOE in 2012, Japan was one of the most advanced countries in publishing environmental report both in the number of organization and the level of disclosure information. In a survey on disclosure of GHG emission in Canada, Europe, and Japan, Japanese companies disclosed more information GHG emission compared with European companies (Freedman and Jaggi, 2009).

Generally, environmental disclosure has been increasing in Japanese companies. This was caused by the governmental promotion as well as business organizations' voluntary. This trend also indicated that Japanese companies have been aware of the benefit of EA and environmental management to their business activity.

4.1.3. Environmental management accounting application in Japanese companies

This section aims to explain what EMA is to Japanese companies and common characteristics of Japanese EMA. According to EA guidelines of MOE, EMA serves the internal function of EA that assists management decision making to achieve the sustainable business.

In 2002, Japanese governmental agency, particularly, METI developed EMA tools to bridge the gap between ER and EMA in Japanese companies. Such EMA techniques include (1) environmentally conscious investment appraisal, (2) environmentally conscious target costing, (3) MFCA, (4) life cycle costing, (5) environmental cost matrix, and (6) environmentally conscious performance evaluation. Based on the environmental investment appraisal, cash flow information and quantitative environmental performance information are considered for investment decision. In environmentally conscious cost management, environmental concern is combined with target costing so that enterprises could design and develop environmentally conscious products. Regarding the guidelines on environmentally conscious cost management, MOE explained how to present environmental costs and benefits in "environmental cost matrix". MFCA originated from Germany but it was illustrated that it played an essential role in environmental management in Japanese companies from the first application. Life cycle costing is a tool to integrate cost accounting and life cycle assessment. The tool of environmental corporate performance evaluation is environmental performance indices such as CO_2 emission, the waste disposal, green product rate, and so on into corporate or division

performance evaluation system. Depending on the environmental policies, the corporation will have environmental performance indices correspondingly. The guideline also indicated the application approach of these EMA tools according to the target of business activities (See Table 3.2[15]).

The characteristics of Japanese EMA can be seen clearly by the newest version of EA guidelines of Japanese MOE (MOE, 2005) and explanation of EMA in *Question and Answer*[16] document (MOE, 2005). According to these guidelines, EA tools support companies to inspect three main factors, namely environmental conservation cost (monetary value), environmental conservation benefit (physical unit) and economic benefit related to environmental conservation activities (monetary value). Therefore, in the publication of EA information, many Japanese companies published these data with the same format of the guideline in their sustainability report (Table 4.6). Thus, the management and presentation of EA information in Japanese companies are usually classified into seven groups. Indeed, this characteristic could be seen in many sustainability reports of Japanese companies; for example, in Ricoh group Sustainability report (2015) (Table 4.7), EA information was presented according to MOE's EA guideline as the Table 4.6 (2005).

Emphasizing the role of EMA, the document explained "[EMA] allows management to monitor account balances to reduce waste disposal cost and recycling expenditure, is to review account balances model for managing expenditures for environmental conservation projects and investment decisions, abets risk management to avoid lawsuits, becomes an integrated part of the environmental management system, and provides examples or models for use in environmental management of performance management." EA includes physical and monetary information, eco-balance and tracing the input-output flow of resources. Moreover, according

[15] This content was mentioned in chapter 3, presenting in the Table 3.2
[16] https://www.env.go.jp/en/policy/ssee/eag_qa.pdf

to the guidelines, “Environmental accounting must function to provide joint quantitative data on environmental conservation activities covering not only disclosure but also internal management within this flow of environmental management activities.”

Table 4.6. Environmental cost categories according to business activities

Category		**Key Activity and Outcome**	**Investment**	**Cost**
(1) Business Area Cost				
Breakdown	(1)-1 Pollution Prevention Cost			
	(1)-2 Global Environmental			
	(1)-3 Resource Circulation Cost			
(2) Upstream/Downstream Cost				
(3) Administration Cost				
(4) R &D Cost				
(5) Social Activity Cost				
(6) Environmental Remediation Cost				
(7) Other				
Total				

(Source MOE, 2005)

[Insert Table 4.7 about here, See Appendix 1]

Besides, Japanese companies also combined EMA tools with eco-efficiency evaluation. Absolutely, MOE suggested disclosing eco-efficiency indicators in its guidelines to Japanese companies. Therefore, it is common to Japanese companies to use eco-efficiency indicators for measurement of environmental impacts and combine eco-efficiency measurement with EMA. This fostered Japanese companies towards sustainable production (Burritt and Saka, 2006). This can be seen in practical sustainability report of many Japanese companies, they disclosed ecological efficiency and eco-efficiency indicators such as CO_2 emission per unit product, water consumption per unit product, Greenhouse gas emissions volume / Added value, Waste

emissions volume / Added value, etc. These indicators present economic-ecological efficiency or eco-efficiency that allow management to assess the improvement or effectiveness of alternative decisions. These indicators are environmental targets of Japanese companies, they usually set the plan to get the better ratios for next years. For example, in Sustainability report of Ricoh group, CO_2 emission per sales unit that separated according to business activity were presented (Table 4.8) such as emission per sales unit for production, emission per sales unit for transportation, water withdrawal per sales unit, etc. (See Ricoh's environmental performance data for more information[17]).

Table 4.8. Eco-efficiency indicators of Ricoh subsidiaries in Japan

	Unit	**Results**				
		2011	**2012**	**2013**	**2014**	**2015**
Emission per sales unit	t-CO_2/100 million yen	27.3	26.7	29.3	36.4	40.4
Water withdrawal per sales unit	1,000 m^3/100 million yen	0.35	0.35	0.33	0.38	0.46
Total wastes per sales unit	ton/100 million yen	4.50	4.31	4.07	4.40	4.98

(Source: EA data of Ricoh group, 2015)

Regarding LCA method, many Japanese companies used this tool for measurement of CO_2 emission and evaluation of environmental impacts. Taking example for LCA application, Ajinomoto Corporation used LCA to reduce environmental impacts throughout the value chain of product (Ajinomoto CSR report, 2015). This company calculated the CO_2 emission for product life, water consumption in production and reduced emission in packaging by LCA. Consequently, Ajinomoto achieved CO_2 emissions per unit of production 28% reduction; resource recovery ratio (waste + by-products) 99.4%; water consumption per unit of production 73% reduction and discharged water per unit of production 75% reduction in 2014 compared

[17] http://www.ricoh.com/environment/data/pfm_energy.html#greenhouse

to the base year – 2005 (Ajinomoto Integrated Report, 2015)[18]. Another characteristic of Japanese EMA is the combination of analysis of LCA and eco-balance. This can be seen by the practical application of Ricoh group[19]. The information of eco-balance was expanded based on LCA; in other word, input and output information was recorded throughout the life cycle of product, from raw material, on-site production, logistic and transportation to consumption and finally, to collection and recycle (See Ricoh group Eco-balance data, 2015 for detail information).

Currently, EA for internal usage – EMA – has been expanded more widely in Japanese companies. Among EMA tools, MFCA is the most attractive approach because it has been accepted quickly and applied widely within Japanese companies (Nakajima, 2010; Kokubu and Kitada, 2012). This can be seen clearly by the number of Japanese companies adopting MFCA as well as studies on MFCA (See METI, 2011). Furthermore, the information of MFCA implementation that was presented in sustainability report or CSR report of Japanese companies indicated the advantages of MFCA application in Japanese companies. Besides, Japanese companies' experience of MFCA has been applied to many other foreign companies by the project of APO on promoting MFCA application in some Asian countries by the assistance of Japanese experts[20]. Although MFCA had been developed in Germany, it achieved great development in the application in Japan (METI, 2011). Japanese companies' application illustrated MFCA could bring the positive effects on environmental performance and economic result and MFCA analysis may be adopted inside a single product or process as well as throughout supply chain (METI, 2011). Particularly, the publication of ISO 14051 substantiated the significant role of MFCA in sustainable development in recent years (Christ

[18] http://www.ajinomoto.com/en/aboutus/pdf/integrated_report.pdf
[19] http://www.ricoh.com/environment/management/eco.html
[20] There were an agreement between 12 countries including Vietnam and Japan on developing and disseminating MFCA with the support of National Productivity Organization, APO and Japanese experts in 2015 in Indonesia.

and Burritt, 2016; METI, 2011). Hence, later, this dissertation will more focus on analyzing the experience of MFCA application of Japanese companies.

4.2. Material Flow Cost Accounting Application as Environmental Management Accounting Tool in Japanese Companies

As the aforementioned, the research methodology for this part is a critical analysis. Therefore, the data is the secondary data collecting from the prior researches and SCR or Environmental report of Japanese companies, which were published on their websites. MFCA implementation of Japanese companies developed for a long time and achieved the high success and status; meanwhile, this tool is still new and unfamiliar to Vietnamese companies. Therefore, in this section, to identify how Japanese companies implemented MFCA successful, the author may consider MFCA experience of Japanese companies from the beginning to the present. Thus, these experiments may sometimes be referred in prior researches but the information from the annual report of such Japanese companies will be analyzed more to clarify how they use MFCA and which benefit MFCA brings to them now. MFCA tool is chosen in this application because it is considered the foremost technique of EMA in Japan (Kokubu and Nakajima, 2003). Besides, the experience of MFCA applications of Japanese companies contributed to the major growth of ISO 14051 standardization process (METI, 2010; Nakajima, 2010; Schmidt, 2015).

According to the "Guidance on Introduction of MFCA" issued by Japanese METI (3rded, 2009), MFCA is a tool of EMA that can lessen the environmental footprints and costs. Opinion on loss costs of MFCA is different to the traditional cost management accounting. From MFCA perspective, loss costs include material cost, energy cost, system cost, and waste management cost (METI, 2011; ISO 14051, 2011). Besides, the loss may incur throughout the manufacturing process and MFCA could identify loss at each step of process into separate

various costs. Indeed, in the production process with many phases, MFCA can show the loss costs in material costs, energy costs, system costs and delivery and disposal costs (Figure 4.4). Based on the principle of material mass balance, MFCA approach calculates product and non-product and clarifies the abnormal loss costs.

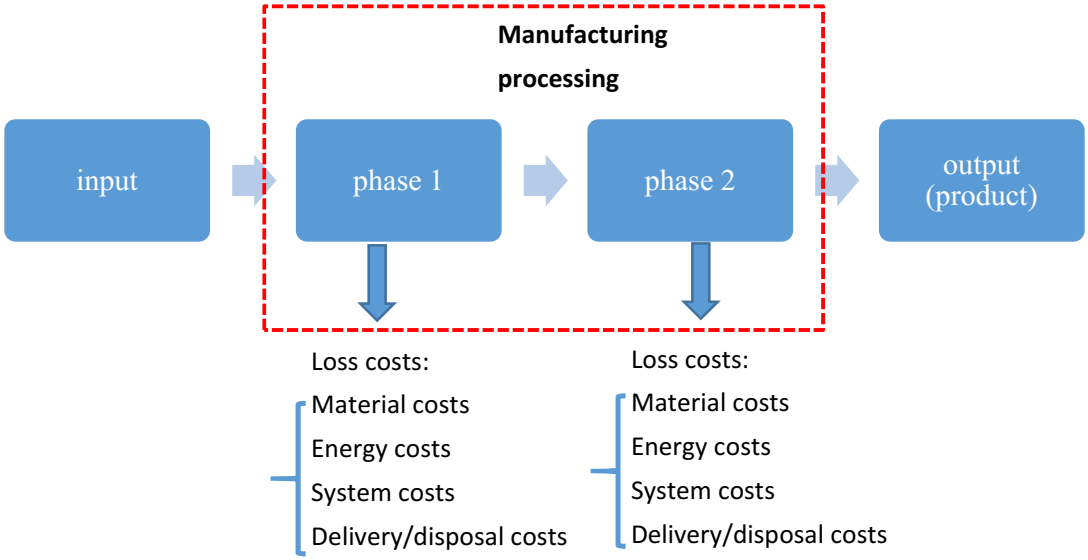


Figure 4.4. Material flow chart

4.2.1. Development of MFCA in Japan

In Japan, among techniques of EMA, MFCA has attracted more attention because of its effectiveness in cases of Japanese companies. This is shown through many projects and studies on MFCA such as METI project in 2000, Business and Environment (BE) project of Institute for Global Environmental Strategies (IGES) since 2001. Even though, MFCA brought positive results to Japanese companies over expectation. According to a survey by Kokubu and Nashioka (2008) on EMA application in the manufacturing industry, a majority of Japanese companies used EMA to improve the production process and reduce waste and a reasonable number applied EMA for budget compilation and investment appraisal. This means that Japanese companies mainly used MFCA tool rather than other tools of EMA system.

4.2.1.1. Brief history of MFCA development in Japan

During the early years of the EA development, Japanese companies have focused on reporting environmental information to external stakeholders rather than using EA as a management tool (Kokubu and Nakajima, 2004; Nakajima et al., 2003). The reason is that the guidelines from the EA of Japanese Ministry of Environment (MOE) were more focused on external factors than internal ones (Kokubu et al., 2003; Kokubu and Nakajima, 2004; METI, 2002). To settle this situation in Japanese companies, the government, particularly the METI implemented projects to develop suitable EMA to Japanese companies. Based on experience from EMA practices in North America and Europe, METI identified an approach that can also enhance internal function of EA and be a tool to improve internal communication of environmental information for decision making (Kokubu and Nakajima, 2004; Wagner, 2015). MFCA has been developed as a result of these projects and considered as a major tool of EMA for sustainable development (Nakajima et al., 2013). The Japanese METI project lasted from 1999 to 2002 to develop EMA tools that fit Japanese companies (Kokubu and Nakajima, 2004). At first, MFCA was introduced into some Japanese companies as samples (such as Nitto Denko, Canon, Tanabe, and Takiron) and later on was evaluated for its effectiveness at the Japanese METI project in 2001 (Nakajima, 2004). The results revealed that companies gained the positive results with lower losses and waste emissions. Japanese companies found MFCA as a tool of EMA – a kind of EA for internal management – in order to protect the environment and to validate the material productivity (Nakajima, 2003; Kokubu and Nakajima, 2004; Nakajima, 2006). One year later after the first successful experience of Nitto Denko, more than 50 Japanese companies also introduced MFCA to their management system (Nakajima, 2004).

At present, MFCA is widely used in Japan. As a matter of fact, several Japanese companies such as Canon, Nitto Denko, Tanabe Seiyaku have become notable symbols of companies that

espouse MFCA. According to a report from the Asia Productivity Organization (APO, 2014), more than 300 companies adopt MFCA in Japan.

4.2.1.2. Key distinctive characters of Japanese MFCA approach

Although Japan's MFCA and Germany's MFCA originate from one source, Japan revolutionized the concept further for being more practically useful. Therefore, in terms of practical usage, there are some discrepancies between the Japanese version and the origin (Nakajima, 2004).

Japanese MFCA, for example, has primarily been concerned with each product line or process at first (IFAC, 2005). The German version, on the other hand, is more interested in constructing company-wide information system as Enterprise Resource Planning (ERP) system (IFAC, 2005). Therefore, MFCA in Japan is usually first applied to single process as a trial and then expanded to another process until it pervades the entire system. This action enables further analysis of process improvements, investment, and innovation (IFAC, 2005).

In Japan, most companies use Microsoft Excel for performing MFCA calculations (Kokubu and Kitada, 2015). In a research on MFCA application in Japanese companies, Kokubu and Tachikawa (2013) mentioned that in Japanese companies manual information preparation by paper or post-it-notes is as effective as a computer program (Christ and Burritt, 2015). Strobel and Redman (2002), by contrast, believed advanced information technology options and Enterprise Resource Planning (ERP) systems are essential in MFCA application in German companies. Meanwhile, Germany's MFCA is combined with advanced information technology even in the first project of expanding MFCA application in German (Wagner, 2015); Japan's may be capable in current information system without the support of high-tech software. This makes Japanese MFCA user-friendly and adaptable to small and medium sized companies (Kokubu et al., 2009). This can be explained by the most distinctive characteristic in

management between Japanese companies and Western ones. While Western companies put more focus on breakthrough innovation, Japanese companies prefer continuous step-by-step improvement (Imai, 1991).

In addition, MFCA applications in Germany seem to focus more on large-sized companies while MFCA projects in Japan are introduced to all sizes of companies (Kokubu and Nakajima, 2004; METI, 2011). Indeed, among 32 companies in the report of MFCA case examples, 15 cases were SMEs (See METI, 2011 for more information).

Overall, Japanese practical applications indicated that MFCA can be applied without the support of advanced information technology and in all size of enterprises as well as for various industries (Kokubu et al., 2009; Kokubu and Nakajima, 2004). Therefore, it is reckoned that Japanese MFCA is easier to apply to Vietnamese cases where low-equipped information system and small and medium-sized companies are dominant.

4.2.1.3. Approaches of MFCA implementation in Japanese companies

Japan's MFCA originated from Germany's MFCA. MFCA is a flow consisting of material cost, energy cost and disposal/delivery cost. An approach identifies the product and non-product separately to find out the losses throughout the production process. However, from practical application, Japan contributed new characteristics to this method so that it is more familiar and relevant to Japanese management. The most interesting addition to the MFCA implementation is the Plan – Do – Check – Act (PDCA) cycle. This method was first established through practical application of MFCA in a Japanese company, Canon (Kokubu and Kitada, 2015; Higashida et al., 2013; Nakajima, 2009; Schmidt and Nakajima, 2013). Adopting MFCA analysis for PDCA cycle management had been carried out successfully by Canon before the official publication of PDCA implementation in ISO system.

According to Asian Productivity Organization (APO, 2014), MFCA may enhance the efficiency of Environmental Management System (EMS) using Plan – Do – Check – Act (PDCA) cycle (Figure 4.5). PDCA is a management style of Kaizen, so Japanese companies sometimes considered MFCA as "green Kaizen" (Nakajima, 2003). In "Plan" step, specific environmental goals are set and action plans to achieve such targets are devised as well, for example, reducing production material waste, or wastewater, etc. "Do" refers to preparations and activities to implement the plan. In "Check" step, the progress of plan implementation is kept on track and inspection to assure that environmental plan operates well and goes on improvement. "Act" refers to particular actions to review how well the plan implemented and what continuous procedure is to promote next environmental objects.

