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The Implementation of Analytical Hierarchy Process to Choose the Best Solution to Increase Mould Maker Profit

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ABSTRACT: Mould Maker is a company that buy and sell machine for their main business activity. Mould maker have long time machine waiting time to be sold and have low profit margin. The longer the time taken by a machine to be sold, the higher the maintenance cost for the machine. Besides, Mould Maker always purchase machines for their stock in every offer that comes to Mould Maker, so they have overstocked machine in their workshop. With many and vary type of machines that they have, Mould Maker can utilize the machines to increase their profit margin.
Mould Maker have good business environment from the external factor analysis. As for internal analysis, Mould Maker still have room for improvement, some of them are the number of their stock and the number for decision maker. Caused by their low profit margin, Mould Maker cannot hire high value employee to be one of the decision makers. The problem that Mould Maker face is how to improve their profit by utilizing the machines that they have.
Further analysis needed to solve this problem. The SWOT analysis used to find some strategies and need to be fit with the problem faced by Mould maker. The strategies that able to be implemented are rent their machine, accepting manufacture order, improving stock policy, boost marketing strategy, and purchasing car to help Mould Maker to sell their product.
From the strategy alternatives, AHP method is used to choose the best strategy. With AHP method, the best solution can be chosen by considering the value from each consideration criteria. For this research, the best solution proposed by AHP method is to accept manufacture order.

KEYWORDS: AHP; Internal analysis; Manufacture; PESTLE analysis; SWOT analysis; Second-hand machinery.

INTRODUCTION

Manufacture industry is an industry that produce semi-finished good to be sell to other industry. In Indonesia, manufacturing Industry is the biggest GDP contributor in Indonesia with IDR 805.62 trillion, or 19.29% from total national GDP at the second quarter in 2021 (Proceedings-Student Conference, 2022). According to Asian Development Bank, manufacturing industry growth in Indonesia is still left behind from other country such as Singapore. This caused by there are still many manufactures industry that not implement technology in their production.
In manufacturing Industry, machine is one of the most important investment to the industry to maintain their business. Machine is the main component to process raw material into product that company sell and give them profit.
The problem for investing in machine is the price for a machine is not cheap. It becomes problem when a company needs to improve their production or replacing old and broken machine. It will need an amount of cost when they need to procure new machine to fulfill their production gap between the demand and their supply. With this problem, Mould Maker comes as a solution for one-stop second-hand manufacturing Industry.
Mould Maker is one of the players in second-hand manufacture industry. Founded in 2000 and established in 2006 made Mould Maker is one of the oldest players in Bandung in the industry. Mould Maker had focused on five main business activities; buy, sell, trade, repair, and rent.
In 2021, Mould Maker revenue is considerably big. Mould Maker revenue is IDR. 1,368,350,000.00. when the revenue reduced by its capital and operating cost, the profit is only IDR. 200,051,142.86.
Another problem faced by Mould Maker is that Mould Maker have no profit it several months, which means their revenue is lower than the operating cost. The detail for Mould Maker revenue and operating cost can be seen in Figure 1.

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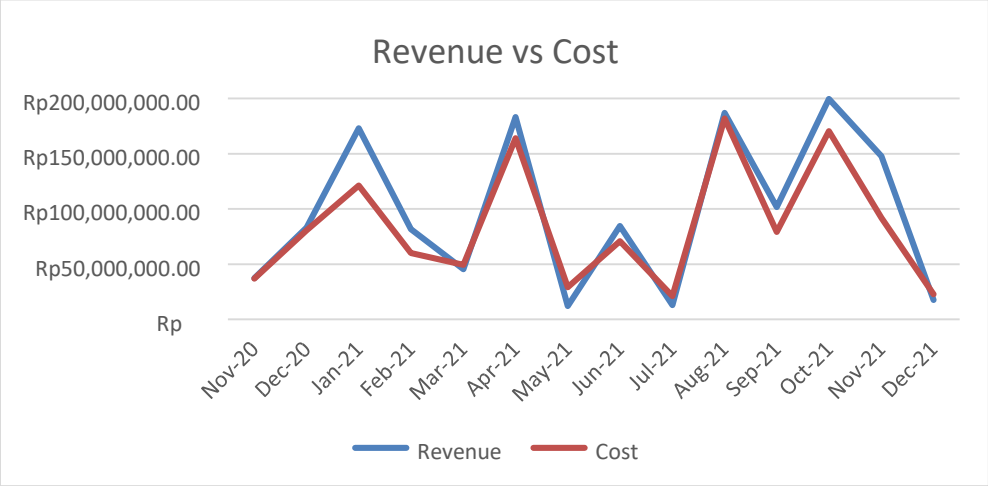
Figure 1. Mould Maker Revenue vs Operating Cost



