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Approaching Material Flow Cost Accounting (MFCA) According To The Management Control System, Factors Affecting The Application Of MFCA In Businesses

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Abstract

Purpose – The article presents a new approach to implementing Material Flow Cost Accounting (MFCA) in enterprises, by including MFCA in strategic goals of enterprises through Management Control System (MSC). We show the specific steps (stages) to apply MFCA through an MSC-based approach, points to pay attention to applying MFCA. The article also outlines the differences between enterprises applying MFCA and those not applying MFCA, factors affecting the application of MFCA in manufacturing enterprises.

Methodology – We conduct the univariate and multivariate regression analysis, using Kolmogorov-Smirnov, Mann-Whitney tests to see if there is any difference between the two groups of enterprises: applied MFCA and not applied MFCA. By synthesizing questionnaires, using correlation analysis techniques, and multivariate regression analysis, we determine and measure the influence of factors on the application of MFCA in selected enterprises. In addition, by the method of document synthesis, we have outlined the stages or the ways to implement MFCA in enterprises, methods to bring MFCA into the control system of enterprises.

Findings – Our research finds a new approach, which is the application of MFCA in enterprises through MCS and Levels of control (LOC), linking MFCA with MCS, integrating sustainability goals into management controls and corporate strategy. We conclude that the group of manufacturing enterprises applying MFCA are those with larger ROE and ROA. The type of business, EPS, ROA, ROE have significant differences between business applying MFCA and not applying MFCA. The article also shows the correlation and influence of factors on the application of MFCA.

Practical implications – Our research finds a new approach, which is the application of MFCA in enterprises through MCS and Levels of control (LOC), linking MFCA with MCS, integrating sustainability goals into management controls and corporate strategy.

Social implications - The article shows how to apply MFCA in enterprises. This is one of the measures to effectively use natural resources, contributing to sustainable development for businesses and society.

Originality/value – The article presents a new way to apply MFCA in enterprises by including strategic goals of enterprises through MCS and LOC.

Research limitations: Future research may focus on adapting the existing logic of the MFCA approach to the material loop manufacturing process.

Keywords Material flow cost accounting (MFCA), Levers of Control (LOC), Residual material cost accounting (RMCA), Flow cost accounting (FCA), Management control system (MCS)

Paper type Research paper

1. INTRODUCTION

The world is facing the depletion of natural resources. Natural resources are vital to the

survival of a business. Therefore, businesses always require to improve the efficiency of using natural resources. One of the approaches of modern accounting is the material flow cost accounting method (MFCA). This is the only internationally standardized and most promising method for the efficient use of natural resources (Gold, S., Hahn, R., & Seuring, S. (2011). However, the goals of the methods can only be achieved if companies are committed to realizing these goals at the strategic level and implementing it at all levels of the company. Management control systems (MCS) play an important role in this process MCS is a system of a set of tools for implementing, communicating, and aligning an organization's strategies by monitoring and evaluating the dynamics of external as well as internal conditions (Chenhall, R. H., 2003). In other words, the strategy formulation is based on organizational goals, while the strategy implementation provides the tools to achieve these goals. An effective way to apply MFCA is to integrate resource efficiency goals at the strategic level by combining MFCA with MCS. Previous studies have not clearly shown the significance of combining MFCA with MSC, specifically Levers of Control (LOC), as well as how to apply MFCA to enterprises in detail. Therefore, we focus on studying the relationship between MFCA and MCS as well as LOC to use resources efficiently. LOC here includes belief system, boundary system, diagnostic control system, and interactive control system. We explain how to apply MFCA to the 4 levels of control. This is something that we have not seen fully covered in previous studies. Thereby, we also point out the issues to keep in mind when applying MFCA through LOC. We also outline the specific steps to be taken to apply MFCA in the enterprise through an MSC-based approach.

Our research focuses on solving the following issues:

• Is it possible to apply MFCA through MCS, LOC?

• How to apply MFCA in business? What are the stages of applying MFCA in enterprises?

• Is there any difference in EPS, ROA, ROE, Beta, etc. between the two groups of enterprises: applying MFCA and not applying MFCA?

• Correlation analysis and measurement of the influence of factors on the application of MFCA

The structure of the paper is as follows: First, we introduce the management control system and its role in corporate strategy, the things to pay attention to apply MFCA. Then, we show how to apply MFCA in the enterprise, the stages of MFCA integration and adoption. Through the data of 195 manufacturing enterprises in Vietnam, we clarify the differences in EPS, ROA, ROE, Beta, ... between two groups of enterprises: applying MFCA and not applying MFCA. Through the results of the questionnaires and techniques of correlation analysis, multivariate regression analysis, we identify and measure the influence of factors on the application of MFCA in manufacturing enterprises. We surveyed 195 manufacturing enterprises in Vietnam because, in recent times, these manufacturing enterprises have dumped waste into the environment, causing heavy damage to the environment. After that, they invested a sizable amount of capital to innovate the technology chain and the way of environmental management, making significant changes. We believe that our research results will give businesses a new approach, a new perception of the application of MFCA. Applying MFCA is not adding to the enterprise a complex information processing system, but rather a tool to realize a strategic goal, helping the business to develop sustainably. When turning it into a strategic goal, all levels of the business need to coordinate to achieve their goals.

