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Driving Sustainable Development Through MFCA and Green Accounting: The Role of Resource Efficiency

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ABSTRACT
This study aims to analyze the influence of Material Flow Cost Accounting (MFCA) and Green Accounting on Sustainable Development, with Resource Efficiency as a moderating variable. The independent variables in this study are Material Flow Cost Accounting and Green Accounting, while the dependent variable is Sustainable Development. Resource Efficiency serves as the moderating variable. The population in this study consists of employees working in consumer non-cyclical companies listed on the Indonesia Stock Exchange (IDX). The sample was selected using a simple random sampling technique, with a total of 84 respondents. Data were analyzed using the Structural Equation Modeling–Partial Least Squares (SEM-PLS) method. The results show that Material Flow Cost Accounting and Green Accounting have a significant influence on Sustainable Development. Furthermore, Resource Efficiency strengthens the relationship between MFCA and Green Accounting with Sustainable Development.
***Keywords**: Material Flow Cost Accounting (MFCA); Green Accounting (GA); Sustainable Development; Resource Efficiency (RE).*

INTRODUCTION

Sustainable development refers to the ongoing process of development that ensures the long-term availability of resources necessary for continued growth Helmina et al (2023). In the current era, companies are increasingly expected to enhance their operational performance by improving productivity, which is typically measured by the ratio of output to input within the production process. Concurrently, public awareness regarding environmental conservation has grown, recognizing its crucial role in securing the well-being of future generations.

A comprehensive study conducted by Greenpeace International (2018) emphasized that Fast-Moving Consumer Goods (FMCG) companies are a dominant force behind the single-use economic model, which significantly contributes to the global plastic waste crisis. The report highlighted that none of the companies surveyed had implemented strategies to reduce the production and marketing of single-use plastics, and the solutions they proposed were likely to exacerbate rather than resolve the problem. Material Flow Cost Accounting (MFCA), as defined by Leon (2018), is a fundamental environmental management tool used to quantify the flow and stock of materials within production systems, expressed in both physical and monetary terms. This approach

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integrates physical material flows with financial information in a unified accounting model.

MFCA encompasses three core cost elements: material costs (referring to the physical quantity and purchase price of raw materials), system costs (covering internal operational expenses such as labor, depreciation, transportation, and maintenance), and waste costs (expenses associated with the disposal of negative outputs, including emissions, wastewater, and by-products). The application of MFCA has been shown to enhance internal profitability and productivity while simultaneously reducing external environmental impacts, thereby supporting the broader objective of corporate sustainability. In line with this, Dwianika et al. (2024) explains that green accounting represents an effort to integrate corporate economic objectives with environmental stewardship. It functions as a strategic tool to assess environmental impacts that influence economic performance, enabling companies to incorporate environmental costs and benefits into their decision-making processes.

Green accounting reflects the reciprocal relationship between a business and its surrounding environmental context. The United States Environmental Protection Agency defines sustainability as the capacity to meet essential human needs for survival and well-being, which are inherently connected to the health of the natural environment. Sustainability involves fostering a balanced relationship between human activities and nature, ensuring that social, economic, and ecological needs of present and future generations can be met. This concept gained global prominence through the Brundtland Commission's report, Our Common Future, published by the World Commission on Environment and Development.

Furthermore, Helmina et al. (2022) define resource efficiency as the optimal utilization of financial, material, human, and physical resources to achieve operational effectiveness while minimizing the consumption of natural resources and reducing environmental degradation. This principle promotes the sustainable use of limited environmental resources. As part of this initiative, contemporary management accounting has developed tools such as MFCA to quantify specific types of waste and to provide both financial and non-financial data. These tools are intended to support managerial decision-making aimed at reducing waste and controlling environmental costs, which typically include waste treatment, disposal, and infrastructure development.

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THEORETICAL BACKGROUND

Material Flow Cost Accounting (MFCA), as defined by Leon (2018), is a management information system that examines the flow of input materials throughout the production process and evaluates the output in terms of finished goods and waste. This approach thoroughly investigates the physical movement of materials, including inputs and processes required to produce the final products, and calculates costs by multiplying material quantities with their unit prices.

MFCA tracks the flow and inventory of all raw materials in the manufacturing process, both in physical and monetary terms. These materials encompass direct raw materials, parts, and components. The MFCA analysis provides a comparative breakdown of costs associated with finished goods and the losses related to raw materials, such as waste, air emissions, and wastewater. As stated by Morata (2017), implementing green accounting plays a significant role in ensuring environmental sustainability. It encourages companies to voluntarily comply with government policies focused on environmental protection and long-term corporate viability.

