Life Cycle Cost for Micro, Small, and Medium-Sized Enterprises in the Indonesian Food Industry

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Abstract

Micro, Small, and Medium-Sized Enterprises are critical to a country's economic growth (MSMEs). Nevertheless, the Covid-19 pandemic affected a wide variety of business sectors. As a result, MSME entrepreneurs must develop a strategy or plan for conducting business. One strategy that MSME entrepreneurs can employ is to calculate life cycle costs to use them as a factor in future decision-making, as they are already aware of the processing costs. Thus, it is hoped that MSME entrepreneurs will avoid closing their businesses due to uncontrollable obstacles. This study aims to calculate the life cycle costs of MSME food entrepreneurs by analyzing the flow of expenditure and revenue associated with operating the production machines used. By utilizing tofu producers in three different locations throughout Indonesia, namely Bekasi, Cikampek, and Karawang, this research will examine three machines: the soybean grinding machine, the water steam generation machine, and the water pump machine. Following a literature review, it is determined that the machine's best life cycle cost will be the one with the lowest Equivalent Annual Cost (EAC). The best life cycle cost calculation was obtained for the soybean grinding machine in Cikampek, with an EAC of IDR 20,665,699, -, for the water steam generation machine in Cikampek, with an EAC of IDR 97,153,664,-, and for the water pump machine in Cikampek, with an EAC of IDR 12,474,880,-. It can be seen that the wages for operating the same machine in different locations affect the choice of the best life cycle cost.

Keywords
Life Cycle Cost (LCC), Equivalent Annual Cost (EAC), Micro, Small, and Medium-Size Enterprises, Food Industry

1. Introduction
The existence of Micro, Small, and Medium-Sized Enterprises (MSMEs), particularly in developing countries, is a pillar of economic growth. MSMEs play a critical role in economic development (Bongomin et al. 2017). Is evidenced by the data on the number of MSMEs in Indonesia, which consistently increases year after year (BPS 2020). According to the Ministry of Cooperatives, Small and Medium Enterprises (2019), MSMEs employ 96.92 percent (119.6 million people) of the total workforce in Indonesia, compared to large businesses, which employ 3.08 percent of the total workforce in Indonesia, with the highest absorption in the micro-enterprise.

Additionally, given their significant contribution to the country's GDP, it is easy to see why MSMEs are economic pillars. At constant prices, MSMEs contributed IDR 7,034.1 trillion to GDP in 2019, up 22.9 percent from IDR 5,721.1 trillion in 2018. Meanwhile, at current prices, MSMEs contribute IDR 9,580.8 trillion to GDP. This contribution increased by 5.7 percent over the previous year's IDR 9,062.6 trillion (Ministry of Cooperatives, Small and Medium Enterprises 2021). According to BPS data (2015), food and beverage processing accounts for 44.9 percent of Indonesia's 3.4 million MSMEs.

On the other hand, numerous business sectors have been affected by the current Covid-19 pandemic. The most significant income decline in the business sector was food or beverage accommodation, at nearly 92.47 percent (BPS 2020). Additionally, 4.28 percent of IMK was closed in the first quarter of 2020, according to BPS (2020) data. It then increased to 5.43 percent in the second quarter of 2020 and continued to increase by 6.03 percent in the third quarter of 2020. The closed IMK reached 7.06 percent in the fourth quarter of 2020.

However, the tofu manufacturing industry data indicate that consumption of tofu has increased throughout the current pandemic. The average weekly consumption of tofu per capita in 2021, according to BPS data (2021), is 0.158 kg. On the other hand, Tofu producers face numerous obstacles in running their businesses. Apart from the pandemic, entrepreneurs have encountered difficulties acquiring raw materials. For instance, recent news indicates that soybeans' scarcity and high price impedes that tofu producers cannot control or forecast, despite continued consumer demand. As a result, tofu producers and entrepreneurs in micro, small, and medium-sized businesses (MSMEs) must have a business strategy or plan in place to ensure survival in the face of unforeseen obstacles.