2. Literature reviews

Durden, C. (2008) has integrated social responsibility into MCS and finds that social responsibility goals to be achieved must also be through MCS, especially formal control measures. On the other hand, informal controls, for example, social control or self-control, have a strong influence on managers' decisions regarding social responsibility. This, once again confirms that the application of MFCA through the MCS is reasonable. Arjaliès, D. L., & Mundy, J. (2013) also suggest that organizations should use MCS to enhance corporate social responsibility by applying the LOC framework. The case study by Riccaboni, A., & Leone, E. L. (2010) adds decentralized structures and cross-departmental collaboration to successfully implement strategies related to sustainability. The authors also highlight linkages with traditional control systems for planning and monitoring. The integration of environmental aspects into the MCS, known as the environmental management control system (EMCS), was introduced by Pondeville, S., Swaen, V., & De Rongé, Y. (2013).

3. Theoretical framework of research

3.1. Management control system and role in corporate strategy

The role of MFCA is undeniable, but some businesses are not ready to apply it yet. We need to understand and implement the MFCA approach to shape corporate strategy. There, strategy is the determination of the basic long-term goals of a business, and the application of active processes, and the allocation of resources necessary to realize these goals (Teece, D. J. (2010). To apply MFCA, it is necessary to have clear information for all employees to help them understand and implement the day-to-day decisions of the Board of Directors. The Board of Directors of the enterprise must also control the implementation of MFCA. All matters: management control, comprehensive underlying measures, and methods are grouped in a management control system (MCS). Marginson, D. E. (2002) presented processes and procedures based on information that managers use to maintain or change patterns in an organization's activities." According to him, the MSC consists of four control levers (LOCs): beliefs systems, boundary systems, diagnostic control systems, and interactive control systems, which are linked to the strategy to control other key metrics or values together.

The first lever is the belief systems, which are commitments to the purpose, fundamental values, and future direction of the organization, guiding the development, and decisions of the organization, usually are statements about the mission, vision of the entity. Belief systems, including codes of conduct that express rules, regulations, and limits to achieve a set goal (Widener, S. K., 2007). Both belief systems, boundary systems must be supported by control systems that ensure the achievement of goals, that is, diagnostic control systems and interactive control systems. Diagnostic control systems are considered feedback systems to monitor and ensure predictable goals, so this system requires the unit's key performance indicators that represent the stated strategy. In contrast, interactive control systems are designed as a formal information system to assist managers to engage in activities to achieve strategic goals. This system, therefore, represents both the opportunities and threats that the organization perceives when it wants to achieve its goals. LOC is the expression of two opposite sides of an issue, creating a balance consisting of two parts: (1) beliefs systems and interactive control systems represent the expansion of the organization's opportunity space, the stakeholders can be able to contribute to the main goals of the company; (2) boundary systems, diagnostic control systems represent a view that constrains only the actors in the organization to participate in the process of achieving a set goal.

3.2. Notes on integrating MFCA in enterprises

Apply to select the types of costs

In enterprises, the choice of which type of cost to control them is an important issue. Enterprises can use standard cost, actual cost, planned cost, the average cost to evaluate the cost. The choice of cost has a significant influence on the comparability and thus the applicability of MFCA in MCS (Wing, K., Onishi, and all, 2008). If using the comparison method between the actual cost of this period and the previous period, the disadvantage is that the cost cannot compensate for the fluctuation. The average cost method can overcome this drawback. Standard costs to compare planned costs are made in the future. From the above analysis, the MFCA method can theoretically use the actual cost method, however, to regularly use MFCA in the MCS for economic - environmental optimization of the businesses. The average cost should be applied because the determination of material lines is often accompanied by unit prices and quantities. Unit prices can change from period to period, so using the average price will give more accurate results. In addition, enterprises can apply MFCA in analyzing cost fluctuations (material or energy costs, waste management costs increased during the period...), product costs (costs going into production), finished product, the cost in waste), product selling price (taking into account both material loss and cost in waste) (Bierer, A., & Götze, U. (2012)

Consider the cost satisfactorily

MFCA provides MCS with a tool for directing the flow, allowing improvements in material handling and product processing leading to cost savings as well as reduced environmental impact (Loew, T., 2003). In addition, the approach of balancing the material flow, also allows enterprises to determine the amount of waste and materials discharged after the production process, helping enterprises to estimate the number of input materials that will be purchased for the next period… In addition to this cost view, businesses also classify costs into variable and fixed costs: Material and energy costs are variable costs, system costs, and waste management costs are mainly the fixed costs. An entity can also classify into predictable and unpredictable costs, external costs, and internal costs. Enterprises can also include energy costs in materials costs where energy costs must also include delivery, transportation, and internal supply costs for points of use (Bierer and Goetze, 2012). Enterprises can base on their specific characteristics to design the most reasonable cost structure, allowing to support planning and cost control as well as economic decision making.

Applying allocation criteria of cost

While direct costs can be determined for a specific cost object, direct costs are incurred for several cost objects and need to be charged to the associated cost centers. In MFCA, indirect costs are allocated based on specific allocation criteria rather than general rates. Using specific allocation criteria provides more accurate data on flow-related costs and thus increases the informational value of using MFCA in MCS. When applying MFCA, businesses need to pay attention to a two-step procedure: In the first step, costs are attributed to different cost centers, and in the second step, costs are calculated for cost units, i.e. products, co-products, and material losses. The allocation criteria identified should best reflect the main cost drivers and are at the discretion of the organizations. In general, businesses can use physical attributes to allocate costs. Different allocation criteria may be required for different types of expenses. In addition, the choice of allocation criteria must be based on the causal relationship between costs and cost objects (Rieckhof, R., Bergmann, A., & Guenther, E., 2015). Cause-and-effect allocation gives decision-makers at all levels of the organization more transparent insights and incentives to better assign responsibilities to reduce cost flows. In this way, planning, control, and

monitoring as well as process selection, production decisions, and product pricing can be supported. A cause-and-effect cost allocation standard must be as transparent, systematic, scalable, and prudent as possible to create acceptance among decision-makers. For costs in which there is no possibility of causal allocation, it is not necessary to make an allocation; instead, these costs should be given separately so as not to compromise the validity of the results. Furthermore, when using the allocation method, firms need to be careful to avoid the risk of double-counting costs already included in other types of costs (Haberl, H., Fischer-Kowalski, and all, 2004). For a manufacturing process enterprise where the material is rotated through various processes, in this case, the MFCA does not differ as to whether a material is incorporated directly into the product or whether it is recycled many times, as long as there is no material loss (Viere, T., Enden, J. V., & Schaltegger, S. (2011).

