

Analysis of the potential implementation of Material Flow Cost Accounting (MFCA) in muslim fashion SMEs Y

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Abstract

Purpose: Conducting analysis on the current inventory control and proposing suggestions and improvements related to inventory control in SMEs Y using the Material Flow Cost Accounting (MFCA) approach.

Research methodology: This research adopts a case study approach with research methods including observation, document analysis and interviews.

Results: Based on the summation of raw material costs, energy costs, and system costs, the total allocation of product costs and allocation of material loss costs can be calculated. In the cost flow matrix, it is concluded that the company experiences a material loss of 7.5%. In fact, every production stage generates waste, and although the percentage of material loss may not always be significant, by reducing that percentage, the company can enhance the cost efficiency of its production.

Conclusions: This study concludes that applying Material Flow Cost Accounting (MFCA) can improve inventory control in SMEs Y, highlighting a 7.5% material loss that affects production costs. Reducing this loss, even slightly, can lead to significant cost savings. While the findings are specific to SMEs Y, they offer valuable insights for other SMEs in Indonesia to optimize inventory management and improve production efficiency using MFCA.

Limitations: The focus on manufactured firms especially SMEs Y limits the generalizability of the study findings to other sectors of the economy and scalability.

Contributions: The results of this study can be used as a consideration in formulating policies related to the management of fashion raw material inventory in Indonesia, particularly for other SMEs in managing their inventory and if they intend to implement Material Cost Flow Accounting in their production processes.

Keywords: *Material Flow Cost Accounting, Production, Raw Material, Efficiency*

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1. Introduction

Indonesia ranks 3rd globally in the modest Muslim fashion sector, according to data from the State of the Global Islamic Economy Report 2020-2021 ([Standard, 2022](#)). The global market for Muslim fashion is currently worth \$270 billion, equivalent to IDR 3,830 trillion. According to the [Statistik \(2023\)](#) Indonesia's economy grew by 5.31 percent in 2022, higher than the 3.70 percent growth in 2021. According to data from 2017, the fashion industry in Indonesia contributed 3.87 percent to the national Gross Domestic Product (GDP), with an export value of 11.97 million US dollars ([Kemenparekraf, 2023](#)). Inventory management of raw materials is crucial for manufacturing companies in terms of

business development, as it influences cost efficiency, production sustainability, and business outcomes ([Atnafu & Balda 2018](#); [Panigrahi, Shrivastava & Nudurupati, 2024](#); [Pristianingrum, 2017](#)).

[Balkhi, Alshahrani, and Khan \(2022\)](#) explained in their research that inadequate inventory management can potentially lead to excess stock, which means that additional assets are tied up in inventory, thereby limiting cash flow and organizational growth. Inventory management also serves as a determinant of competitiveness, including through efficient inventory management practices and minimizing inventory investments. In manufacturing companies, the production process is crucial for the survival of the company. Manufacturing inventory consists of three types: raw material, work-in-progress, and finished goods inventories. The scope of this research focuses on raw material inventory for the production process ([Aprilianti & Hidayat, 2019](#)).

SMEs Y is a company engaged in the Muslim fashion industry since 2017. SMEs Y conducts production after receiving prior orders from partners, who directly sell the products to end customers. Based on the gathered information, SMEs Y currently lacks clear inventory control for raw materials in its production process. Currently, several issues exist in inventory management at SMEs Y. SMEs Y often overlook their production processes by running each process independently, resulting in wastage of raw materials and negative company performance. This wastage contributes to inefficiencies in resource management during production. The notion that material loss costs are not significant and do not affect the production cost of goods is often disregarded by SMEs Y, leading to unnecessary expenses that ultimately erode the generated profits ([Dierkes & Siepelmeyer, 2019](#)).

To address the issue of reducing raw material waste, management accounting has developed a method for capturing production waste called Material Flow Cost Accounting (MFCA), which provides information on both economic and non-economic waste. This method is valuable for managers in decision-making regarding how to reduce the waste of raw materials ([Fakoya, 2015](#)). In a previous study by [Alfian, Ritchi, and Hasyir \(2020\)](#), the implementation of MFCA at PT Unipres Indonesia led to a significant reduction in material loss costs of IDR 650,325 per spare part produced. This reduction was achieved through various measures, such as energy savings, optimizing human resources, and reducing overhead costs.

