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The Effectiveness of Implementation Material Flow Cost Accounting (MFCA): A Case Study in The Standard Concrete Company in Duhok

An Applied Study on The Standard Concrete Company in Duhok

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Abstract

This study aims to explore the role of Material Flow Cost Accounting (MFCA) in enhancing both financial and environmental performance in industrial companies. The importance of this research stems from the fact that MFCA is one of the most advanced techniques in environmental management accounting, providing quantitative and monetary data that contribute to improving cost control and supporting decision-making processes, thereby achieving competitive pricing advantages. The study adopted a descriptive–analytical approach by analyzing data and reports of Standard Concrete Company in Duhok during the study period. It tested the research hypotheses, highlighted the main challenges facing MFCA implementation, and demonstrated the limitations of traditional costing systems. The findings revealed that the application of MFCA effectively reduces costs and supports competitive pricing policies, as it provides accurate data on emissions, waste, and costs related to both positive and negative products. The analysis showed that positive outputs accounted for 96.126%, while negative outputs represented 3.874%, which included 77,745 liters of water, 5,874 electricity units, 4,226 liters of fuel and lubricants, 261 tons of cement, 460 tons of sand, 280 tons of gravel, and 453 cubic meters of concrete debris. The study concluded that MFCA can be successfully implemented in Standard Concrete Company and plays a pivotal role in reducing waste, cutting costs, and promoting cleaner production. It recommends expanding the application of MFCA in other industrial firms and emphasizes the importance of forming specialized and well-trained teams in modern cost and management accounting practices to address environmental and technological challenges.

1. Introduction

In recent years, enhancing environmental management has become a central focus in accounting research and studies due to various pressures and motivations faced by companies. These pressures include the growing demands from stakeholders for companies to commit to addressing environmental issues and mitigating their harmful impacts on the surrounding environment and society. Moreover, there is an urgent need for companies to shift their focus from an exclusive emphasis on short-term profits toward adopting long-term strategies aimed at survival, sustainability, and achieving competitive pricing.

The Material Flow Cost Accounting (MFCA) technique is an effective method that helps companies achieve harmony between profitability and environmental protection, thereby reducing societal pressure. This technique was developed following the issuance of the first ISO standard (ISO 14051) in 2011 by the International Organization for Standardization (ISO), to support industrial companies in improving production efficiency through the optimal utilization of available energy and resources, reducing production costs, and achieving competitive pricing. Despite the theoretical benefits of MFCA, previous studies have not sufficiently addressed its application in industrial companies in the Kurdistan Region, particularly regarding the practical challenges and obstacles that companies may face during implementation. Therefore, this study aims to fill this research gap by exploring the feasibility of applying MFCA at The Standard Concrete Company in Duhok, assessing its impact on cost reduction, quality improvement, and competitiveness, and analyzing the practical challenges associated with its implementation.

The main problem of the study is "Is there an impact of applying the MFCA technique on achieving a competitive price?" Based on the above, the following sub-questions can be answered:

- Is it possible to use the Material Flow Cost Accounting (MFCA) technique to contribute to providing information that helps improve the quality level and reduce product costs?
- Is it possible to use the Material Flow Cost Accounting (MFCA) technique to provide a strategic vision for achieving a competitive price?
- Can the Material Flow Cost Accounting (MFCA) technique be applied in the Standard Concrete Company in Duhok?

Thus, the study aims to explore the potential application of the Material Flow Cost Accounting (MFCA) technique, as one of the most modern approaches in environmental managerial accounting, in improving both financial and environmental performance and achieving competitive pricing in the company under study. The sub-objectsives of the study include:

- Review previous literature and studies to highlight their contributions to the development and application of the MFCA technique in the company under study.
- Analyze the nature of the MFCA technique and explore how the industrial company can benefit from it to achieve competitive pricing through optimal resource utilization while considering the needs of future generations.
- Assess the practical significance of the results from implementing the MFCA technique in the study sample and highlight its role in achieving competitive pricing.

Based on the research problem and its objectives, this study assumes that the implementation of the Material Flow Cost Accounting (MFCA) technique positively contributes to improving operational cost efficiency, enhancing product quality, and achieving competitive pricing at The Standard Concrete Company in Duhok. To further examine this assumption, the following sub-hypotheses are proposed:

1. The use of the MFCA technique provides relevant and accurate information that supports improvements in product quality and the reduction of production costs.
2. The application of the MFCA technique offers a strategic perspective that facilitates the achievement of competitive pricing and supports effective pricing decisions.

3. The MFCA technique is applicable at The Standard Concrete Company in Duhok and has a significant positive impact on both financial and operational performance.

Finally, the scientific significance of this study stems from its focus on measuring the effectiveness of implementing the Material Flow Cost Accounting (MFCA) technique as one of the modern approaches in managerial and environmental accounting, and its role in enhancing both financial and environmental performance in industrial companies. The study contributes by providing accurate quantitative and financial data that support managerial decisions related to cost reduction and achieving competitive pricing, while also filling a knowledge gap in the applied local literature, where research on the impact of MFCA in industrial companies in the Kurdistan Region is limited. Thus, this study provides a scientific reference that enriches theoretical knowledge regarding the relationship between modern accounting techniques, operational efficiency, and environmental sustainability. The practical significance lies in highlighting the role of MFCA implementation in improving resource utilization efficiency and reducing environmental waste, as well as supporting competitive pricing to enhance the company's competitive advantage. The study also offers an applied framework that can be utilized to train specialized teams in using modern accounting tools to address environmental and technological challenges, thereby contributing to environmental sustainability and improving the financial and operational performance of industrial companies.

