

# Material Flow Cost Accounting (MFCA) to green Supply Chain Management System : A Review

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## ABSTRACT

### Article Info

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This paper examines the potential of adopting material flow cost accounting (MFCA) to help generate innovation in green supply chain management while playing its essential role. A descriptive study for reducing material losses described in this paper was employed to inspect whether MFCA technique would achieve in material losses reduction among multiple suppliers through efforts by the buyer. With MFCA and green supply chain management combined, it can be seen that the implementation can potentially be used as strategic competitive tools for companies to solve logistical problems in order to win global competition. There is potential benefit between joint adoption of MFCA approach and green supply chain management as an integrated system. Despite the potential usefulness, there appear constraints of combining supply chain management system with MFCA approach to be addressed with further study. Those are technological developments and capabilities, environmental issues, global business competition, and the different point of view related to choice for responsive or efficient in business strategy.

### Article History

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## I. INTRODUCTION

In the concept of sustainable development, the process of development is expected can meet the need of present life without gives an adverse impact to the needs of future generation in utilizing the potential natural resources efficiently and effectively. In the company, the problem of efficiency and effectiveness

of the use of natural resources, especially in the cost of production always becomes a highlight by the financial report users. According to [11], production cost is the component of the main cost in manufacture's company.

The company should focus on the efficiency of the natural resources to minimize the production cost.

The argument about efficiency of natural resources especially related with the reduction and management of waste not only concern for scientists and environmental activist, but also the management executives [5]. Management is aware and has understood that traditional accounting system currently has limitations. The limitations will be felt when the accounting system is related with the business operations that associated with environmental management. The costs generally related to management waste, waste disposal, installation development, fees to the third parties, licensing fees, and others.

In attempts to contribute on the problem of reducing waste from different perspective, contemporary accounting management tool has been developed, namely Material Flow Cost Accounting (MFCA). The tool functions as an information provider are it financial and non-financial in order to support the decision on reducing waste by managers. MFCA particularly aims to manage the process of manufacturing related with material flow, energy, and data, thereby achieving a more efficient and appropriate manufacturing process with the target that had been determined [7,16]. The advantages of using MFCA concept is that it can potentially increase the profit and productivity (internal benefit) and also decrease an adverse effect toward the environment (external benefit) which further contributes in corporate sustainability development. Ref. [2] refers that the concept of corporate sustainable development is growing in last decade and has been the center of attention for business sector. Ref. [1] mentions that there are 5 (five) elements for company organization in developing sustainable environment, namely sustainable economy, social indicators, environment analysis, sustainable indicators which are selected independently and the material and resource used.

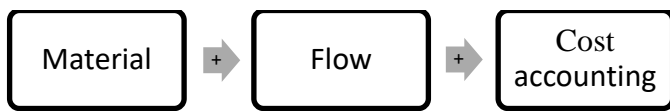
Among the prior study about MFCA is one that has been conducted by [11]. They conduct a research to design and implement MFCA in a factory processing

palm oil CPO to know its effect toward increasing the company's sustainability. It was shown that there was significant influence between implementation of MFCA and company's sustainability. Ref. [3] conducts a MFCA- based research by adopting and adjusting the framework of MFCA in supporting the management's decision of reducing waste. The result showed that there was an influence on the use technology and tool of management accounting in supporting the process of decision making of company management for reducing waste. Another study focusing on detection model of MFCA with environmental accounting shows that MFCA could be a model for detecting the production and company's business at the same time [10].

