

Original Article

Factors Affecting the Decision to Apply the Material Flow Cost Accounting Method in Steel Manufacturing Enterprises in Thai Nguyen Iron and Steel Industrial Park, Vietnam

Nguyen Thi Kim Huyen¹, Nguyen Thi Hoang Oanh²

^{1,2} Faculty of industrial economy, Thai Nguyen University of technology, Thai Nguyen, Vietnam

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Abstract - This study uses the results of surveys and interviews with questionnaires to analyze the factors affecting the decision to apply Material Flow Cost Accounting (MFCA) in steel manufacturing enterprises in Thai Nguyen Iron and Steel Industrial Park of Vietnam. From the research hypotheses and the designed survey, the authors carry out a sociological survey with 90 accountants and managers in 6 Thai Nguyen steel manufacturing enterprises then use SPSS 22.0 software to perform the necessary analysis. The results show that applying MFCA to the manufacturing process in these enterprises depends on the System of legal documents related to the environmental accounting; the Enterprises' strategies; the Business resources and the current Accounting system of the enterprises. These are the factors that have a positive and statistically significant influence on the decision to apply MFCA in these enterprises. However, standardized regression model of the factors explains only 65% the change of the dependent variable that is the decision to apply the MFCA.

Keywords - Material Flow Cost Accounting, MFCA, Factors, Steel production enterprises, Decision to apply.

I. INTRODUCTION

Material Flow Cost Accounting (hereafter referred to as "MFCA") is not only a management tool but also a method of Environmental Cost Accounting, that promotes the efficient use of materials more effectively, contributes to reduce the waste, emissions and nonproducts. The differences between MFCA and the conventional cost accounting used to increase transparency of material use practices through the development of a material flow model that traces and quantifies the flows and stocks of materials within an organization in physical and monetary units [2]. Beside, MFCA is being highly appraised and rapidly

disseminated as a powerful method to realize "reduced environmental impacts" and "improved business efficiency" simultaneously by increasing transparency of material losses [13].

MFCA has also been receiving the attention from Asia-Pacific countries, including Asian Productivity Organization (APO) member countries. And Vietnam is one of them. In Vietnam, with the support of APO, in 2011, MFCA was piloted in three small and medium enterprises which include the seafood, confectionery and sugar industries, then it has been spreaded and brought many benefits for other industries. Although MFCA brings many benefits, up to now, it Vietnam has not been applied popularly, especially in the heavy industrial production with the high pollution. And steel production is also as a such one.

In fact, the steel manufacturing industry in Vietnam not only includes the production process from steel billets and scrap iron but also other manufacturing processes. Those processes form a closed production chain from raw iron ore, then sintering, iron making, steel making and finally rolling. Input materials are different for each production process; however in general, at each stage of production, the value of the materials is transferred into the products and the waste. However, cost accumulation, as well as production costs in steel manufacturing enterprises, especially Thai Nguyen steel production is being implemented by traditional accounting method; therefore accounting for cost accumulation, allocating and calculating causes arising production costs in the product costs, not excluding the value of the inputs in the waste, or the material losses at each stage.

Therefore, researches related to factors affecting the decision to apply Material Flow Cost Accounting in steel manufacturing enterprises are essential. This study are carried out at steel production enterprises in Thai Nguyen Iron and Steel Industrial Park .



II. LITERATURE REVIEW RELATED TO FACTORS AFFECTING THE APPLICATION OF MFCA IN MANUFACTURING ENTERPRISES

Studying the factors affecting the application of MFCA in manufacturing enterprises, Michiyuki Yagi and Katsuhiko Kokubu (2018) demonstrate that: (i) Policies promoting MFCA; (ii) Analyzing the characteristics of the flow management; (iii) The responsiveness of the enterprise's control management system is a factor affecting the application of MFCA [11]. Khaled M.A. Salim et al (2017) in the study "Material Flow Cost Accounting, Perceived Ecological Environmental Uncertainty, Supplier Integration and Business Performance: A Study of Manufacturing Sector in Malaysia" examine the effect of perceived ecological environmental uncertainty and supplier integration on MFCA implementation, and thus understands MFCA implementation on firms' environmental and economic performance [9].