4. RESEARCH METHODS AND RESULTS

4.1. Methodology

Our research focuses on solving the following issues:

• Is it possible to apply MFCA through MCS, LOC?

• How to apply MFCA in business? What are the stages of applying MFCA in enterprises?

• Is there any difference in terms of EPS, ROA, ROE, Beta, etc. between the two groups of enterprises: MFCA is applied and MFCA is not applied?

• Correlation analysis and measurement of the influence of factors on the application of MFCA

To answer the research questions, we systematically reviewed the existing literature on MFCA and its precursor approaches concerning their correlation with the LOC framework to address this research gap. From the literature review, we first infer salient issues related to the relationship between MFCA and LOC, points for future development, and our considerations on the matter of research. During the research and development of the conceptual framework, we consulted many academics for valuable feedback.

We surveyed 195 businesses (in which 42/195 businesses have applied partial MFCA), the data includes EPS, ROA, ROE, Beta, Number of stock, Market capitalization, each index is calculated. on average in 3 years 2018, 2019, 2020. In addition, we also distributed 195 survey questionnaires to these 195 enterprises, the questions focused on 5 groups of factors affecting the application of MFCA in enterprises.

We solved 2 problems:

1. We conduct a univariate and multivariate regression analysis, using Kolmogorov-Smirnov, Mann-Whitney tests to see if there is any difference between the two groups of enterprises: MFCA has been applied and not applied MFCA.

2. By synthesizing questionnaires, using correlation analysis techniques, multivariate regression analysis to determine and measure the influence of factors on the application of MFCA in surveyed enterprises.

4.2 Discussion and results

4.2.1. Systematic evaluation of research on MFCA and LOC

After studying the published publications related to MFCA, LOC we obtained the following summary of the relationship between MFCA and LOC:

As argued above, integrating the MFCA tool into the MCS requires that all LOCs be mobilized to support purposefully. We review the literature on MFCA and its predecessors based on the LOC framework of Simons, 1995. Next, we infer conclusions about the correlation between MFCA and the four LOCs from the compiled literature. Previous studies mainly focused on two LOCs: beliefs systems, boundary systems.

4.2.2. How to apply MFCA in business

a. Combining MFCA with the information system in the enterprise

To achieve the full effectiveness of MFCA as a routine, systematic and comprehensive analysis tool of MCS, the data collection of MFCA must be linked to existing information systems. However, when integrating with existing information systems, businesses may face some challenges because the information system already exists, organizations often have little incentive to extend it to information systems based on existing information systems on material flows because they consider the existing indicators to be sufficient (Loew et al., 2004). Therefore, MFCA is often still implemented solely as a separate system in separate applications. However, for regular use of MFCA in MCS, integration with existing information systems is required. For this purpose, the implementation of MFCA will gradually adapt to the information system. The process of applying MFCA can go through the following steps: Step 1: Enterprises can use their system to deploy MFCA to evaluate and learn from experience. If the synchronous implementation is not yet possible, it is possible to focus on the area of ecological environmental impact. Step 2: For continuous economic-environmental improvement of processes or products, ongoing MFCA assessments are required to avoid duplicate data collection and the risk of isolated assessments. The integration of MFCA into existing information systems depends on the size of the organization: small and medium-sized organizations can integrate MFCA using a database, large organizations are encouraged the incorporating it into their information systems, such as incorporating it into enterprise resource planning (ERP), SAP R/3, and enterprise environmental information systems to create combinations in data collection (eg, Christ, K. L., & Burritt, R. L., 2015).

The integration of ERP and enterprise environmental information systems requires the adaptation of data structures as well as accounting and forecasting reporting functions to provide the necessary information to MFCA. To facilitate the implementation of MFCA, material flows must be separately reported and managed at a specific cost center to create a cause-and-effect relationship and define organizational accountability. The information reported should include storage information, production order data, material quantity information per cost center, and process and machine data (Strobel, M., & Redmann, C., 2002).

b. Combine MFCA with traditional cost accounting

Combining MFCA with traditional cost accounting can enhance the information value and thus improve the efficiency of MCS (Guenther, E., Rieckhof, R., Walz, M., & Schrack, D., 2017). However, if MFCA is combined with traditional accounting, there will be many complications, so businesses often choose the solution to improve traditional accounting in the direction of applying MFCA. Businesses should first improve their conventional control processes to identify flow-based cost and impact drivers for a broad range of instruments of operational cost management for process optimization. Businesses can use tools such as strategic cost, balance scorecard, budgeting, cost-benefit analysis, breakeven analysis, price forecasting. In the long run, MFCA can take into account the determination of raw material consumption value, added value as well as profit and loss statement and some other financial indicators. From there, the application of MFCA will spread to the rest of the LOC: diagnostic control systems and interactive control systems. Doing this takes some time and harmonizes with boundary systems and may need to be combined with a lifecycle costing approach.

