

Material Flow Cost Accounting: A Literature Review To Encourage Research In The Industrial Revolution 4.0 Implementation Era

Wijaya Triwacananingrum¹, Y Anni Aryani², Doddy Setiawan³
{wijaya.tri@uph.edu¹, y_anniaryani@staff.uns.ac.id², doddy.setiawan@staff.uns.ac.id³}

Universitas Pelita Harapan, Jl.M.H.Thamrin Boulevard Lippo Village Tangerang 15811 Indonesia¹, Universitas Sebelas Maret, Jl.Ir.Sutami No.36AJebres Surakarta Jawa Tengah 57126², Universitas Sebelas Maret, Jl.Ir.Sutami No.36AJebres Surakarta Jawa Tengah 57126³

Abstract. To face the Industry Revolution 4.0 era that has started to be implemented, strategic courses of action need to be done. Therefore, scholars and businessmen/women need to conduct researches that are in line. In this study, the researchers try to describe the development of Material Flow Cost Accounting (MFCA) research from 31 journal articles, and selected 25 published on Scopus Quartir Rank 1 (Q1) from 2008 to 2018. This study classifies articles based on the publication year, countries the research was conducted, the journal published, the research method used, and the significance of MFCA. This study also wants to see the suitability of countries that have sensitivity about the need for this MFCA to be applied and in the viewpoint of publication. MFCA is a form of cost calculation that aim to increase efficiency and eliminate hidden profit. This has the same value as the Revolution Industry 4.0 era.

Keywords: Analytical method, Material Flow Cost Accounting (MFCA), bibliography, literature review, Revolution Industry 4.0 era

1. Introduction

Production management in its development and management in industrial companies is an important part of the attention of stakeholders [27]. The purpose of MFCA that is in line with the value of the Revolution Industry 4.0 era, is set to offer improvement towards energy efficiency, improvement in material efficiency and ultimately would reduce production costs so that products could be manufactured at competitive prices to eliminate hidden profit & to achieve the desired profit. Many countries, such as Germany and the USA, support scholars and businessmen/women to conduct researches to welcome the Industry Revolution 4.0. The researcher believes that the articles created, published in a country could reflect its sensitivity and concern to these issues, also about MFCA. This study was inspired by a research conducted by [14] about bibliography research in management accounting and Michael D. Shields (2011) - in this case the researchers used MFCA as a topic of study. Therefore, this study presents a mapping of 25 selected articles from 31 articles obtained in groups published on Scopus Quartir Rank 1 (Q1) from 2008 until 2018 [1-6], [8-13], [15-21], [23-25], [29-31]. From this research map, we can see developments from time to time regarding research in the MFCA domain, and it can be seen that countries that are responsive to and care about efficiency through MFCA practices are expected to encourage

research on MFCA considering the importance of the benefits that can be taken with the application of MFCA to current industries in the context of company's sustainability.

1.2 Problem Formulation and Restrictions

MFCA is a way for companies to avoid hidden profits by making efficiency on costs by reducing waste, reducing energy, and reducing the use of materials. However researchers also see the phenomenon that not all countries have the responsiveness to make aware of the application of MFCA to companies so that competitiveness can be achieved. Published studies are believed to be the indicator of whether or not MFCA runs in a country. For this reason, the researcher tried to examine to what extent the results of the mapping of MFCA studies published in Scopus with a first rank (Q1), published during 2008-2018 and available online. Then the researcher will analyze the results of the selected articles' mapping from the MFCA.

1.3 Purpose

The purpose of this study is to obtain an overview and the development of research on MFCA conducted over the past ten (10) years, by knowing the developments regarding MFCA studies conducted so far, it is hoped that policy makers and researchers can further focus attention on this MFCA, so that in the future it will intensify its business because companies are able to compete.

1.4 Relevance

Collaboration between researchers and business people is something that is very necessary in order to achieve a good economy state. Academics are one of the researchers expected to be able to update and bring the gap between the concepts of theory and practice. In present time, company sustainability is a concern for management and MFCA is one tool that can help companies produce competitive products. With literature review, this study is expected to be able to open and show researchers and people in the business about the development of MFCA in the past ten years.

2. REVIEW OF LITERATURE

2.1 Supporting Theory

Production management in its development and management on industrial companies are an important part stakeholder are paying their attention to [27] The three elements contained in the MFCA are material, row and cost accounting. Material refers to material for products and material loss. These three things will be an inseparable part of the application of MFCA. Furthermore, MFCA can meet the gap between economic and quality aspects with environmental aspects [28]. MFCA became an international standard in September 2011 (ISO 14051). Improved work from this approach is expected. MFCA now a global standards. Now, everyone can implement it anywhere. A lot of Malaysian, Vietnamese, Thai industries began to implement MFCA and experience a significant reduction in environmental costs. MFCA significantly contributes to a company's sustainable performance. MFCA is an international standard (ISO 14051) and used in many countries. Case's examples prove that MFCA is very effective, a new Kaizen method for companies and supply chains.