Additionally, PT Unipres Indonesia effectively manages production waste by selling scrap or leftover materials to third parties, resulting in increased revenue and improved financial performance of the company. The study conducted by [Huang, Chiu, Chao, and Wang \(2019\)](#) concluded that implementing Material Flow Cost Accounting (MFCA) can help companies reduce waste and improve resource utilization efficiency. With the MFCA, companies can obtain more accurate and detailed information about the costs incurred at each stage of production, enabling them to determine strategies to minimize waste and optimize resource utilization.

The implementation of Material Flow Cost Accounting is expected to help address the existing issues in SMEs Y. The following are the problems faced by SMEs Y in their business processes:

1. This results in a significant amount of leftover material scraps.
2. Inconsistency between the quantity of raw material orders and incoming orders.
3. Lack of analysis regarding the procurement of raw materials and scheduling of orders to ensure timely delivery to customers.

1.1 Problem Formulation

Based on the background of the issues outlined, the research questions that the author proposes to address the research problems are as follows:

1. How is the production process in SMEs Y assessed from the perspective of the Material Flow Cost Accounting (MFCA) framework?
2. What are the strategies for production efficiency in SMEs Y?

2. Literature Review

2.1 Environmental Management Accounting (EMA)

[Graff, Reiskin, White, and Bidwell \(1998\)](#) explained that Environmental Management Accounting (EMA) is a method that considers environmental costs and material usage in business operations. According to [IFAC \(2014\)](#) EMA is the management of environmental and economic performance through the development and implementation of accounting systems and practices related to the environment. EMA is considered an extension of management accounting that addresses environmental issues ([Chan et al., 2017](#)).

Management accounting aims to improve the quality of environmental information and integrate it into decision-making processes such as investment assessment, capital budgeting, and strategic management. Management accountants play a crucial role in verifying the integrity and reliability of information during the process of searching, collecting, and disclosing information. They also play a more strategic role in policymaking and planning ([Burritt, Hahn, & Schaltegger, 2002](#)).

2.2 Material Flow Cost Accounting (MFCA)

Material Flow Cost Accounting (MFCA) is one of the most important environmental management tools that enhances transparency in material usage practices by developing material flow models, reducing environmental impacts, and improving business efficiency. The ISO Technical Committee (ISO/TC 207) aims to standardize MFCA practices by developing the ISO 14051 standard, published in 2011, which complements the ISO 14000 series for environmental management systems, life cycle assessment (ISO 14040, ISO 14044), and environmental performance evaluation (ISO 14031) activities ([APO, 2014](#)).

[Kokubu and Kitada \(2015\)](#) stated that highly competitive Japanese companies have identified a broader scope for improvement by utilizing MFCA, as the concept of losses in MFCA differs from the conventional concept of suitability in traditional business management. The ISO 14051 standard assists organizations in implementing the MFCA framework, which includes developing material and energy flow frameworks, calculating costs related to materials, energy, systems, and operations, and identifying opportunities to improve efficiency. The mission of the MFCA is to provide environmental management accounting tools and practices that help companies clarify material flows in relation to cost allocation. The outcomes of MFCA aim to assist organizations in making more comprehensive decisions to optimize production process efficiency ([APO, 2014](#)).

2.2.1 Objectives and Elements of Material Flow Cost Accounting (MFCA)

[Alfian et al. \(2020\)](#) stated that MFCA can enhance transparency in material flow and energy usage, as well as consider associated costs and environmental impacts. The information obtained from the MFCA can support decision-making in companies. This can be achieved by adhering to the four core principles of the MFCA methodology, which are as follows:

1. Understanding material flow and energy usage
2. Connecting physical and monetary information data
3. Ensuring accuracy, completeness, and comparability of physical data
4. Estimating and determining material loss costs

2.2.2 Steps of Implementing Material Flow Cost Accounting (MFCA)

2.2.2.1 Involving Management and Determining Roles and Responsibilities

To successfully implement all stages of the MFCA, full support from management and a bottom-up approach in the field are key factors. The implementation of MFCA will be easier if management understands the benefits and implications of its application in achieving the company's environmental and financial targets, as well as the commitment of the entire organization to it. Additionally, collaboration and support among the internal departments of the company are important in ensuring the success of the MFCA implementation ([APO, 2014](#)).

2.2.2.2 Scope and Limitations of Process and Determination of Material Flow Modes

The next step in implementing the MFCA is to determine the boundaries that encompass the scale of the MFCA activities. This begins by focusing on a specific product or initial process and then expanding it for use with other products or processes.

2.2.2.3 Cost Allocation

The MFCA divides costs into the following categories:

1. Raw material costs include the costs of all raw material inputs entering the quantity center.
2. Energy costs include costs for electricity, fuel, steam, heat, and compressed air.
3. System costs include labor, depreciation and maintenance, and transportation costs.
4. Waste management costs include the costs of waste handling generated at the quantity center.