To date, PDCA cycle was published in ISO 14051 as a guideline for implementing MFCA. Besides, the combination between MFCA analysis and PDCA cycle for environmental and business countermeasure in Japanese companies has been implemented widely. Consequently, this approach enables to reduce material losses and increase resource productivity in Japanese companies (Nakajima, 2009).

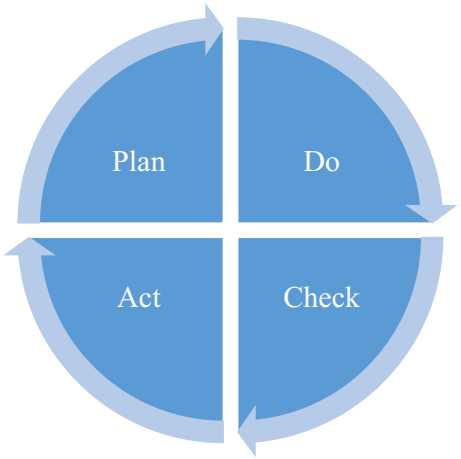


Figure. 4.5. PDCA cycle (Source: ISO 14051)

Overall, to Japanese companies, MFCA means a tool that combines technique of mass balance and material cost accounting (Nakajima, 2006). It could scanner inside problems of

companies (Nakajima, 2004). MFCA is a useful tool of management because it can provide the information on costs related to the positive and negative products and costs across various departments in the actual condition of the organization. As a result, it supports the whole enterprise to develop sustainably. Comparing with traditional cost management, MFCA is more advanced. For example, MFCA reduces cost based on the material quantity information because of management's problem and considers the scope of costs from a wider viewpoint. The success of this application has been illustrated in many cases of Japanese manufacturers such as Canon, Nitto Denko, Tanabe Seiyaku, Shionogi, Takiron, etc. (Nakajima, 2009). MFCA is a technique for analyzing the process of material flow to find out inefficient cost and loss of cost and to find the reasons for such issues. Indeed, from Japan's experience, MFCA is a suitable management tool in processing industry (Nakajima, 2006). Additionally, to Japanese companies, MFCA analysis could be used for various contexts of decision making including, (1) identifying occurrence of negative products; (2) changing the waste disposal method as a safer and more environment-conscious method; (3) determining losses separated by cause of occurrence in order to reduce losses properly; (4) evaluating costs of negative products; (5) applying in value chain; and (6) using to reduce CO_2 emission (Nakajima, 2006).

At present, more than 300 Japanese companies applied MFCA (APO, 2014). MFCA is a main tool for green productivity process, therefore, it not only makes an increase in economic performance but also creates a reduction in environmental impacts (METI, 2011).

4.2.2. Advantages of MFCA application in some Japanese companies

MFCA has been recognized and used in Japan since 1999 under the project of METI aiming at EMA promotion in Japan. Three years later, IGES Kansai Research Center cooperated with two Japanese companies namely Nippon Paint, and Shionogi to implement the second MFCA project (Nakajima, 2003). Two projects tried to reduce environmental impacts and enhance

economic benefit due to business activities. Particularly, IGES project also assessed the role of MFCA as EMA tool to look inside enterprises and provide accurate information for management decisions (Nakajima, 2003). From the practical application, gradually, Japanese companies improve MFCA theory more. By practical experiments, the original version of MFCA was modified into Japanese version to deal with real problems in Japanese companies. Particularly, it differs from the origin over the objectives and implementation approach (Nakajima, 2004). Currently, MFCA is considered as the most advanced tool of EMA in Japanese companies (Nakajima, 2010; Schmidt, 2015). Therefore, in this part, the thesis will focus on presenting the experience of MFCA application in Japanese companies, especially two advanced cases that adopted MFCA since 2000 (Canon and Nitto Denko) and one case in food processing industry (Shinryo). Information on their achievements will be obtained from prior researches and their recent EA reports. In this section, two most advanced cases of Japanese companies in MFCA application will be analyzed because of their advantages and availability of MFCA approach and results. The analysis aims to clarify the distinctive approach of MFCA of Japanese companies.

4.2.2.1. Experience of Canon Inc.

Canon group is a global corporation with the headquarters located in Japan. Canon group owns more than 300 subsidiaries around the world. In 2015, the capital was 174,762 million and the number of employees was 26,360. This research will mainly analyze MFCA experience of Canon Incorporation in Japan. The 2015 sales of Japan Canon was ¥714.3 billion.

Canon implemented MFCA in the lens process as a pilot introduction in 2001 (Nakajima, 2009). Canon saved 7.4 million Japanese yen during three years (2004-2006) thanks to the reduction of raw material input (Nakajima, 2009). Recently, Canon has continuously applied MFCA in various aspects namely environmental assurance activities, energy conservation,

emission reduction and higher resource productivity and this company achieved great economic benefit from this application. According to the Sustainable report of Canon, it earned 1.95 billion yen from sales of recycled waste, 4.94 billion yen for recycling used products, and saved up to 3.54 billion yen from energy costs and waste handling costs in 2015 (Canon SR, 2016).

In the case of Canon, they used the PDCA cycle in combination with MFCA implementation in order to identify material losses that may be lessened. It focused on using the management tool to enhance resource productivity through a stage of Plan (P) and Check (C). Besides, this company expanded the QCD (Quality, Cost, and Delivery) process into EQCD (Environment, Quality, Cost, and Delivery) and embraced the involvement of all staff in the manufacturing department. Currently, Canon also formulated environmental management following PDCA cycle shown in the diagram of Figure 4.6. It established the annual and mid-term environmental goals and environmental action plans in PLAN step. Then, environmental assurance activities were promoted by activities of departments in DO step. Environmental performance evaluation and environmental audit were conducted in CHECK step to check how environmental activities work towards its goals. In ACT stage, environmental assurance activities were promoted and enhanced continually. MFCA information serves for all the cycle. The aim of maximizing resource efficiency was the core of this cycle and for each step, while this target was achieved by MFCA approach.

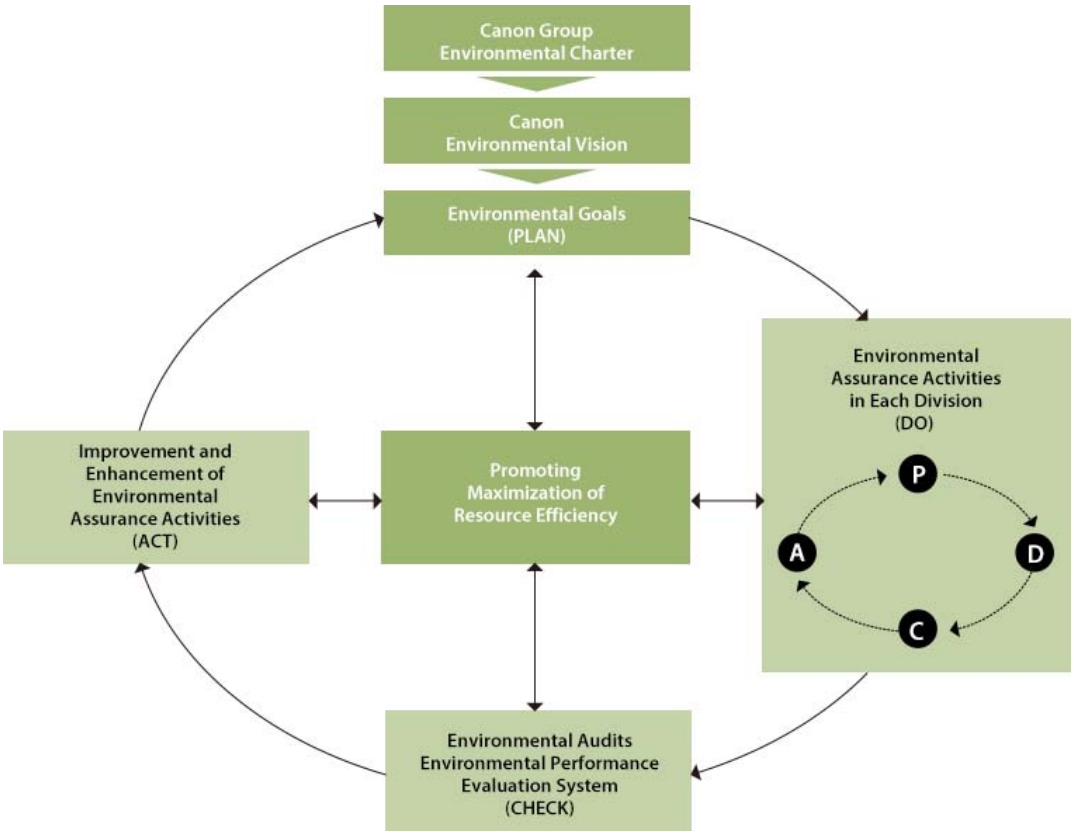


Figure 4.6. PDCA cycle of environmental management system (Source: Sustainable Report of Canon Global, 2016)

The Figure 4.6 presents that in each department, they also followed PDCA cycle to implement environmental targets. In each department, PDCA cycle was integrated with LCA method to develop new products that create lower environmental impacts, especially CO_2 emission throughout the product life cycle. They aimed to manufacture products with energy-efficient designs, resource-efficient designs, more compatibility and easier recycling (Green procedure of Canon Global, 2016).

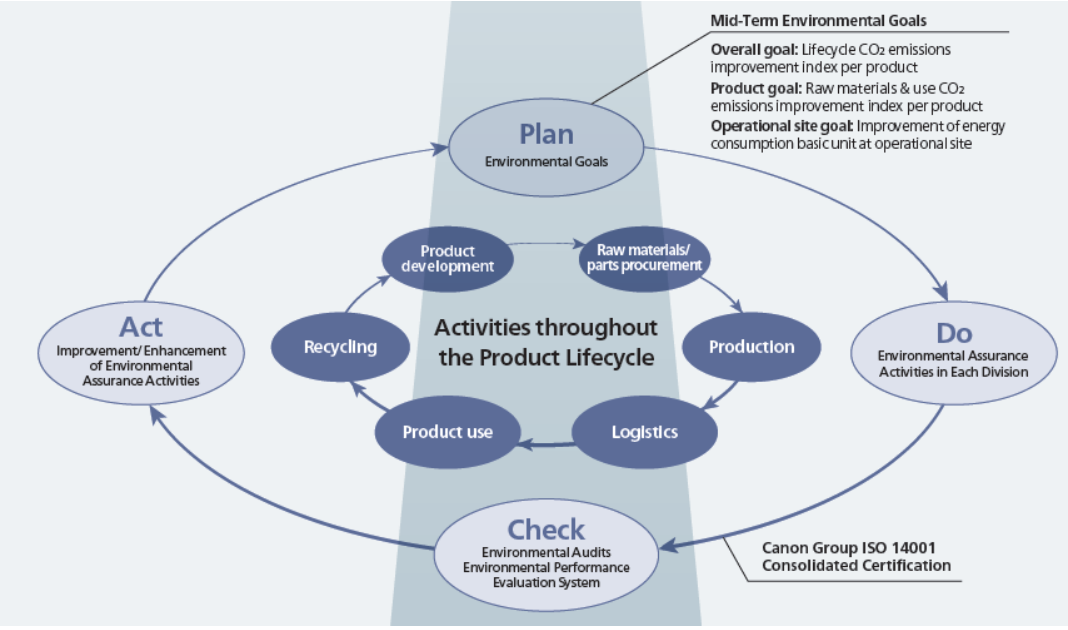


Figure 4.7. PDCA cycle of environmental assurance activities (Source: Sustainable Report of Canon Global, 2016)

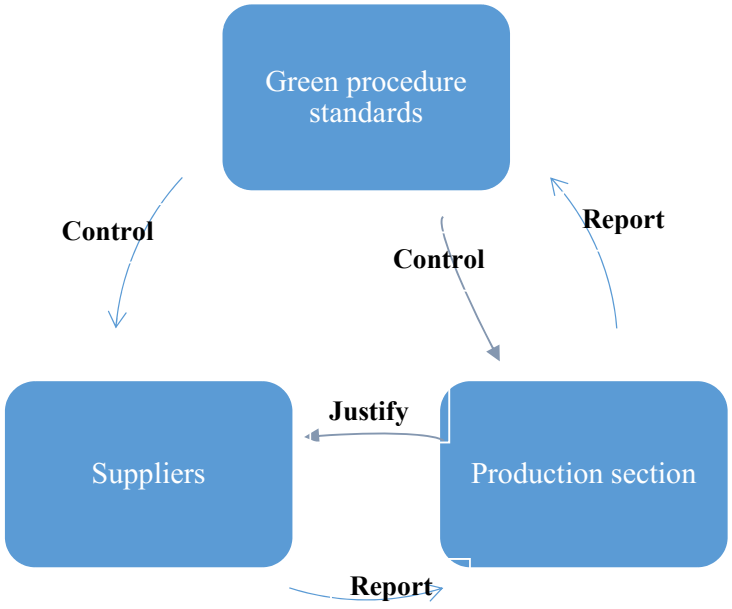
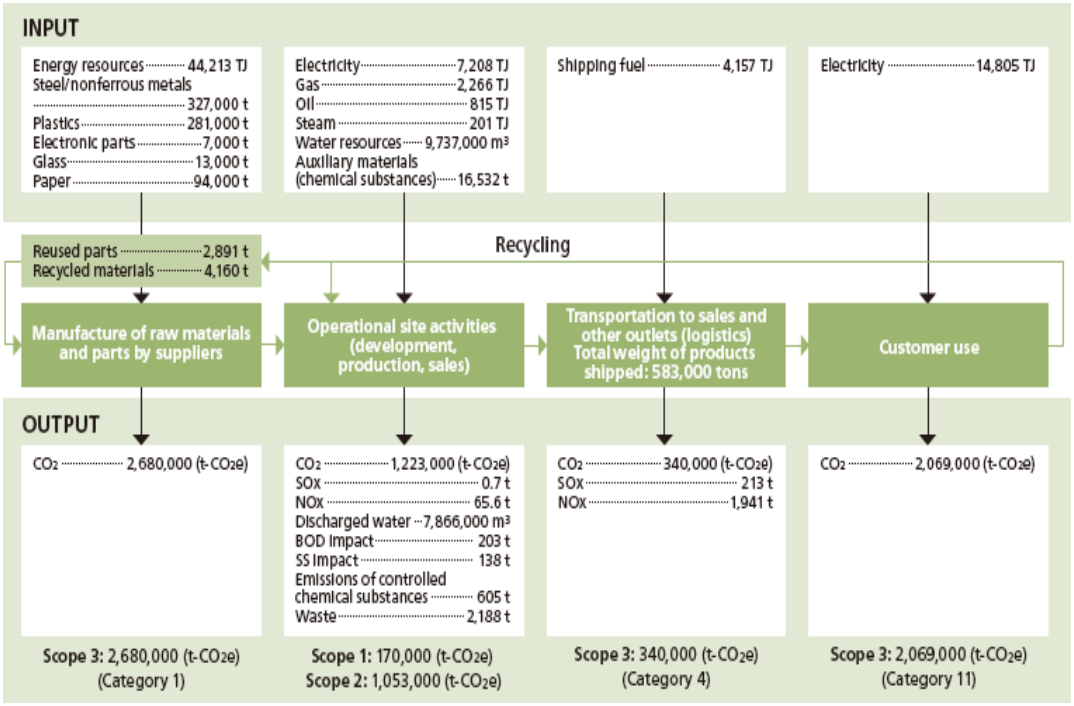


Figure 4.8. Process of implementing Green Procedure Standards in supply chain

Regarding implementing environmental management in supply chain, Canon established Green Procurement Standards that require suppliers to comply with in their cooperation (see Figure 4.7). For example, Canon may require the transportation of chemical substances of suppliers to ensure no environmental impacts. Besides, Canon's suppliers have to introduce environmental management system to control their emission and disposal with the aim of reducing environmental impacts. It also used the information from suppliers to control the chemical substances used in its products (See Figure 4.8). Additionally, Canon evaluated the status of suppliers' efforts on environmental impact reduction annually. Then, all information of environmental management was reported in green management standards.

Canon also integrated material mass balance and LCA in MFCA application; the input and output are evaluated throughout the life cycle of the product (Figure 4.9). By this approach, the emissions of various stage of product's life were presented. Therefore, emissions were controlled broadly (Figure 4.9); CO_2 emission was calculated at each phase of product's life, so based on this information, this company could improve their product's design and production to reduce the emission.

Overall, Canon is one of the most advanced cases of MFCA adoption. This case showed various benefits of MFCA analysis in management, including abnormal wastes and emissions reduction, emissions control from production design stage and throughout the life cycle of a product. Furthermore, MFCA implementation was expanded throughout the supply chain and carried out frequently and uniformly.



Note: The scope is separated by emission of various energy

Figure 4.9. Mass balance analysis throughout the life cycle product of Canon's product (Source: Canon Sustainability Report, 2015)

4.2.2.2. Experience of Nitto Denko

Nitto Denko is a global group with the headquarters located in Japan and has more than 100 companies in the whole world. Its' present capital is ¥26,783 million. In this research, the author will mainly analyze the experience of Nitto Denko in Japan site. The net sales of FY 2015 were ¥793,054 million.

Regarding the case of Nitto Denko, this company was one of the earliest MFCA applicants in Japan. MFCA was first adopted to adhesive tape production process in the Toyohashi Plant of Nitto Denko in 2000 (Nakajima, 2003; MET, 2011). At that time, this method indicated the actual cost of waste and energy in this plant was more than 30% of total production costs while its traditional management accounting believed there was no loss. Thanks to MFCA analysis, the actual material loss of this corporation was reduced year by year. In 2001, the cost

percentage for the material loss was more than 30%, but after two years, this figure decreased by 22% and in 2012, this proportion was only 7% (Table 4.8). This company was also the first Japanese company that used MFCA for facilities investment (Nakajima, 2009). In 2004, this corporation made an effective investment up to 7 billion Japanese yen thanks to MFCA information (Nakajima, 2009).