MFCA is one of important methods of environmental cost accounting and a environmental management accounting(EMA); therefore, factors affecting the application of the EMA also impact on the application of MFCA. Some researches who study the factors influencing on the application of EMA can be mentioned: Altohami Otman Alkisher (2013), Zohre Karimi et al (2017), William Lekimankusi Ntalamia (2017), Roger (1995), Chang (2007), Pham Duc Hieu (2010), Jalaludin et al (2011), Alkisher (2013), Setthasakko (2014), Jumila et al (2014), Nguyen Thi Nga (2017), etc.

In Altohami Otman Alkisher (2013), the study of Factors influencing on the Environmental Management Accounting adoption in Oil and Manufacturing firms in Libya finds out some factors including organization; Environment; technology [1]. Zohre Karimi et al (2017) analyze the Factors Affecting the Adoption and Use of Environmental Management Accounting to Provide a Conceptual Model [15]. William Lekimankusi Ntalamia (2017) studies the factors influencing adoption of Environmental Management Accounting (EMA) practices among manufacturing firms in Nairobi, Kenya. The authors finds that the financial statuses and qualifications of employees have a positive and significant impact on the application of the EMA [14]. Nguyen Thi Nga (2017) analyzes the impact of some groups of the factors on the application of the environmental cost in management accounting in Vietnamese steel manufacturing enterprises. She finds out some determinants as followings: the leadership, organization and the outside of the organization [10].

III. RESEARCH PROCEDURE AND METHODOLOGY

A. *Comprehensive study - preliminary theoretical framework*

Based on the literature review, we build the preliminary theoretical research framework, after that determine the

research gap, research problem, and finally we synthesize the factors affecting the decision on applying the material flow cost accounting in the manufacturing enterprises.

B. *Quantitative approach*

This study uses a number of quantitative methods approaches such as Descriptive Statistics, Cronbach Alpha Reliability Analysis, EFA exploratory factor analysis, correlation analysis to determine the factors affecting the decision on applying MFCA in Thai Nguyen steel manufacturing.

C. *The research populations*

Because the number of surveyed enterprises as well as the number of people asked are not many, we survey the population. The survey to identify the factors which affect the decision on applying MFCA to the accounting process of steel manufacturing enterprises in Iron and Steel Industrial Park - Thai Nguyen is carried out directly with 90 accountants and managers working at 6 steel enterprises.

D. *Data collection methods*

Data collection methods include some methods as followings: Collecting primary and secondary data, Methods of investigation, Interview method, Information gathering tools, Overall approach.

E. *Data processing methods*

The information got from the questionnaire survey was synthesized and processed by SPSS 22.0.

F. *Data analysis methods*

Data analysis methods include EFA exploratory factor analysis; Correlation analysis method; Multiple Linear Regression analysis.

IV. FACTORS AFFECTING THE DECISION ON THE APPLICATION OF MATERIAL FLOW COST ACCOUNTING IN PRODUCTION ENTERPRISES

In "The decision-making entrepreneur - Literature review", Elissaveta Ivanova, Petra Gibcus (2003) cited the research results of Mador (2000), Mintzberg (1976) and Papadakis et al. (1998). Those results show that most theories concern the decision-making process gravitate around a model of decision-making, which comprises three components: (i) The environment; (ii) The specific characteristics of the decision to be taken; (iii) The entrepreneur himself. And the authors state that the elements, which are expected to influence strategic processes, are the manager's individual characteristics, internal organisational context, and environmental factors [5].

Inheriting previous researches, the factors in our study include:

(1) Factors belong to the system of legal documents related to environmental accounting (VBPQ): (1.1) The flexibility; (1.2) Completeness; (1.3) The enforcement of the

system of legal documents on environmental accounting.

(2) Factors belong to the steel supply chain (CCU): (2.1) Supplier pressure; (2.2) Customer pressure; (2.3) Competitors pressure.

(3) The enterprises' strategies (CL): (3.1) Using resources effectively; (3.2) Sustainable Development; (3.3) Aiming to cleaner production.

(4) Business resources (NL): (4.1) Capital size; (4.2) The qualifications of the employees; (4.3) The capacity of the manager; (4.4) Information system; (4.5) Technology.