2.2.2.4 Interpreting and communicating the results of MFCA

The MFCA provides information on material losses, unused raw material utilization, energy costs, and system costs associated with material losses during the production process. This information enhances operational awareness within the company and provides opportunities for managers to improve the efficiency of material usage and overall business performance.

2.3 Conceptual Framework

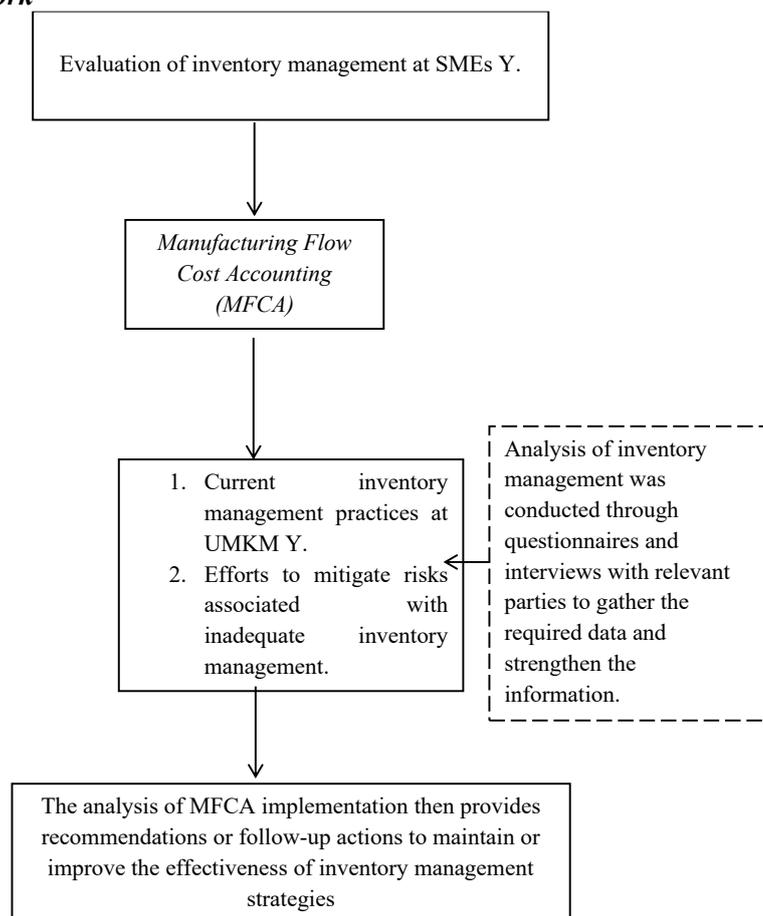


Figure 1. Conceptual framework

3. Methodology

This study focuses on a micro-entepreneurship in the Muslim fashion industry as the research object. The company currently lacks reliable inventory management and planning, which hinders its ability to determine the estimated quantity of units for warehousing and inventory activities. This study adopts a

qualitative research methodology that focuses on the interpretation and understanding of experiences in the world in which people exist. This study used both primary and secondary data. Primary data were obtained directly through interviews with individuals who served as informants within relevant entities and possessed expertise and involvement in the issues under investigation.

The primary data used in this study includes Sales Reports and Inventory Reports of SMEs Y in the year 2022. The findings can provide a depiction or description of an object that was previously unclear, resulting in a clearer understanding after the research (Saunders, Lewis, & Thornhill, 2009). Yin (2018) defines a case study as a research plan that takes place in various fields, particularly in the realm of evaluation. A case study involves conducting an in-depth analysis of a particular event, often a program, event, activity, process, or individual.

3.1 Data Analysis

3.1.1 Descriptive Quantitative Analysis

According to Creswell & Creswell (2018), quantitative descriptive analysis is a method used to create an objective overview or description through numbers. This involves collecting data, interpreting the data, and presenting the results. A quantitative descriptive analysis was conducted using the ISO 14051 guidelines for MFCA calculations.

3.1.2 Content Analysis

Content analysis aims to code quantitative data to analyze the content within the themes under investigation (Turunen, Vaismoradi, & Bondas, 2013). The content analyzed consists of data found in the collected texts. Researchers classify words, themes, and concepts found in the texts and then analyze them using NVivo 12 Pro software. The content analysis process involves several steps, including topic identification, determination of content categories, testing of content categories, data collection, and content analysis to draw conclusions. In this study, the focus of the research themes is related to waste materials and production processes in SMEs Y, as well as the implemented management strategies.