2. Research Framework and Methodology

In the context of implementing Material Flow Cost Accounting (MFCA), the researcher adopted a combination of research methodologies to establish a solid theoretical foundation and to collect and analyze practical data. A deductive approach was first employed to develop the theoretical framework of the study. This was achieved through a comprehensive review and analysis of relevant accounting literature, including both Arab and international studies related to the study variables and associated concepts. This process helped in grounding the research theoretically and in formulating the study's hypotheses.

In addition, an inductive approach was used to gather the required empirical data. This involved field visits and interviews with management and employees at the selected company, enabling the researcher to observe actual practices and collect real-world data. This approach facilitated the analysis of practical evidence and the derivation of meaningful conclusions based on the company's operational reality.

Regarding the study boundaries, the research was geographically limited to The Standard Concrete Company in Duhok. Temporally, the study focused on financial statements and related financial and non-financial reports for the year 2024. As for the data sources, they were divided into two main categories. Theoretical sources included Arab and international references such as books, research papers, theses, academic journals, and credible online publications. Practical sources consisted of field visits to the company, in addition to the review of internal records, documents, and both financial and non-financial reports relevant to the organization.

It should be noted that the study is also constrained by specific limits. The spatial limitation is restricted to The Standard Concrete Company in Duhok, while the temporal limitation relates to the financial statements of the company for the year 2022.

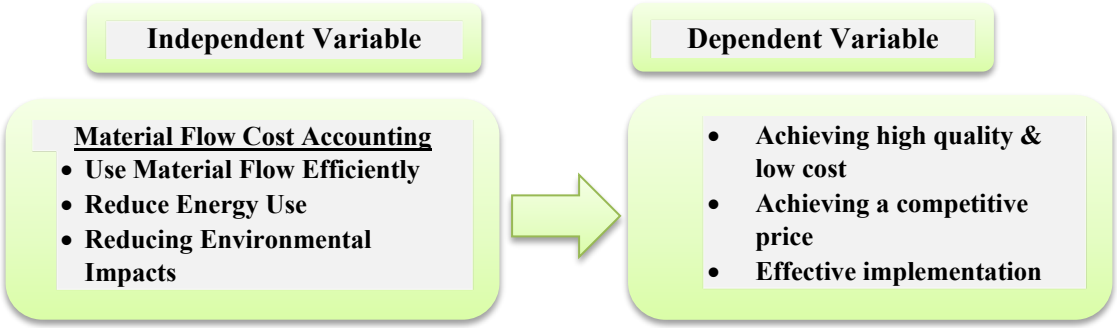

Figure 1. Study Model

Achieving the objectives of this study requires developing a conceptual model that clarifies the relationship between the study variables. In this model, the Material Flow Cost Accounting (MFCA) approach represents the independent variable, while the attainment of a competitive price is considered the dependent variable. This relationship is illustrated in Figure 1, which presents the proposed framework of the study and shows how the application of MFCA is expected to influence pricing competitiveness at The Standard Concrete Company in Duhok.

3. Literature review

3.1 Previous Studies

Mohsin & Mohammed (2025) examined the role of Material Flow Cost Accounting (MFCA) in promoting environmental sustainability and innovation within refining companies. The study focused on the application of MFCA as a tool for reducing carbon dioxide (CO_2) emissions and material losses, while also assessing its combined economic and environmental impacts. The research sample consisted of three refining companies, with their names withheld for confidentiality. The findings indicate that MFCA not only reduces the carbon footprint but also supports the development of eco-friendly products, thereby providing firms with a competitive advantage in global markets. Overall, MFCA offers valuable insights into material flows and financial efficiency, enabling companies to minimize waste, improve operational performance, and achieve long-term sustainability.

According to Sahu et al. (2021), the application of Material Flow Cost Accounting (MFCA) in an Indian small and medium-sized enterprise (SME) specializing in the manufacturing of steel pipes and tubes. The study employed a case-based research methodology to demonstrate how MFCA can be effectively used to enhance both financial and environmental performance. Material costs, system costs, and energy costs were calculated at each quantity center to identify inefficiencies within the production process. Subsequently, several measures were implemented to address these inefficiencies. The results showed annual savings of USD 302,350 achieved through an initial investment of USD 7,123. The implementation also led to increased productivity, improved energy efficiency, and enhanced environmental performance. In addition, the company's performance was monitored over five years to assess the long-term benefits of MFCA. The findings indicated that the return on invested capital increased by 29.37%, while material usage costs decreased by 26.58% following MFCA implementation. Overall, the study provides valuable insights for managers, practitioners, and policymakers regarding the effective implementation of MFCA in SMEs.

The study by Elgably & Abou Nel (2023) proposed an integrated framework combining Material Flow Cost Accounting (MFCA) and Target Costing (TC) to reduce costs, improve product quality, and enhance business competitiveness. A survey and field study were conducted involving cost accountants, financial and production managers, senior management, and academics. Quantitative and statistical analyses were employed to test the study hypotheses. The results indicate that MFCA contributes to reducing defective products, minimizing production losses, shortening production cycles, lowering costs, and increasing profits, while Target Costing optimizes resource utilization, reduces material costs, improves design efficiency, and enhances team motivation. Overall, the integration of MFCA and TC supports enterprises in achieving optimal quality levels and sustaining competitive advantage.