Green accounting involves tracking costs related to production, inventory, waste, and performance metrics, which inform planning, development, evaluation, and decision-making processes. In addition, MFCA takes into account the costs linked to material losses and production waste. The adoption of MFCA enables companies to improve internal profitability and productivity while reducing negative environmental effects, thus supporting corporate sustainable development. Furthermore, Dimitrov (2021) emphasizes the importance of maintaining strong relationships with stakeholders.

This involves addressing the needs and expectations of key stakeholders who influence the availability of resources essential to company operations, such as employees, customers, and owners. By acknowledging and publicly addressing environmental concerns, companies can fulfill stakeholder expectations and enhance their long-term sustainability. The disclosure of financial, social, and environmental information fosters a dialogue between companies and stakeholders, offering transparency about business practices and shaping perceptions and expectations. This approach aligns with Law No. 32 of 2009, Article 1, paragraph (2), which advocates for

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a systematic, integrated strategy to preserve environmental functions and prevent pollution or damage, including planning, utilization, control, maintenance, monitoring, and enforcement.

METHOD, DATA AND ANALYSIS

This research uses legitimacy theory and stakeholder theory as the foundation for the study. The aim of this research is to determine the importance of implementing Green Accounting, Material Flow Cost Accounting (MFCA), and Resource Efficiency in influencing the sustainability of consumer companies, analyze the application of their impact within the dimensions of corporate sustainability, and formulate recommendations for the development of corporate performance in enhancing sustainability. The population in this study consists of employees and managers, specifically from the human resources division, corporate social responsibility division, and stakeholder relations division working in consumer non-cyclical companies listed on the Indonesia Stock Exchange.

The sample was determined using the simple random sampling method, which is a sampling technique without specific consideration or criteria. The data analysis method used in this study is PLS (Partial Least Squares), as stated by Ghozali (2018): "This analytical method is powerful because it does not assume the data must have a certain scale and allows for small sample sizes. PLS can be used to confirm theories and explain the presence or absence of relationships between variables. Compared to covariance-based SEM (LISREL, EQS, or AMOS), PLS can avoid problems faced by SEM, such as inadmissible solutions and factor indeterminacy.

The population in this study consists of all employees working in consumer non-cyclical companies listed on the Indonesia Stock Exchange. The sampling method used in this research is simple random sampling, with a total of 84 respondents.

RESULTS

After the data meets the measurement criteria, the next step is to perform the Bootstrapping method using SmartPLS 3. The Bootstrapping method is a procedure for repeatedly drawing new samples, N times, from the original data of size n. For each new sample, data points are drawn from the original data one at a time until n points are selected (Egbert, 2021).

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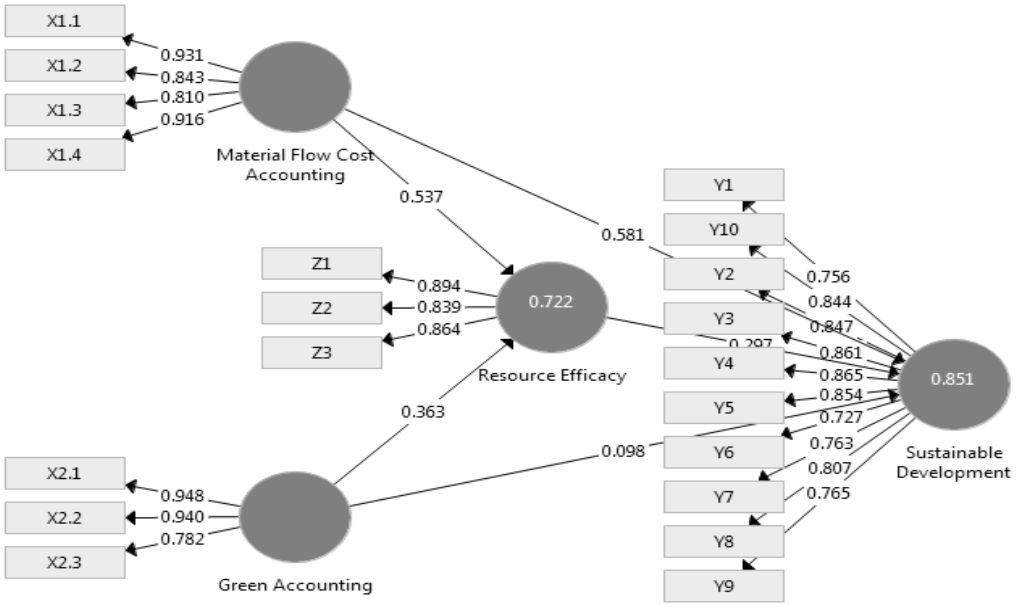