4. Results and discussions

4.1 Company Overview

SMEs Y was established and has been in operation since 2015. SMEs Y is a company that provides Muslim fashion products, including hijabs, abayas, gamis, baju koko, and other supporting accessories. The company initially started with the sale of hijabs and later expanded its market coverage through partnerships, resulting in a broader market reach than its competitors. Based on initial interviews and the owner's experience and passion for selling, within a short period of time, SMEs Y has attracted many new customers and partners who have become regular buyers (subscribers) because SMEs Y maintains the quality of its products with the slogan "Beauty in Simplicity". SMEs Y embraces the principle that the Muslim fashion business is not just about selling and treating it as a mere commodity, but also fosters a close sense of family among its partners and the women workers supported by SMEs Y.

Indonesia has great potential to become a globally competitive producer of Muslim fashion, as global Muslim consumer spending reached USD 295 billion, and the national textile and textile products (TPT) industry showed a growth of 13.44% in the third quarter of 2022. The development of the Muslim fashion industry ecosystem begins with the initial stages related to access to raw materials, production, branding, exhibition, and promotional activities. It is also important to have industry human resources with adequate qualifications and competency. Therefore, a national qualification scheme that integrates the fields of education, job training, and the business world is needed (Kepemenerin, 2022).

4.2 Result and Analysis

4.2.1 The Production Process SMEs Y

In the Research Findings section, the focus was only on the fabric production cycle from November 2022 to April 2023. In November 2022, UMKM Y received an order for 66,000 sets of sarimbit products, requiring a total of 53,416 yards of morena fabric and 30,612 yards of jacquard fabric. The

production process at UMKM Y consists of seven stages. Each stage of the fabric takes three to four days to complete, starting from the input of the main raw materials to the finished product. The production process is illustrated in the diagram.