This study intends to address these issues by developing a plan that can be implemented by tofu producers, specifically by calculating the machine's life cycle cost. Therefore, it can be used as a factor in future decision-making, as they already know the processing costs associated with each machine for its use.

2. Literature Review

2.1 Micro, Small, and Medium-Sized Enterprises (MSMEs)

In Indonesia, the term "MSMEs" is defined by Law Number 20, 2008. According to Article 1 of Chapter I (general provisions) of the Law, a microenterprise (MIE) is a productive business owned independently by an individual or a business entity that meets the MIE criteria specified in the Law. A small enterprise (SE) is a self-contained productive economic enterprise conducted by an individual or a business entity that is not a subsidiary or a branch of a company that is owned, controlled, or becomes a part of, either directly or indirectly, a medium enterprise (ME) or a large enterprise (LE) that meets the Act's SE criteria. While a ME is a stand-alone productive economic enterprise conducted by an individual or a business entity that is not a subsidiary or a branch of a company that is owned, controlled, or becomes a part of, directly or indirectly, an MIE, a SE, or an LE that meets the Act's criteria for ME.

According to Article 6, the following criteria define an MSME: net asset value excluding land and buildings used for business purposes or annual sales. MIE is a business unit with an asset value of no more than 50 million Indonesian rupiahs (Rp) or annual sales of no more than Rp300 million; SE is a business unit with an asset value greater than Rp50 million but less than Rp500 million, or annual sales greater than Rp300 million but less than Rp2.5 billion; and ME is a company with a net worth greater than Rp500 million but less than Rp10 billion, or annual sales greater than R Alternatively, BPS uses the following criteria: MIE: 0–4 workers; SE: 5–19 workers; ME: 20–99 workers; and LE: > 99 workers.

2.2 Life Cycle Cost

The term "Life Cycle Cost" refers to estimating the costs associated with the acquisition, commissioning, operation, maintenance, and disposal of equipment. It is a cost analysis from "cradle to grave" (Hasting 2015). Life cycle costing aims to ensure that all relevant costs are identified and considered during the planning, acquisition, and budgeting stages. Acquisition costs include both direct material and labor costs and indirect costs such as taxes, insurance, energy, production facilities, equipment, and overhead costs such as administrative, marketing, and product development. Sustaining costs primarily comprise the operating costs of a product/system and the cost of failures. The cost of failure may include warranty costs, liability costs, repair and replacement costs, downtime costs, and future profit loss due to customer goodwill erosion (Waghmode et al. 2006).

Enparantza et al. (2008) previously researched life cycle cost calculations by forecasting life cycle costs during the supply phase and managing machine behavior data directly during the design phase. Machines such as machining centers, transfer lines, and grinding machines are tested, covering four major areas. More precisely, the development of cost models, the definition of cost concepts and fundamental data, the development of product models, and the computation of instance costs. According to Wong and Wang (2010), the Singaporean government promotes public transportation and more fuel-efficient vehicles to alleviate congestion and save money. Then an electric vehicle is proposed, and the life cycle cost is used to determine the initial, operating, and external costs of an electric vehicle. These costs are then compared to a gasoline-powered vehicle and used to determine whether to switch to an electric vehicle. Fleischer et al. (2007) conducted research by controlling and maintaining seller-related costs and utilizing the Monte-Carlo method to consider the entire system and estimate the risk figure flexibly. Thus, a procedure for estimating life cycle costs is developed to minimize risk.

According to a review of research papers, there are still few studies on the correlation between life cycle costs in micro, small, and medium-sized enterprises. As a result, the author conducts research using life cycle cost calculations to develop future strategic plans.