Table 4.9. Improvement of cost percentage of material loss of Nitto Denko

Cost	2001	2004	2012
Product	67%	78%	93%
Material loss	**33%**	**22%**	**7%**
Total	100%	100%	100%

(Source: Nitto Denko, 2013)

Nitto Denko proposed the necessary steps for MFCA implementation (Figure 4.10). This supported MFCA application in Nitto Denko sounder and more active. Nitto Denko also clearly defined the losses based on the perspectives of MFCA. They recognized that losses included abnormal loss, normal loss and theoretical design loss (Nitto Denko, 2013; Furukawa, 2016).

Nitto Denko has recognized MFCA as an EMA tool and currently calls MFCA by the name of "MATEFURO" to use it for all environmental conservation activities. This tool was used to clarify losses of material and energy to increase resource productivity throughout the group. The volume of wastewater and CO_2 emission in 2015 in Japanese branches were lower compared with previous years (See Nitto Denko Report 2016). Indeed the percentage of waste disposal recycle reached 93% in 2015. The MATEFURO committee was organized in Japan in 2014 and expanded to another area, especially East Asia (Taiwan, Korea) in 2015 (Nitto Denko Group Report, 2016). The MATEFURO meeting has been held annually with the participation of headquarter and other branches. According to MATEFURO, MFCA and Life

Cycle Assessment (LCA) tool were combined to evaluate the material efficiency throughout products' life. Based on this, they separated products into two groups, namely low environmental impact products, and positive environmental impact products. This company also continued to apply MFCA in the supply chain. The company tried to understand the environmental impacts of its business activities throughout the supply chain.

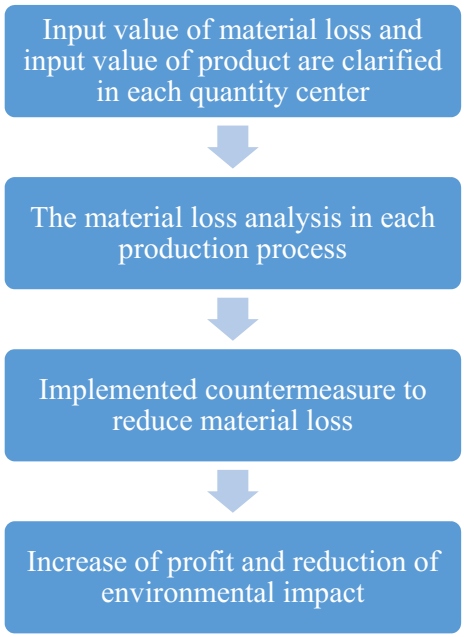


Figure 4.10. Flow chart of process of implementing MFCA and decision making (Source: Nitto Denko, 2013; Furukawa, 2016)

Nitto Denko combined LCA and MFCA implementation; the positive and negative products were presented throughout the life cycle of a product with the aim to reduce the environmental impacts during the whole product life. Therefore, the information of input and output was evaluated from design phase to sale phase (Figure 4.11). By this way, the negative impacts on the environment were evaluated for the whole product life. For example, the quantity of disposal waste was calculated by the waste in production inside the company and the waste for distribution and sale of the respective product (see Figure 4.11).

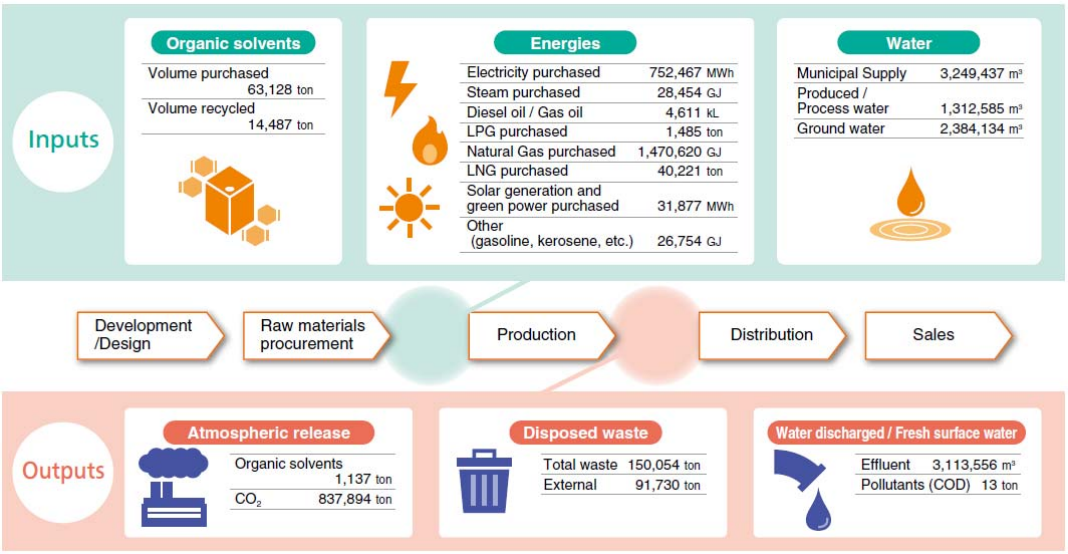


Figure 4.11. Mass balance analysis throughout life cycle product in the case of Nitto Denko (Source: Nitto Denko Sustainability Report, 2015)

In Nitto Denko, the MFCA analysis was also used for PDCA cycle management to implement countermeasures of reducing environmental impacts and increasing economic return. The practical application of MFCA analysis in PDCA cycle management is explained by the Figure 4.12. Regarding MFCA implementation, depending on resources, circumstance, and targets of the company, the company identified the boundary for material flow model and then this flow was built. In MFCA implementation, the quantity centers were determined and the data for material flow were calculated. Later on, energy and system cost was allocated for each quantity center according to the unique principle throughout the period. Based on the information of previous steps, elements of material flow were presented in material flow cost matrix. This material flow cost matrix was expected to show the abnormal losses and wastes according to the quantity centers throughout the boundary. Later on, based on the MFCA analysis, environmental plans were set to solve problems. The environmental plans were built and formulated continuously to achieve environmental and economic targets.

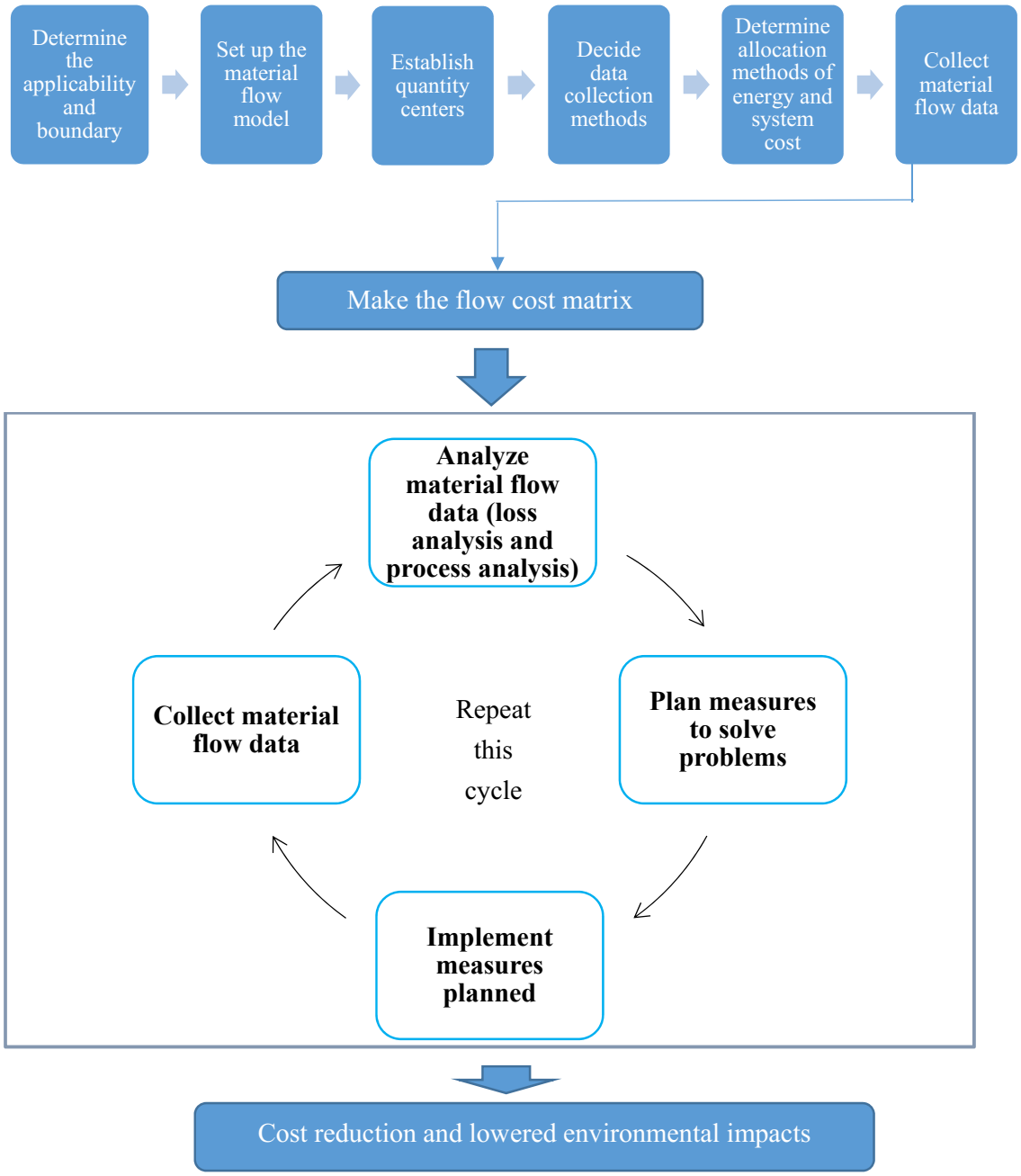


Figure 4.12. Model of combining MFCA analysis and PDCA cycle in Nitto Denko (Source: Nitto Denko Corporation, 2013; Furukawa, 2016)

To conclude, Nitto Denko implemented MFCA for management successfully, not only reducing the wastes and losses but also supporting decision making in production, energy control, and other long-term investments. Nitto Denko's experience showed how to combine

MFCA implementation and PDCA management to achieve the environmental and economic goals clearly. Besides, in Nitto Denko, MFCA technique was also combined with other EMA tools, LCC to attain the low emission throughout the life cycle of products.

4.2.2.3. Experience of Shinryo Limited Corporation

Shinryo is a small company with about 36 employees in 2009. Its' capital was 26 million. Its product is brown sugar. This case was introduced by METI in 2011. This company applied MFCA to its packaging process of brown sugar product. Thanks to MFCA, this company detected material loss due to dropped sugar in the manufacturing process and in packaging process as well. Besides, in this case, MFCA analysis showed the losses because of excessive packaging.

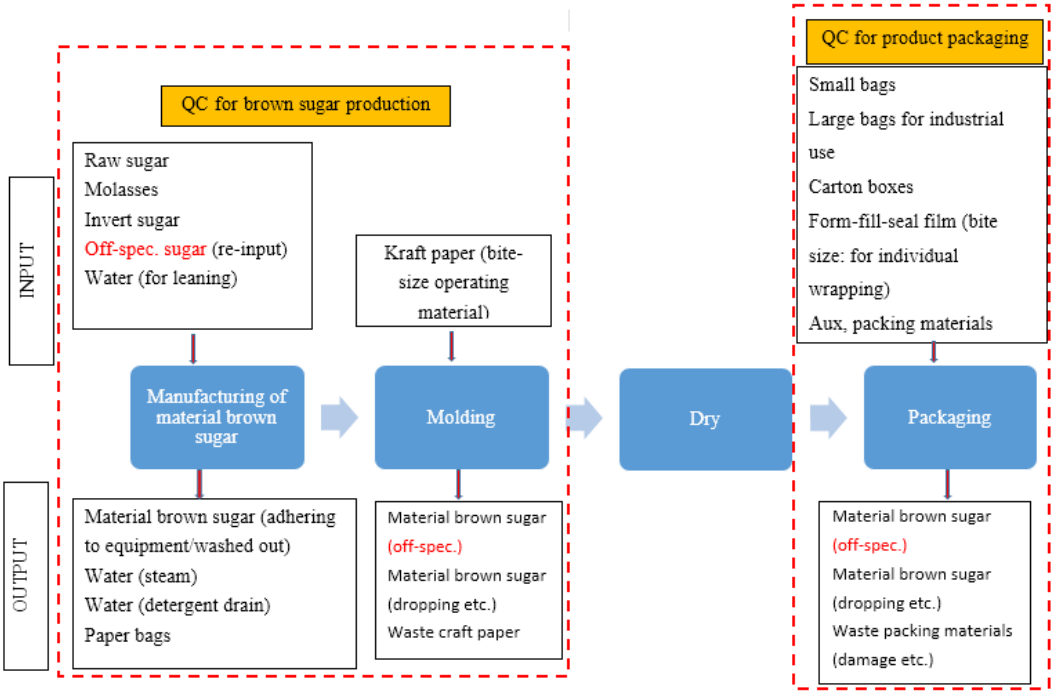


Figure 4.13. Material flow chart of Shinryo (Source: METI, 2011)

Indeed, based on the material flow chart, some losses were identified. They included off-specification material, dropped products during molding and packaging step, the loss from

packaging materials for the raw sugar, and the loss from excessive packaging. Particularly, off-specification products comprised for 5% of overall product quantity. And other losses accounted for 5% of costs of overall products (METI, 2011).

Overall, although in this case, the loss costs that were uncovered by MFCA analysis were not too high, it made a diminution in the financial performance of this company. Furthermore, MFCA data discovered that excessive packaging costed this company more and could also make the higher impacts on the environment.

4.3. Conclusion

The experience of Japanese companies clearly showed that EMA has been implemented successfully in Japan thanks to the governmental support and the enterprises' efforts. Japanese companies were engaged to participate the governmental projects and continued to improve EMA tools by their practical experience. Indeed, MFCA was improved by Japanese companies' experience although it was developed in Germany. It is clear that MFCA was applied successfully and effectively in many Japanese companies. Such firms took advantages of MFCA analysis to enhance their economic return, productivity and reduce environmental damage. Japanese companies' experience showed that MFCA could be applied effectively to reduce losses and wastes. Furthermore, MFCA approach could implement not only in internal one organization but also across the supply chain. Such experience may be seen clearly by practical results of Canon and Nitto Denko as the abovementioned.

The most distinctive character of MFCA approach in Japan is the combination with PDCA cycle management. This integration supports Japanese companies to improve environmental management system and business productivity. Besides, Japanese MFCA approach does not require high-tech information management system or ERP and can be simplified for the applications in the small companies or the beginners depending on their resources and contexts

as the experience of Nitto Denko. They built material flow cost based on the boundary that they identified. Furthermore, MFCA does not impose any limitation due to the size of company (METI, 2011). It is clearly shown that the extremely small company like Shinryo could also apply MFCA to identify abnormal losses. In fact, MFCA approach enables application depending on companies' production characteristics and resources rather than their industries and sizes. Thus, it is expected that Japanese MFCA approach can be useful to Vietnamese companies to achieve their win-win targets in financial benefit and environmental conservation. This content will be mentioned in the next chapter.

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Chapter 5

Applicability of Japanese Environmental Management Accounting Approach to Vietnamese Companies

This chapter aims to describe the process of case studies preparation and assess the results of case studies' applications. The case studies were prepared to indicate whether Japanese EMA, especially MFCA approach benefit to Vietnamese companies or not. MFCA analysis will be introduced to show the potential abnormal losses and wastes from the practical business operation of the case studies; consequently, Vietnamese companies' managers could make decisions to improve their company's economic and environmental performance. Thus, this chapter will answer whether Japanese EMA technique is useful to Vietnamese companies or not.

5.1. Overview

Although the types and intensities of environmental issues and attention can vary from nation to nation as well as among various business sectors and enterprises, countries, and organizations that now focus on SD can use EMA as an essential tool (Burritt, 2004; Rikhardsson et al., 2005). This was demonstrated by many prior researches; for example, in the book of "Environmental Management Accounting – Case studies of South-East Asian companies" (Herzig et al., 2012), EMA framework developed by Burritt et al. (2002) was examined in many cases and all applications achieved positive results to environmental protection and economic performance. Besides, although MFCA was developed in Germany but made the breakthrough in Japan (Schmidt, 2015). Nevertheless, it must also consider the business context and resources of applicant cases. The prior research showed that EMA application could save environmental-related opportunity costs such as treatment costs,

environmental-tax costs, etc. because less resources consumption and losses resulted in less wastes and emissions (Schaltegger et al., 2008). Moreover, it is clear that by disclosing environmental information, the companies could explain and show how their business activities affected to the environment and how much they developed sustainably.

Regarding the importance of EMA in the current business context of SD, as aforementioned Chapter 1, so this chapter focuses on its significance to Vietnamese cases in their present context. To deal with challenges of material shortage, global competition and stricter environmental laws and regulations, Vietnamese companies need to change from traditional management to environmental management and conventional management accounting to environmental management accounting because these systems enable the conserving environment in concurrence with achieving economic goals. EMA application and research in Vietnam have been still inadequate. Although there was a project to develop EMA in developing countries including Vietnam (See Herzig et al., 2012), there have been still various interesting issues in EMA application in Vietnamese companies; for example, it may need to more focus on industries that bring increasing return but release rising wastes into environment or to try a particular tool of EMA that is applicable to Vietnamese companies. Furthermore, as abovementioned Chapter 3, there was a stimulating research on MFCA application in a Vietnamese beer brewing company (see Schaltegger et al., 2015). In their study, the inefficiency in the management of the production facility and the industry's energy consumption was highlighted. Particularly, the authors analyzed the physical accounting information of material and energy through material and energy flow accounting (MEFA) system which was patterned after the EMA framework of Burritt et al. (2002). Meanwhile, in this research, the emphasis will be on how the Japanese MFCA approach to be the valuable experiences of a Vietnamese seafood processing business. The abnormal losses and wastes are expected to be identified.