Source: Author

From Figure 1., seen that March, May, July, and December Mould Maker needs to suffer from loss; and it happened annually. When there are close to Christmas, beginning of school year, and Eid al-Fitr. Mould Maker needs to find way to increase their revenue by utilizing their asset.

In this research, the root cause analysis will be using why-tree analysis. From the why tree analysis, there will be alternative solutions from the why tree analysis. AHP will be used to select the best solution from the alternative solution given from the root cause analysis.

From the analysis result, the chosen alternative solution is develop new market for manufacture service with value 36%. The others alternatives can be implemented after developing new market for manufacture service.

LITERATURE REVIEW

The AHP method allows complex problems to be decomposed into sets of straightforward judgements and provides a documented rational for choosing a particular options. The use of pairwise comparison means that the decision maker can focus, in turn, on each small part of the problem. The AHP requires more comparison to be made by the decision-maker than are needed to establish a set of weights.

Saaty in the "Decision Making with the Analytic Hierarchy Process" (Int. J. Services Sciences, Vol.1, No.1, 2008) says that to decide in an organized way to generate priorities, the decision shall be structured into the following steps:

1. Define the problem and determine the kind of knowledge sought
2. Structure the decision hierarchy from the top with goal of the decision, then the objectives from a board perspective, through intermediate levels
3. Construct pairwise comparison matrixes.
4. Use the priorities obtained from the comparisons to weigh the priorities in the level immediately below. Do this for every criteria and sub-criteria, then add its weighted values and obtain the global priority. Continue the process until weighting and adding until the absolute priorities of the alternatives in the bottom-most level are obtained.
5. Check the consistency. AHP calculates a consistency ratio (CR) comparing the consistency index (CI) of the matrix in the question divided by the consistency index of a random-like matrix (RI). The value of RI shown in the Table 1. the n is the number of items compared and the RI is the value. The value for CR gained by dividing CI and RI.

Table 1. RI Value

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Source: Author

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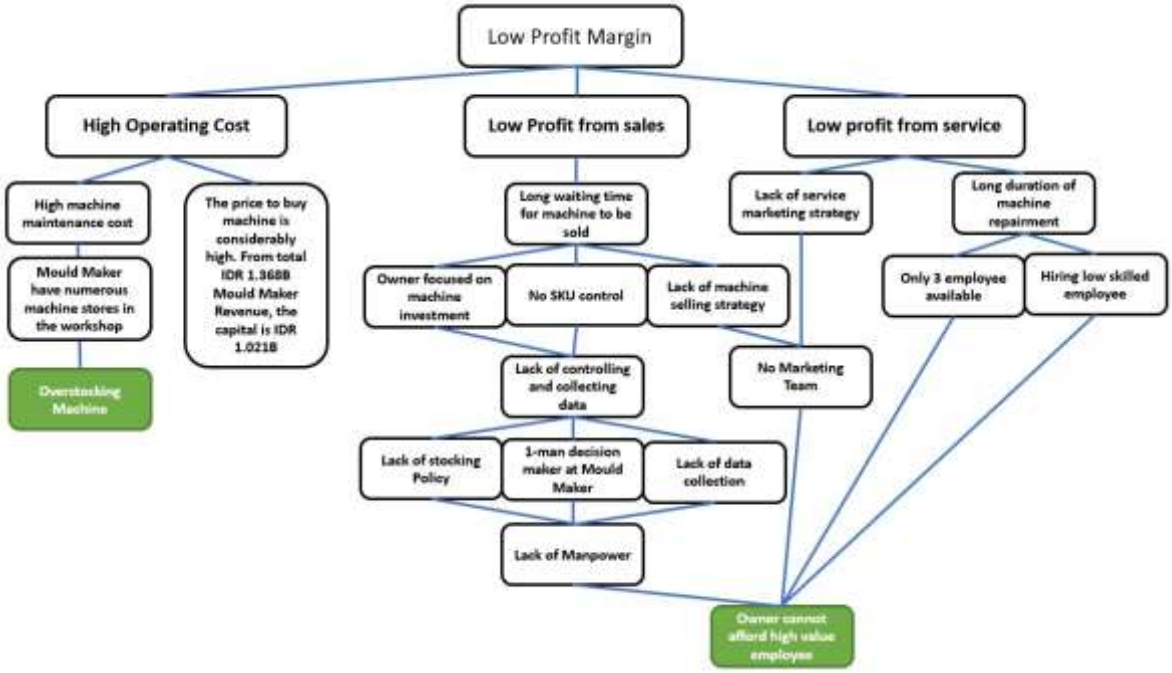
METHOD