c. Information reporting problem

When MFCA is applied on the MCS platform, the main function of MFCA is to provide information to support the

decision-making of managers. Since then, due to the approach to material flow accounting, the information provided will be different from the environmental management accounting system. The functions of diagnostic control systems and interactive control systems are brought into play. As such, a cost stream report will be drawn up with the monetary information acting as a cause-and-effect model. The report should include information on the input of the material, the cost in progress at the production stage, the value of the finished product, and the amount of material lost. From there, managers can see the points that need to be improved in the production process (if any). Combining physical and monetary information into a single number containing an additional information value is very useful compared to traditional cost accounting methods. Business managers see the links of the organization to have a unified overview. In addition, reports under the MFCA can be designed to show finished product costing information and costs going into waste as well as material loss. Another type of report is described in the form of a flow cost matrix, which shows the material inputs and physical transformations of the materials to produce work in progress, finished products, and finished products. defective products, waste, loss of materials. It is these report templates that contribute to the use of diagnostic control systems and increase transparency over associated flows and costs, enabling organizations to better analyze existing conditions related to profitability. and environmental impacts. MFCA reporting should be incorporated into the company's regular reporting system. First, the MFCA report can be used for internal reporting for use by the environmental management system. Then it can also serve for external reporting to form an effective communication tool. Intending to reduce the material loss, the MFCA method provides incentives for businesses to develop and design new products, technologies, or change production processes.

d. Metrics to measure performance which MFCA

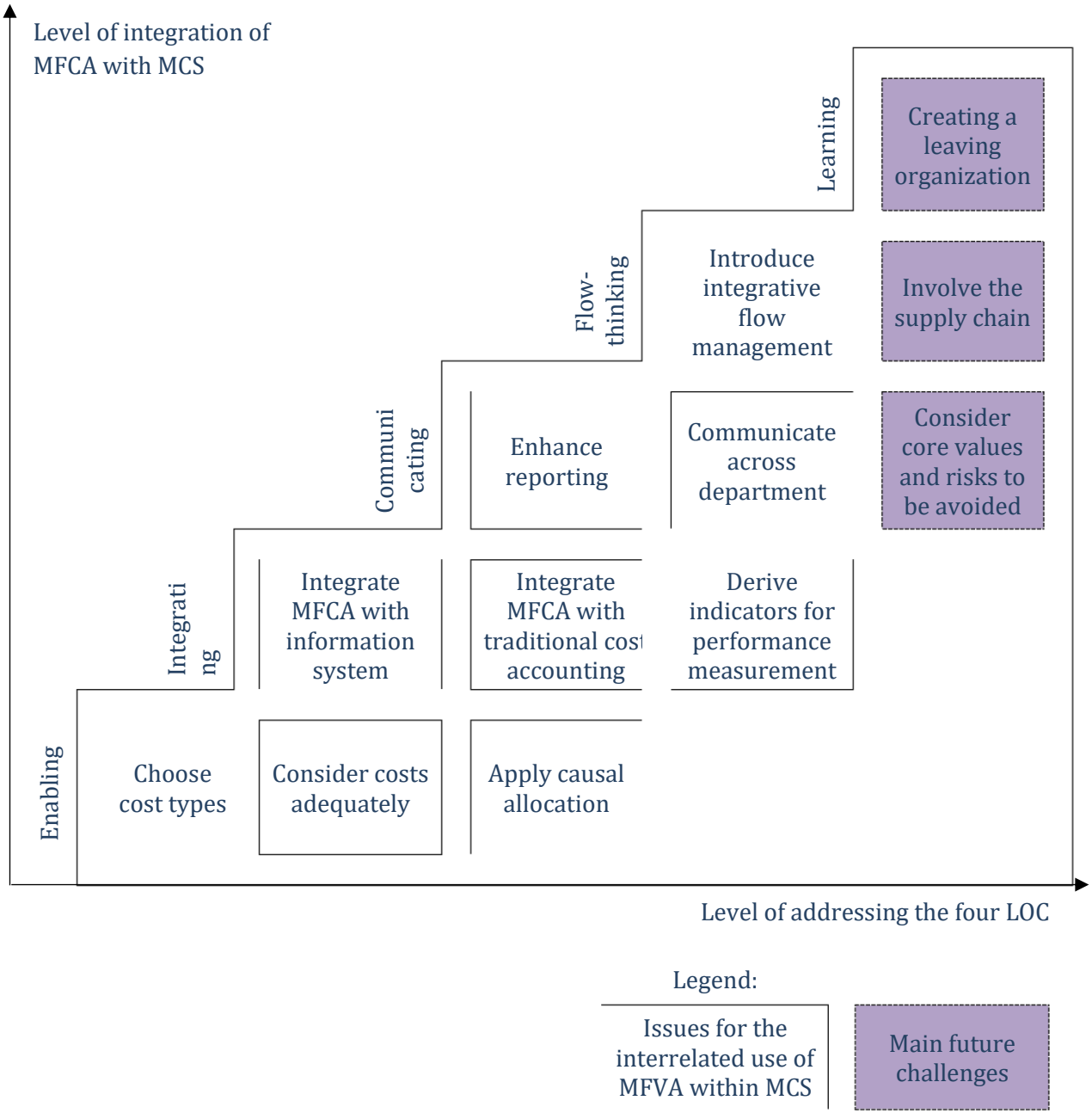
When applying MFCA with the MCS tool to monitor and evaluate the environment through diagnostic control systems and interactive control systems. Henri, J. F., & Journeault, M. (2010) introduced four ways to incorporate MFCA into MCS: (1) Use performance metrics in both physical and monetary terms (e.g. energy inputs, outputs of solid waste, financial impact metrics, etc.), (2) use them to monitor compliance, support decision making, drive continuous improvement and external reporting, identify properly identify strengths and weaknesses (3) assign specific goals in planning environmental costs, income and investments, and (4) link environmental objectives to indicators effective performance". With the information reported, the MFCA allows conclusions about the environmental impacts that may be caused by or even affecting the organization. In addition, MFCA data and indicators can be used for external communication to stakeholders. The MFCA's metrics about process organization, and supply chain can help businesses better collaborate with external supply chains.