(5) Accounting system of the enterprises (HTKT): (5.1) Competence of accountants; (5.2) Accounting information system; (5.3) Applying technologies in accounting.

From many factors affecting the decision to apply MFCA in steel manufacturing enterprises, we build the research hypotheses as followings:

Hypothesis 1 (H1): Factors belong to the system of legal documents related to environmental accounting affecting positively on the decision in application of MFCA in steel manufacturing enterprises.

Hypothesis 2 (H2): Factors belong to the steel supply chain affecting on the decision in the application of MFCA in steel manufacturing enterprises.

Hypothesis 3 (H3): The enterprises' strategies influence on the decision to apply MFCA in steel manufacturing enterprises.

Hypothesis 4 (H4): Business resources influence on the decision to apply MFCA in steel manufacturing enterprises.

Hypothesis 5 (H5): The current accounting system of the enterprises influences on the decision to apply MFCA in steel manufacturing enterprises.

The multivariate regression equation is used in this study as follows:

$$MFCA_i = \alpha_0 + \alpha_1 VBPQ_i + \alpha_2 CCU_i + \alpha_3 CL_i + \alpha_4 HTKT_i + \varepsilon_i$$

Whereas:

$MFCA_i$ is the dependent variable which represents for the decision to apply Material Flow Cost Accounting in Steel Production Enterprises in steel manufacturing enterprise i ;

ε_i is the error term; and

$\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$: the coefficients need to be found

V. RESULTS OF THE RESEARCH AND DISCUSSION

A. Results of the research

The questionnaire are used as the instrument of the study. All the items are pointed from 1 to 5 and arranged as are arranged as from 1- Very negative effect to 5- Very

positive effect. The time to carry out the primary research was from June 01 to June 12, 2021. SPSS 22.0 software is employed to analyze the factors affecting on the decision to apply MFCA in manufacturing enterprises in Iron and Steel Industrial Park - Thai Nguyen.

Evaluate the reliability of the factors

Cronbach Alpha value is used to test the reliability of scales:

Table 1. Cronbach's alpha reliability coefficient

Variables	Code	Cronbach's Alpha	No of Items
Factors belong to the system of legal documents related to environmental accounting	VBPQ	0.732	3
Factors belong to the steel supply chain	CCU	0.672	2
The enterprises' strategies	CL	0.745	3
Business resources	NL	0.869	5
Accounting system of the enterprises	HTKT	0.815	3
Total		0.756	16

The factors' Cronbach's Alpha Indices are almost higher than 0,600. These results show that those factors are significant enough for research. In the other hand, all factors which have Cronbach's Alpha correlation coefficient, the population's Cronbach's Alpha is greater than 0,300 and Cronbach's Alpha if Item Deleted, therefore they correlate to other factors and are kept in the model.

The Explore Factor Analysing - EFA

KMO coefficient = 0.749, ensures the requirements that $0.5 < KMO < 1$, it shows that factor analysis is suitable for research data [6]; Bartlett's Test of Sphericity is 699.730 with significance level Sig. = 0.000. It meets the conditions Sig.<0.050 (reject the hypothesis that the observed variables are not correlated with each other in the population). Accordingly, the data used for factor analysis is completely appropriate.

Table 2. KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.749
Bartlett's Test of Sphericity	Approx. Chi-Square	699.730
	df	136
	Sig.	0.000

With a rotation matrix 5 total factor, the model explains 71.977 % of the variation of total factor (Table 3). Rotation matrix result of converging factors warrants the requirement of loading Factor: With 90 samples, Factor loading samples of the elements must be greater than 0.75 [6], and as result on Table 4, all factors in the model are remained.

Table 3. Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.848	28.519	28.519	4.848	28.519	28.519	3.456	20.327	20.327
2	2.505	14.733	43.253	2.505	14.733	43.253	2.438	14.342	34.669
3	1.944	11.434	54.687	1.944	11.434	54.687	2.178	12.812	47.481
4	1.618	9.515	64.202	1.618	9.515	64.202	2.129	12.521	60.002
5	1.322	7.775	71.977	1.322	7.775	71.977	2.036	11.975	71.977

Extraction Method: Principal Component Analysis.