2.2 Results of Previous Research

Improved performance of this approach is highly expected. MFCA at this time has become a global standard. With MFCA, production management is more efficient, so the industry becomes more competitive [7]. Literature review is a tool that can be used for identifying potential research in the future from the development of MFCA [22]. MFCA is a very promising instrument in terms of identification and communication inefficiencies and monetary consequences and improvements resource efficiency. This MFCA highlights the potential for further benefits for such the following financial matters, strategic marketing managers and giving the possibility for this recipient to be involved in increasing efficiency material as a specific form of environmental efficiency. This paper analyzes several decision situations where tools that are based on MFCA still must be (further) developed to produce the information needed [22]. In all categories, the impact of the product is dominant and, in some cases, constitutes almost all impacts such as in land use and potential eutrophication. In other impact categories, packaging can be significant from 4% up to 10%.

3. RESEARCH METHODS

The Charting the Field and Analyzing the Community Method developed by [14]. was used in this study, where researchers will select articles about MFCA which were published in Scopus first rank quarter (Q1). The selected articles will be grouped and processed based on predetermined topics and criteria. The stages in this study are as follows: The first stage of the researchers conducted a sample selection by looking for articles with the keywords material flow cost accounting (MFCA) and scopus, and researchers searched from the year of publication of articles 2008-2018. From here the researchers found and downloaded 31 articles about MFCA, then researchers identified ranking scopus from each of these articles and the results of those 31 articles 25 of which are scopus with rank 1 (Q1) that the researchers used as the object of this study. At the second stage, the researcher made a mapping of the 25 articles by tabulating data. The third stage, at this stage the researcher groups each article according to the topic that the researcher determined, namely the mapping of the year of article publication, the countries where the research was conducted, the journalist journal of the articles, the research methods used, and the significance of MFCA. At the fourth stage, the researcher analyzes the results of the mapping and draws conclusions, so that later this can be used and utilized by the reader of this research. At the fifth stage, as the final stage of this research, conclusions, suggestions and continuity for this research are presented so that the next researcher could use them as a reference and follow-up for subsequent research on the topic of MFCA.

4. RESULTS AND ANALYSIS

4.1. Article's Publication Year

On the research map, it appears that the highest number of research publications on MFCA were in 2014 and 2015, in which there were 8 articles each both those years. In 2018, publications on MFCA research began to increase, namely the 4 articles (data taken up to semester 1), that can be seen in figure 4.1.

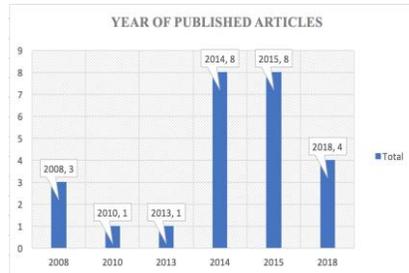


Figure 4.1. Article's Publication Year

The result of this analysis is in accordance with the conditions in 2014. Japan developed the MFCA beginning in 2011 and the Japanese government issued a Manual on Material Flow Cost Accounting: ISO 14051 (Asian Productivity Organization, 2014) [28]. thus the good responses from companies in Japan in particular. This can be seen in the study of 4.2. Japan was ranked second, which is 20% of all research conducted in Japan. It was sustainable through 2015, and the great circumstances emerged again in 2018; where companies were faced with conditions that required competition between them to maintain the sustainability of the company.

4.2. Countries Where Researchers Conduct MFCA Research

The three largest countries that conduct research and publications about MFCA are Germany 32%, Japan 20% and Australia 16%. What is interesting here is that Japan, which occupies the second highest position, is the country of origin for these MFCA tools.



Figure 4.2. Countries where researchers conduct MFCA research

Given the history of Germany as the country where MFCA was born, this goes in line with the result of the analysis showing that does Germany rank first as the country that conducts research and publishes MFCA. Next in Japan, the country that developed the MFCA further to be easier to implement, IPoint Blog Germany (2018) writes that more than 300 companies in Japan have used MFCA, except that this research is not visible. Whereas in the third highest rank, is Australia, showing that this country has good awareness towards efficiency issues by using MFCA tools.