As aforementioned Chapter 4, from experience of Japan, in 2000, Japanese companies focused more on external disclosure of environmental information rather than internal function for decision making (Kokubu and Nakajima, 2004). Due to this situation, Japanese government implemented a project to promote EMA tools in Japanese companies. These tools were environmental capital investment appraisal, environmental cost management, material flow cost accounting, environmental corporate performance evaluation, and life-cycle costing (Kokubu and Nakajima, 2004). Among these five tools, MFCA was considered the most important and attractive technique (Kokubu and Nakajima, 2004; METI, 2011; Nakajima, et al., 2015). Based on characteristics of these tools, practical application in Japanese companies and actual economic and environmental situation and management requirement of Vietnamese seafood processing companies, the author chose the most proper tool for such context. According to the guidelines of Japanese MOE and METI, there are six tools of EMA that have been using in Japanese companies including environmentally conscious investment appraisal, environmentally conscious target costing, life cycle costing, environmental cost matrix, environmentally conscious performance evaluation, and MFCA (METI, 2002). According to these guidelines, MFCA could be used for management of production, logistics and other decisions. Besides, from the practical experience of Japanese companies, MFCA method could combine with other tools effectively. According to Bennett et al. (2003), choosing the proper EMA tool is the most important step of EMA application. Hence, to achieve the research objectives of finding a suitable EMA approach for Vietnamese companies from Japanese companies' experience in order to concurrently solve problems in production and environment, MFCA technique is chosen to do the examination.

As mentioned in Chapter 4, the most advanced technique of EMA in Japan was MFCA approach. Therefore, in this thesis, the author will also focus on applying MFCA technique to Vietnamese companies based on the experience of Japanese MFCA application that makes a

significant contribution to ISO 14051: 2011 – Environmental Management – MFCA (METI, 2010; Nakajima, 2012). Besides, the literature review in the abovementioned of Chapter 3 indicated that EMA application could benefit management of cleaner production and sustainable development regardless where the companies operate (Rikhardsson et al., 2008). Thus, in this study, the author will adopt MFCA approach to Vietnamese companies based on the suitable experience of Japanese companies. Besides, the guidelines of MFCA implementation of ISO 14051 will be used. Therefore, the model of MFCA will be simplified to suit to Vietnamese companies.

5.2. Introduction of Research Method

5.2.1. Case study in EMA research

As the abovementioned Chapter 1, the research methodology for the trial application of EMA in Vietnamese companies is case study methodology. The case study method is chosen to clarify whether Japanese MFCA approach is useful and feasible in the particular context of Vietnamese companies. Properly case study method is suitable because this research objective requires extensive and "in-depth" description of a social phenomenon. Indeed, Yin (2014) stated: "case study is an empirical inquiry that investigates a contemporary temporary phenomenon in depth and within the real world context, especially when the boundaries between phenomenon and context may not be clearly evident". Besides, to the issue of MFCA approach for Vietnamese companies, there has been not clear evidence or official studies. Therefore, this research is expected to show the evidence of applying Japanese MFCA approach in Vietnamese business' context. This study aims to understand the phenomenon of applying MFCA approach of Japanese companies to Vietnamese seafood processing companies. Additionally, case study methodology is immensely popular among EMA research, and especially, for the purpose of guiding example, case study methodology is more relevant

than other methods (Burritt, 2004). The case study design could provide more information of a complex context of the production process to identify its problems, examine the solution and evaluate the result (Schaltegger et al., 2012). Another important reasons are economic, human resource and time rationality. This is a personal research for PhD. dissertation and the author contacts with Vietnamese companies to explain and guide MFCA tool. Thus, she cannot have enough time to observe many enterprises and evaluate their results to finish the research by survey method. Additionally, this dissertation focuses on qualitative exploration rather than quantity one. Therefore, case study methodology is the most suitable.

5.2.2. Research scope

The study will focus on analyzing the applicability of MFCA application into seafood processing industry because of its role in the economy and its serious impacts on the environment in Vietnam. Properly, Vietnamese seafood processing industry is causing severe pollutants such as high organic load, high COD and BOD effluents and inefficient water consumption in production.

5.2.2.1. Development of seafood industry

According to VASEP, Export turnover in 2015 is US$ 6.57 billion and the labor force of this industry is more than 4 million. Seafood industry plays an important role in the national economy, accounting for 4-5% GDP; 9 -10% of total national export turn-over and rank 5th for export value (follow: electronics, garment, crude oil, shoes) (VASEP, 2015)[21]. Furthermore, the frozen seafood products are the most important and beneficial to Vietnamese economy[22]. Indeed, production result of this industry has increased continuously (Figure 5.1).

[21] http://vasep.com.vn/1192/OneContent/tong-quan-nganh.htm (Available in Vietnamese)
[22] http://www.vietrade.gov.vn/vung-kinh-te-trong-diem-mien-trung/2415-cac-nganh-kinh-te-chu-yeu-cua-da-nang.html (Available in Vietnamese)

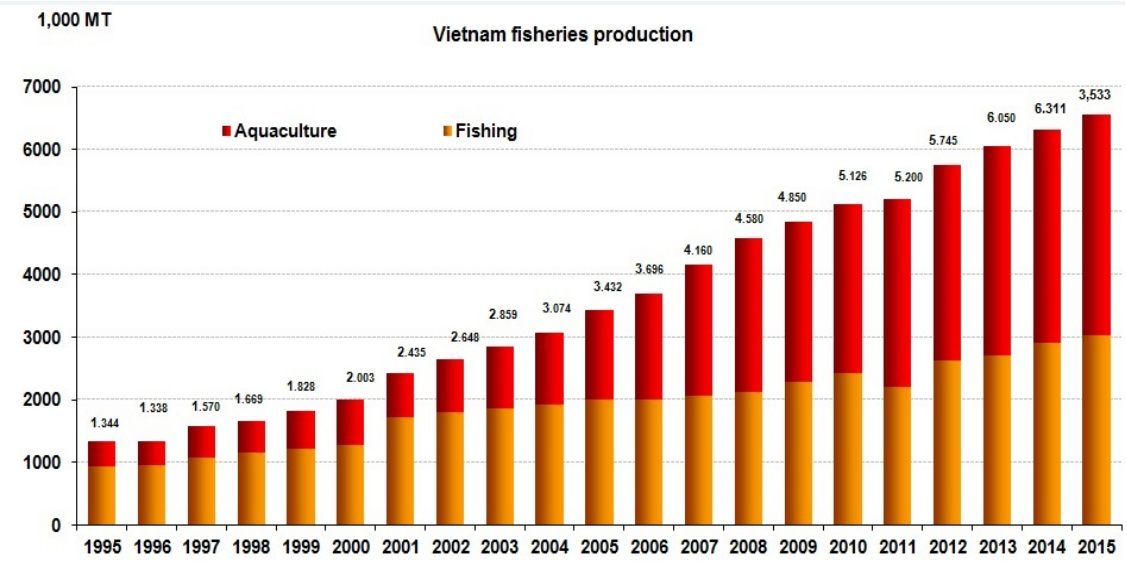

Figure 5.1. Development of fishery production and aquaculture in Vietnam (Source: Vietnam Association of Seafood Exporters and Producers (VASEP))

5.2.2.2. Environmental issues caused by seafood processing companies

In Vietnam, the environmental protection has not been addressed by many businesses. Many cases violated environmental regulations and dumped wastewater into rivers or creeks and the environment without any treatment. Particularly, in seafood processing industry, only about 70% companies are equipped with wastewater treatment system (VASEP, 2014).

Seafood processing industry was chosen to be case study because it produced extremely hazardous pollutant to the environment. Indeed, in many countries, food processing industry also disposed the high organic load and high COD and BOD effluents that caused severe impacts on local environmental bodies (Olmez, 2014). Moreover, in Vietnam, the seafood processing industry has been dumping a large amount of waste into the environment improperly. According to the news from Vietnam Seafood Research Institution, in order to produce one ton of frozen seafood product, firms dispose 0.75 ton of waste to shrimp

production and 0.8 ton to Tra fillet production[23]. These amounts do not include waste water and emission. Furthermore, the disposal from this industry is extremely toxic to the environment because of highly organic impurities from fishes' intestines and shrimps' cell. Therefore, pollutants from production of seafood processing industry caused serious problems such as high level of BOD and COD, and odor smell for surrounding area; for example, in Surimi production, the indices of BOD and COD in wastewater were approximately 3,120mg/l and 4,890mg/l respectively. Especially, the solid waste from seafood processing accounts for the large proportion of total material quantity; for instance, 40-50% in Surimi production and 35-45% in Shrimp production. Additionally, this kind of waste spoils rapidly and is a rich source of protein, carotenoid, and enzymes, thus causing severe environmental problems. In addition, according to a news about problems in seafood processing industry[24], the average of wastewater disposal of one seafood processing firm is around 50,000m^3/day. Waste water from seafood processing presented severe pollution with indicators such as Suspended Solids around 300-600mg/l, total Nitrogen: 100-150mg/l, total Phosphorus: 20-50mg/l, micro Coliforms more than 1,105 MPN/100ml[25]. With this trend, in the near future, polluted water source may cause serious impacts on human life and well-being in Vietnam.

Meanwhile, the seafood processing companies have not implemented waste treatment system well. According to the news from Seafood Research Institution, in the period of 2006 to 2007, up to 15% of seafood firms caused extreme damage to the environment and paid the heavy fine or shutdown penalty. In addition, many companies have operated their business without waste treatment systems; for example, in Vung Tau province, there are ten companies

[23]See more information in: http://www.thuysanvietnam.com.vn/che-bien-thuy-san-giai-quyet-van-nan-o-nhiem-moi-truong-article-9682.tsvn (Available only in Vietnamese)
[24] See more information in: http://hiendaihoa.com/cong-nghe-moi-truong/thuc-trang/moi-truong-trong-che-bien-thuy-san-nhung-van-de-dat-ra.html (Available only in Vietnamese)
[25] See more information in: http://tapchimoitruong.vn/pages/article (Available only in Vietnamese)

without treatment system over total 34 firms of seafood processing; this rate in Ca Mau province is 16%. Indeed, currently, there is a wide range of seafood processing firms that received harsh punishments on the whole nation of Vietnam[26]. Moreover, currently, most Vietnamese companies use end-of-pipe technologies in their environmental management. This method just focuses on treating, handling and disposing emissions and wastes from production rather resolve the causes of emission and disposal. Therefore, the end-of-pipe technologies are short-term and limited management (Jasch, 2009).

It is clear that the seafood processing industry has caused substantial and severe environmental degradation in Vietnam while companies in such industry have not concentrated on environmental protection. Hence, there should be solutions to encourage environmental protection in such Vietnamese companies' production. Due to this problem, MFCA may be a suitable tool because it could forthwith show economic returns and reduce the environmental impacts.

5.2.2.3. Challenges to seafood processing companies in sustainable development

Recently, due to the international protocols on sustainable development, the Vietnamese government has imposed decrees on the natural resources management and environmental protection. Among them were the decrees and decisions on maritime resource management and regulations to fishing, restructuring in the production of seafood processing firms. Because of more stringent governmental law on fish catch, Vietnamese firms in seafood processing industry have to deal with the dearth of materials and higher input price. In addition, the shortage of material in seafood processing industry was caused by salinity intrusion and drought into many aquaculture areas, the yields of shrimp, Tra fish has been decreasing in

[26] See more information in: http://thuysanvietnam.com.vn/nong-o-nhiem-moi-truong-trong-che-bien-thuy-san-article-13285.tsvn (Available only in Vietnamese)

recent years. According to the news from Vietnam Steering Committee for Climate Change Mitigation and Adaption, in first months of 2016, “shrimps dye because of drought and saltwater intrusion”, “salinity was over 30%”.

Another challenge is that seafood processing consumes huge volumes of water, thus seafood processing firms usually pay high expenses for water consumption and wastewater treatment. For instance, in Surimi production, a seafood processing company needs approximately 70 m^3 of water for producing one ton of product. However, according to the newest research on Surimi production (Park, 2013), the reasonable level is about 20 to 25 m^3 merely. This illustrates Vietnamese seafood industry is overusing water. Additionally, according to the official reports from the Vietnamese Ministry of Finance[27], in compliance with new environmental laws, the rate of fee of wastewater treatment for seafood processing industry will be higher. This means that the seafood processing firms may pay an extremely higher expense for wastewater disposal.

In a global perspective, the price of seafood products from Vietnam is relatively lower compared to countries such as Indonesia, India, and Thailand. The exporting turnover of Vietnam is also lower compared to these countries because of the unstable yields of aquaculture (VASEP, 2016[28]).

Inferring from the strategy of *developing Vietnam seafood to 2020*[29], the return of seafood industry is expected to increase eight to ten percent per year and the export is planned to reach nine billion USD by 2020. This plan puts pressure on the seafood production industry in

[27] See more information in: http://www.mof.gov.vn/webcenter/portal/ (Available in Vietnamese only)
[28] See more information in: http://vasep.com.vn/Tin-Tuc/1217_43509/Co-hoi-va-thach-thuc-cua-thuy-san-Viet-Nam-khi-hoi-nhap.htm (Available in Vietnamese only)
[29] See more information in: http://chinhphu.vn/portal/page/portal/chinhphu/noidungchienluocphattrienkinhtexahoi (Available in Vietnamese only)

Vietnam. To achieve this target, Vietnam's seafood industry should attain a higher competitive advantage in export, more efficient operations, and cleaner production.

These issues indicate that Vietnamese seafood businesses are facing the challenges to yield higher productivity and cleaner production to relieve the pressures of material shortage, world competitiveness and higher environmental fees.

In conclusion, Vietnamese seafood processing industry has to face big challenges under the strategy towards sustainable development. To solve this problem, it should have proper policies to show as many as Vietnamese companies the benefit of environmental management to their business and environment. Thus, encouragement of environmental management accounting tool is potentially suitable.

5.2.2.4. Potential impact factors of MFCA application to Vietnamese seafood companies

There are some reasons that MFCA may be useful to Vietnamese seafood companies. Regarding issues of Vietnamese context and general advantages of MFCA, first, this technique can show the benefit immediately after implementation. Second, at the first application, the company may make a little change or no change while still gaining advantages from MFCA analysis. To Vietnamese companies, they are not willing to change or make the improvement, especially, to whom are getting fairly high profit. This may be suitable for cases that do business in an environmental sensitivity industry because this approach promotes applicants to achieve a higher economic return from reducing environmental impacts. As a developing nation, Vietnam governs business operation under the less statutory environmental regulations compared with developed countries. Therefore, Vietnamese business organizations are offered the low governance incentives to protect the environment. Nevertheless, enterprises are always promoted by financial goals, so MFCA may be useful to solve the current situation of Vietnam. Besides, Japanese MFCA approach may own potentially applicable characteristics to Vietnamese companies. From the experience of Japanese companies, MFCA application does

not have to adopt ERP and high-tech information system. Additionally, Japan presented many successful SMEs in MFCA introduction. Such conditions are nearly same to almost Vietnamese companies that do not equip cutting-edge information system for management and are small sized companies.

5.2.3. Case studies information

This section introduces the general information of two Vietnamese cases that tried to apply Japanese EMA tool. The companies were selected depending on the willing of cooperation of these companies rather than other factors because the awareness of companies on EMA implementation is one of the most important factors for success (Bennett et al., 2003). Besides, the study aims to show that the feasibility and effectiveness of EMA application in Vietnamese companies may not depend on the size of company. Thus, the case studies include one small company and one large company. Regarding the role of SMEs in Vietnam's economy, it seems that environmental and social impacts of business activities from large sized or multinational corporations overwhelmed the SMEs (Johnson, 2015); however, such SMEs substantially contribute to economic development of a developing country. According to the news from Vietnam Trade Promotion Agency, in 2012, there were about 700 thousand of SMEs. They produced 50% of GDP and employed more than 61% of working labor of the country. In particular, the industry of seafood processing created a high export turnover, more than four billion dollars in 2008 and ranked the eighth highest seafood export in the whole world[30]. All cases are located in the seaside region, a seafood processing industrial zone of the city. As the abovementioned, EMA tool should be chosen based on the actual business situation and

[30] http://www.rimf.org.vn/bantin/tapchi_newsdetail.asp?TapChiID=33&muctin_id=2&news_id=2305 (Available in Vietnamese)

management requirement of the cases; therefore, the general internal information about the on-site production is presented.

5.2.3.1. General information about case studies in research

a. Case 1

Case 1 is a small company operating in seafood processing industry. At the time of implementing research, its employees were 135 people. The sale of the fiscal year 2015 was more than 360 billion Vietnam Dong (VND). Its main product is Surimi, a kind of product that "[…] is stabilized myofibrillar proteins obtained from mechanically deboned fish flesh that is washed with water and blended with cryoprotectants. Surimi is an intermediate product used in a variety of products ranging from the traditional kamaboko products of Japan to various surimi seafood products, otherwise known as, shellfish substitutes." (Park et al. 2013). All of its products are exported.