3. Methods

This study used primary data through direct observation of tofu producers in three different locations throughout Indonesia, namely Bekasi, Cikampek, and Karawang, this research will examine three machines: the soybean grinding machine, the water steam generation machine, and the water pump machine, recording specifications for each machine used, and conducting interviews with business owners and workers. According to Hastings (2015), there are several elements to calculating life cycle costs. However, not all elements must be used, depending on the cost. After identifying the elements that contribute to calculating the life cycle cost, the Net Present Value (NPV) is determined. We must consider net present value because asset investments frequently involve a series of expenditures and revenues spread over several years. When making asset management decisions, we must consider the magnitude and timing of these cash flows. The NPV enables us to compare any series of cash flows.

$$\text{NPV}= \boldsymbol{V_0 + pV_1 + p^2V_2 + \cdots + p^nV_n} \qquad (1)$$

After calculating the NPV, the Equivalent Annual Cost (EAC) is calculated. EAC is the amount of a regular annual cost with the same NPV as any given series of costs over a given year. The EAC converts the NPV to an annual value. It facilitates option comparison, mainly when the options are dissimilar in type or duration. When two options are converted to annual costs, the difference between them is frequently more apparent, mainly when external or risk factors are considered.

$$\text{EAC}= \frac{\boldsymbol{NPV}}{\boldsymbol{Annuity\ Factor}} \qquad (2)$$

$$\text{EAC= NPV x Capital Recovery Factor} \qquad (3)$$

4. Data Collection

Data collection is carried out directly to the research location, so that it can be analyzed the elements used in the calculation of the life cycle cost of tofu producing and the data that will be used in the calculation of the life cycle cost (Table 1).

Table 1. Elements Utilized

ELEMENTS	DEFINITION
ACQUISITION	
Purchase Price	The machine's initial purchase price
Storage, handling, and transportation	Costs associated with the storage, handling, and transportation of machines
Support equipment cost	Cost of auxiliary equipment
OPERATIONS (COST / YEAR)	
Energy (e.g., power, fuel)	Energy cost
Net personnel cost	Salary of a person employed
MAINTENANCE (COST / YEAR)	
Routine maintenance including lubricants and consumables	Costs associated with routine maintenance, such as lubricants and consumables
Spare parts	Cost of spare parts
DISPOSAL	
Product residual value	Residual value of the product

Apart from establishing the components of the life cycle cost calculation, the age of each machine is also established.

5. Results and Discussion

After determining the components used and obtaining cost information from each machine, the life cycle cost of all machines in all research locations was then calculated then the life cycle cost chosen is the one with the lowest EAC value. The following example illustrates how to calculate the life cycle cost of a steam-generating machine in Bekasi, as shown in Table 2.

Table 2. Life Cycle Cost Calculation for Steam Generators in Bekasi

BEKASI						
Real Rate of Interest	0%					
Year	0	1	2	3	4	5
ACQUISITION						
Purchase Price	Rp 6,815,000		Rp 515,000		Rp 515,000	
Storage, handling, and transportation	Rp 80,000					
Support equipment cost						
OPERATIONS (COST / YEAR)						
Energy (e.g., power, fuel)		Rp 94,691,664	Rp 94,691,664	Rp 94,691,664	Rp 94,691,664	Rp 94,691,664
Net personnel cost		Rp 10,800,000	Rp 10,800,000	Rp 10,800,000	Rp 10,800,000	Rp 10,800,000
MAINTENANCE (COST / YEAR)						
Routine maintenance including lubricants and consumables		Rp 750,000	Rp 1,750,000	Rp 750,000	Rp 1,750,000	Rp 750,000
Spare parts						
DISPOSAL						
Product residual value			-Rp 30,000		-Rp 30,000	-Rp 1,030,000
TOTALS	Rp 6,895,000	Rp 106,241,664	Rp 107,726,664	Rp 106,241,664	Rp 107,726,664	Rp 105,211,664
INITIAL COST	Rp 6,895,000					
MAINTENANCE COST	Rp 533,148,320					
TOTAL COST	Rp 540,043,320					
NPV (Net Present Value)	Rp 540,043,320					
EAC (Equivalent Annual Cost)	Rp 108,008,664					

After calculating the life cycle cost of soybean grinding machines in the Bekasi, Cikampek, and Karawang locations, table 3 summarizes the calculation results.