4.2.3. Stages of MFCA implementation through the MCS and LOC tools

We have summarized that there are 5 stages for gradual integration of MFCA into MCS. Enterprises do not necessarily immediately reach stage 5, but can gradually implement MFCA integration from stage 1 onwards. Each stage has implemented resource efficiency goals as part of the corporate strategy and thereby led the way to more sustainable development. The five stages: Enabling, Integrating, Communicating, Flow-thinking, and Learning are described in more detail below. The first three phases focus on diagnostic control systems, and interactive control systems; The following 2 stages are used to resolve all LOCs. A graph with the horizontal axis showing the

extent to which the four LOCs are addressed and the vertical axis the degree of MFCA integration in the MCS shows the five stages of MFCA implementation in the enterprise (Rieckhof, R., Bergmann, A., & Guenther, E. (2015).

Figure 1 - Stages of applying MFCA in business



Enabling: This phase allows data to be collected regularly to assess flexibility and transparency on cost flows, to better motivate employees, and assign responsibilities. Data should be collected in the format normally required by an expense recognition system. At this stage, average and standard cost methods can be used to form the basis for balancing volatility and supporting strategic functions. Direct costs are recorded to normal cost objects, indirect costs use appropriate allocation criteria to increase the information value for the evaluation of the process using MCS. At this stage, the cost classification will begin to be approached according to the MFCA classification: material costs, energy costs, system costs, and waste management. This is how to move from environmental cost management accounting to MFCA's integrated economic-environmental assessment.

Integrating: This is the phase that combines data collection and data evaluation. At this stage, it is necessary to adjust the existing information system to manage the required data according to the MFCA. This is the phase of gradual improvement of the traditional cost accounting system to a flow-based costing system. Enterprises can add investment evaluation methods (e.g. life cycle costs) to assess future states in the MCS. This is the stage where MFCA-based indicators were used through the MCS and considered as measurement tools for continuous monitoring and evaluation.

Communicating: Communicating is the 3rd stage, the application of MFCA has reached the provision of information through the MFCA reporting forms. The report shows the material flow of the whole unit, so it shows the communication between the departments, shows the value of each part, the risks to avoid in each department. Therefore, this stage also showed two controls: beliefs systems, boundary systems. During this phase, external costs are also considered to support decision-making and risk assessment.

Flow-thinking: This phase focuses on the issue of introducing integrative flow management. Integrative flow management is a step up from conventional MCS and management thinking by focusing on flows related to corporate communication, thinking, and structure. Therefore, this phase needs to integrate flow thinking across all levels of management, leading to the involvement of the entire supply chain. In particular, at this stage, goal conflicts become more apparent as the number of actors and decision criteria increases. Therefore, there is a need for multi-criteria-based decision-making methods by applying whole supply chain assessments and reporting in a consolidated report. Thus, the role of MCS can be further enhanced. Stages 1 to 4, MFCA has been gradually implemented, the main functions of MCS are increasingly fully demonstrated.

Learning: Based on the practice of applying MFCA, organizational learning can help to get a clear picture and adapt to new requirements from the application of MFCA

4.2.4. Factors affecting the application of MFCA in enterprises

4.2.4.1. Research sample

According to Hair, J. F., Gabriel, M., & Patel, V. (2014). and Tu, J. C., & Huang, H. S. (2019), for an estimated variable, the minimum sample size needed for this study is n with n> 50 + 8× number of variables = 50 + 8×18 = 194, we decided to choose 195 for the sample size.

The sample in the official study was conducted by a non-probability sampling method, collecting data from 195 enterprises out of more than 1800 manufacturing enterprises (According to the Securities Commission of Vietnam). Our quantitative study consists of 2 parts: (1) to examine the difference between 2 groups of enterprises: partially applying MFCA and not applying MFCA, the basic data of businesses are taken from the General Statistics Office data through the website: www.cophieu68.vn; (2) to identify

and measure the influence of factors on the application of MFCA, we surveyed 195 enterprises (18 rubber processing enterprises, 42 mineral enterprises, 32 plastic packaging enterprises, 15 fertilizer enterprises, 26 steel manufacturing enterprises, 55 food processing enterprises). 195 questionnaires were distributed to 195 enterprises. The people who were given questionnaires are business leaders, chief accountants, and accountants. Survey period is from September 2020 to April 2021.

Table 1 Statistics of surveyed firms by industry sectors:

STT	**Scope of activity**	**Number of firms**	**Proportion**
1	Rubber processing	21	10,8%
2	Mineral	42	21,5%
3	Plastic packaging	32	16,4%
4	Fertilizer	19	9,7%
5	Steel manufacturing	26	13,3%
6	Food processing	55	28,3%
	Total	195	100%

Research models and hypotheses

We have distributed questionnaires to test the factors affecting the application of MFCA in enterprises. We then conclude that: MFCA depends on the company's strategy, the level of clean and sustainable production, and the views of its leaders and shareholders.