The study by Tran & Herzig (2020) explored the application of Material Flow Cost Accounting (MFCA) in developing countries experiencing rapid structural transformation and environmental challenges. A systematic review of 28 studies across nine countries (China, Indonesia, Iran, Malaysia, South Africa, Sri Lanka, Thailand, the Philippines, and Vietnam) revealed that MFCA research is primarily concentrated in Asian contexts. While MFCA is often associated with eco-efficiency, it also supports strategic decision-making processes. The study identified key challenges, including limited data availability and insufficient cost allocation within existing accounting systems. It further highlighted future research needs, particularly the importance of quantitative and comparative analyses, as well as a greater focus on small and medium-sized enterprises (SMEs) and

diverse industry sectors.

Dekamin & Barmaki (2019) applied Material Flow Cost Accounting (MFCA) to soybean production to reduce material and energy waste and enhance economic and environmental sustainability. MFCA was used to quantify losses across different production stages and to compare the results with conventional analysis. The MFCA-based approach demonstrated higher gross production value, gross return, and benefit-cost ratio (2,103 USD/ha, 695 USD/ha, 1.49) compared to conventional calculations (1,781 USD/ha, 373 USD/ha, 1.26), with 322 USD identified as material waste cost. Although energy efficiency decreased, MFCA provided comprehensive insights into the economic-environmental relationship, supporting more sustainable and data-driven agricultural management.

3.2 Advantages of MFCA

In 1990, Professor Bernd Wagner presented the idea of Material Flow Cost Accounting (MFCA) in Augsburg, Germany, as an accounting method for environmental preservation. By concentrating on monitoring waste, emissions, and losses, MFCA helps to enhance both environmental and economic performance. As one of the most well-known environmental management accounting (EMA) methods, it has attracted a lot of interest because it can offer comprehensive data on emissions and waste that can be used to inform decisions (Tajelawi & Garbharran, 2015, p. 3641).

Material flow cost accounting is defined as an accounting technique used to precisely track material flows and thereby give management vital information that ultimately supports appropriate decision-making and improves manufacturing efficiency. This definition has been contributed to by a number of researchers and organizations (Fatah, & Jaf, 2023,P 573). (Hyršlová et al., 2011, p. 4). Christ and Burritt (2016) state that ISO 14051 defines it as "a tool for measuring the flows and balances of materials in both processes and production lines, expressed in physical and monetary units. Material Flow Cost Accounting is acknowledged as a cutting-edge method of cost recording and measurement with the goal of cutting expenses and reducing waste to lessen environmental effects. Furthermore, it boosts output and gives businesses a competitive edge in terms of both the environment and finances (Kovanicova, 2011, p. 7).

One of the most sophisticated methods for quantifying and valuing material and energy flows is Material Flow Cost Accounting (MFCA). In summary, scientists claim that MFCA is an important use of environmental management accounting that yields useful data by monitoring materials during production, quantifying outputs, and identifying end products, emissions, and residues. This strategy reduces expenses, improves manufacturing effectiveness, and lessens its negative effects on the environment.

The Role of MFCA in Improving Product Quality includes reducing waste and enhancing efficiency. By tracking material and energy flows, MFCA helps identify waste and analyze its causes, contributing to improved operational efficiency and reduced defects. Further, it improves transparency and decision-making as MFCA provides accurate information about costs associated with waste, enabling management to make informed decisions to enhance product quality (Walls et. al.,2023). Additionally, it promotes sustainability and environmental quality by reducing waste and optimizing resource use. MFCA also contributes to improving the environmental quality of products, thereby enhancing the company’s market reputation. Finally, with regard to balancing quality and cost by identifying costs related to waste, MFCA assists companies in achieving a balance between quality improvement and cost reduction, which strengthens their market competitiveness (Sahu et al.,2021).

Moroever, (Ahmed et al., 2024), regarding the benefits of MFCA in cost reduction, three main benefits were indicated: Improving Resource Efficiency: By tracking material and energy flows, MFCA helps identify losses and analyze their causes, contributing to improved process efficiency and reduced costs; Reducing Waste Costs: MFCA enables the identification of costs associated with waste, supporting informed decisions to minimize waste and enhance financial performance; and Enhancing Transparency and Decision-Making: MFCA provides accurate information on costs

related to losses, enabling management to make informed decisions to improve efficiency and reduce costs.

Nevertheless, according to (Tran & Herzig, 2020; Walls et al., 2023), the key obstacles in MFCA implementation include the following:

1. The absence of appropriate digital and technical tools for data collection and analysis hinders the effective implementation of MFCA.
2. Companies, especially small and medium-sized enterprises, face challenges in understanding the importance of MFCA and how to implement it effectively. This lack leads to internal resistance and difficulties in adopting the technology.
3. MFCA requires significant investments in training, system development, and data collection, which imposes a financial burden on organizations.
4. Difficulty in obtaining reliable data on material and energy flows and waste hinders the effective implementation of MFCA.
5. The challenge of integrating MFCA with current accounting or resource management systems can complicate operations and lead to duplicated efforts.

3.3 Achieving Competitive Price and the Contribution of MFCA to Decision-Making

3.3.1 Achieving a Competitive Price Concept

Many concepts have been presented for achieving a competitive price, and these concepts share many aspects. For example, Saunders & Others (2009: 121) believe that achieving a competitive price is an administrative decision based directly on a set of information and internal and external factors that affect the profitability of the economic unit. As for Horngren et al. (2017: 601), they believe that these are decisions that have crucial consequences on the condition of the economic unit and its competitive advantage in relation to the cash flow planned to be achieved in light of those decisions.