Table 3. Summary of Life Cycle Cost Calculation for Soybean Grinding Machine

SUMMARY	BEKASI	CIKAMPEK	KARAWANG
INITIAL COST	Rp 6,853,000	Rp 7,103,000	Rp 6,614,000
MAINTENANCE COST	Rp 341,507,480	Rp 302,882,480	Rp 311,912,480
TOTAL COST	Rp 348,360,480	Rp 309,985,480	Rp 318,526,480
NPV (Net Present Value)	Rp 348,360,480	Rp 309,985,480	Rp 318,526,480
EAC (Equivalent Annual Cost)	Rp 23,224,032	Rp 20,665,699	Rp 21,235,099

Although the soybean grinding machine in Cikampek has the highest initial cost, the annual replacement cost of spare parts, and annual maintenance costs, the total annual maintenance cost is low due to lower worker salaries. As a result, the machine's NPV and EAC values are reduced. Then, in Table 4, a summary of the steam generator's calculation will be found.

Table 4. Summary of Life Cycle Cost Calculation for Steam Generator

SUMMARY	BEKASI	CIKAMPEK	KARAWANG
INITIAL COST	Rp 6,895,000	Rp 6,900,000	Rp 6,970,000
MAINTENANCE COST	Rp 533,148,320	Rp 478,868,320	Rp 481,403,320
TOTAL COST	Rp 540,043,320	Rp 485,768,320	Rp 488,373,320
NPV (Net Present Value)	Rp 540,043,320	Rp 485,768,320	Rp 488,373,320
EAC (Equivalent Annual Cost)	Rp 108,008,664	Rp 97,153,664	Rp 97,674,664

The steam generator Cikampek was chosen because, even though it incurs initial costs, annual replacement costs for spare parts, and moderate annual maintenance costs, the total annual maintenance costs are low due to lower labor costs. As a result, the machine's NPV and EAC values are reduced. Then, in Table 5, a summary of the calculation for the water pump machine will be found.

Table 5. Summary of Life Cycle Cost Calculation for Water Pump Machine

SUMMARY	BEKASI	CIKAMPEK	KARAWANG
INITIAL COST	Rp 2,400,000	Rp 2,050,000	Rp 2,250,000
MAINTENANCE COST	Rp 78,774,400	Rp 60,324,400	Rp 63,724,400
TOTAL COST	Rp 81,174,400	Rp 62,374,400	Rp 65,974,400
NPV (Net Present Value)	Rp 81,174,400	Rp 62,374,400	Rp 65,974,400
EAC (Equivalent Annual Cost)	Rp 16,234,880	Rp 12,474,880	Rp 13,194,880

The water pump machine in Cikampek was chosen because it has low initial, low worker salaries, and low routine maintenance costs, resulting in low annual maintenance costs. As a result, the machine's NPV and EAC values are reduced.

6. Conclusion

The life cycle cost method is beneficial for determining a business's expenses and revenue. Financial flows are extremely sensitive for MSMEs, which can still be said to have a limited number of calculation elements and a small profit margin. Primarily to maintain or replace the machine in use, MSMEs can use this life cycle cost calculation to determine which costs can be reduced in a future crisis. According to this research, when three different locations are considered, namely Bekasi, Cikampek, and Karawang, the resulting life cycle cost calculation varies even when the same machine is used.

The best life cycle cost calculation was obtained for the soybean grinding machine in Cikampek, which had an EAC of IDR 20,665,699, -, the water steam generation machine in Cikampek, which had an EAC of IDR 97,153,664,-, and the water pump machine in Cikampek, which had an EAC of IDR 12,474,880,-. As can be seen, wages for operating the same machine in different locations affect the best life cycle cost selection.

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