## **II. Material Flow Cost Accounting (MFCA)**

MFCA is a management information system that explores all input materials that flows during production process, and measures the output in final product and its waste. Moreover, [9] explain that the MFCA method will explore in detail the physical flow of material in production process; started from input, work in process, and final product. Then it calculates the cost of material by multiplied and qualified it to the other cost. Ref. [16] show an important idea from MFCA. In classic cost accounting, all of the costs are only allocated for production as a whole cost [10]. According to them, MFCA will divide the material cost into production cost and waste material; it depends on whether the material will end up on the storage, process or transportation. MFCA is developed because in conventional cost accounting, the potential of transparent information about the material's flow and energy including the management supporting decision related to increase the efficiency of material and energy used, are limited. In conventional cost accounting system, the cost of material and energy lost usually are not counted. Because the material costs become the dominant costs that can be allocated directly to production cost, the costs will directly be

charged to the cost center in the company's cost of goods sold. Therefore, the company management will directly focus to reduce it. Moreover ref. [7]-[8], [18] categorize MFCA as a management supporting tool that shows the material's flow by focusing on the importance of information to optimize the production process. Its purpose is to serve a system on output of the final items and show the importance of data collected from the MFCA system to optimize the manufacturing process.



**Material:** Material refers to any raw material, auxiliary material, component or part that is used to manufacture a product. Any material that does not become part of the final product considered material loss. In any process, waste and resource loss occur in different steps of the process, including:

- Material loss during processing, defective products, impurities
- Materials remaining in manufacturing equipment following set-ups
- Auxiliary materials such as solvents, detergents to wash equipment, water
- Raw material that becomes unusable for any reason

**Flow:** MFCA traces all input materials that flow through production processes and measures products and material loss (waste) in physical units using the following equation for different quantity center.

$$\text{Input} = \text{Products} + \text{Material loss (waste)}$$

**Cost Accounting:** Under MFCA, the flows and stocks of materials within an organization traced and quantified in physical units (e.g., mass, volume) and then assigned an associated cost. The four types of costs are quantified: material costs, system costs, energy costs, and waste management costs. Each cost is defined as follows:

**Material cost:** Cost for a substance that goes through a quantity center (measurement unit of input and

output for MFCA analysis). Typically, the purchase cost is used as material cost.

**Energy cost:** Cost for energy sources such as electricity, fuels, steam, heat, compressed air.

**System cost:** Cost incurred in the course of in-house handling of the material flows, excluding material cost, energy cost, and waste management cost.

**Waste management cost:** Cost for handling material losses.

### III. Sustainable Supply Chain Management

The world economy continues to grow, a clear positive impact on the level of welfare of the world, also produce negative effects on and environmental factors are very close relation to social factors of a nation. One that affects the country's economic growth is the sector transportation [15]. That is the importance of sustainable supply chain management concept. Ref. [2] describes sustainable supply chain management as the development of science in supply chain itself, in order to sustainable, it has to meet three main factors in terms of economic, social and environmental, as shown in Figure 1.

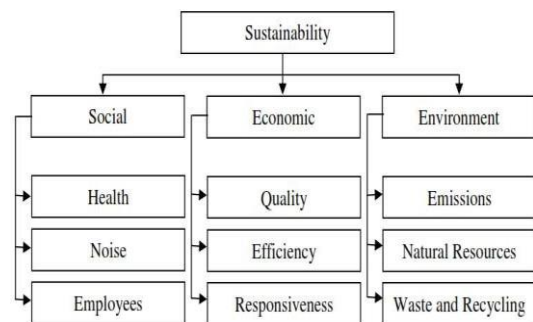


Figure 1. Matric Dimensions and Sub Dimension of Sustainable Supply Chain

The success or failure of implementing a management strategy consists of the following four factors [13]:

- The suitable company's strategy to face the business competition;
- Supply chain strategy;
- How to connect between corporate strategy and supply chain strategy; and
- How to make it possible in sustainability.