Figure 1. Path Diagram PLS-Alghoritm

Source: Processed Data (2025)

Table 1. Results

Hypothesis	Relationship	Standard Deviation	t-statistic	p-value	Remark
H1	Material flow cost accounting has a positive effect on Sustainable Development	0.077	9.628	0.000	Accepted
H2	Green Accounting has a positive effect on Sustainable Development	0.085	2.436	0.015	Accepted
H3	Resource Efficiency strengthens the effect of Material Flow Cost Accounting on Sustainable Development	0.054	2.968	0.003	Accepted

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H4	Resource Efficiency strengthens the effect of Green Accounting on Sustainable Development	0.052	2.094	0.037	Accepted

Source: Processed Data (2025)

H1= Material flow cost accounting has a positive effect on Sustainable Development

The t-statistic value for the variable Material Flow Cost Accounting on Sustainable Development is 9.628 with a p-value of 0.000. This t-statistic value is greater than the t-table value of 1.988 and the p-value is less than 0.05. Therefore, it can be concluded that hypothesis H1 is accepted.

H2= Green Accounting has a positive effect on Sustainable Development

The t-statistic value for the variable Green Accounting on Sustainable Development is 2.436 with a p-value of 0.015. This t-statistic value is greater than the t-table value of 1.988 and the p-value is less than 0.05. Therefore, it can be concluded that hypothesis H2 is accepted.

H3= Resource Efficiency strengthens the effect of Material Flow Cost Accounting on Sustainable Development

The t-statistic value for the hypothesis that Resource Efficiency strengthens the effect of Material Flow Cost Accounting on Sustainable Development is 2.968 with a p-value of 0.003. This t-statistic value is greater than the t-table value of 1.988 and the p-value is less than 0.05. Therefore, it can be concluded that hypothesis H3 is accepted.

H4= Resource Efficiency strengthens the effect of Green Accounting on Sustainable Development

The t-statistic value for the hypothesis that Resource Efficiency strengthens the effect of Green Accounting on Sustainable Development is 2.094 with a p-value of 0.037. This t-statistic value is greater than the t-table value of 1.988 and the p-value is less than 0.05. Therefore, it can be concluded that hypothesis H4 is accepted.

DISCUSSION

Based on the research findings, it is known that Material Flow Cost Accounting has a positive effect on Sustainable Development in consumer non-cyclical companies

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listed on the Indonesia Stock Exchange in 2021-2022. This is shown by the t-statistic value of the Material Flow Cost Accounting variable on Sustainable Development, which is 9.628 with a p-value of 0.000. This t-statistic value is greater than the t-table value of 1.988, and the p-value is less than 0.05. Material Flow Cost Accounting (MFCA), according to Favi et al.(2022), states that: "The key tool in this management approach is called flow management, which is specifically aimed at managing manufacturing processes related to the flow of materials, energy, and data so that the manufacturing process becomes more efficient and meets the established targets. The advantage of using the Material Flow Cost Accounting (MFCA) model is that it can increase profits and productivity (internal) while reducing negative environmental impacts (external), which in turn contributes to corporate sustainable development."

The connection of Legitimacy Theory, as proposed by Deegan, with the use of Material Flow Cost Accounting (MFCA) in the context of consumer non-cyclical companies in Indonesia emphasizes the importance of maintaining social support and legitimacy through responsible resource and environmental management practices. This not only enhances the operational efficiency of the company but also leads to a greater contribution to long-term sustainable development. The research findings by Angelin (2024) state that: “The Material Flow Cost Accounting (MFCA) detection model with environmental accounting shows that MFCA can be used as a model to detect production and business costs of a company, which can improve the company's sustainability.

According to Loen (2018), the research reveals that Material Flow Cost Accounting (MFCA) has a positive effect on sustainable development. Marota (2017), who studied the design and implementation of Material Flow Cost Accounting (MFCA) to improve corporate sustainability, found a significant effect between the implementation of Material Flow Cost Accounting (MFCA) and business sustainability.”