The paper uses the logistic regression model to measure the impact of macro factors on MFCA application in manufacturing enterprises in Vietnam. The dependent variable in binary is encoded into two values 0 and 1 to estimate the applicability of MFCA. We pre-identified 41/195 businesses that had partially applied MFCA (numbered 1), the rest were businesses that did not apply MFCA (number 0). Therefore, the paper will use the logistic regression method, a popular method of the positive accounting theory, according to Kolsi, M., & Zehri, F. (2013). Based on inheritance, the article building the research model is expected as follows:

$$\textbf{LOGIT [MFCA =1]} = \alpha 0 + \alpha 1 * \textbf{DOCU} + \alpha 2 * \textbf{CHAIN} + \alpha 3 * \textbf{STRATE} + \alpha 4 * \textbf{CHARAC} + \alpha 5 * \textbf{ACCOU} + \varepsilon \quad \textbf{(M1)}$$

Dependent variable: is a dummy variable, takes the value of 1 if the enterprise applies MFCA and takes the value of 0 if the enterprise does not apply MFCA.

Independent variables: DOCU, CHAIN, STRATE, CHARAC, ACCOU

Parameters: α0, α1, α2,… .., αn; Error: ε

The independent variables and the dependent variables

	Legal document system related to MFCA (DOCU)
1	Timeliness and suitability of the legal document system related to MFCA (DTIME)
2	Completeness of legal documents related to MFCA (DFULL)
3	The enforcement of the legal system of legal documents related to MFCA (DFORCE)
	Characteristics of Supply Chain (CHAIN)
4	Pressure from supplier require businesses to apply sustainable accounting (CHSUPP)
5	Pressure from customers require businesses to apply sustainable accounting (CHCLIE)
6	Competitor pressure require businesses to apply sustainable accounting (CHCOMP)
7	Pressure from employees require businesses to apply sustainable accounting (CHEMPLO)
	Strategy of the business (STRATE)

8	Strategies for effective use of resources require businesses to apply sustainable accounting (SRESOR)
9	Sustainable development strategy requires businesses to apply sustainability accounting (SSUS)
10	Clean production strategy requires businesses to apply sustainable accounting (SCLEA)
11	Ensuring the interests of stakeholders requires businesses to apply sustainable accounting (SSHA)
	Characteristics of the business (CHARAC)
12	Production technology is updated with MFCA (CHPRO)
13	Managers' competencies ensure the application of sustainable accounting (CHMANA))
14	Information system ensure the application of sustainable accounting (CHINFO)
15	Tools and methods of measuring inputs and outputs to enable sustainable accounting measurement (CHAMEDS)
	Enterprise accounting system (ACCOU)
16	The level of accounting staff of the enterprise is capable of applying sustainable accounting (ACAPA)
17	Accounting information system ensures sustainable accounting application (AINFO)
18	Application of modern technology ensures sustainable accounting application (ATECH)
	Applying material flow cost accounting (MFCA)

Select a survey sample

The sample size depends on the method of processing the regression model. Hair, J. F., Gabriel, M., & Patel, V. (2014) assumed that a minimum sample size of 50, preferably 100, and an observed-to-measure ratio (N / p) of 5: 1 means that a measurement variable requires a minimum of 5 observations, preferably 10: 1 or more. The number of independent variables is 18, the number of dependent variables is 1 variable. The formal sample size is n = 195 is suitable. The article uses descriptive statistical methods and regression analysis to analyze the data. The author used the tool is SPSS 22 software

Research hypotheses

Hypothesis H1: Factors in the system of legal documents related to MFCA that affect the application of MFCA in manufacturing enterprises

Hypothesis H2: Factors in the supply chain of enterprises that affect the application of MFCA in manufacturing enterprises

Hypothesis H3: Enterprise's strategy affects the application of MFCA in manufacturing enterprises

Hypothesis H4: Firm-specific factors affect the application of MFCA in manufacturing enterprises

Hypothesis H5: Factors of an enterprise's accounting system that affect the application of MFCA in manufacturing enterprises

4.2.4.2. Research results

a. Descriptive statistics:

• *General descriptive statistical analysis*:

The statistical analysis describes the data of EPS, PE, ROA, ROE of 195 manufacturing enterprises. This is the average data in 3 years 2018, 2019, 2020 of 195 manufacturing enterprises in 6 industries:

Table 1 - Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
EPS	195	-29.0	27.6	1.463	4.1073
ROA	195	-49.00%	32.00%	3.2557%	9.24924%

ROE	195	-40.00%	42.00%	7.76%	12.08667%
Beta	195	-1.27	4.80	.3266	.59816
Number of stock	195	1190000	3313173359	106440033.76	321988273.634
Market capitalization	195	9	229059	4685.04	22614.112
Valid N (listwise)	195				

The results of the group descriptive statistical analysis showed that among Business size is shown by the market with the average value of 4685.04 billion VND (the exchange rate is about 23,000 VND/ 1 USD). In which, the enterprise with the largest scale is 229 059 billion VND dong and the business with the lowest asset scale is 9 billion VND. The average ROE of the survey group is 7.76%, ROE ratio for the largest business is 42%, for the smallest business is -40%. The average ROA of the survey group is 3,256%, ROA ratio for the largest business is 32%, for the smallest business is -49%. The survey questionnaires show that 41/195 enterprises have applied MFCA, accounting for 21.2%.