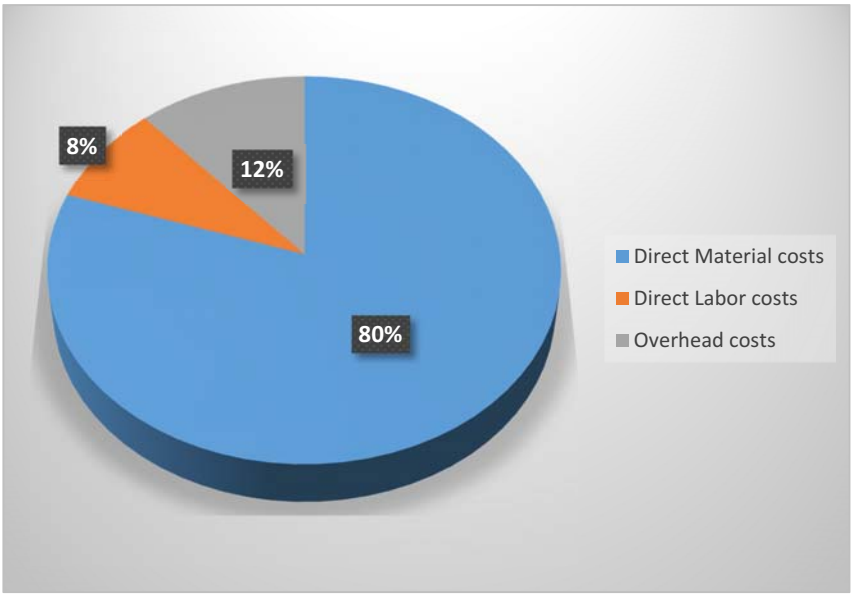

Figure. 5.2. Proportion of production costs of Case 1

According to the information of current accounting system, the production costs consist of up to 80% of direct material cost, 12% of overhead cost and only 8% direct labor cost (Figure 5.2). Moreover, the percentage of finished product to material input is really low, about 50%; this means that one ton of material produces one a half of ton of product. This poses a great challenge for this company because of the fluctuation of seafood price and the lack of raw fishes. Regarding the equipment, the production process has been equipped with the fair modern systems of machines that enable to satisfy required production capacity. This company is in accordance with Vietnamese HACCP (Hazard Analysis Critical Control Point) but does not obtain any environmental management certificate. This company has been just equipped with waste water treatment system following the bio-chemical technology. This indicated that such company only focuses on the end-of-pipe method of environmental management.

Presently, conventional cost accounting has been applying in the company. All costs related production including materials costs, labor cost, and overhead cost are accounted for finished products. They use costs of previous period as standard costs and make a comparison with actual costs of the present period to control costs. The revenue from selling the solid waste from production has not presented separately in annual accounting statement. All environmental costs are recorded at overhead cost account, consisting of effluent treatment costs, solid collecting and disposing costs. Alas, the employees who record statistics of waste and waste water treatment are not accountants and they cannot access accounting information. The person who takes the responsibility of recording operating time of machines is not an accountant and he does not know about accounting information of depreciation as well as production costs and product's price. Each department works mainly independently and separately.

Although it is not the purpose of this thesis to present production process of case studies; it is useful to have an overview of this information in order to analyze the application in the later

section of this chapter. The manufacturing process of Surimi – the main product of the case study – includes five steps (Figure 5.3), as follows:

(1) First washing and temporary storing

This step includes two tasks. Cold water is used to remove the possible impurities that cling or are attached to the fish skin. Once done, the fishes are stored on the ice while waiting for the next step of production.

(2) Preliminary processing (heading, gutting, boning, and washing).

Unlike the production of surimi from the cold water fish which are large enough to process mechanically, tropical fishes like this case are too small to cut mechanically. Therefore, fishes are headed and gutted manually. However, headed and gutted fishes are boned by machine. In this step, intermediated products are also washed to eliminate undesirable parts of fishes excluding the fish flesh.

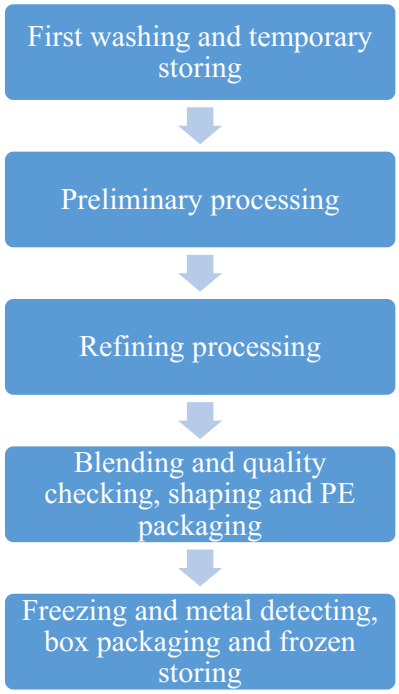

Figure. 5.3. Surimi production process of Case 1[31]

[31] See Appendix 2 to watch the actual pictures of the process

(3) Refining processing (mincing, washing and dewatering).

The fillet is minced, washed and then dewatered before proceeding to the next step.

(4) Blending, quality checking, shaping and PE packing phase

Fillet is blended with some substances at fixed rate according to fish meat quantity. This step is done by a machine which takes about 10 minutes for each turn. After blending, the sample of blended minced meat will be taken to test its moisture and firmness. Later on, the minced meat is extruded into PE bags with 10kg per one bag and shaped by a tray to become a block.

(5) Freezing and metal detecting, Packaging and frozen storing

Freezing is done to satisfy the required temperature for intermediate products and to prepare for checking whether the products have any metal traces after processing. Two blocks of Surimi without metal hazard are put into one carton box and stored under the low temperature. Storage requires arrangement between boxes high enough, around 10 to 20 centimeters. The carton box is designed following particular customers' requirement and such boxes are ordered from the box producer.

b. Case 2

Case 2 is a large-sized company, located in seafood processing industry zone of a city in the central of Vietnam. It has approximately 2,000 employees. It specializes in frozen shrimp production for export. This product is produced from headless (HL), peeled and deveined shrimps that are quickly and separately frozen. Last year sales of frozen shrimp products were more than 25 million USD. Japan was the largest portion of export turnover of this company, with more than 80% (Figure 5.4).

Similarly to the case 1, the direct material costs of frozen shrimp production also account for more than 80% of total production costs (See Figure 5.5). The production process is

equipped with the fair modern machines made in Japan, or Korea or Germany. According to its managers, equipment system satisfies its production capacity. This company controls the quantity of good products rather than both the good products and non-products because it believes that economic value of non-products is very low.

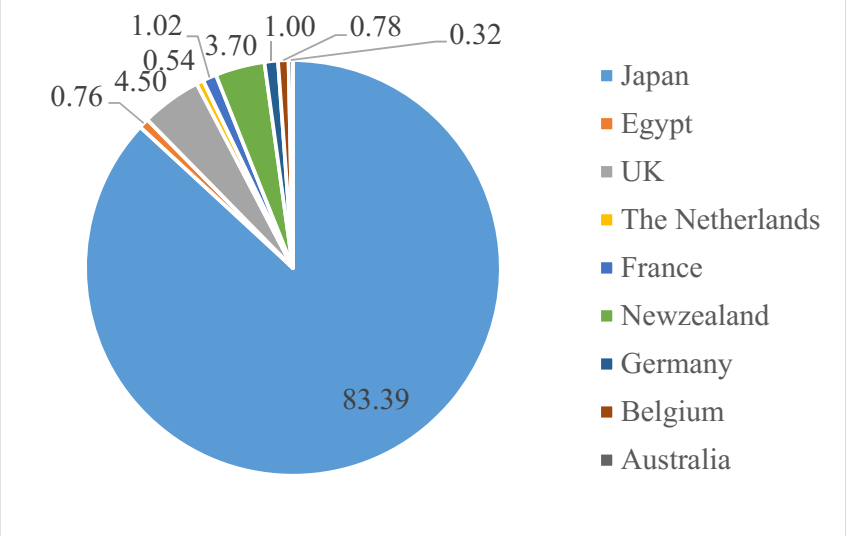

Figure 5.4. The proportion of exporting turnover of frozen shrimp of Case 2 in 2015

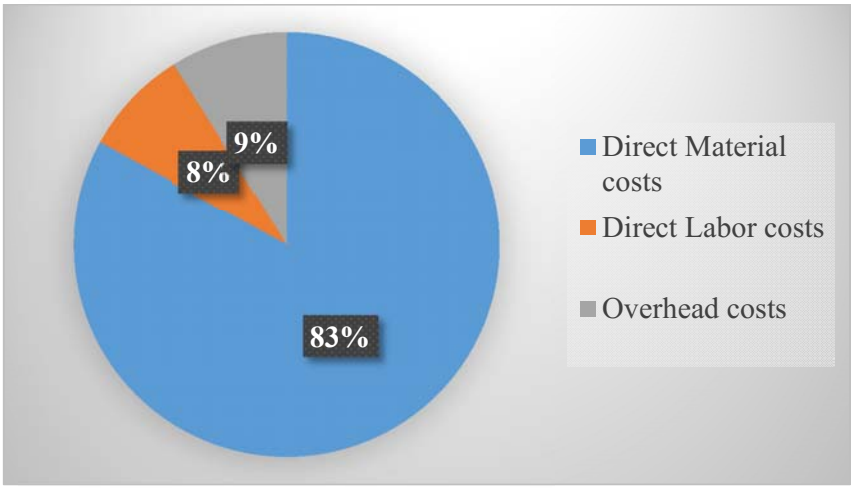

Figure 5.5. Proportion of production costs of Case 2

Regarding management certificate, although the company is large-sized one, it has not obtained any certificate on environmental management. However, this case focuses on quality management certificates, so it was accordance with ISO 22000:2005[32], ISO 9001:2008[33], and Vietnamese HACCP and GMP. Besides, this company has not concerned environmental management and only focused on the end-of-pipe method of environmental management. It has just been equipped with waste water treatment system following the bio-chemical technology. The solid wastes such as heads and carapaces of shrimps are sold daily for other companies to produce the food for poultry. The solid wastes such as plastic bags are disposed of as general garbage.

The manufacturing process of frozen shrimp– the main product of the case study 2– includes six steps (Figure 5.6), as follows:

(1) Washing 1 and Preliminary processing and Washing 2

This step includes two tasks. The cold water is used to remove the possible impurities that gripping the outside of shrimp. After that, shrimps are headed, peeled and veined by workers and then they wash shrimp meat to remove all gunk substance inside of the shrimp

(2) Sizing and Washing 3

Workers separate shrimps according to the certain size[34]. Later, Shrimps are washed by the machine to make sure that all dirty substances on their flesh are removed.

[32] "ISO 22000:2005 specifies requirements for a food safety management system where an organization in the food chain needs to demonstrate its ability to control food safety hazards in order to ensure that food is safe at the time of human consumption." (ISO)

[33] "ISO 9001:2008 specifies requirements for a quality management system where an organization: needs to demonstrate its ability to consistently provide product that meets customer and applicable statutory and regulatory requirements, and aims to enhance customer satisfaction through the effective application of the system, including processes for continual improvement of the system and the assurance of conformity to customer and applicable statutory and regulatory requirements." (ISO)

[34] Size of shrimp is divided according to the number of shrimp, there are some common sizes in production of case study: 16/20, 21/25, 26/30, 31/40, 41/50 per pound. The size based on number of shrimps per 550gram may be 25, 30, 40, and 50.

(3) Soaking and Washing 4

Meat shrimp is dipped into additives tank for about 3 hours and shaken 30 minutes for each hour. After soaking, shrimps are washed again by machines.

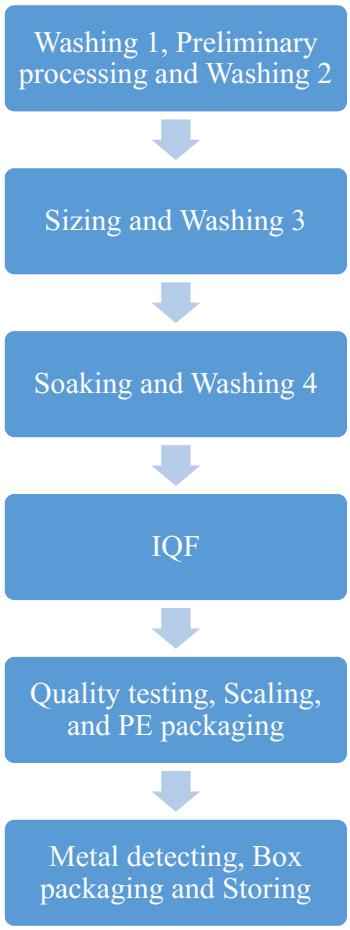

Figure 5.6. Frozen Shrimp production process of Case 2[35]

(4) IQF

IQF means individually quick frozen. This is a system that can freeze shrimps separately and quickly.

(5) Quality testing, Scaling, and PE packaging

[35] See Appendix 3 to watch the actual picture of process

Samples of frozen shrimps are tested on moisture and hazard according to customers' requirement and Vietnamese HACCP. After that, workers scale shrimps to put them into PE pack; net weight for one pack is one kilogram, so the scaled weight is 1.1 kilogram.

(6) Metal detection, Box Packaging, and Storing

In this phase, shrimps in PE packs are checked the possibility containing metal by the X-ray machine. Five to six PE packs of shrimp that are no metallic hazard are put into one carton box to store under the low temperature. Storage temperature is required about minus 18 degree on Celsius scale.

5.2.3.2. Waste disposal and treatment in case studies

This part mentions the main points of waste disposal of the production process and waste treatment systems in two case studies.

a. Waste disposal and treatment of Case 1

The main material of Surimi is raw fish. Only the flesh of this sea creature becomes product and the other parts including head, fins, grill, shell, leg and viscera are eliminated as waste. Although such solid wastes will be recycled as food for aquaculture; these kinds of waste, especially viscera cause the high rate of bacteria and organic materials such as Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) in wastewater and also create a large amount of sludge. Consequently, seafood processing company has to pay an extremely high cost for wastewater treatment and disposal. Besides, the odour from this processing is also unfavorable and may endanger to the surrounding environment in case of the low quality deodorizing system.

Concerning wastewater treatment system: all wastewater is collected and treated by the bio-mechanical method before being disposed into the common treatment system. According to

the environmental regulation of local area, after first treatment inside the firm, all wastewater has to be piped into the common treatment tank for all of seafood processing companies in the industrial zone. At present, this seafood processing company uses bio-technology for waste treatment, including treating smell, water, and sludge. The everage monthly expense for wastewater treatment is more than 100 million VND including inside and outside service. This company expects to reduce environmental impacts by reducing polluted level (COD, BOD) in the wastewater; however, currently, the company just focuses on wastewater treatment. This means that the company just concentrates on the end-of-pipe method that cannot bring the long-term benefits for the environmental protection and the economic growth.

b. Waste disposal and treatment of Case 2

The main material is raw shrimp. Only the flesh of this sea creature becomes products and the other parts including heads, shells, and legs are eliminated as waste. Although solid waste will be recycled as food for aquaculture, these kinds of waste cause a high rate of bacteria and organic materials such as Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) in wastewater and also create a large amount of sludge. Consequently, this company has to pay an extremely high cost for wastewater treatment and disposal. Besides, the odor from this processing is also unfavorable and may endanger the surrounding environment in case of the low quality deodorizing system.

This company has invested the waste water treatment system in 2015. The wastewater is collected and treated by bio-mechanical method before being disposed into the governor treatment system. The average monthly expense for wastewater treatment is more than 300 million VND including inside and outside service. Currently, the company just focuses on wastewater treatment. Indeed, it concentrates on the end-of-pipe method that cannot bring the long-term benefits for environmental protection and economic growth.

Overall, in these companies, the direct material cost is the highest production cost proportion. They both do not use ERP. In management, seafood processing companies pursue product quality and efficiency only, so they comply with quality standards such as HACCP and GPM but have not been aware of environmental standards. Meanwhile, their production disposes a large amount of solid waste and waste water to the environment.

5.3. Material Flow Cost Accounting Applications in Vietnamese Seafood Processing Companies

This part will indicate the progress of applying MFCA in these Vietnamese companies and show the positive results thanks to the applications. The applications may be completed at the stage of identifying problems and weakness in the management of waste and loss that may bring the benefits in short-term period. Besides, probably the applications may increase the continuous benefit in the near future for such companies because in the current year of initial application, these companies have not been ready to change and improved by new large investment on production system and waste water treatment system. Therefore, at first, the study will show them the potential benefits and current problems in their management and discuss the suitable solutions for such issues. The purpose of MFCA applications in these case studies is to identify the actual waste in particular phase to find the solution for each step properly and throughout.

As aforementioned Chapter 1, EMA applications for these Vietnamese companies are focused on production processes. Therefore, the suitable method is MFCA. Another reason is that MFCA is considered as the most important tool of Japanese EMA (Kokubu and Nakajima, 2004; Nakajima, 2009). Besides, MFCA is chosen to apply because it is the leading and most important approach of EMA in Japan (Nakajima, 2003; Kokubu and Nakajima, 2004). Indeed, in IFAC (2005) statistics of EMA application examples on the whole world, Japan is

highlighted by cases of MFCA adoption. In addition, not only Japan, presently, MFCA attracts the international interest (Onishi et al., 2008) because of its qualifications. EMA applications to different cases are manipulated flexibly depending cases' environmental performance, resource capacity, production condition, and management requirement because the effectiveness of EMA application is affected by the techniques adopted (Kokubu and Nashioka, 2008). The applications in cases focus on MFCA adoption and aim to indicate the better waste management and production efficiency. Especially, in this study, these cases applied MFCA to one process and material at first to check and show the real benefit of MFCA application to them. Consequently, this result may manipulate themselves to expand the adoption as the same way that Japanese companies did. Particularly, the model of MFCA may be simplified to be feasible to Vietnamese seafood processing companies. Indeed, this is an advantage of MFCA approach, it can be adopted partly and simply in case of first application and small company (Nakajima, 2009).

5.3.1. Data collection

Data of case studies are based on multiple sources (Yin, 2014). They may include the written records of the cases, personal on-site observation of the author, and the oral information from interviewing production, engineering, quality-control and the accounting departments. The data were collected from various departments because environmental management involves many information including environment, business strategies, manufacturing results, etc. The physical information on wastes and losses were collected from the document of production and environment department and from the interview of production and environment managers because people in the production and environmental department know more exactly about material loss and waste than the accounting department. Financial information from the accounting department was also used to compare and evaluate. A large spectrum of direct

interviews was carried out to get the relevant and factual information. The interviews with production managers and on-site subdivision managers have been carried out for many times to clarify whether there was any discrepancy between the accounting department and production one on loss and waste.

At first, the author contacted with some seafood processing companies in the industrial zone of the area. Two companies answered they may cooperate. After that, the appointments were decided between the managers of cases and the author. At the first stage, the author explained the purpose of research and introduced MFCA to top managers and department managers. Actually, top managers believed their current management system had not had any problems and their losses were very low, so they did not need to change. Therefore, the author had to persuade them to listen to MFCA method and how the author would test in their cases and after testing, they might decide to change or not depending on them. This was similar to discussion with direct managers, they believed that the current processes were operated well and effectively.