3.3.2 Material Flow Cost Accounting (MFCA) Technique as an Information System for Achieving a Competitive Price

The problem of the need for accurate and appropriate information about production costs arises when an inappropriate method is used to collect information or when it is unable to provide sufficient information to manage industrial companies and report on resource utilization. This leads management to make incorrect decisions, and consequently, these decisions affect the financial position and competitive advantage of the companies in the market (Mustafa et al., 2022, p. 4). Traditional accounting systems have been criticized for their narrow focus on producing a specific type of accounting information and for neglecting important information, particularly that related to the quantity and size of waste and the loss of materials and energy (Rashid & Jaf, 2023, p. 411; Jasch, 2009, p. 3).

As a result of these criticisms, companies have adopted appropriate waste reduction techniques. Decisions regarding waste rationalization may be made incorrectly in the absence of an efficient system that provides precise data on waste and losses. Therefore, reliable data must be available to support sound decision-making. In contrast to conventional management accounting systems, Material Flow Cost Accounting (MFCA) technology enables waste-related accounting and non-accounting data to be identified and centrally stored in a single database system (Fakoya, 2014, p. 158).

Material Flow Cost Accounting (MFCA) technology is an accounting method designed to provide stakeholders and other interested parties with new information that supports decision-making. This allows users to implement corrective actions by measuring material flows and proposing measures that lead to significant improvements in production processes (Hyršlová et al., 2011, p. 7). Doorasamy (2015, p. 54) stated that MFCA is a sufficient methodology for achieving better data and improving information systems in industrial companies, as it not only reduces costs of actual materials used but also contributes to reducing, processing, and disposing of waste.

4. Findings

4.1 An Introductory Overview of the Factory, Study Sample

The Standard Concrete Company in Duhok was established in 2009 under Administrative Order No. (5944) dated 30/3/2009 by the Ministry of Trade and Industry in the region, with a capital of (350,000,000) Iraqi dinars. It is affiliated with the Standard Contracting, Electrical and Mechanical Contracting Company. The factory is located in the industrial zone of the Duhok Autonomous Administration, and it began its production operations on 24/6/2009. The main activity of the Standard Concrete Company in Duhok is the production of various types of concrete.

4.2 Application of the Material Flow Cost Accounting (MFCA) Technique in the Study Sample Factory

One of the most significant challenges faced by some industrial companies today is maintaining their presence and competitiveness in local and international markets amid resource scarcity and difficulties in acquiring materials at appropriate prices and required quality levels. It is evident that substantial quantities of materials and energy are wasted during the production process. To measure and analyze these losses, the Material Flow Cost Accounting (MFCA) technique was selected. This technique is based on the principle that all material inputs must be converted into outputs, with the difference classified as negative products (waste). The flows of materials and energy are then tracked and analyzed in both physical and financial terms (quantitative and monetary). Therefore, it is essential first to identify material inputs and outputs along with their associated costs. The study relied on the factory's final accounts for the year 2022, focusing specifically on the product most produced and sold - C25 - which is considered the factory's flagship product, as previously noted, detailed as follows:

4.2.1: Determine the Quantitative Input and Output of the Product (C25)

Materials are the larges
t part of the costs of producing concrete (C25), which can be divided into the main materials that enter the production process (cement, sand, gravel, and water).

4.2.2: Quantitative (Physical) Flow of Concrete Product (C25) for the year 2022

Table 1 shows the quantities of input materials and concrete production for the product (C25) for the year 2022, as follows:

Table (1) Quantity of inputs and outputs for the product (C25) for the year 2022

<table>
<tr><th colspan="2">Quantitative Inputs</th><th colspan="2">Positive Outcomes</th><th colspan="4">Negative Outputs</th></tr>
<tr><th>Raw Materials</th><th>Thousands of Quantities</th><th>Products</th><th>Thousands of Quantities</th><th colspan="2">Waste</th><th colspan="2">Thousands of Quantities</th></tr>
<tr><td>Cement</td><td>75,119Tons</td><td rowspan="8">Concrete Product (C25)</td><td rowspan="8">33,512 per Cubic Meter</td><td colspan="2">Material Damage</td><td>Concrete Lost Cube (412)</td><td>Lost Total</td></tr>
<tr><td>Sand</td><td>40,283 Tons</td><td>Cement</td><td>261 Tons</td><td>158 Tons</td><td>420 Tons</td></tr>
<tr><td>Gravel</td><td>23,198 Tons</td><td>Sand</td><td>460 Tons</td><td>555 Tons</td><td>1015 Tons</td></tr>
<tr><td>Water</td><td>3,978,742 Liters</td><td>Gravel</td><td>280 Tons</td><td>319 Tons</td><td>600 Tons</td></tr>
<tr><th>Energy</th><th>Thousands of Quantities</th><th colspan="2">Emissions</th><th colspan="2">Thousands of Quantities</th></tr>
<tr><td>Electrical Energy</td><td>77,129 Units</td><td colspan="2">Water</td><td colspan="2">77,745 Liters</td></tr>
<tr><td>Fuel and Oil Energy</td><td>56,998 Liters</td><td colspan="2">Fuel and Oils</td><td colspan="2">4,226 Liters</td></tr>
</table>