Supply chain management came into prominence during the years 1980-1990, due to business interests in logistics and operations management [6]. The most fundamental thing in implementation of supply chain management is how it can meet the demand of the market is very volatile, operational challenges, and face as well as adjusting for development in the chain of supply is itself such as environmental issues, and onwards. Five scopes of the decision are usually taken by the company, as shown in Figure 2. In terms of the application of the supply chain, whether taken individually or collectively:

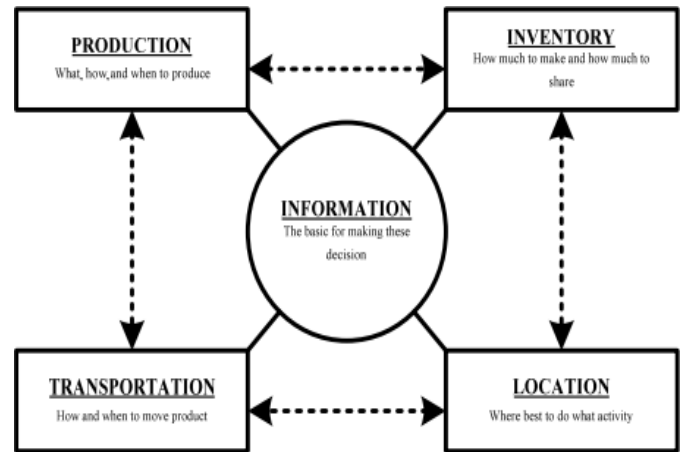


Figure 2. Supply Chain Drivers

1. Production, how relates to any product desired by the market? How many products have to be made either in the number or type and when being produced?
2. Inventory, relates to what items should be saved in a number of in particular? With the criteria such as how much to the raw materials, semi-finished and finished goods?
3. Location, with respect to which a production facility and warehouse should be placed? Where a production facility and warehouse has to offer the most cost- efficient?
4. Transportation, dealing with how the movement of goods or material from one chain to the next chain?
5. Information, how much data needs to be collected and shared?
6. How fast and accurate information will be provided between the coordination and decision-makers?

According to [6] there are three steps in connecting between supply chain with business strategy, as follows:

1. What are needed by the market?
2. What are the core competencies of an enterprise that will provide services to the market?
3. How to increase the level of capability that owned a supply chain company to support the many options that can be given to provide the best service to the market?

Those steps explain a different point of view related to choice for responsive or efficient in business strategy, as shown in Table 1.

Table 1. Responsiveness vs Efficiency

Supply Chain Drivers	Responsiveness	Efficiency
Production	Excess Capability Flexible manufacturing Many smaller factories	Little excess capability Narrow focus Few central plants

Inventory	High inventory levels Wide range of item	Low inventory levels fewer items
Location	Many location close to customers	Few central location serve wide areas
Transportation	Frequent Shipments Fast and flexible mode	Shipments few, large, slow, chapter mode
Information	Collect and share timely accurate data	Cost of information drops while others cost rise

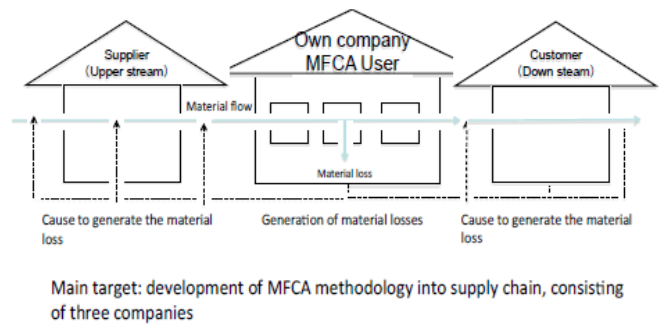
**IV. Discussion**

**MFCA Approach in Supply Chain Management**

Build on the [13]’s work, we attempt to introduce MFCA into supply chain management system. The objective is to achieve a low-carbon supply chain and to emphasize the necessity of raising awareness of environmental issues. The proposed approach is also to encourage information sharing with suppliers, e.g., boosting the role of the purchasing departments. Purchasing departments at present is not prepared to deal with environmental issue related to external benefit of MFCA concepts. Ref. [12] outline the global cooperation between supplier and buyer in supply chain management system in technological development. It is indicated that the impact of introducing MFCA in supply chains is different from the effect of its introduction in individual companies [14]. In addition, the analysis shows that there is significant potential to improve losses by changing the raw material in the supply chain. These factors

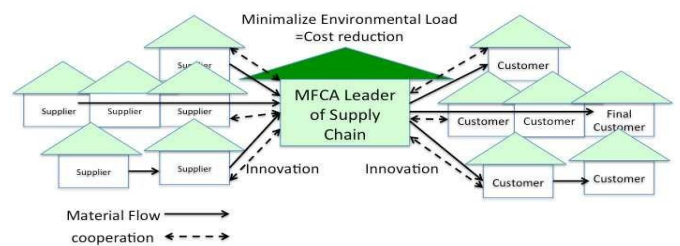
indicate that introducing MFCA in the supply chains has proved to be beneficial so far.