- *Descriptive statistical analysis for two groups of enterprises:*

Group of enterprises that apply MFCA and groups of businesses that do not apply MFCA - *For groups of enterprises applying MFCA*

Table 2 - Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
EPS	41	-29.0	12.2	1.463	5.8899
ROA	41	-38.00%	16.00%	5.1724%	10.00178%
ROE	41	5.00%	36.00%	16.4195%	6.09472%
Beta	41	-1.27	1.66	.3276	.51030
Number of stock	41	1904400	3313173359	132509169.56	515871084.953
Market capitalization	41	14	140815	4724.41	21921.614
Valid N (listwise)	41				

Table 3- Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
EPS	154	-3.5	27.6	1.452	3.5101
ROA	154	-49.00%	32.00%	2.7455%	9.00409%
ROE	154	-40.00%	42.00%	5.4545%	12.25070%
Beta	154	-.93	4.80	.3264	.62096
Number of stock	154	1190000	2089955445	99499549.55	248301815.434
Market capitalization	154	9	229059	4674.56	22864.885
Valid N (listwise)	154				

Tables 2 and 3 show that: The average EPS and market capitalization of enterprises applying MFCA and not applying MFCA do not have much difference (1463 thousand VND and 1452 thousand VND), (4724.41 billion VND and 4674,56 billion VND). However, the ratio of ROA and ROE of enterprises applying MFCA is much higher than that of enterprises not applying MFCA (5.17% and 2.74%), (16.42% and 5.45%).

b. Regression analysis

Univariate analysis

Univariate analysis determines the impact of each independent variable on MFCA application. The paper compares two groups as described above. Kolmogorov-Smirnov test to test whether the data's distribution hypothesis is consistent with the theoretical distribution. With a sample size greater than 50, it is advisable to use this test. The sample has a normal distribution when Sig. > 0.05. The Kolmogorov-Smirnov test is less than 0.05, continues to perform the Mann-Whitney test to compare the average ranking of one variable among the two groups of observations (manufacturing firms applied MFCA and manufacturing enterprises not applied MFCA).

Univariate analysis for groups of factors Inspection:

Kolmogorov-Simirnov:

Because the sample size is 195 enterprises (> 50) according to A. Sahu, R. Padhy, Debabrata Das, Amitosh Gautam, (2021) and Huixiang Zeng, Z. Zhou, X. Xiao, 2019) should use the Kolmogorov-Smirnov test to determine the distribution of the sample. All independent variables in the model have the value Sig. = 0 (<0.05) indicates that the data has no normal distribution. Therefore, the Mann-Whitney non-parametric test is used for the next test step

Table 4 - One-Sample Kolmogorov-Smirnov Test

		PE	EPS	Number of stock	Beta	Market capitalization
N		41	41	41	41	41
Normal Parameters[a,b]	Mean	8.434	1.463	132509169.56	.3276	4724.17
	Std. Deviation	9.9089	5.8899	515871084.953	.51030	21921.667
Most Extreme Differences	Absolute	.240	.304	.414	.181	.415
	Positive	.240	.199	.414	.123	.398

	Negative	-.159	-.304	-.400	-.181	-.415
Test Statistic		.240	.304	.414	.181	.415
Asymp. Sig. (2-tailed)		.000[c]	.000[c]	.000[c]	.002[c]	.000[c]
a. Test distribution is Normal.						
b. Calculated from data.						
c. Lilliefors Significance Correction.						

Non-parametric test Mann-Whitney:

This test helps to compare the mean values of the variables for 2 groups of firms with and without MFCA application.

Table 5 - Test Statistical

	Type company	PE	EPS	ROA	ROE	Beta	Number of stock	Market capitalization
Mann-Whitney U	1616	2734.5	1912	1887.5	766	2937	3051	3003
Wilcoxon W	2477	3595.5	13847	13822.50	12701	14872	3912	14938
Z	-4.924	-1.316	-3.881	-3.962	-7.451	-.692	-.330	-.480
Asymp. Sig. (2-tailed)	.000	.188	.000	.000	.000	.489	.741	.632
a. Grouping Variable: MFCA								

The results of Mann-Whitney test for factor groups show that: Factor Type company, EPS, ROA, ROE has a significant difference in applying MFCA and not applying MFCA. The remaining factors such as PE, Beta, Number of stock, Market capitalization did not differ significantly for the group of enterprises that applied MFCA and did not apply MFCA.

Test correlation between variables

Thus, we have finished the descriptive statistics section, now we move to the quantitative research section from the results obtained in the survey forms with 6 groups of independent variables and the dependent variable is MFCA.

Table 6 – Correlations

		MFCA	DOCU	CHAIN	STRATE	CHARAC	ACCOU
MFCA	Pearson Correlation	1	0.565	.101	.692**	.361**	0.100
	Sig. (2-tailed)		.835	.001	.007	.000	.002
	N	195	195	195	195	195	195
DOCU	Pearson Correlation	-.015	1	.030	-.014	.024	-.228**
	Sig. (2-tailed)	.835		.677	.842	.738	.001
	N	195	195	195	195	195	195
CHAIN	Pearson Correlation	.101	.030	1	.042	.014	-.032
	Sig. (2-tailed)	.001	.677		.564	.001	.002
	N	195	195	195	195	195	195

STRATE	Pearson Correlation	.192**	-.014	.042	1	.346**	.047
	Sig. (2-tailed)	.007	.842	.564		.000	.517
	N	195	195	195	195	195	195
CHARAC	Pearson Correlation	.361**	.024	.014	.446**	1	-.050
	Sig. (2-tailed)	.000	.003	.002	.000		.002
	N	195	195	195	195	195	195
ACCOU	Pearson Correlation	-.100	-.528	-.032	.047	-.050	1
	Sig. (2-tailed)	.002	.001	.002	.0017	.004	
	N	195	195	195	195	195	195
**. Correlation is significant at the 0.01 level (2-tailed).							