At the second stage, the author visited the plants and manufacturing processes many times and also interviewed direct managers of cases. Visiting plants enabled on-site observation on production processes of two companies. The author observed the actions of all workers in the processes to comprehend their actual production. Besides, the author also read the documents of the production department to obtain the quantity of material, intermediate product and final product throughout the process. The author interviewed employees how they do their working tasks. In the preliminary process, the direct workers tried to accomplish the tasks as much as possible because their performance was used to calculate their wage. In other processes and departments and managers, employees' salary was based on the working time. Each department completed their duties from top manager's assignment and departments did not support together to solve their tasks or to improve the economic performance of the company. The

interviews were also focused on understanding of the opinion of losses of case studies' managers, in which processing steps losses occurred, how many percentages of losses were, how they managed costs, etc. and getting more explanations on production processes. The author also read accounting document of companies to know how they recorded and measured the production costs. These companies thought that losses were the spoilt products under the quality standard and unwanted materials were a waste. They also believed that these unwanted materials just brought low economic value thanks to selling to other recycled companies, so they did not control the quantity of such items. The author also interviewed the manager of the environmental department. To both companies, this department took the responsibilities of cleaning the tools for production such as knifes, baskets, tables, sinks, and floor, collecting the solid waste to sell or dispose, and also operating the waste water treatment system. Thus, this department recorded the quantity of the solid waste that is sold and the chemical substances they use for waste water treatment.

The author considered all elements of the production process and the sewage treatment system throughout one year. However, to make the simpler model for these starting companies, the MFCA applications were conducted to direct material only, thus, other elements of MFCA such as water, energy, system costs and delivery/disposal costs were skipped. MFCA analysis was adopted to raw material first because for both companies material cost was the largest proportion and in order to make the model becoming little simple to suit to these companies. After obtaining results from MFCA analysis, the author showed them the results and discussed solutions for these problems with managers. The author mentioned the PDCA cycle to support environmental management in these companies and suggested them to try. Later on, the knowledge of PDCA was explained with all managers. After that, the companies set their plans and listed possible actions they can implement to solve problems but not to change or invest

much money on. The author also recorded the result after PDCA cycle implementation to evaluate the efficiency of each application.

Regarding the exactness of the data, because of the sensitivity and business secret, some numbers have been slightly changed without affecting the nature or direction of conclusions reached.

5.3.2. Material Flow Cost Accounting applications

In this part, the author presents the trial examinations of MFCA application into two Vietnamese companies and the management of PDCA cycle based on the result of MFCA analysis.

The database required for establishing material flow throughout the production process was available but widely dispersed among different sources of departments. For example, the solid waste and water consumption for each phase were not recorded and concerned by the accounting department but the production department. The technology department noted the working hour and energy consumption per machine while the accounting department recorded only the total monthly energy consumption and energy cost based on the invoices.

MFCA is probably one of the major tools of EMA and adaptable to many kinds of size and industry regardless companies operate in developed or developing countries (METI, 2011; Nakajima, 2009). Although MFCA has been developed more to fit Japanese companies; comparing to the opinions of Germany and US, they are similar approaches of material flow chart and management decision-making support (Wagner, 2003). Therefore, the author considered MFCA application might be a feasible solution to Vietnamese companies and tried to apply the Japanese MFCA approach to Vietnamese seafood processing companies to identify the usefulness of Japanese EMA application in Vietnam. Learning the experience of MFCA application of Japan at the beginning (METI, 2002), the implementation focused on the

material costs rather than all elements of MFCA. Hence, in these cases analysis, the author will focus only the raw materials and skip other elements of MFCA including water, energy costs, and system and disposal costs.

5.3.2.1. MFCA application in Case 1

MFCA method could be used for various management purposes; in this case, the application focused on ascertaining abnormal losses and wastes in the production process and then, reducing waste costs and protecting the environment.

a. MFCA implementation steps

(1) Step 1

The boundary, time period and quantity center will be identified. In this case, the boundary of material flow is Surimi processing in the company. The time period is chosen in one month. Quality centers consist of five phases of production process: (1) First washing and temporary storing; (2) Preliminary processing (PP); (3) Refining processing; (4) Blending and quality checking, shaping and PE packaging; (5) Freezing and metal detecting, box packaging and frozen storing.

(2) Step 2

In this step, there are two main responsibilities. First, the input and output for each quantity center must be defined and calculated in the physical unit by the principle of material mass balance: “total material input should be equal to total material output”. Secondly, these inputs and outputs will be calculated in monetary by the formula: “Material costs = weight of material x unit price of material”. The unit price of the material is the unique price throughout the process. In this case, the unit price is 14,000 thousand Vietnamese Dong (Ths VND).

Based on the information of this case study, this step could be displayed in Table 5.1

Table 5.1. Input – Output information of raw material in MFCA of Case Study 1

Quantity center	Input	Output
First washing and temporary storing	Raw fishes (2,285,628 kg; 31,998,792 Ths VND)	Raw fishes (2,285,628 kg; 31,998,792 Ths VND)
	Cool water, ice (Liter)	**Wastewater** (Liter)
Preliminary processing	Raw fishes (2,285,628 kg; 31,998,792 Ths VND)	Fillets (1,028,875 kg; 14,404,250 thousand VND) Head, bone, intestine (recycled) (972,782 kg; 13,618,948 Ths VND) **Solid waste** (283,971 kg; 3,975,594 Ths VND)
	Cool water (Liter)	**Wastewater** (Liter)
Refining processing	Fillets (1,028,875 kg; 14,404,250 Ths VND)	Minced meat (817,672 kg, 11,447,408 Ths VND) Fish fat (recycled) (114,281 kg; 1,599,934 Ths VND) **Solid waste** (96,967 kg; 1,357,538 Ths VND)
	Cool water (Liter)	**Wastewater** (Liter)
Blending and quality checking, shaping and PE packaging	Minced meat (817,672 kg, 11,447,408 Ths VND), Substances (5,314 kg; 74,396 thousand VND) PE bag (bags)	Surimi (822,532.5 kg; 11,515,455 Ths VND) Waste for quality checking (408.5kg; 5,719 Ths VND)

Freezing and metal detecting, box packaging and frozen storing	Surimi (822,532.5 kg; 11,515,455 Ths VND) Carton box (boxes)	Surimi (822,532.5 kg; 11,515,455 Ths VND)

Table 5.1. (Continuous)

Note: The paper focuses on identifying loss in raw material, so the information of input and output of energy and other systems cost are not presented in this table.

(3) Step 3

In this step, the flow chart of MFCA is drawn based on the flow of material throughout the quantity centers that identified in step 1 and the information of input and output of step 2 (Figure 5.7). This flow chart presents the information of input and output of raw material throughout five quantity centers. Then, based on this, the abnormal losses and wastes can be uncovered.

[Insert the Figure 5.7 about here, see Appendix 4]

[Insert the Table 5.2 about here, see Appendix 5]

In this phase, the information of input and output raw material also expresses in a cost matrix table (Table 5.2). This table shows the information of abnormal losses and wastes separately according to the quantity centers.

(4) Step 4

From the information of material flow matrix (Figure 5.7) and material cost matrix (Table 5.2), the managers could detect the actual quantity of material loss and hidden loss in the existing accounting information system.

b. Analyzing potential usefulness and improvement

In this case, material flow matrix and material cost matrix table clearly showed that some solid waste flowing into wastewater stream that was not recorded while this solid waste made the wastewater more polluted and also reduced the return from recycling of the solid waste. Indeed, in the lens of existing cost accounting system, the non-recycled solid waste was ignored; meanwhile, in MFCA cost system, this can be seen and able to calculate. Thus, the company can find solutions to increase productivity and reduce environmental impacts.

c. Implementing countermeasure by tool of PDCA cycle and MFCA analysis

In this case, MFCA analysis showed that a quite considerable amount of solid waste was ignored and drained into the waste water causing more pollution for waste water. Consequently, this caused more costs for waste water treatment and less return from selling solid waste. From the MFCA data (Table 5.2), it could be seen clearly that the solid waste was drained into waste water in preliminary processing and refining processing. Analyzing the root of problems, the company recognized that in preliminary processing, the cause of loss was that workers dropped fish heads, fins, and intestines into the floor while cutting and cleaning workers, then later, swept them into the drain (see Figure 5.8 a and Figure 5.8 b). In the refining processing, the loss occurred while dredging fish fat by the racket (see Figure 5.9a and Figure 5.9b).

The company planned to implement suitable solutions to reduce the loss of solid waste into the waste water with its available resources of human, facilities and finance step by step. Thus, the company tried to adopt PDCA cycle for its environmental management (Figure 5.10). In the Plan step, the company concentrated on collecting more solid waste in preliminary processing phase at first; so then, straightforwardly, in Do step, the company added some requirements for the task of cleaning workers in the preliminary area. Instead of only keeping clean for the preliminary area, they should filter the solid waste while sweeping the floor. In order to check whether the solid waste was collected better, the quantity of solid waste was

scaled after collected after each phrase of the production process and the ratios of input material and solid waste output between months were compared. In the Act step, the company prepared the next possible solutions to reduce loss in the preliminary phase. This company expected to improve the dredged net of fish fat to reduce loss in the refining process.

Figure 5.8 a. Solid waste drained into wastewater due to manually headed and gutted step

Figure 5.8 b. Solid waste was wept into the pipe

According to their management plan, the PDCA cycle will be formulated continuously to reduce loss as much as possible. Regarding the next actions of the continuous PDCA to achieve environmental plan of reducing solid waste drained into waste water, some action plans were discussed such as adding the edge for working tables in PP step (see Figure 5.8a, the table to put fishes for heading and gutting without edge), using the thicker net and more frequently

cleaning rackets to collect more fish fat in refining process step. The managers believe they can try these solutions because such approaches do not cost them much; by contrast, they can earn more from more collected solid waste and less polluted waste water disposal and concurrently they can protect the environment and join green food supply chain.

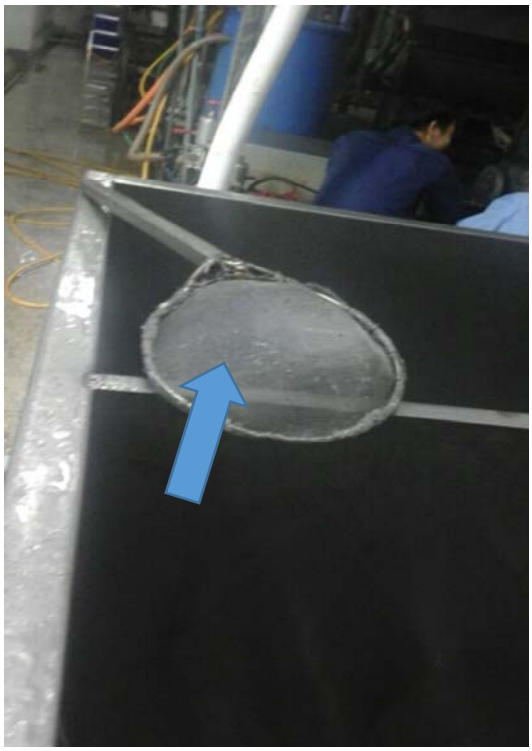

Figure 5.9a. Racket used to filter fish fat in refining processing

Figure 5.9b. Solid waste drained into wastewater due to refining processing

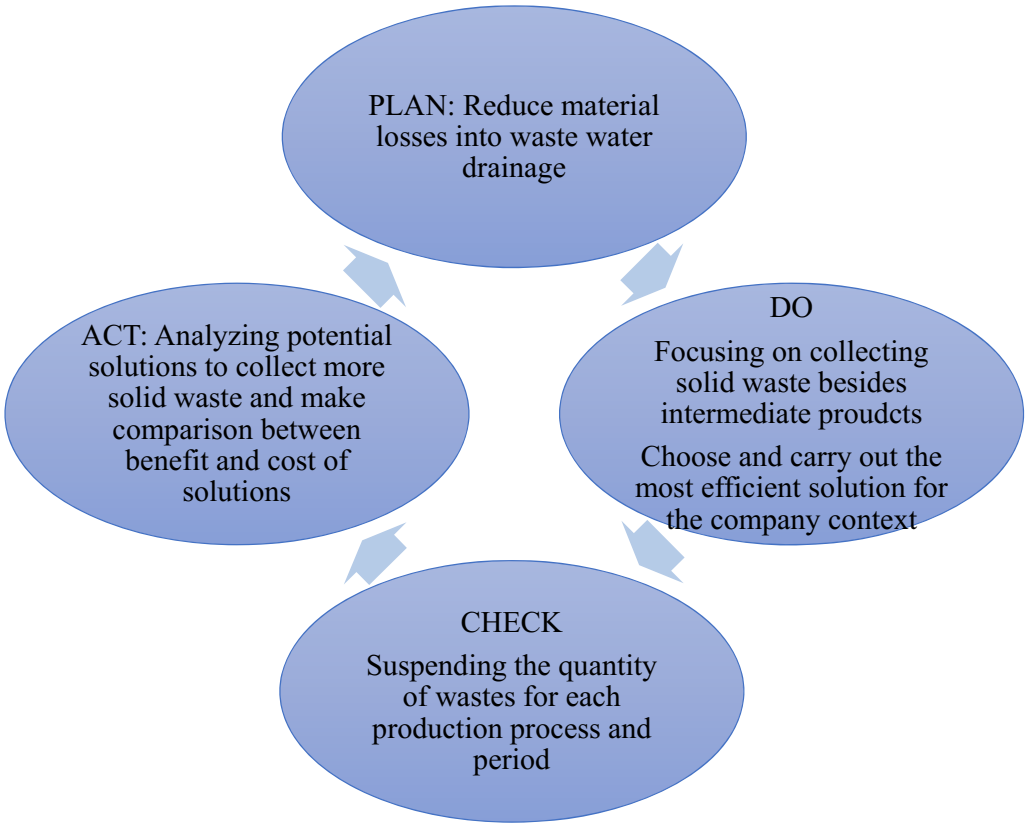

Figure 5.10. PDCA cycle of the case study 1

d. Results

In this case study, MFCA analysis showed that some solid waste flowing into the effluent stream was not recorded while the lost solid waste made the wastewater more polluted and reduced return from selling of this waste. Indeed, in the lens of existing cost accounting system, the non-recycled solid waste was ignored; meanwhile, in MFCA cost system, this can be seen and able to calculate. Based on the MFCA data the company could identify hidden losses and wastes in its production process and combine such data to find the solutions to reduce the loss of solid waste by continuous PDCA cycle. By the first round of PDCA implementation, the company achieved the plan of collecting more solid waste in the preliminary process and making a less polluted level of waste water without adding cost. Regarding the efficiency of this application, the quantity of collected solid waste increased 3% and the cost of waste water

treatment reduced 5%. This result shows the efficiency of MFCA analysis and PDCA adoption in the company situation. By the continuous PDCA cycle, plans and solutions to reduce the loss of solid waste will be unstopped, so probably, the Vietnamese company may improve their production management to increase more economic benefit and protect the environment better.

5.3.2.2. MFCA application in Case 2

Similarly, in the case 2, MFCA application was also aimed to identify the abnormal losses in the production process and then, to reduce waste costs and environmental impacts.

a. MFCA implementation steps

Implementing MFCA analysis was carried in the case 2 as following steps.

(1) Step 1

The boundary, time period and quantity center are identified. In this case, the boundary of material flow is frozen shrimp processing in the company. The time period is chosen in one month. Quality centers consist of six phases of production process: (1) Washing 1, preliminary processing and washing 2; (2) Sizing and washing 3; (3) Soaking and washing 4; (4) IQF; (5) Quality testing, scaling and PE packaging; (6) Metal detection, box packaging and storing.

(2) Step 2

In this step, there are two main responsibilities. First, the input and output of each quantity center must be defined and calculated in the physical unit by the principle of material mass balance: “total material input should be equal to total material output”. Secondly, these inputs and outputs are calculated in monetary by the formula: “Material costs = weight of material x unit price of material”. The unit price of material is the unique price for all the process. The unit price per one kilogram of shrimp is 70 thousand Vietnamese Dong (Ths VND).

Based on the information of this case study, this step could be displayed in the Table 5.3.

Table 5.3. Input – Output information of raw material in MFCA of Case Study 2

Quantity center	Input	Output
Washing 1 and Preliminary processing and Washing 2	Raw shrimps (252,216 kg; 17,655,120 Ths VND)	Shrimp meat (150,522.51kg; 10,536,575.616 Ths VND) Heads and carapaces (88,960.14 kg; 6,223,429.8 Ths VND) **Solid waste (12,787.35 kg; 895,114.584 Ths VND)**
	Cool water, ice (Liter)	**Wastewater** (Liter)
Sizing and washing 3	Shrimp meat (150,522.51kg; 10,536,575.616 Ths VND)	Shrimp meat (150,522.51kg; 10,536,575.616 Ths VND)
	Cool water (Liter)	**Wastewater** (Liter)
Soaking and washing 4	Shrimp meat (150,522.51kg; 10,536,575.616 Ths VND), Salt (4,515.67 kg; 11,289.175 Ths VND)	Soaked shrimp meat (155,038.18kg; 10,547,864.791 Ths VND)
IQF	Soaked shrimp meat (155,038.18kg; 10,547,864.791 Ths VND) Cool water (15,503.818kg; 155,038.18 Ths VND)	Frozen Shrimp meat (170,541.9967 kg; 10,702,902.9698 Ths VND)
Quality testing, scaling and PE packaging	Frozen shrimp meat (170,541.9967 kg; 10,702,902.9698 Ths VND)	Frozen shrimp in PE package (170,541.9967 kg; 10,697,568.5257 Ths VND) Frozen shrimp used for quality testing (85kg; 5,334.4441 Ths VND) PE pack (15,496 packs)

Metal detection, box packaging and frozen storing	Shrimp in PE package (170,541.9967 kg; 10,697,568.5257 Ths VND) Carton box(7,748 boxes)	Frozen shrimp in box (170,541.9967 kg; 10,697,568.5257 Ths VND) Carton box (7,748 boxes)

Table 5.3 (Continuous)

Note: The study focuses on identifying loss in raw material, so the information of input and output of energy and other systems cost are not presented in this table.