Based on [17], MFCA is applicable to the entire supply chain, covering the extraction of resources to the disposal of products, which is beyond the scope of the single organization. Figure 3 shows the MFCA application to individual organization relates to cost reduction and environmental management as well as MFCA application to supply chain management related to solving technical issues of competitiveness, enhancement of material productivity and business sustainability. MFCA has significant improvement that can be generally considered more widely than other existing productivity management approaches in supply chain management system.



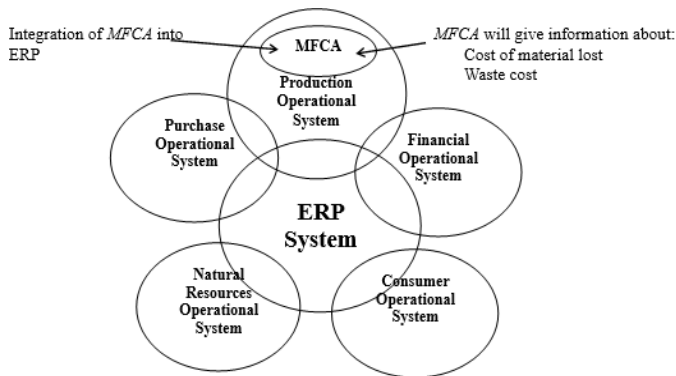
**Figure 3. Visualization of MFCA in Supply Chain**

There is potential collaboration between MFCA approach and supply chain management as a system. All information provided by MFCA consists of cost information deemed to be useful for decision-making within organizations, while price information is useful for decision-making about clients. But both cost and price are involved in collaboration between buyers and suppliers, and need to be systematized as information useful for decision-making.



**Figure 4. MFCA Leader of Supply Chain**

We need an integrated system that leads the supply chain management environment as shown in Figure 4. This system as shown in Figure 5, shall be synergized into Enterprises Resources Planning (ERP) as the integration of all information systems management and accounting to aid management in decision making, especially regarding information production waste, the cost of material loss, and the efficiency of production, to produce a product that is environmentally friendly and has industrial competitiveness. For that reason, the applicability of this article is specific on the supply chain management or material management modules that are typically exist in many ERP modules.



**Figure 5. Integrating MFCA to ERP System**

Having said that, there appear remaining constraints in supply chain management system when combining the MFCA approach:

- Technological developments including technological capabilities due to differences in each suppliers and buyers concerns to their manufacturing trading;
- Awareness of managements in environmental issues;
- Trend global economy which showed inflationary tendencies, due to global business competition that greatly improved; and
- The supply chain management system drive a different point of view related to choice for responsive or efficient in business strategy.

## V. CONCLUSION

This paper presents a conceptual design of how to integrate MFCA approach into supply chain management system. The benefit of MFCA approach is believed to be of valuable when it is placed in an integrated system environment. To be precise, where supply chain management module is utilized within an enterprise resources planning system.

We contend that the current paper has potentially pave a way to be further augmented into a more complete conceptual model or a more empirical investigation. Future works could expand the current work by extending the potential of MFCA in a more technically conceptual approach. For example, one could design the MFCA meta representation that needs to be modeled using popular class modeling in the context of supply chain management area. This meta representation could involve object of interest, such as risk, cost, and business process performance metrics. At the end of this study should be followed by qualitative research that takes some samples of individual expert in information system, supply chain management as well as MFCA to explore the potential usefulness of this approach.

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