4.3. Journal-Journal Publishers from MFCA Articles

The most published research articles about MFCA are published in the ELSEVIER Journal Cleaner Production, a total of 13 articles, 7 articles in which are published in the Journal Science Direct - ELSEVIER, while the Journal of Environmental Management Accounting for Cleaner Production - SPRINGER published 3 articles. This can be seen in Figure 4.3.

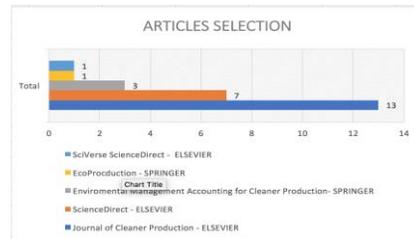


Figure 4.3. Journal publisher of MFCA articles

4.4. Research Methodology Used By MFCA Articles

The research method used mostly in the research articles uses case studies, as many as 11 articles and descriptive research, along with 5 articles.

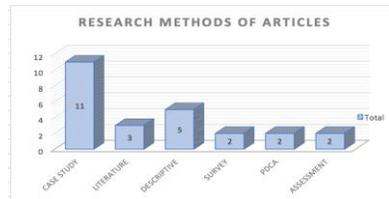


Figure 4.4. The research methodology used by MFCA articles

The methodology classified shows that case studies are the most used methodology in MFCA research. This illustrates that MFCA, as one of the management tools to avoid hidden profits and to increase efficiency, is an urgent need for companies.

4.5. Significance of MFCA

In the discussion of MFCA studies, there are 12 articles using the physical approach, 2 articles using the monetary approach, and 3 articles using both approaches, 8 articles using other approaches. Physical approach is one of the easiest research approaches to implement.

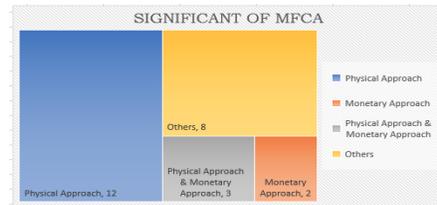


Figure 4.5. Significance of MFCA

5. CONCLUSION, SUGGESTIONS AND RESEARCH SUSTAINABILITY PLAN

5.1 Conclusion

Researchers analyzed 25 articles that discussed MFCA published in Scopus journal ranking 1 (Q1) during the 10-year period of publication. Based on the classification of topics, most of MFCA studies were carried out in 2014 and 2015, when Japan developed the MFCA and in 2018 where the economic competition was getting tougher, requiring companies to carry out efficient production. Whereas the country that did the most researches was Germany, the birthplace of MFCA. Japan was one of countries inclined to develop MFCA. Australia had good consideration towards production efficiency problems. The journal that publishes the most MFCA researches is the Journal of Cleaner Production-Elsevier; a journal that specializes in production efficiency and has a high commitment to actively publishing publications. The Science Direct-Elsevier Journal and on the third place is Environmental Management Accounting for Cleaner Production-Springer journal. The methodology used by the MFCA use a physical approach, monetary approach, and a combination of both physical and monetary approach.

5.2 Suggestion

This research is a literature review, while the object of research in this study is limited to articles that are published in Scopus Q1 and limited to those published online, so the expansion of the object of research is highly recommended for subsequent research.

5.3 Research Continuity

Researchers will try to develop this research by extending the object of research, not just limited to articles published in Scopus Q1, but also by developing the content accuracy of MFCA.

REFERENCES

- [1] Amadeo, Kimberly. 2018. World Economy-What are Emerging Markets, Five Defining Characteristics.
- [2] Bierer, Annet, Uwe Gotze, Lilly Meynerts, Ronny Sygulla . 2014 Integrating life-costing and cycle assessment using extended Material Flow Cost Accounting Journal of Cleaner Production, Elsevier.
- [3] Christ, Katherine L, Roger L. Burritt, 2014. Material flow cost accounting : a review and agenda for future research. Journal of Cleaner Production, Elsevier.
- [4] Christ, Katherine Leanne, Roger Burritt. 2017. Material flow cost accounting for food waste in the restaurant industry. Journal of Cleaner Production, Elsevier
- [5] Daniel, Ayes. 2009. Environmental and Material Flow Cost Accounting ScienceDirect, Elsevier
- [6] Dekamin, Majid. Morteza Barmaki 2018. Implementation of Material Flow Cost Accounting (MFCA) in soybean. Journal of Cleaner Production, Elsevier