Source: Prepared by the Researchers Based on Factory Data

Table (1) mounting to (75,119) tons, and the amount of electrical energy, fuel, and oils used in the production process for the concrete product (C25), while the positive outputs amount to (33,512) cubic meters. From the concrete product (C25). It is clear from the analysis of the results that the quantities of raw materials used in producing the positive product are (cement 11,219 tons, sand 39268 tons, gravel 22,598 tons, water 3,846,000 liters). Through the application of this technology in the factory, it was found that the percentage of positive outputs is (96.126%), while the percentage of negative outputs is (3.874%), distributed among damaged materials (cement 261 tons, sand 460 tons, gravel 280 tons), and concrete waste (453 cubic meters), as well as emissions (water 77,745 liters, electricity 5,874 units, fuel and oils 4,226 liters).

4.2.3: Cost Flow for Concrete Product (C25) for the year 2022
The inputs and outputs of the concrete product (C25) can be determined according to the application of the (MFCA) technique, which is divided into four types as follows:
1. Material costs: This is one of the elements of the MFCA technology and includes costs for the raw materials involved in the production process for an amount of (75,119 tons of materials) and (3,978,742 liters of water).
2. Energy costs: This is one of the elements of the MFCA technology and includes the costs of electrical energy for the amount of (77,129 units), and fuel and oil energy for the amount of (56,998 liters) used during the production process.
3. System costs: Then they are one of the technical elements (MFCA) and include the costs of salaries, wages, maintenance of machinery and equipment, wear and tear, and other marketing and administrative costs.
4. Waste management costs: This is one of the elements of the MFCA technology and includes waste disposal costs for an amount of (453 per cubic meter).

After determining the cost of materials, energy, system, and waste management costs, the Material Flow Cost Accounting (MFCA) technique is applied to produce the product (C25) as shown in Table 2, and as follows:

Table (2) Application of (MFCA) technology for (C25) product

Seq	Material	The Total Amount	The Total Amount	Total Costs	Positive Outcomes	Negative Outputs
Input						
1	Cost of Raw Materials	11,638	Tons			
1.1	Cement	40,283	Tons	914,001000		
1.2	Sand	23,198	Tons	262,049,000		
1.3	Gravel	3,978,742	Liter	92,953,000		
1.4	Water			3,036,000		
2	Energy cost					
2.1	Energy (electrical)	77,129	Loneliness	10,026,000		
2.2	Energy (fuel and oils)	55,998	Liter	28,499,000		
3	System Cost					

3.1	Salaries and Wages			73,558,000		
3.2	Maintenance of Machinery and Equipment			98,547,000		
3.3	The Two Extinctions			73,084,000		
3.4	Food			14,516,000		
3.5	The Other			21,539,000		
3.6	Marketing and Administrative			50,050,0000		
4	Cost of Waste Management					
4.1	Waste Disposal Costs			2200,000		
	Total Input			**1,644,061,000**		
Outputs						
1	Concrete Product (C25)	33,512	Cube		1,260,680,000	
2	Solid Waste					
2.1	Product Loss (C25)	453	Cube			22,358,000
2.1	Cement	261	Tons			20,474,000
2.3	Sand	460	Tons			2,992,000
2.4	Gravel	280	Tons			1,124,000
3	Emissions					
3.1	Water	77,745	Liter			59,000
3.2	Electricity	5,874	Loneliness			763,000
3.3	Fuel and Oils	4,226	Liter			2,113,000
4	The System	%3.8	Cube		319,700,000	11,595,000
5	Trash Management					2,200,000
	Total Outputs				**1,580,380,000**	**63,680,000**

Source: Prepared by the Researchers, based on Factory Data

Table 2 shows the total production costs, which consist of the cost of materials, energy, system, and waste management across the manufacturing line for the concrete product (C25), and determines the quantities of damaged materials, concrete losses, and emissions during the production process. The principle of a physical balance between inputs and outputs has been achieved through the application of this modern technology.

The results of operations according to the application of the material flow cost accounting technique show that the total production costs amount to (1,644,061,000) Iraqi dinars, and this cost is distributed between the positive product and the negative product. The cost of the positive product amounted to (1,580,380,000) Iraqi dinars, while the cost of the negative product amounted to (63,680,000) Iraqi dinars, representing a percentage of (3.874%) of the total production costs. This percentage is considered to exceed the approved standards for costs, and the Factory can conduct an analysis of the deviations to determine the aspects lacking in performance.
It is clear from the analysis of the negative product cost that the largest percentage is the loss of concrete (C25), amounting to (453) cubic meters, with a value of (22,358,000) Iraqi dinars. This is because the quantities required for workplaces are usually not homogeneous with the nature of the product preparation process, which leads to the remaining of some production quantities, resulting in a loss. Finally, it becomes clear by comparing the results of the analysis according to the factory's current cost system, which amounts to (1,644,061,000) Iraqi dinars, while according to the application of the Material Flow Cost Accounting (MFCA) technique it amounts to (1,580,380,000) Iraqi dinars, with a difference of (63,680,000) Iraqi dinars, as a result of not bearing the negative product cost on the cost of the final product in calculating the cost per unit.