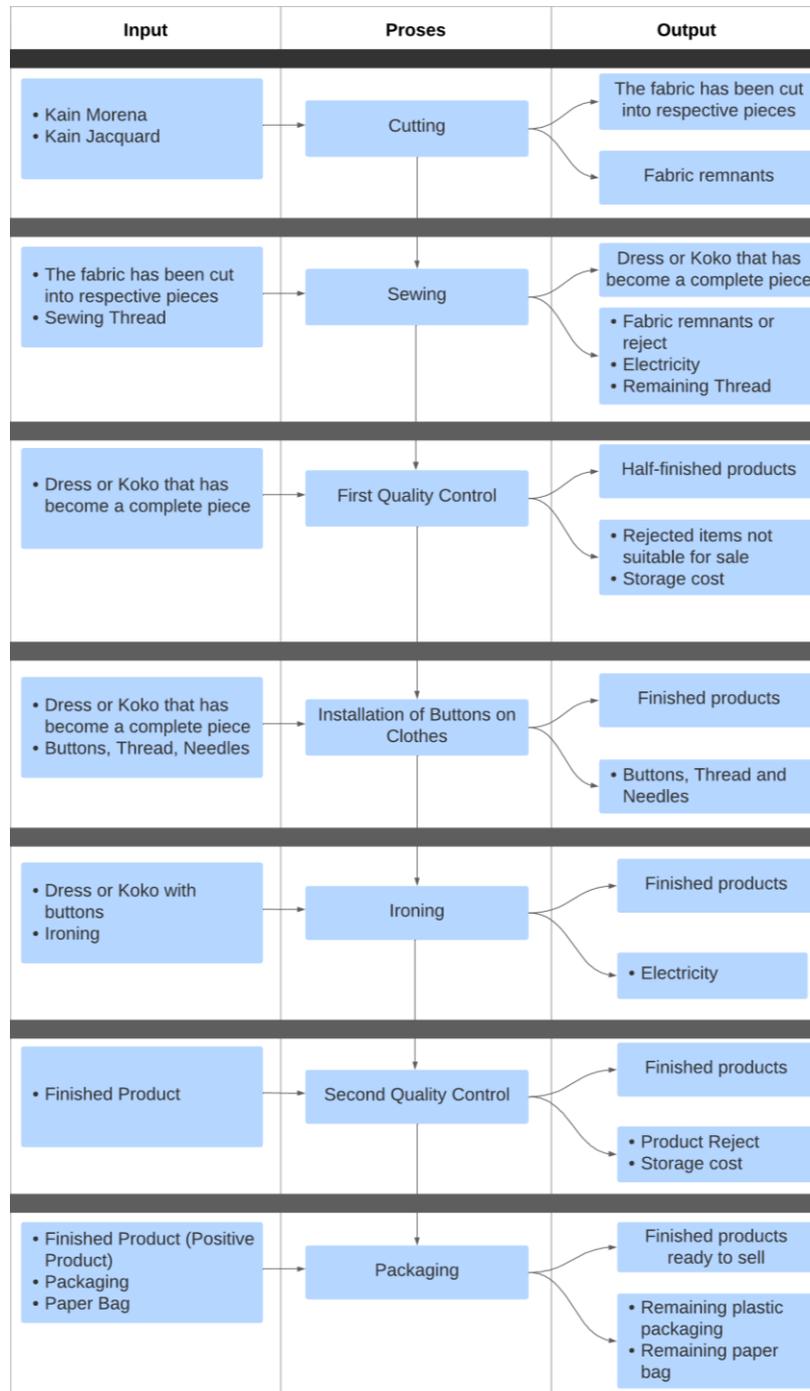


Figure 2. Production process

4.2.1 Production Process in SMEs Y Reviewed from the Material Flow Cost Accounting (MFCA) Framework

4.2.1.1 Involving Management and Determining Roles and Responsibilities

After communicating and obtaining commitment from various departments within the organization, the next step is to form an MFCA implementation team by establishing clear roles and responsibilities. In planning the implementation of the MFCA, it is important to establish a clear organizational structure so that roles and responsibilities can be determined accurately.

The head of the production department at SMEs Y serves as the chairperson of the MFCA implementation team. The reason for selecting the head of production as the team leader is to provide motivation for team members, as they feel supported by the leadership and production department in performing their tasks to the fullest extent.

Table 1. Role and responsibilities of the MFCA implementation coordinator

No	Position	Total Needed	Responsibilities
1	Head of Production	1	Overseeing the flow of material and energy during the production process
2	Quality Control	1	Checking finished products to ensure they meet the desired quality standards set by the company. Supervising the management of production waste and its disposal.
3	Head of Finance	1	Creating and calculating the production costs incurred at each production stage

4.2.1.2 Scope and Limitations of Process and Determination of Material Flow Modes

After determining the scope and boundaries of the production process in the design phase of MFCA implementation, the next step is to create a material flow model. The first step in creating this model is to determine the quantity of centers. Quantity centers are parts of the process where inputs and outputs are physically measured and represent the stages in which raw materials are transformed. The production process of SMEs Y consists of seven stages, but not all of them can be quantity centers. After conducting an analysis, it was found that there are five quantity centers in the production process of SMEs Y: cutting, sewing, button installation, ironing, and finishing. At each quantity center, raw materials are processed into products or waste materials, as well as measurable inputs and outputs.

1. Cutting Process

The cutting process is the first quantity center. Morena and jacquard fabrics were used in this stage. UMKM Y does not use any other materials besides these fabrics because their quality is already excellent. From November 2022 to April 2023, SMEs Y produced 66,144 pieces of sarimbit products, which translates to 84,045 yards of fabric. This included 53,370 yards of morena fabric and 30,675 yards of jacquard fabric. Prior to production, SMEs Y usually purchase fabrics in rolls so that they can be cut according to customer orders, reducing waste in each production run. Morena and jacquard fabrics often result in fabric scraps after the cutting process is complete.

Although some fabric scraps can be reused for future production, if their length is less than 3 yards, they generate negative outputs. SMEs Y produces an average of 0.1-2% negative outputs each month from the total processed raw materials. During the period from November 2022 to April 2023, SMEs Y generated approximately 60 rolls of fabric scraps out of the total 1,507 rolls of fabric processed. However, these fabric scraps can be reused in future production. If the fabric is used to make products with the smallest size, less than 3 yards, the fabric scraps will be stored in SMEs Y's warehouse or disposed of, as they cannot be reused.

2. Installation of Buttons

In this process, fabric that has passed the first stage of quality control is used. At this stage, 111,781 buttons and 12,715 acrylic pieces are used as accessories. The focus of this process is on attaching buttons and accessories to products that have passed the first stage of quality control, using sewing thread. In this process, there is still a possibility of waste materials, namely buttons and sewing threads, resulting in negative outputs.

3. Ironing

After the button attachment process, the next step is ironing to ensure that the products sent to customers are neat and free of loose threads. This process requires electrical energy and involves five workers.