Table 4. Rotated component matrix

	Component						Component				
	1	2	3	4	5		1	2	3	4	5
NL1	0,794					CCU1			0,812		
NL2	0,781					CCU2			0,791		
NL3	0,790					CCU3			0,789		
NL4	0,780					CL1				0,776	
NL5	0,823					CL2				0,797	
HTKT1		0,853				CL3				0,796	
HTKT2		0,847				VBPQ1					0,823
HTKT3		0,759				VBPQ2					0,757
						VBPQ3					0,823

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

After exploratory factor analysis, the results from 17 observed variables converge into 5 factors as detailed in Table 5 as follows:

Table 5. Table of grouping and renaming items

Factor	Code	Item	Variable
T.VBPQ	VBPQ1	The flexibility of the system of legal documents on environmental accounting	The system of legal documents related to environmental accounting
	VBPQ2	The completeness of the system of legal documents on environmental accounting	
	VBPQ3	The enforcement of the system of legal documents on environmental accounting	
T.CCU	CCU1	Supplier pressure	The steel supply chain
	CCU2	Customer pressure	
	CCU3	Competitors pressure	
T.CL	CL1	Using resources effectively	The enterprise' strategies
	CL2	Sustainable Development	
	CL3	Towards cleaner production	

T.NL	NL1	Capital size	Business resources
	NL2	The qualifications of the employees	
T.NL	NL3	The capacity of the manager	
	NL4	Information system	
	NL5	Technology	
T.HTKT	HTKT1	Competence of accountants	Accounting system of the enterprises
	HTKT2	Accounting information system	
	HTKT3	Applying technology in accounting	

Results of the research

The correlation analysis is employed to find the strength of relationship between 5 independent variables and the decision to apply MFCA. Correlation analysis results show that all variables are positively correlated with the decision to apply MFCA (Table 6).

The system of legal documents related to environmental accounting; The steel supply chain; The enterprise’ strategies; Business resources and Accounting system of the enterprises have the Sig. (2-tailed) respectively 0.001; 0.007; 0.008; 0.000; 0.000<0.050. So they are statistically significant and included in the regression analysis model.

Table 6. Correlations

		MFCA	T.VBPQ	T.CCU	T.CL	T.NL	T.HTKT
MFCA	Pearson Correlation	1	0.351**	0.284**	0.278**	0.587**	0.668**
	Sig. (2-tailed)		0.001	0.007	0.008	0.000	0.000
T.VBPQ	Pearson Correlation	0.351**	1	0.114	-0.035	0.007	0.042
	Sig. (2-tailed)	0.001		0.285	0.746	0.951	0.698
T.CCU	Pearson Correlation	0.284**	0.114	1	-0.147	0.275**	0.296**
	Sig. (2-tailed)	0.007	0.285		0.166	0.009	0.005
T.CL	Pearson Correlation	0.278**	-0.035	-0.147	1	0.142	0.153
	Sig. (2-tailed)	0.008	0.746	0.166		0.183	0.150
T.NL	Pearson Correlation	0.587**	0.007	0.275**	0.142	1	0.501**
	Sig. (2-tailed)	0.000	0.951	0.009	0.183		0.000
T.HTKT	Pearson Correlation	0.668**	0.042	0.296**	0.153	0.501**	1
	Sig. (2-tailed)	0.000	0.698	0.005	0.150	0.000	

** . Correlation is significant at the 0.01 level (2-tailed).

Multiple regression analysis by Enter method was used to test the roles of independent variables in making the decision to apply MFCA. According to Adjust R Square, the model accounts for 65% of variable the decision to apply MFCA [4] (Table 7).

Table 7. Model summary

Model	R	R ²	Adjusted R ²	Std. Error of the Estimate	Change Statistics				
					R ² Change	F Change	df1	df2	Sig. F Change
1	0.818 ^a	0.67	0.65	0.4245	0.67	34.056	5	84	0.000

a. Predictors: (Constant), T.HTKT, T.VBPQ, T.CL, T.CCU, T.NL

With df = 5, the result of regression analysis showed that the value of F = 34.056 and Sig. statistically significant = 0.000 less than the α - critical index (0.05), so we rejects the hypothesis that the study elements are heterogeneous and

concludes that there is statistical difference between the independent variables and the dependent variable (Table 8).