(3) Step 3

In this step, the flow chart of MFCA is drawn based on the quantity centers that were identified in step 1 and the information of input and output in step 2. The information of material input and output through the process is also presented in flow matrix, so, the abnormal and hidden loss that cannot be identified in the existing accounting information system is showed clearly (Figure 5.11).

[Insert the Figure 5.11 about here, see Appendix 6]

In step 3, the information of input and output raw material also expresses a cost matrix table to clearly show in which quantity center raw material lost.

[Insert Table 5.4 about here, see Appendix 7]

(4) Step 4

In this step, the reasons for abnormal losses and wastes are clarified. The managers clearly knew that in preliminary processing some solid waste was drained into the waste water stream.

b. Analyzing potential usefulness and improvement

In this case, MFCA analysis showed that some solid waste flowing into wastewater stream was not recorded while this solid waste made the wastewater more polluted. In addition, the flow of solid waste into wastewater stream reduced the return from recycling of solid waste. Indeed, in the lens of existing cost accounting system, the non-recycled solid waste was

ignored; meanwhile, in MFCA cost system, this can be seen and able to calculate. Thus, the company could identify inefficient points in the production process, then they could increase economic performance and reduce environmental impacts.

c. Implementing countermeasure by tool of PDCA cycle and MFCA analysis

In this case, MFCA analysis showed that a quite considerable amount of solid waste was ignored and drained into waste water caused more pollution for waste water, more costs for waste water treatment and less return from selling solid waste. From the MFCA data (Table 5.2), it could be seen clearly that the solid waste was drained into waste water in the preliminary processing and refining processing. Analyzing the root of problems, the company recognized that in the preliminary processing and washing 2, the shrimps' heads, shells were put into baskets and then put into the large tanks. These solid wastes were drained into the waste water while throwing into large tanks and washing after peeling (Figure 5.12a and Figure 5.12b).In peeling and washing stage, the workers focused on making as high as possible pre-product in good quality because the quantity of re-product is used to calculate their wage. Thus, they did not care how much head and shell flowing into the effluent stream. The company adopted PDCA cycle to solve this problem (Figure 5.13). In the Plan step, the company focused on collecting more solid waste in preliminary processing phase and washing 2; so then, in Do step, the cleaner workers tried to avoid making the loss when putting solid wastes into the large tanks. In order to check whether these solid wastes were collected better, the quantity of solid waste was scaled after collected and the ratios of input material and solid waste output between months were compared. In the Act step, the company will continue to propose potential solutions to reduce loss and protect the environment.

Figure 5. 12a. Heads, legs and shells of shrimps are put into the baskets

Figure 5.12b. The solid waste was drained into waste water in step of washing 2

According to their management plan, the PDCA cycle will be formulated continuously. Regarding next actions of the continuous PDCA to achieve environmental plan, the company plans to expand MFCA in supply chain. This aims to increase the return value of this waste and also contribute to reduce environmental impacts in the downstream of this waste. Although the solid waste from shrimp processing is sold for producing poultry foods, this production in Vietnam is done by semi-manual system and using acid for production (see Figure 5.14), so

this also causes serious environmental problems in Vietnam[36]. However, recently in Vietnam there are increasing production firms that equipped modern machine system to produce heads and shells of shrimp to be more valuable products while less emissions and environmental impacts. In order to contribute reduce environmental impacts caused by downstream of such solid waste, the case study can contact with cleaner producers. This may not only bring higher return from solid waste sale but also result in less environmental impacts in the downstream of waste because with more modern technology, the recycled producers could manufacture more valued products such as chitin and chitosan[37]. In order to implement this plan, the company itself has to concern solid waste storage because the solid shrimp waste quickly putrefy because of its alkaline nature (pH 7.5–8.0) (Kelleher, 2005). In addition, under tropical climate conditions, the perishability of shrimp waste is shorter, the decay may start within an hour after (Kandra et al., 2012). Therefore, this waste is needed to conserve in an appropriate condition up to the next process.

The managers believe they can try these solutions because such approaches do not cost their company; by contrast, they can earn more from more collected solid waste and make less pollution. Potentially, they hope they can join green food supply chain in near future.

[36] http://dantri.com.vn/xa-hoi/che-bien-dau-vo-tom-bang-a-xit-song-va-nguoi-cung-chet-1150138221.htm

[37] http://thucphamvahoahoc.saodo.edu.vn/index.php?language=vi&nv=news&op=Nghien-cuu-khoa-hoc/NGHIEN-CUU-SAN-XUAT-CHITIN-CHITOSAN-TU-PHE-LIEU-TOM-THE-CHAN-TRANG-Litopenaeus-vannamei-UNG-DUNG-BAO-QUAN-MOT-SO-NONG-SAN-THUC-PHAM-99 (Available only in Vietnamese)

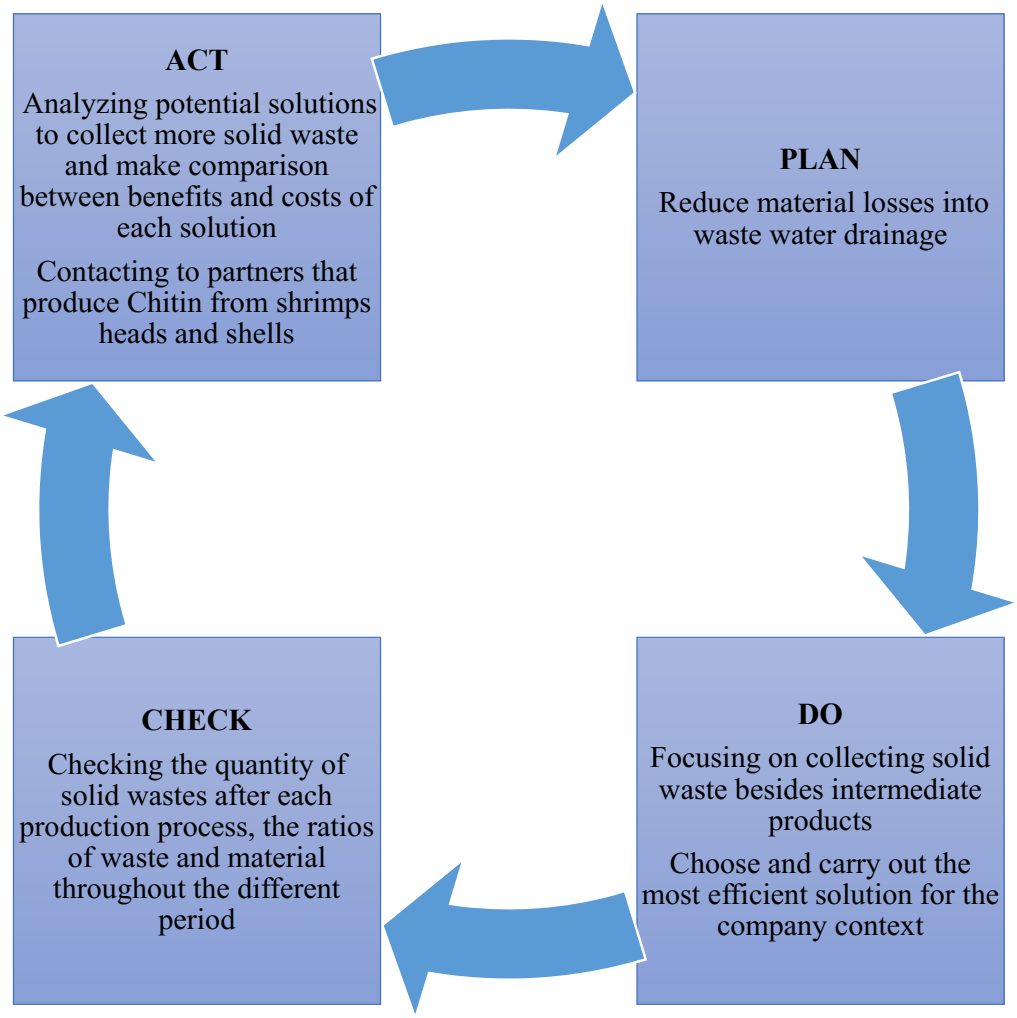

Figure 5.13. PDCA cycle of the case 2

d. Results

In this case study, MFCA analysis showed that some solid waste flowing into the stream was not recorded while the lost solid waste made the wastewater more polluted and reduced the return from recycling of this waste. Indeed, in the lens of existing cost accounting system, the non-recycled solid waste was ignored; meanwhile, in MFCA cost system, this could be seen and able to calculate. MFCA identified the hidden losses and wastes in its production process. Based on MFCA analysis, this company could combine such data with continuous

PDCA cycle to find the solutions and reduce the loss of solid waste. By the first round of PDCA implementation, the company achieved the plan of collecting more solid waste in the preliminary process and making a less polluted level of waste water without adding cost. Regarding the efficiency of this application, the quantity of collected solid waste increased 5% and the cost of waste water treatment reduced 7%. This result shows the efficiency of MFCA analysis and PDCA adoption in the company situation. By continuous PDCA cycle, plans and solutions to reduce the loss of solid waste will be unstopped, so probably, this Vietnamese company could improve their production management to increase more economic benefit and protect the environment better.

Figure 5.14. Manual production of shrimp heads and shells for poultry foods in Vietnam

Furthermore, MFCA application of this company can expand to the supply chain. As the abovementioned, they can choose the better partners to sell carapaces and heads to manufacturers. The better partners mean who can produce these solid wastes more effectively

and cleaner. Consequently, the company can get higher financial benefit and contribute to reducing the environmental impacts caused by recycled shrimp waste.

5.4. Conclusion

Overall, the applications to these companies focused on the raw material only and the waste management was not concentrated in these cases. However, the MFCA analysis indicated problems in the waste management of these companies. In both these companies, solid wastes were collected and sought by the environmental department. At the end of each month, the environmental department reports to the accounting department the quantity and revenue of solid waste they collected and sought. The wage of processing workers was calculated according to products' quantity of each duty, so they tried to finish the intermediate products rather than focusing on collecting heads and shells. Clearly, conventional management of these companies, indeed, did not focus on the management of solid waste. Therefore, a considerable amount of these solid wastes were dumped with effluents discharge. However, according to the data from MFCA, it could be seen clearly that they lost a lot because of loss of solid waste. Based on MFCA analysis, PDCA cycle was adopted to implement environmental plans to increase economic performance and protect the environment.

The empirical studies illustrated that MFCA could increase economic income by reducing material losses and waste costs (e.g. Kokubu and Kitada, 2010). In this study, the case studies also showed that more material loss has been recognized by MFCA than an existing cost accounting system of the case studies. Thanks to the lens of MFCA, the companies could recognize a large amount of abnormal loss (the solid waste was drained into the wastewater stream) that had not been recorded by existing accounting department and based on the data of MFCA table or flow chart, these companies can propose the solutions to reduce loss. As a result, the companies could cut down the cost and gain the higher return. In these case studies,

the companies could pay less fee for wastewater treatment because of less polluted wastewater and earn more from selling solid waste. Besides, these cases applied MFCA without investing new information system; all data were collected via existing accounting system and the production department. Therefore, applying MFCA by PDCA cycle may be useful and adaptable to Vietnamese companies. Consequently, it is expected that MFCA application could support Vietnamese companies to overcome hurdles to achieve higher productivity and better environmental performance. Because on the one hand, MFCA could show the material loss and waste clearly; on the other hand, MFCA application did not charge for further investment on the information system. Therefore, hopefully, Vietnam Seafood processing companies or other Vietnamese companies could optimize their business by MFCA application. Nevertheless, MFCA is a tool to demonstrate the data, MFCA itself cannot solve the problems. The success of MFCA may depend on the cooperation of managers, accountants and working employees in the company. Therefore, after finishing the experiment, a discussion was held with managers to inform the results and explain further about MFCA approach as well as introduce other EMA tools for future application. Managers were astonished by the results of MFCA and more eager to continue the application.

Consequently, the result from these cases studies indicated MFCA showed the unseen costs of material loss and potential environmental impacts of losses. This means that MFCA is potentially useful and applicable to Vietnamese companies. In these cases, wastewater treatment cost can be reduced sharply due to less solid waste draining into the effluent stream. The research indicated that Vietnamese companies could achieve advantages from MFCA technique, following abovementioned steps and continuous the PDCA cycle. The research also illustrated that the size of companies did not affect the ability to adopt MFCA tool. Nevertheless, the management culture, resources ability, and management visions may influence measures that companies take to solve their environmental and economic problems

based on MFCA analysis. Besides, from the practice of case studies, possibly confrontations between traditional management and management following MFCA may prevail; therefore, it will be better if the external stakeholders involved in promoting companies to protect the environment. Especially Vietnamese government may take the central role in this issue. Hopefully, these case studies could become the guiding examples for other Vietnamese companies in EMA application. Understanding and identifying the most powerful EMA tools for decision-making situations, management tends to involve EMA application more (Schaltegger et al., 2012). Therefore, thanks to successful trial applications, these case studies may broaden the applications to many more EMA tools. More importantly, these successful applications imply that EMA is adaptable and useful to any company size in developing countries, not only distinctive advantage of developed countries and large-sized companies. Potentially, this procedure may be implemented in other Vietnamese companies to adopt MFCA because the procedure of environment-related management accounting adoption may be similar between various companies in different industries (Frost and Wilmshurst, 2000).

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Chapter 6

Conclusion and Discussion

This chapter provides the conclusion for all the thesis and gives some discussions of the contributions and limitations of the thesis as well as the prospects that the author expects to improve and continue the research further in the near future.

6.1. Conclusions of Dissertation

To conclude, the thesis presented research ideas in five chapters. Chapter 1 expressed the weakness of conventional financial and management accounting, research promotion, research scope and research questions. EMA is a voluntary accounting and EMA can be encouraged by environmental policies and plans of the government rather than be controlled by governmental policies. Therefore, EMA could flexibly be adopted between different companies in different industries, economies, and political institutions. Thus, it is possible to apply a proper and efficient method to many kinds of enterprises doing business in the different geography. It is possible to have differences in the format of environmental reporting and indicators disclosure because the pressure from the governmental laws, regulations or stakeholders; however, companies in different countries or different industries can use the same indicators for environmental reporting such as NO_X, CO_2, SO_2 emission, etc. Currently, there is a wide range of multinational companies that operate their business around the world. They can follow the unique method for EMA because this kind of accounting is voluntary and is not significantly affected by the environmental law rather than the environmental policy and awareness of these companies. It is, thus, possible to have the similar framework of EMA for companies located in different countries. Hence, although there is a disparity between Japan and Vietnam economy as well as the environment as abovementioned in Chapter 2, the experience of

Japanese EMA could be the valuable lessons to Vietnamese companies. The literature review of Chapter 3 illustrated that EMA tools have been applied in developed countries more widely than developing countries. These previous researches also presented MFCA is an essential tool of EMA for sustainable development. The research questions were answered clearly in Chapter 4 and Chapter 5. Chapter 4 presented the experience of EMA application in Japanese companies. This chapter presented information of MFCA adoption in Japan and practical examples of Japanese companies in the combination of PDCA cycle and MFCA analysis to achieve environmental targets. Chapter 5 showed how to implement Japanese MFCA approach in Vietnamese companies and adopt PDCA cycle management to solve environmental problems. Consequently, Chapter 5 illustrated that Japanese EMA approach is applicable to Vietnamese companies.

All in all, this study indicated the experience and characteristics of EMA application in Japanese companies and carried out the trial adoption and evaluated such applications in Vietnamese companies in seafood processing industry. Indeed, the result from this research illustrated that Japanese MFCA approach could be applied in Vietnamese companies because this tool provided more accurate information on material loss in these cases. This technique indicated that these Vietnamese companies had not been concentrated on physical information of material waste while such information showed them the actual costs of loss and potential savings.

Regarding practical contribution, the result from this research also revealed that it is not extremely complex and impossible to apply MFCA approach in companies in developing country. Following step by step of implementation procedure, companies can utilize MFCA method to obtain more detailed and accurate information for decision making. It is concluded that Japanese EMA approach is applicable to Vietnamese companies to achieve the positive results, consisting of discovering abnormal losses in the production process and indicating the

potential benefits. Potentially, EMA may support Vietnamese companies doing business towards sustainable development as other countries. Indeed, MFCA applications in two Vietnamese companies supported these companies to identify the abnormal losses and wastes in their production processes. Although the study does not show all elements of MFCA, as mentioned in Chapter 5 applications' result supported Vietnamese companies in improving two items of costs (waste management costs and waste water cost) among four important categories of environmental management including waste management costs, energy costs, water costs, and waste water cost (Bouma et al., 2002). The study has attempted to illustrate the benefit of EMA application with the most important tool of MFCA in Vietnamese companies. Potentially this could attribute to the tide of increasing adoption EMA in Vietnam to promote sustainable development. The result also supplements the principle that environmental protection activities may bring the financial benefits for corporations (Hatakeda et al., 2012). This study may also promote Vietnamese companies to reconsider their management on the environment. It is not sufficient and efficient if they just focus on the solution of end-of-pipe treatment. Thus, particularly this study provides the valuable experience to these two Vietnamese companies and generally useful example to other Vietnamese companies. Indeed, this research is expected to promote EMA application among Vietnamese companies to improve their economic performance as well as to protect the environment.

With regard to the theory contribution, this study also supplements the current research on the applicability of EMA tools in various business contexts thanks to the flexibility of EMA tools when interacting with corporate management practice (Herzig et al., 2012). Indeed, MFCA has being applied successfully in many developed countries such as Japan, Germany, but also could be used in developing countries as well (Guenther et al., 2015; Jamil et al., 2015). Besides, this study also illustrated the procedure of MFCA implementation may be adopted for various sizes of companies like previous researches (e.g. METI, 2011) presented.

6.2. Drawbacks of Dissertation

While this research contributes some EMA understanding to practical applications in two Vietnamese companies and provides actual samples to other companies, the thesis still remains four main limitations.