4.2.4: The Effect of Applying the Material Flow Cost Accounting (MFCA) Technique on Reducing Costs

The implementation of Material Flow Cost Accounting (MFCA) technology facilitates the provision of quantitative and financial information that aids in cost reduction through the optimal utilization of materials, energy, and water throughout the entire product life cycle. It enables the analysis of product costs by distinguishing between positive and negative outputs, identifying losses, waste, and emissions, and minimizing the proportion of damaged materials during the production process. After applying the Material Flow Cost Accounting (MFCA) technique and analyzing costs according to this technique, a list will be prepared to calculate the cost of one unit of concrete product (C25) according to the MFCA technique, and the difference in determining the cost of one unit through this technique and the current cost system of the factory will be demonstrated as well. Shown in Table (3) below:

Table (3) List of calculations of the cost of one unit of concrete product (C25)

Statement	The Current Costing System of the Factory	Material Flow Cost Accounting (MFCA)
Total Production Costs	**1,644,061,000**	**1,580,380,000**
Number of Units Produced	**33,512**	**33,512**
Cost Per Unit	**49,059**	**47,158**
Selling Price	**52,490**	**50,460**

Source: Prepared by the Researchers Based on Factory Data

It is clear from Table 3 that the cost of one unit of concrete product (C25) in the factory sample of the study has become (49,059) dinars, according to the application of the Material Flow Cost Accounting (MFCA) technique, while the reality of the factory's current cost system indicates that the cost of one unit amounts to (47,158) dinars. The cost of one unit of concrete product (C25) can be extracted through the following equation:

Cost per unit = positive product cost/number of units produced (C25)
Cost per unit = 1,580,380,000 / 33,512 = 47,158 Iraqi dinars for product (C25)

However, the reality of the actual numbers showed a clear decrease in reducing the cost of the product (C25), as shown in the following equation:
Reducing the cost per unit = 49,059 – 47,158 = 1,901 Iraqi dinars per unit. Therefore, it is clear that the cost of one unit decreases by (1,901) dinars according to the application of the MFCA

technology.
The percentage decrease in the unit cost of the product (C25) is (3.874%), as shown in the following equation:
Discount percentage = (product cost before discount – product cost after discount) / product cost before discount
The reduction percentage = (49,059 – 47,158) / 49,059 = 3.874%, meaning that the total savings of the factory amount to (63,680,000) Iraqi dinars from applying this technology.
It is clear from the above that a percentage decrease in the cost of one unit of the product (C25) is the result of not charging the cost of the negative product, waste, and damage to the cost of the final product. Here, the need for the factory to focus on reducing spoilage in production and reducing the negative product through the application of the MFCA technology will emerge. It leads to highlighting the wasted quantities of concrete, materials, and emissions to the embarrassment of management through what has been analyzed according to this technology for both positive and negative production, and thus addressing what can be reduced or increased by the percentage of negative production, increasing positive production, holding those responsible for these deviations accountable, and adopting skilled workers. And advanced machines for transporting materials and preparing places designated for raw materials so that they are within the primitive stages of production, thus protecting the environment from waste and emissions. Thus, the second objective of the study was achieved by applying this technology in order to reduce costs and improve the efficiency of resource use in the Factory sample of the study.

3.2.5: The Impact of Applying the Material Flow Cost Accounting (MFCA) Technique on Achieving a Competitive Price
Achieving a competitive price is crucial for the success, survival, and sustainability of industrial companies in the market, as the selling price plays a pivotal role in the effective marketing of products. The Material Flow Cost Accounting (MFCA) technique contributes by efficiently and accurately analyzing the costs of materials and energy, thereby enabling a more precise determination of product costs.
After analyzing the study and comparing the price of the concrete product (C25) at (52,490) Iraqi dinars per cubic meter under the factory's traditional cost system with the new price when applying this technology, the price of the product (C25) was determined at (50,460) Iraqi dinars per cubic meter, through the following equation:
MFCA target price = product cost + (product cost * profit margin 7%)
MFCA target price = 47,158 + (47,158 * 7%) = 50,460 Iraqi dinars for the target price of the product (C25).
It is clear from the above that the application of material flow cost accounting (MFCA) affects the rationalization of administrative decisions through achieving a competitive price, as the price achieved through the application of this technique and compared to the old price there is a difference of (2,030) Iraqi dinars, and it also helps the management to provide quantitative information It also provides transparency in the process of flow of materials and energy during the production process, optimal exploitation of available resources, achieving production efficiency and sustainability of the product, achieving a competitive price, protecting the environment from negative production, avoiding its recurrence in the future, remaining in the local market, and continuing to compete.
The application of MFCA contributes to achieving a competitive product price. The analysis showed that the target selling price of C25, calculated with a 7% profit margin, decreased from 52,490 to 50,460 Iraqi dinars per cubic meter. This price reduction of 2,030 dinars per cubic meter is likely to have a positive impact on the company's sales by making the product more attractive to customers, potentially increasing demand and market share. Lowering the price while maintaining profitability can enhance the factory's competitiveness in the local market and encourage larger purchase volumes from both existing and new clients. Additionally, this strategy may help the company respond effectively to competitors' pricing and stimulate customer loyalty over time.

4. Discussion

The results of this study highlight the significant impact of applying the Material Flow Cost Accounting (MFCA) technique on both the production efficiency and cost management of concrete product (C25) in the factory. The analysis of the quantitative flow of materials indicates that the factory achieved a high percentage of positive outputs (96.126%) and a relatively low percentage of negative outputs (3.874%), including damaged materials, concrete losses, and emissions. This demonstrates that MFCA provides clear visibility into the flow of materials and energy, allowing management to identify inefficiencies and sources of waste.