Table 6 shows CHAIN, CHARAC, ACCOU with the value of Sig. <0.05 proves this variable has a linear correlation with the variable MFCA. *Hypothesis H2, H4, H5 are accepted.*

The variables DOCU, STRATE have the value Sig. > 0.05 so there is no linear correlation with MFCA. Two independent variables required no correlation with each other, ie value Sig> 0.05. The independent variables have Sig <0.05 but have Pearson Correlation> 0.4 (According to Hoang Trong & Chu Nguyen Mong Ngoc, 2005.), there is the phenomenon of multicollinearity: CHARAC variable has sig 0.000, has Pearson Correlation with variable STRATE is 0.446, on the other hand, STRATE also has Pearson Correlation with DOCU of 0.842> 0.8 with multicollinearity phenomenon (so exclude variable STRATE); ACCOU variable has sig 0.001, has Pearson Correlation with DOCU variable is -0.528, on the other hand, DOCU also has Pearson Correlation with MFCA is 0.835> 0.8, so there is multicollinearity phenomenon (so exclude DOCU variable). *Hypotheses H1, H3 are rejected.*

Multivariate analysis

The purpose of multivariate analysis is to examine the effects of the independent variables on the application of MFCA using logistic regression functions. This model is a popular approach to analyze and measure the correlation between the independent and dependent variables by estimating probabilities to analyze binary data (Fernando Acabado Romana, 2020 and Huixiang Zeng, Z. Zhou, X. Xiao, 2019).

If the Wald test has Sig <0.05, it proves that the variable is statistically significant with the 5% significance level. Next, test the suitability of the model through the level of prediction accuracy and the suitability level of the model (Omnibus Test). The level of accuracy forecast based on Overall Percentage shows the percentage of correct prediction of the entire model, the higher the index, the more appropriate the model. The relevance of the model (Omnibus Tests of Model Coefficients) with the index Sig. <0.05 shows that the independent variable has a linear relationship with the dependent variable in the population or the selected model is appropriate. The overall suitability was assessed by the criteria of -2LL (-2 Log Likelihood). The smaller the -2LL value, the higher relevance. A minimum value of -2LL is 0 (no error) then the model has a perfect fit.

Multivariate analysis with groups of factors

The study examined the impact of factors on the application of MFCA using logistics regression for the model. The dependent variable is the dummy variable that will receive the value 1 if the business applies

MFCA until 31/12/2020 or receives 0 if the business do not apply MFCA. Multivariate analysis of all 195 firms in Vietnam. The results of the implementation of logistic regression with the dependent variable MFCA are as follows:

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	.432	1.117		.387	.042	1.771	2.635
	CHAIN	.788	.063	.793	1.394	.016	.037	.213
	CHARAC	.944	.178	.856	5.313	.000	.593	1.294
	ACCOU	.384	.156	.279	1.179	.0240	.492	.124

a. Dependent Variable: MFCA

The Logistic regression function of the model is estimated in the form:

Ln (p/(1-p)) = 0,432 + 0,944 * CHARAC + 0,788 * CHAIN + 0,384 * ACCOU

5. CONCLUSION:

Our research is that the approach of applying MFCA in enterprises through MCS and 4 LOC will help businesses use resources efficiently, bringing sustainable development into the business's strategy. From previous studies on integrating sustainability goals into corporate strategy and management controls, we added a new research approach by linking MFCA with MCS. We have highlighted the view of using MFCA from an enterprise strategy approach based on MCS and LOC. We believe that this approach will allow business managers to accept the inclusion of MFCA in their development strategy, considering MFCA as the core tool of management control to support strategy implementation. We believe this research approach can be applied to other sustainability control methods by integrating into MCS to incorporate the selected control objective into corporate strategy.

With survey and investigation data from 195 manufacturing enterprises in Vietnam, we conclude: According to descriptive statistics, the group of manufacturing companies applying MFCA are those with ROE and ROA much larger. The company's sectoral factors, EPS, ROA, ROE are significantly different in applying MFCA and not applying MFCA. For test results and regression analysis: CHAIN, CHARAC, ACCOU have values of Sig. <0.05 indicates that these variables have a linear correlation with the MFCA variable. The variables DOCU, STRATE have the value Sig. > 0.05, so there is no correlation with MFCA. The results of multivariate regression analysis showed that: Business characteristics have the most influence on the application of MFCA. The business has the right technological process to identify and measure material flows; good managers who have policies and orientations for clean production and environmental protection; clear and separate information system for each stage and department of the enterprise; Especially, enterprises with good ability to measure input and output of raw materials, will be very suitable for the application of MFCA. Next, the supply chain variable (CHAIN) has a significant influence on the adoption of MFCA, specifically: which businesses are affected and pressured by suppliers, customers, competitors, and employees will have to tend to apply MFCA more than other businesses. The

third factor is the corporate accounting system (ACCOU): Any enterprise has a good accounting team, a complete and clear accounting information system, application of current accounting technology, and applicability, MFCA will be higher.

Ethical Approval: This research did not contain any studies involving animal or human participants, nor did it take place on any private or protected areas. No specific permissions were required for corresponding locations.

Consent to Participate: I have received, read and kept a copy of the information letter/plain language statement. I have had the opportunity to ask questions about this research and I have received satisfactory answers. I understand the general purposes, risks and methods of this research.

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Conflict of Interest: The authors declare that they have no conflict of interest.

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