The Influence of Green Accounting on Sustainable Development

Based on the research findings, it is known that Green Accounting has a positive effect on Sustainable Development in consumer non-cyclical companies listed on the Indonesia Stock Exchange in 2021-2022. This is shown by the t-statistic value of the Green Accounting variable on Sustainable Development, which is 2.436 with a p-value

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of 0.015. This t-statistic value is greater than the t-table value of 1.988, and the p-value is less than 0.05. Dwianika et al. (2024) states that: "Green accounting is an effort to connect the economic interests of a company with environmental preservation. Green accounting is considered an important tool for understanding the aspects of the environment that affect the economy. Green accounting is part of environmental accounting, which combines environmental benefits and costs in decision-making.

Green accounting is influenced by and affects the surroundings of the company. The implementation of green accounting focuses on the concept of savings, such as saving land, saving materials, and saving energy. This is based on the ecosystem concept. The purpose of implementing green accounting is to increase the efficiency of environmental management by assessing environmental activities from a cost perspective (environmental costs) and the benefits of corporate sustainability from the economic, social, environmental, and technological aspects. According to Loen (2018), he briefly states: "The implementation of Green Accounting can provide information on how far an organization or company contributes positively or negatively to human life and its environment." In line with the research by Pitriani (2025), it shows that the implementation of green accounting has a positive and significant effect on the company's sustainability.

Resource Efficiency Strengthens the Influence of Material Flow Cost Accounting on Sustainable Development

Based on the research findings, it is known that Resource Efficiency strengthens the influence of Material Flow Cost Accounting on Sustainable Development in consumer non-cyclical companies listed on the Indonesia Stock Exchange in 2021-2022. This is shown by the t-statistic value of the hypothesis that Resource Efficiency strengthens the influence of Material Flow Cost Accounting on Sustainable Development, which is 2.968 with a p-value of 0.003. This t-statistic value is greater than the t-table value of 1.988, and the p-value is less than 0.05.

Resource Efficiency (RE) in general, according to UNEP (2010), states that: "It is about managing raw materials, energy, and water, as well as the values associated with reducing waste and harmful impacts on the ecosystem throughout the production life cycle. Efficient use of resources reduces production costs. When done correctly, Resource

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Efficiency can be a relatively cheap and quick way to reduce waste and subsequent processing costs and disposal costs. Using resources efficiently can also save a company money because, if they can use their resources efficiently, they will only need to buy new resources in smaller quantities."

According to Alhumaudi et al. (2014), when introducing Material Flow Cost Accounting (MFCA) to the supply chain with the aim of building a low-carbon supply chain and addressing environmental issues, the framework is formed, and resource efficiency is also established. According to the research of Loen (2018), it is revealed that Material Flow Cost Accounting (MFCA) has a positive effect on sustainable development, and resource efficiency strengthens Material Flow Cost Accounting (MFCA) in relation to sustainable development.

Resource Efficiency Strengthens the Influence of Green Accounting on Sustainable Development

Based on the research findings, it is known that Resource Efficiency strengthens the influence of Green Accounting on Sustainable Development in consumer non-cyclical companies listed on the Indonesia Stock Exchange in 2021-2022. This is shown by the t-statistic value of the hypothesis that Resource Efficiency strengthens the influence of Green Accounting on Sustainable Development, which is 2.094 with a p-value of 0.037. This t-statistic value is greater than the t-table value of 1.988, and the p-value is less than 0.05.

According to research by Gao et al. (2024), it is stated that: "The debate about resource efficiency, especially related to waste reduction and management, is not only a concern for scientists and environmental activists but also for company management. The production process of a product, from raw material extraction to the disposal of the product after use, should not damage the environment. Especially if the company can detail these environmental costs. This ensures that the company does not generalize indirect costs, including environmental costs, into overhead costs, making them hidden and making it difficult for managers to track and control these costs."

CONCLUSIONS

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Material Flow Cost Accounting and Green Accounting have a positive and significant influence on sustainable development. Material Flow Cost Accounting (MFCA) can be used as a model to detect production and business costs of a company, which can improve the company's sustainability.

Resource efficiency and green accounting strengthen the influence of Material Flow Cost Accounting on Sustainable Development. Resource efficiency can be a relatively inexpensive and quick way to reduce waste, as well as the costs of subsequent processing and disposal. Using resources efficiently can also save companies money because if they can utilize existing resources effectively, they will need to purchase fewer new resources.

Resource efficiency, especially related to waste reduction and management, is not only a concern for scientists and environmental activists, but also for company management. The production process of a product—from raw material extraction to the disposal of the product after consumption—must not harm the environment. A successful product-service system requires different societal infrastructure, human structures, and organizational layouts in order to be sustainable.

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