From a cost perspective, MFCA enabled a precise allocation of expenses into material, energy, system, and waste management costs. The total production cost using MFCA amounted to 1,644,061,000 Iraqi dinars, while the cost associated with positive outputs was 1,580,380,000 Iraqi dinars, indicating that 3.874% of costs were attributed to negative outputs. This differentiation allows management to better understand the cost of losses, which traditional costing systems may obscure, and emphasizes the importance of monitoring damaged materials and concrete waste to optimize resource utilization.

The application of MFCA led to a reduction in unit cost from 49,059 to 47,158 Iraqi dinars per cubic meter, achieving a 3.874% cost decrease. This cost reduction results primarily from excluding the cost of negative outputs from the final product, highlighting the potential for factories to increase profitability by minimizing waste and improving production processes. Additionally, MFCA supports the identification of specific operational weaknesses, encouraging the adoption of skilled labor, advanced machinery, and optimized material handling practices to reduce negative outputs.

Furthermore, MFCA contributes to achieving a competitive product price. The analysis showed that the target selling price of C25, calculated with a 7% profit margin, decreased from 52,490 to 50,460 Iraqi dinars per cubic meter. This demonstrates that by providing detailed quantitative and financial insights into the production process, MFCA enables management to set more accurate and competitive prices while maintaining profitability. This approach not only enhances market competitiveness but also promotes sustainability by reducing material waste, energy consumption, and environmental emissions.

However, several challenges were identified that may limit the full implementation of MFCA in the company:

1. Data Collection Difficulties: Accurate tracking of material and energy flows requires detailed and timely data, which may not always be readily available.
2. Technical and Skill Limitations: Employees may require additional training to correctly apply MFCA and interpret the results.
3. Resistance to Change: Some staff and management may resist adopting new accounting and production monitoring practices.
4. Financial Constraints: Implementing MFCA may involve initial costs for software, measurement tools, or process adjustments.
5. Integration with Existing Systems: Aligning MFCA with current costing and production systems can be complex and time-consuming.

In summary, while MFCA significantly improves cost efficiency, resource utilization, and competitiveness, successful application requires addressing these obstacles through proper training, investment in measurement tools, and management support. By overcoming these challenges, the factory can fully benefit from the insights provided by MFCA to minimize waste, reduce production costs, and achieve optimal pricing strategies.

5. Conclusion

Applying MFCA increased positive outputs to 96.126% and reduced negative outputs to 3.874%. MFCA enabled accurate allocation of costs to materials, energy, operations, and waste, providing clear insights into losses and negative outputs. The cost per unit of the C25 product decreased from

49,059 IQD to 47,158 IQD, a 3.874% reduction, by excluding negative output costs from the final product. Lower production costs and better loss management improved the factory's profitability through optimal resource utilization. MFCA helped determine a target selling price of 50,460 IQD per unit (with a 7% profit margin) compared to the previous price of 52,490 IQD, enhancing market competitiveness. The technique contributed to reducing material and energy waste and emissions, supporting environmental protection. MFCA allowed management to detect loss points, improve processes, and encourage skilled labor and advanced machinery adoption. Obstacles include accurate data collection, employee training, resistance to change, financial constraints, and integration with existing cost systems, requiring strategic solutions for effective implementation.

5.1 Recommendations

1. It is recommended that MFCA be applied to all production lines in the company to ensure comprehensive tracking of material and energy flows, minimizing waste, and reducing production costs.
2. It is recommended to provide continuous training programs for employees, particularly accountants, production managers, and operational staff, to effectively implement and utilize MFCA.
3. It is recommended to integrate MFCA results into strategic and operational decisions, including pricing, resource allocation, and process improvement initiatives, in order to maximize efficiency and competitiveness.
4. It is recommended to leverage MFCA insights to enhance quality control, reduce defective products, and optimize processes to ensure both high-quality outputs and cost efficiency.
5. It is recommended to address obstacles such as data accuracy, employee resistance, and system integration by adopting structured procedures, upgrading technology, and promoting a culture supportive of change.
6. It is recommended to use MFCA to evaluate the financial impact of pricing adjustments, ensuring that reductions (e.g., from 52,420 IQD to 50,460 IQD) improve competitiveness without sacrificing profitability.

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کاریگەری جێبەجێکردنی ژمێریاری تێچووی ڕۆیشتنی ماددە (MFCA):توێژینەوەیەکی کەیس لە کۆمپانیای ستاندارد کۆنکرێت لە دهۆک