4. Finishing and Packaging

This process is carried out when the finished products are ready to be packaged as the sarimbit products. This process focuses on packaging and assessing the suitability of the products produced in the previous production process. In this finishing process, 50,000 pieces of plastic packaging are required, and eight workers are involved. The negative output generated from this process is damaged packaging materials, such as plastic packaging and cardboard used for packaging. Packaging damage rarely occurs because packaging must be ordered from a third party. However, occasional occurrences may be due to human error or the stacking of other packages, resulting in approximately 1% of the total packaging being unusable.

4.2.1.3 Cost Allocation

In this stage, the cost allocation is performed. In the MFCA, costs are classified into four categories: material, energy, labor, and disposal costs. To determine the material cost, the physical quantity of input raw materials at each quantity center is multiplied by their unit cost, and the material cost flow is tracked through each quantity center. Once the material cost is identified and allocated, the energy, system, and disposal costs for each quantity center are calculated.

1. Cutting Process

The cutting process is the first quantity center. Two types of fabric are used in this stage: morena and jacquard. From November 2022 to April 2023, SMEs Y produced a total of 30,671 pieces of sarimbit products, equivalent to 84,045 yards of fabric, divided into two categories: 53,370 yards for morena fabric and 30,675 yards for jacquard fabric. The unit price is IDR 20,000 for morena fabric and IDR 24,000 for jacquard fabric, resulting in a total raw material cost of IDR 1,803,606,000. The positive outputs in this stage were 47,629 and 29,958 yards for morena and jacquard fabrics, respectively. These figures are divided by the total input in this process, which is 53,370 yards for morena and 30,675 yards for jacquard fabric, and multiplied by the total raw-material cost. Consequently, the cost allocation for a positive output is IDR 952,580,352 for morena fabric and IDR 718,999,181 for jacquard fabric.

The negative output of raw materials in this production process was 5,741 yards of Morena fabric. The estimated quantity of 5,741 yards of morena fabric was divided by the total input of 53,370 yards and multiplied by the total input cost of raw materials, resulting in a cost allocation of IDR 114,819,648 for the negative output in this process. The percentage of positive output in the allocation of raw materials in this process was obtained by dividing the quantity of Morena fabric (47,629 yards) by the input of 53,370 yards and multiplying by 100%. The percentage of negative output in the allocation of raw materials in this process was obtained by dividing the quantity of Morena fabric (5,741 yards) by the input of 53,370 yards and multiplying by 100%.

The negative output of raw materials in this production process was 717 yards of jacquard fabric. The estimated quantity of 717 yards of jacquard fabric was divided by the total input of 30,675 yards and multiplied by the total input cost of raw materials, resulting in a cost allocation of IDR 17,206,818 for the negative output in this process. The percentage of positive output in the allocation of raw materials in this process was obtained by dividing the quantity of jacquard fabric (717 yards) by the input of 30,675 yards and multiplying by 100%.

The percentage of negative output in the allocation of raw materials in this process was obtained by dividing the quantity of morena fabric (717 yards) by the input of 30,675 yards and multiplying by 100%. This process generated a positive output of raw materials amounting to 89% and a negative output of 11%. In this stage, there is also the input cost of sewing, which amounts to IDR 1.186 billion for the entire output of the cutting and sewing processes.

2. Button Installation

In this process, fabric that has passed the first stage of quality control is used. In this stage, 111,781 buttons and 12,715 acrylic pieces are used as accessories, with prices of IDR 197.92 per piece for buttons and IDR 800 per piece for acrylic. The total costs incurred were IDR 22.12 million for buttons and IDR 32.3 million for acrylic. This production stage requires a total of 25 workers, with one worker assigned to each machine. According to the information provided by SMEs Y, this process does not yield negative output because any leftovers can be reused in the subsequent production process

3. Ironing

After the buttons are attached, the next process is ironing to ensure that the products sent to customers are neat and free of loose threads. This process requires electrical energy and 10 workers to operate. One machine is required for one worker for the ironing process. In this stage, there is also an input of energy, which is 2 kWh at a unit price of IDR 1,444.70. The production process takes 480 min multiplied by the packing time of 7 days. This process does not yield negative outputs, as it does not generate waste.

4. Finishing and Packaging

This process is carried out when the finished products are produced as sarimbit products. This process focuses on packaging and assessing the suitability of the products made in the previous production process. In the finishing process, 36,700 pieces of plastic packaging and eight workers are required. The negative output generated from this process is damaged packaging plastic or cardboard used for packaging. Packaging damage rarely occurs because packaging must be ordered from a third party. Usually, it occurs due to human error or the accumulation of other packaging errors, resulting in approximately 1% of the total packaging being unusable.