Table 8. ANOVA^b

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	30.685	5	6.137	34.056	.000 ^a
Residual	15.137	84	0.180		
Total	45.822	89			

a. Predictors: (Constant), T.HTKT, T.VBPQ, T.CL, T.CCU, T.NL

b. Dependent Variable: The decision to apply MFCA

VBPQ, CL, HTKT, NL have Beta valuable > 0 and each of these factors has values of statistical significance Sig less than the α - critical value (0.05) shows that these factors are statistically significant. CCU has Sig. >5% should be excluded from the model.

Beside, results of multivariate regression analysis showed that 4 independent variables (VBPQ, CL, HTKT, NL) are correlated with the dependent variable and there isn't multicollinearity between variables - Collinearity Tolerance of all variables are less than 1 with VIF tolerance are less than 2 (Table 9). So that, of all the proposed hypotheses, hypothesis H2 is rejected, the remaining 4 hypotheses are accepted.

Table 9. Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients (Beta)	t	Sig.	Collinearity Statistics		
	B	Std. Error				Tolerance	VIF	
1	Const	-5.368	0.821					
	VBPQ	0.524	0.100	0.330	5.228	0.000	0.986	1.015
	CCU	0.072	0.095	0.052	0.755	0.452	0.839	1.192
	CL	0.300	0.107	0.183	2.804	0.006	0.924	1.082
	NL	0.619	0.144	0.318	4.315	0.000	0.722	1.385
	HTKT	0.687	0.113	0.451	6.056	0.000	0.708	1.413

These results also indicate that the system of legal documents related to environmental accounting; The enterprise' strategies; Business resources and Accounting system of the enterprises have positive correlations with the decision to apply MFCA. All the independent variables have strong correlation with the decision to apply MFCA (Beta>0.3). Accordingly, the regression model is normalized by the following factors:

$$MFCA = -5.368 + 0.524VBPQ + 0.3CL + 0.619NL + 0.687HTKT$$

B. Discussion

Because the system of legal documents related to the environmental accounting impacts directly on the decision of MFCA application in the steel manufacturing enterprises, the clear legal framework has to be built up. This framework roles as a factor in creation both promotion and pressure on these enterprises to be more fully aware of the importance of MFCA in improving the business efficiency and reducing emissions into the environment.

The Vietnamese National Assembly needs to study and complete more the system of legal documents related to accounting generally and environmental accounting particularly so as to enhance the flexibility and suitability as well as the coerciveness of this system.

In addition, the Vietnam Steel Association needs to bring out the MFCA manuals in which they introduce the successful cases in applying this method from some countries such as Japan, Germany, USA....That might to help MFCA spread to the steel manufacturing enterprises.

The enterprises, in the long term, need to build up the development strategies related to the efficient use of sources, substantial development, cleaner production. Those strategies are integrated with customers, suppliers relationships, especially with all actions of competitors. In the short term, the enterprises plan to meet given objectives, the main point is to build the plan in application of the MFCA soon and a schedule to implement the MFCA that is consistent with the reality of the enterprises.

In addition, to apply and promote the efficiency of MFCA operation the enterprises can develop the intranet information system which connects all the parts in the enterprises, especially the connection among accounting, technology, production, inventory, planning. This system is developed based on accounting system which used the software in implementation of accounting.

In the future, the enterprises do researches to complete ERP system step by step by themselves, and then integrate this system with MFCA to standard and update the information and data which is used in the analysis of the MFCA implement more efficiently in terms of time, labors and costs.

VI. CONCLUSION

From the research hypotheses, the designed survey and SPSS 22.0 software to perform the necessary analysis, this study shows that applying MFCA to the manufacturing process in steel manufacturing enterprises depends on some factors such as the System of legal documents related to the environmental accounting; the Enterprises' strategies; the Business resources and the current accounting system of the enterprises. Although the study builds the regression model normalized, our model only explains 65% the change of the dependent variable, the rest, 35%, is not explained by this model. , To improve the reliability of the model, the future researches should add more other factors that might help to explain more the change of dependent variable, the decision to apply the MFCA, in the model -

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