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پوختە
ئەم توێژینەوەیە ئامانجی لێکۆڵینەوەیە لە ڕۆڵی ژمێریاری تێچووی لێشاوی ماددە (MFCA) لە بەرزکردنەوەی ئەدای دارایی و ژینگەیی لە کۆمپانیا پیشەسازییەکان. گرنگی ئەم توێژینەوەیە لەو ڕاستییەوە سەرچاوە دەگرێت کە MFCA یەکێکە لە پێشکەوتووترین تەکنیکەکان لە ژمێریاری ژینگەیی بەڕێوەبردن، دابینکردنی داتای چەندایەتی و دراوی کە بەشدارە لە باشترکردنی کۆنترۆڵکردنی تێچوون و پشتگیریکردنی پرۆسەکانی بڕیاردان، بەم شێوەیەش سوودێکی کێبڕکێی لە نرخدانان بەدەست دەهێنێت .توێژینەوەکە ڕێبازێکی شیکاری وەسفکەری گرتەبەر بە شیکردنەوەی داتا و ڕاپۆرتەکانی کۆمپانیای ستاندارد کۆنکرێت لە دهۆک لە ماوەی توێژینەوەکەدا. توێژینەوەکە گریمانەکانی توێژینەوەکە تاقیکردەوە، تیشکی خستە سەر ئاستەنگە سەرەکییەکانی بەردەم جێبەجێکردنیMFCA ، و سنوورەکانی پەیوەست بە سیستەمی تێچووی تەقلیدی دەستنیشانکرد.ئەنجامەکان دەریانخست کە جێبەجێکردنی MFCA بە شێوەیەکی کاریگەر تێچوونەکان کەمدەکاتەوە و پشتگیری لە سیاسەتەکانی نرخدانانی کێبڕکێ دەکات، چونکە داتای ورد لەسەر دەردانی گازی ژەهراوی، بەفیڕۆدان و تێچوونەکانی پەیوەست بە هەردوو بەرهەمی ئەرێنی و نەرێنی دەدات. شیکارییەکە دەریخستووە کە بەرهەمە ئەرێنییەکان 96.126% پێکدەهێنن، لەکاتێکدا بەرهەمە نەرێنییەکان 3.874% پێکدەهێنن. ئەم بەرهەمانە بریتی بوون لە: 77 هەزار و 745 لیتر ئاو، 5 هەزار و 874 یەکە کارەبا، 4 هەزار و 226 لیتر سووتەمەنی و نەوت، 261 تۆن چیمەنتۆ، 460 تۆن خۆڵ، 280 تۆن قەراغ، 453 مەتر سێجا پاشماوەی کۆنکرێت.توێژینەوەکە گەیشتە ئەو ئەنجامەی کە دەتوانرێت MFCA بە سەرکەوتوویی لە کۆمپانیای ستاندارد کۆنکرێت بەکاربهێنرێت و ڕۆڵێکی سەرەکی دەگێڕێت لە کەمکردنەوەی پاشەڕۆ و کەمکردنەوەی تێچوونەکان و پێشخستنی بەرهەمهێنانی پاکتر. هەروەها توێژینەوەکە پێشنیاری فراوانکردنی بەکارهێنانی MFCA دەکات بۆ کۆمپانیا پیشەسازییەکانی دیکە، جەخت لەسەر گرنگی پێکهێنانی تیمی تایبەتمەند دەکاتەوە کە بە باشی ڕاهێنراون لە پراکتیکەکانی ژمێریاری بەڕێوەبردنی مۆدێرن بۆ چارەسەرکردنی ئاستەنگە ژینگەییەکان و تەکنەلۆژییەکان.
وشە سەرەکیەکان: EMA، MFCA، کەمکردنەوەی تێچوون، بەرهەمهێنانی بێ وون بوی، نرخدانانی کێبڕکێ.

فعالية تطبيق محاسبة تكاليف تدفق المواد :(MFCA) دراسة حالة في شركة ستاندارد للخرسانة في دهوك

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الملخص
تهدف هذه الدراسة إلى استكشاف دور محاسبة تكاليف تدفق المواد (MFCA) في تعزيز الأداء المالي والبيئي في الشركات الصناعية. وتنبع أهمية هذا البحث من كون MFCA واحدة من أكثر التقنيات تقدمًا في المحاسبة البيئية الإدارية، إذ توفر بيانات كمية ونقدية تساهم في تحسين الرقابة على التكاليف ودعم عمليات اتخاذ القرار، وبالتالي تحقيق ميزة تنافسية في التسعير.اعتمدت الدراسة على المنهج الوصفي التحليلي من خلال تحليل البيانات والتقارير الخاصة بشركة ستاندرد للخرسانة في دهوك خلال فترة الدراسة. وقد اختبرت الدراسة الفرضيات البحثية، وسلّطت الضوء على التحديات الرئيسية التي تواجه

تطبيقMFCA ، كما بيّنت القيود المرتبطة بأنظمة التكاليف التقليدية .كشفت النتائج أن تطبيق MFCA يقلل التكاليف بفعالية ويدعم سياسات التسعير التنافسية، حيث يوفر بيانات دقيقة عن الانبعاثات والنفايات والتكاليف المرتبطة بالمنتجات الإيجابية والسلبية على حد سواء. وأظهر التحليل أن المخرجات الإيجابية شكلت 96.126%، بينما مثلت المخرجات السلبية 3.874%، والتي شملت: 77,745 لتر ماء، 5,874 وحدة كهرباء، 4,226 لتر وقود وزيوت، 261 طنًا من الأسمنت، 460 طنًا من الرمل، 280 طنًا من الحصى، و453 مترًا مكعبًا من مخلفات الخرسانة .خلصت الدراسة إلى أن MFCA يمكن تطبيقها بنجاح في شركة ستاندرد للخرسانة، وأن لها دورًا محوريًا في تقليل الهدر، وخفض التكاليف، وتعزيز الإنتاج النظيف. كما توصي الدراسة بتوسيع تطبيق MFCA في شركات صناعية أخرى، مع التأكيد على أهمية تكوين فرق متخصصة ومدربة جيدًا في ممارسات المحاسبة الإدارية والحديثة لمواجهة التحديات البيئية والتكنولوجية.

الكلمات المفتاحية:MFCA , EMA، خفض التكاليف، الانتاج الخالي من الفاقد, التسعير التنافسي .