Therefore, there was a positive output of 36,333 pieces with a total cost of IDR 36.01 million and a negative output of 367 pieces with a total cost of IDR 363,750. After the calculation, these costs were presented as expenses during production, as shown in the following Table 2, 3, and 4:

Table 2. Cost allocation, positive output, and negative output on SMEs Y's production raw materials.

Raw Material	Cost Allocation (IDR)	Allocation of positive output costs (IDR)	Allocation of negative output costs (IDR)
Kain Morena	1.07 billion	952.58 million	114.82 million
Kain Jacquard	736.21 million	719.00 million	17.21 million
Kancing	22.12 million	22.12 million	-
Acrylic	32.30 million	32.30 million	-
Plastik Packaging	36.38 million	36.01 million	0.36 million
Total	1.89 billion	1.76 billion	132.39 million
Percentage (%)		93%	7%

Table 3. Cost allocation, positive output, negative output on UMKM Y's production energy

Production Stages	Energy	Energy Requirements	Unit	Unit Price (IDR)	Cost Allocation (IDR)	Positive output percentage (%)	Positive output cost	Negative output percentage (IDR)	Negative output cost
<i>Cutting</i>	-	-	-	-	-	100	-	0	-
<i>Sewing</i>	-	-	-	-	-	100	-	0	-
Button Installation	-	-	-	-	-	100	-	0	-
Ironing	Listrik	4800	Kwh	1.44 million	6.93 million	100	-	0	-
Packaging	-	-	-	-	-	100	-	0	-
Total					6.93 million	100	-	0	

Table 3 presents the cost allocation, positive output percentage, and negative output associated with each production stage of UMKM Y in relation to energy use. Based on the data, only the ironing stage utilizes electrical energy, with a total energy requirement of 4,800 kWh, while the cutting, sewing, button installation, and packaging stages do not record direct energy consumption. The unit price of electricity is reported at IDR 1.44 million, resulting in a total energy cost allocation of IDR 6.93 million for the ironing stage. All production stages show a positive output percentage of 100 percent, indicating that the production process operates efficiently without any loss of added value. Furthermore, the negative output percentage for each stage is recorded at 0, suggesting that no energy waste or production inefficiency was identified. Overall, the total energy cost allocation in UMKM Y's production process amounts to IDR 6.93 million with fully positive production performance.

Table 4. Cost allocation, positive output, negative output on UMKM Y's production system

Production Stage	Number of Workers (Vendor/ Individual)	Requirements (Pcs)	Wage/Pcs (IDR)	Cost Allocation (IDR)	Positive output percentage (%)	Positive output cost	Negative output percentage (%)	Negative output cost (IDR)
<i>Cutting and Sewing</i>	5	6.134	30.000	920.13 million	89	818.92 million	11	101.21 million
Button Installation	25	30.671	301.90	231.49 million	100	231.49 million	0	-
Ironing	10	30.671	1.141	35.00 million	100	35.00 million	0	-
Packaging	8	30.671	114.11	28.00 million	99	27.72 million	1	0.28 million
Total				1.21 billion	91.6	1.11 billion	8.4	101.49 million

4.2.1.4 InteIDRreting and communicating the results of MFCA

The next step after calculating the cost allocation related to the production process is to inteIDRret the results of the MFCA using cost flow matrices. These costs can be categorized as product or material losses.

Table 5. The cost flow matrix for the production process in SMEs Y

Component	Raw Material Cost	Electricity Cost	System Cost	Waste Management Cost	Total
Product	IDR 1.76 billion (93%)	IDR 6.93 million (100%)	IDR 1.11 billion (91.6%)	-	IDR 2.88 billion (92.5%)
Material Losses	IDR 132.39 million (7%)	-	IDR 101.49 million (8.4%)	-	IDR 233.88 million (7.5%)
Total	IDR 1.89 billion (100%)	IDR 6.93 million (100%)	IDR 1.21 billion (100%)	-	IDR 3.12 billion (100%)

Based on the data presented in Table 5 on raw material, energy, and system costs, the total allocation of product and material loss costs is determined. In the cost flow matrix, it can be concluded that the company incurred a material loss of 7.5%. Each production stage generates waste, and although the percentage of material loss may not always be significant, reducing this percentage can help the company improve cost efficiency in production.