- [7] Dhakiri, Moh.Hanif, 2015. <https://www.liputan6.com/bisnis/read/2304155/menaker-resmikan-indonesia-material-flow-cost-accounting-forum>
- [8] DOORASAMY Mishelle. 2014. The Effectiveness of Material Flow Cost Accounting (MFCA) In Identifying Non-Product Output Costs And Its On Environmental Performance In Paper Manufacturing Companies: A Case Study In Kwa-Zulu Natal. Emerald.
- [9] DOORASAMY , Mishelle . Hari Lall Garbharran. 2015. Theoretical Developments in Environmental Management Accounting and The Role and Importance of MFCA. Environmental Economics.
- [10] Doorasamy, Mishelle . 2015. Benchmarking: A Strategy to Improve Environmental Performance by using Material Flow Cost Accounting Empirical Study Based on a Paper Manufacturing Company. Asian journal of Business and Management.
- [11] DOORASAMY , Mishelle . 2016. Using Material Flow Cost Accounting (MFCA) to Identify Benefits of Eco-Efficiency and Cleaner Production in A Paper and Pulp Manufacturing Organization. Foundation of Management.
- [12] Fakoya, Michael B. 2014. Adopting material flow cost accounting model for waste-reduction decisions in a micro-brewery. Journal of Accounting and Management.
- [13] G. Konstantinos . Papaspyropoulos, Dimitrios Karamanolis, Christos K. Sokos, Periklis K. Birtsas. 2016. Enhancing Sustainability in Forestry Using Material Flow Cost Accounting. Scientific Research Publishing.
- [14] Hesford, J.W., Lee, S.H., Van der Stede, W.A., & Young, S.M. 2007. Management Accounting: A Bibliographic Study. Handbook of Management Accounting Research. Elsevier Ltd. All 16-39.
- [15] Hinterberger Friedrich, Stefan Gilljum, Mark Hammer. 2003. Material Flow Accounting and Analysis (MFA).
- [16] Hysrlova, Jaroslava. Miroslav Vagner, Jiri Palasek. 2011. Material Flow Cost Accounting (MFCA)-Tool for the optimization of corporate production processes. Business, Management and Education.
- [17] Jasch, Christine. 2002. The use of Environmental Management Accounting (EMA) for identifying environmental costs. ScienceDirect. Elsevier.
- [18] Kourilova Jindriska , Dana Plevkova. 2013. DMFCA Model as a possible way to detect creative accounting and accounting fraud in an enterprise. Financial Assets and Investing.
- [19] Mahmoudi, Elham, Naeimeh Jodeiri, Esmaeil Fatehifar. 2017. Implementation of flow cost accounting for efficiency improvement in wastewater treatment unit of Tabriz oil refining company. Journal of Cleaner Production, Elsevier
- [20] Moller, Andreas. 2009 .Material and Energy Flow-Based Cost Accounting
- [21] Morfeldt, Johannes, Semida Silveira, Tomas Hirsch, Susanne Lindqvist, Alena Nordqvist, Jan Petterson, Magnus Petterson. 2015. Improving energy and climate indicators for the steel industry-the case of Sweden. Journal of Cleaner Production, Elsevier
- [22] Schaltegger, Stefan, Dimitar Zvezdov, 2014. Expanding material flow cost accounting. Framework, review and potentials. Journal of Cleaner Production, Elsevier
- [23] Schandl, Heinz, Alessio Miatto, 2018. On the important of linking inputs in material flow accounts. The Weight of Nations report revisited. Journal of Cleaner Production, Elsevier
- [24] Schmidt. A, Hache, B, Herold F. Gotze U. 2013. Material Flow Cost Accounting with Umberto. Proceeding of the 1st and 2nd workshop of cross – sectional group 1 Energy related technologic and economic evaluation.
- [25] Siemiatkowski Mieczyslaw S., Maria Vargovska. 2018. Process layout planning and optimized product range selection in manufacture of wooden construction sets. Maderas-Cienc Tecnol
- [26] Shields, M.D., Christopher Sygulla, R, A.Bierer, U.Gotze. 2011 Material Flow Cost Accounting- Proposals for Improving the Evaluation of monetary Effects of Resource Saving Process Designs. Proceeding of 44th CIRP Conference on Manufacturing Systems
- [27] Tachikawa, Hiroshi, 2015. Material Flow Cost Accounting-MFCA Concepts, Practices and Impact. Training material on management consultancy.

- [28] The International Organization for Standardization, 2011. ISO 14051 Material Flow Cost Accounting (MFCA). Asian Productivity Organization.
- [29] Yap, Alex. 2018. Material Flow Cost Accounting (MFCA) Fundamental. Ecolean Consultancy SDN BHD.
- [30] Van der Poll, H.M. 2015. Facilitating a greener environment through Management Accounting. African Journal of Hospitality, Tourism and Leisure.
- [31] Viere, Tobias, Andreas Moller and Martina Prox. 2006. A Material Flow Cost Accounting Approach to Improvement Assessment in LCA.