First, the research has just focused on exploring the experience of Japan and MFCA approach while there is a wide range of valuable experience of many countries such as Germany, US, Australia, UK, etc. However, the research explored the valuable experience for Vietnamese companies from Japanese ones. EMA also has other extremely useful tools for management decision-making in sustainable development. However, it is no doubt that ISO 14051 publication and expansion of MFCA among Japanese companies indicated the significance and efficiency of this tool to sustainable management. In addition, Kokubu and Kitada (2015) wrote that "in practice, MFCA could improve such aspect including investment appraisal of plant and equipment, modifications or substitutions of raw materials, improvement in product design and production planning, and on-site improvement activities". Due to the limitation of research time, thus, the author decided to choose the most crucial tool of EMA in Japanese experience to do the experiment in Vietnamese companies. Besides, this study aims to show the immediate positive results for companies to encourage their involvement and application, so it is impossible to cover all techniques of EMA. Nevertheless, this success of application may become the valuable lesson to these Vietnamese companies and provide practical samples to other firms.

The second limitation is that MFCA model was examined during one month processing period of the case; yet, one-month data may be reasonable to analyze because the input and output ratio of material has not changed dramatically in different months; so one-month data could present the pattern of practical production of case study rather than a random period. The

application of two Vietnamese companies in this study is also limited to the flow of the raw material and skipping other elements of MFCA including water, energy, system costs and disposal/delivery costs. Nevertheless, in seafood case study, the cost of raw material surpasses other cost elements as mentioned above, so the model of this case study is acceptable. Indeed, according to Japanese companies' experience, it is possible for small companies or beginners to simplify MFCA model to adopt (Nakajima, 2009). Moreover, the gradual and small improvement is better for such Vietnamese companies that were not so willing to change and adopt a new theory. Furthermore, the success of EMA application depends on the effort of managers and cooperation of employees that are affected by the companies' culture management and environmental management experience. Hence, due to the lack of experience in EMA and conservative management, MFCA applications in these Vietnamese companies were limited to the raw material flow. However, by MFCA analysis and PDCA cycle management, these companies identified the avoidable loss in their manufacturing processes and proposed relevant solutions. Therefore, the applications in cases were limited to material management and the thesis has not discovered all potential losses and waste in energy and system cost management.

Third, MFCA application in this thesis has just focused on the short-term orientation while MFCA could also benefit to long-term management decisions. Nonetheless, it may start with the short-term decisions to state the actual benefits of MFCA approach to Vietnamese companies; consequently, these companies can expand their application by themselves and this is also a characteristic of Japanese management, focusing on continuously small improvements rather than an irregularly large breakthrough (Imai, 1986).

Finally, these cases adopted MFCA inactively. Although EMA is concerned to solve environmental and economic management (Burritt et al., 2003), it may be better if the companies choose EMA tools by themselves rather than accept a persuasion and trial.

6.3. Future Research Prospect

Regarding implication of MFCA application in the Vietnamese context, there may be some advantages and disadvantages. On the one hand, by this approach, to obtain MFCA information, Vietnamese companies may not need to make any change to the production process and investment while this tool may immediately bring higher economic benefit and less environmental impacts. Because MFCA analysis may be calculated by existing accounting information. Besides, currently, many samples of MFCA application and guidelines for MFCA were published by the Japanese government as well as other organization such as ISO. Thus, learning from such experience, managerial solutions for MFCA implementation to Vietnamese companies may be more feasible and efficient. Furthermore, Vietnamese government has signed the agreement to promote MFCA in Vietnamese SMEs with the support of APO and assistance of Japanese experts. By next years, this will open opportunities for Vietnamese SMEs to access and employ MFCA as a management tool for economic and environmental goals.

On the other hand, in order to foster MFCA expansion in Vietnam, there may be some challenges. First, the fine for breaking environmental law activities is still lower than costs for environmental investment. Therefore, this does not make pressure on business organizations to manufacture more cleanly or concern environmental impacts due to their activities. This means that managers may easily ignore the benefits of MFCA application while this adoption really needs the commitments of the top manager. Second, in Vietnamese companies, cross-function and internal communication between departments are very poor. They mainly individually carry out the duty and solely report the results to the top manager. Thus, Vietnamese company may struggle with more difficulties to combine MFCA information and existing management information. Finally, further development of MFCA needs fully understanding on MFCA of the top manager (Nakajima, 2011); however, to reach this condition it takes a long time and

requires the official education and experts' support. All in all, to promote MFCA implementation in Vietnam, it needs the governmental factors such as environmental tax, environmental management, and environmental management training for enterprises besides major concern of Vietnamese enterprises on cleaner production.

Currently, in Vietnam, the awareness of the environmental protection of organizations and individuals as stakeholders has been still low. However, due to the globalization in many areas including environmental protection, social responsibility, and economic competition, Vietnamese companies also have to change towards the world trend of preserving natural resource and ecosystem. Indeed, due to the agreement of Kyoto protocol of GHG emission, Vietnamese companies may deal with legal and competitive obstacles if they do not change to cleaner production and consider environmental protection while doing business. Furthermore, Vietnamese companies' knowledge of EMA application is still limited. However, the author believes that this situation is just a latent phenomenon, Vietnamese companies would have recognized that EMA application could possibly bring benefits for them. From the experience of EMA development in many countries such as Germany, Japan, US, etc., all their projects were carried out by cooperation between corporations and researchers under the sponsor of the governmental agencies. Hopefully, Vietnamese companies could attend EMA projects of Vietnamese government or international organizations to implement and expand EMA application with more tools and for various management decisions. Besides, Vietnamese government could encourage EMA application by specific education, stricter environmental laws, and regulations. Indeed, both external and internal involvement is needed for promoting EMA implementation (Burritt, 2004). Expectantly the further research could be done under

Vietnamese government's promotion and nongovernment organization like APO's project to promote MFCA application in SMEs in Vietnam[38].

Regarding the local pollution, with a high number of seafood processing firms (37 firms) in the location area of the case studies, solutions for the environmental management caused by this industry are going to be the utmost concern. Besides, the processing phase plays an important role in sustainable food supply chain because this phase may decide how much waste is disposed of after processing in its life cycle. Hence, more proper environmental management for processing firms like such Vietnamese companies is also significant for solving global environmental problems and promoting sustainable supply chain in the upstream. Thus, the author hopes to continue to develop the research to many Vietnamese companies and build a model for EMA application as well as environmental management adoption.

In conclusion, in this thesis, the author tested the basic approach of MFCA and mainly focused on the material. However, it may be the useful background for further development in the near future in Vietnam. Besides, although at present, Vietnamese government imposes stricter environmental law but has not encouraged the development of environmental management tools and environmental management accounting tools in business organizations. Therefore, Vietnamese companies may lack knowledge and motivation of applying new management tools for cleaner production to get the higher economic return; though PDCA cycle management by using MFCA analysis may show a proper path for Vietnamese companies. Thus, the future development of EMA application in Vietnamese companies extremely needs the encouragement of the local government and external stakeholders like

[38] There were an agreement between 12 countries, Vietnam and Japan included, on developing and disseminating MFCA with the support of National Productivity Organization, APO and Japanese experts in 2015 in Indonesia.

customers. Consequently, more Vietnamese companies may assess the EMA knowledge and will be able to adopt EMA tools successfully.

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Appendix 1

Table 4.7. Environmental Accounting information of Ricoh (Source: Ricoh Environmental accounting data, 2015)

Category	**Costs of environmental conservation (100 million yen)**					**Economic benefits (100 million yen)**		
	Item	Investment	Year on Year (YOY) change	Costs	YOY change	Item	Monetary effect	YOY change
Business area	Pollution prevention/Global environmental conservation/Resource circulation	4.6	2.2	57.6	17.8	Energy savings and improved waste processing efficiency	24.4	14.6
Upstream/ downstream	Collecting products, turning recycled materials into saleable products	0.0	0.4	195.8	6.8	Sales of recycled products, etc.	218.5	18.4
Administration	Establishing and operating environmental management system	0.0	0.3	30.4	10.3			

Research & development	Research and development for environmental impact reduction	1.8	0.8	40.3	0.8			
Social activity	Environmental improvement measures, supporting environmental conservation activities	0.0	0.0	1.8	0.9			
Environmental remediation	Restoration of contaminated soil and damaged nature	0.0	0.0	1.0	0.1			
Total		6.4	2.3	326.9	21.2			

Table 4.7 (Continuous)

Appendix 2 Pictures of actual production process of Case 1

Appendix 2 (Continuous)

Appendix 2 (Continuous)

Appendix 2 (Continuous)

Appendix 2 (Continuous)

Appendix 3 Pictures of actual production process of Case 2

Appendix 3 (Continuous)

Appendix 3 (Continuous)

Appendix 4

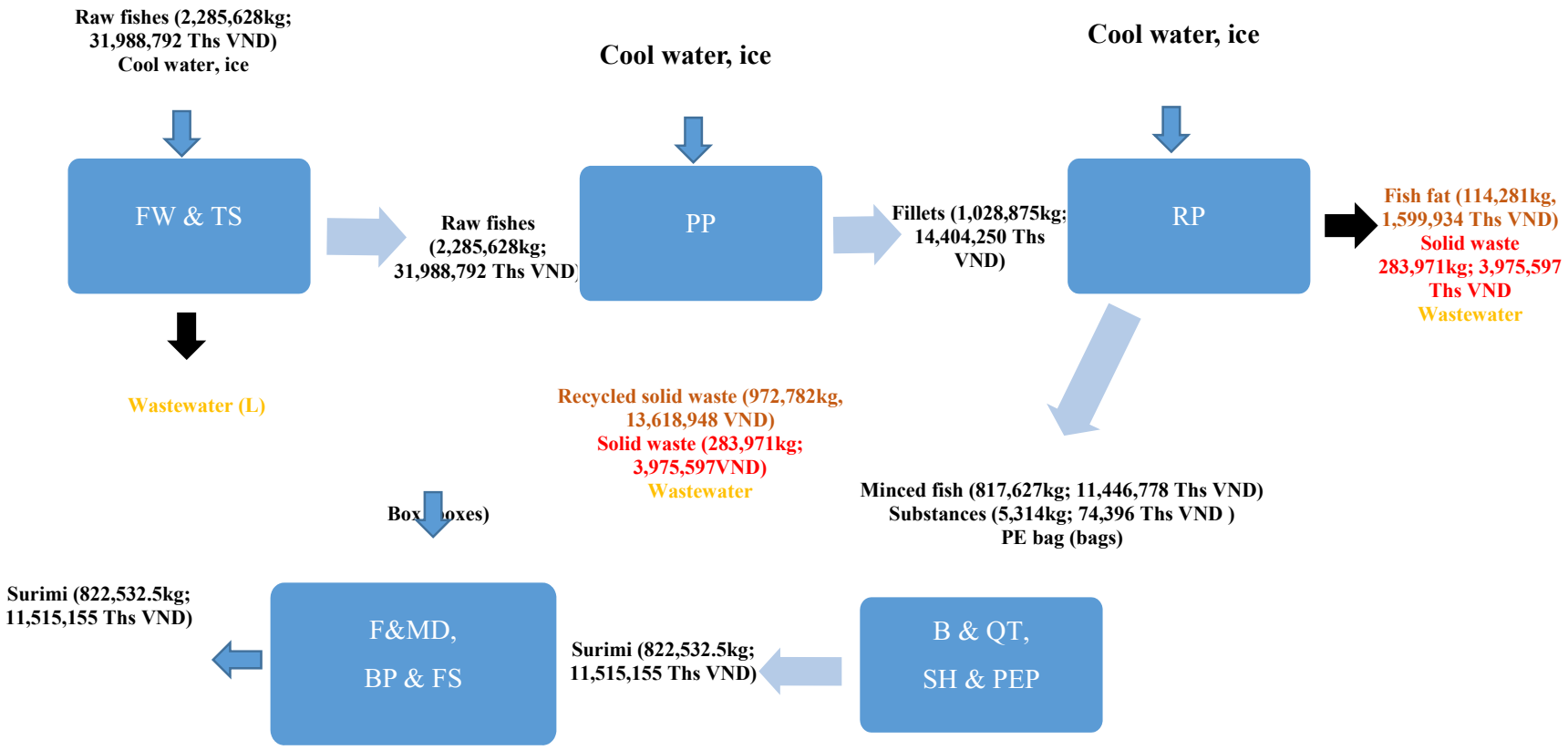

Figure 5.7. Material Flow Cost Accounting of Case 1

Appendix 5

Table 5.2. Material Flow Cost Matrix of Case study 1

Quantity center	**Product**		**Non-product**			
			Non-recycle		**Recycle**	
	Quantity (kg)	Cost 1,000 VND	Quantity (kg)	Cost 1,000 VND	Quantity (kg)	Cost 1,000 VND
FW and TS	Raw fishes		None		None	
	2,285,628	31,998,792				
PP	Fillets		**Solid waste**		Head, intestine, bone	
	1,028,875	14,404,250	283,971	3,975,594	972,782	13,618,948
RP	Minced fish		**Solid waste**		Fish fat	
	817,627	11,446,778	96,967	1,357,538	114,281	1,599,934
B and QC, SH and PEP	Surimi		Waste for quality checking		None	
	822,532.5	11,515,455	408.5	5,719		

F and MD, BP and FS	Surimi		None	None
	822,532.5	11,515,455		

Table 5.2 (Continuous)

Appendix 6

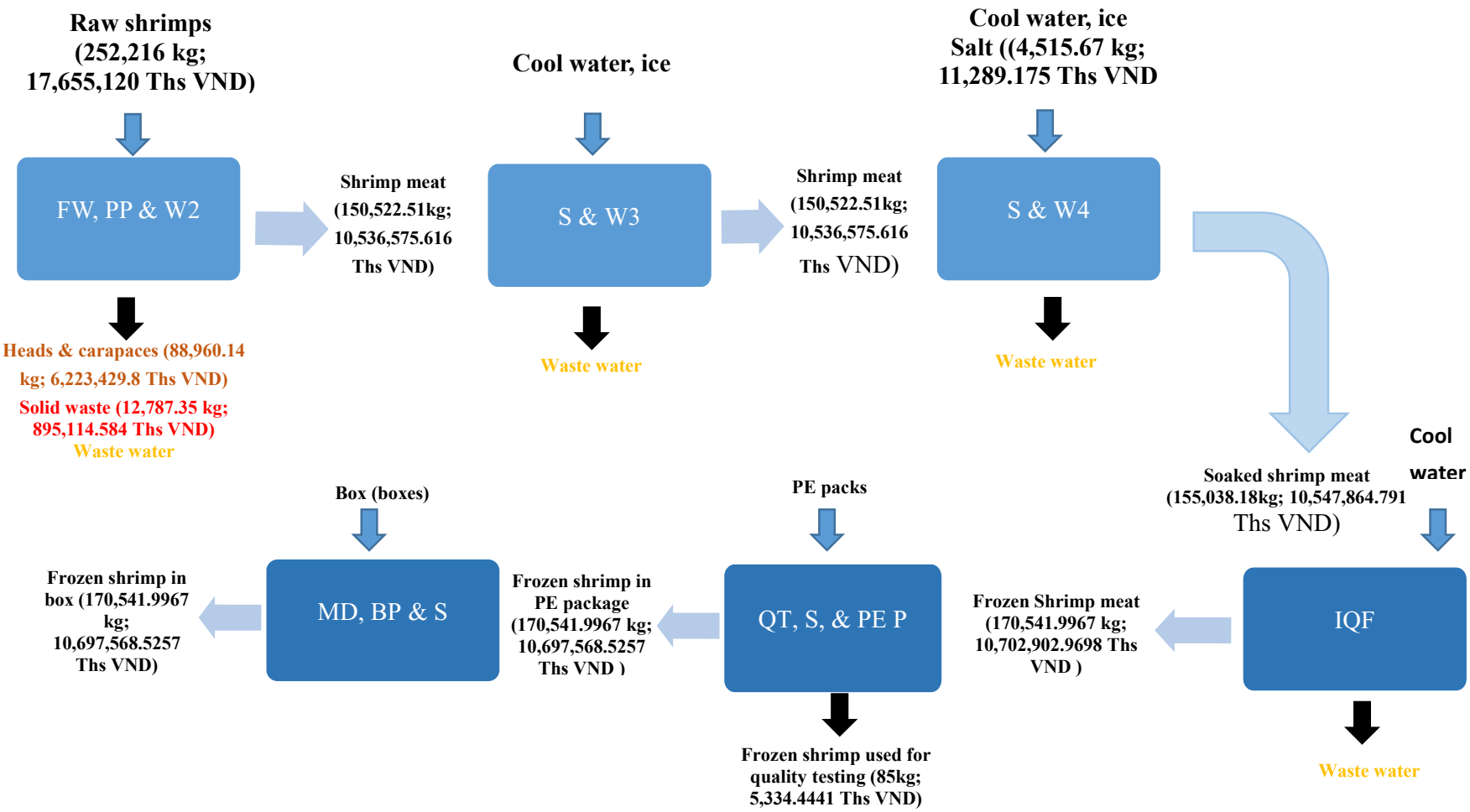

Figure 5.11. Material Flow Cost Accounting of Case 2

Appendix 7

Table 5.4. Material Flow Cost Matrix of Case study 2

Quality center	**Product**		**Non-product**			
			Non-recycle		**Recycle**	
	Quantity (Kg)	Cost 1,000 VND	Quantity (Kg)	Cost 1,000 VND	Quantity (Kg)	Cost 1,000 VND
W1&PP &W2	Raw shrimps		**Solid waste**		Heads & carapaces	
	252,216	17,655,120	**12,787.35**	**895,114.584**	88,960.14	6,223,429.8
SI & W3	Shrimp meat		None		None	
	150,522.51	10,536,575.616				
SO & W4	Soaked shrimp meat		None		None	
	155,038.18	10,547,864.791				
IQF	Frozen shrimp		None		None	
	170,541.9967	10,702,902.9698				
QT, SC & PEP	Frozen shrimp in PE pack		Frozen shrimp used for quality testing		None	
	170,541.9967	10,697,568.5257	85	5,334.4441		
MT, BP & ST	Frozen shrimp in carton box		None		None	
	170,541.9967	10,697,568.5257				