4.2.1.5 Recommendations for Implementation Based on MFCA Results

Using the MFCA, the management of UMKM Y can accurately assess data on material losses and the associated costs to identify opportunities for improving environmental and financial performance. The following steps can be taken to improve the production process: material substitution, process modification, production line or product optimization, and enhancing R&D activities related to material and energy efficiency. Based on the MFCA analysis conducted at UMKM Y, the following alternative improvements or production process management strategies can be considered:

a) Management of leftover fabric as raw material

Alternative management of morena and jacquard fabrics involves planning the material requirements from the beginning based on the sales and marketing team's estimates. This requires the use of more modern cutting tools to ensure accurate fabric cuts and minimize leftover pieces. The cutting process requires employees to have high precision and discipline. Some of the leftover fabric pieces can be used for further production, but if the remaining fabric length is less than three yards, it will result in a negative output.

The discarded fabric can be reused to create handicrafts, such as tablecloths, napkins, and other small items. By reusing the leftover fabric in the cutting process, it can increase savings in raw materials and reduce the amount of leftover fabric, adding economic value. If it is possible to use the leftover fabric to create hijabs again, as it is still related to modest fashion and can be sold separately to retailers or other partners, it can turn the material loss into profit for UMKM Y more quickly. This approach avoids wasting or storing leftover fabric as raw material without processing it, compared to directly selling the fabric without further utilization.

b) Reducing the width of each pattern piece's edge

This solution reduces fabric waste generated after the sewing process. Its implementation requires the use of more modern cutting tools to ensure more accurate cuts, thereby minimizing fabric remnants. The cutting process requires meticulous and disciplined workers. Narrowing the width of each pattern piece's edge (the smallest distance at which the fabric can be cut by the machine) can

refers to the issues faced by UMKM Y in the production process. According to the Kamus Besar Bahasa Indonesia (Indonesian Dictionary) through <https://kbbi.kemdikbud.go.id/>, “sisa” means “what is left (after eating, taking, etc.); excess; leftovers.” In this context, it pertains to the remaining raw fabric materials used by the company. Further management is needed for these remnants to minimize the costs associated with leftover fabric raw materials.

The next word in terms of frequency mentioned by the respondents in the Nvivo 12 Pro analysis is “reject.” The word “reject” was mentioned 52 times, with a coverage of 0.35%. This word is significant because it relates to the procurement of fabric materials and the sewing process, which can result in rejected products. The term “reject” refers to the rejection or refusal of products or goods that do not meet the established quality standards or specifications.

5. Conclusions

5.1 Conclusions

The implementation of Material Flow Cost Accounting (MFCA) is crucial for companies, especially small and medium-sized enterprises (UMKM), as it makes the production process more transparent through the material flow scheme. By implementing the MFCA, businesses can assess the efficiency of material utilization in a production process by measuring the amount of waste generated. MFCA also enables businesses to allocate costs to raw materials, energy, and labor, which is beneficial for making efficient and profitable decisions in the long run.

In the case of SMEs Y, it is evident that material losses (negative outputs) from the cutting process reach 10%, and there is currently no systematic follow-up on leftover fabric. This leads to the accumulation of fabric waste in the environment. The lack of a dedicated workforce to manage roles and responsibilities also contributes to the neglect of material losses resulting from fabric waste. Therefore, the researcher proposes adding internal business processes to SMEs Y to address fabric waste and transform it into useful products in the future while preventing the occurrence of fabric leftovers.

5.2 Research Limitations

The limited access to and availability of the required data for material flow cost accounting calculations resulted in this research being limited to a period of six months, from November 2022 to April 2023. Production planning is carried out when there are orders from customers, which means that the production cost records for the entire year are not presented as separate reports. As a result, the researcher had to separate the production costs from the overall annual cost reports of the company. UMKM Y does not yet have an integrated system and still relies on manual records for cost recording and production planning purposes. In addition, this study employed a qualitative method through observation and interviews without using quantitative comparative data. Therefore, future studies should consider incorporating other methods for comparing research findings.

5.3 Suggestions and Directions for Future Research

The researcher suggests that for future studies, if the company does not have internal data related to material flow cost accounting, data can be collected through a longer period of observation. For example, observations can be conducted on the production process for one year. In cases where cost-related data are not available, benchmarking can be conducted with other batik industries or by considering market prices.

The use of material flow cost accounting (MFCA) is recommended by the researcher as an environmental management accounting system so that negative outputs and hidden costs in the production process can be identified by the company, thus improving production process efficiency. Control measures can be implemented by the company through appropriate corrective actions, and the outcomes of these actions on negative outputs can also be monitored.

Author Contributions

MWP was responsible for conceptualization, study design, data collection, data analysis, and manuscript drafting. DA contributed to research supervision, critical revision of the manuscript, and final approval. Both authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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