This research use quantitative method. The data for the problem gathered from Mould Maker revenue annually, and the owner filled the survey for AHP calculation.

RESULTS AND DISCUSSION

The problem that faced by Mould Maker will be analysed in the why-tree diagram. The diagram will analyse the two main factor that causing Mould Maker gain low profit. The why tree analysis for Mould Maker root cause analysis will be shown in the Figure 2.

Figure 2. Mould Maker Root Cause Analysis



From the diagram, seen that Mould Maker root problem is overstocking machine and owner cannot affort high value employee. Mould Maker needs to increase their revenue to afford high value employee by utilizing the machines that Mould Maker have. From the analysis, the root cause for Mould Maker prroblem is machine overstocks and owner cannot hire high value employee. Mould Maker needs to increase their profit by utilizing their machine in the workshop.

While the root cause determined, the external and internal analysis will be conducted. The external analysis will use PESTLE analysis while the internal analysis will use resources and capabilities analysis. The PESTLE analysis will be shown in Table 2. From Table 2., seen that Manufacture Industry have a good business environtment. Mould Maker can use this opportunities to sell **their machine more and increase their profit, while the profit will be use for Mould Maker needs to expand their business.**

Table 2. PESTLE Analysis for Manufacture Industry

Political	Economic	Social	Technology	Legal	Environment
Indonesian Government push the KCIC construction in Indonesia	PMI in manufacturing in Indonesia decreased until 31.37, in two months in row	Increasing in manufacture product cause the increasing in labor demand	In digital era, orders may come anywhere using internet	PSBB caused decrease in orders for manufacturing product	Increasing in manufacture product demand

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	In October 2021, PMI in Manufacturing in Indonesia increased until 57.2	Manufacture industry can be integrated with other industry	Indonesia still not implement High Technology Industry	Relaxation in PSBB regulation in 2021	The cost for Raw Material import is expensive
			In the future, Manufacture industry will use new technology and abandoned the old technology.	Relaxation in import tax	Fluctuation in IDR exchange rate
				Relaxation in export activity restriction	From the PMI graph, the resilience in manufacturing industry tends to be stable in 2013 until 2019
					In 2020, the Covid-19 pandemic hit Indonesia, caused uncertainty in manufacturing industry. This condition proved by the decreasing in PMI score.

Source: Author

The next analysis will be internal analysis. The internal analysisi will e conducted by resources analysis and capabilities analysis. The resources analysis will be shown in Table 3.
The resources analysis will analyse Mould Maker strength and weakness. With this analysis, Mould Maker can strengthen their strength and improve their weakness.
The other factors analysed for internal analysis is the capabilities analysis. The capabilities analysis for Mould Maker will be shown in Table 4. below.

Table 3. Mould Maker Resources Analysis

Tangible Resources	Factors	Intangible Resources	Factors
Physical	IDR 3.324.890.000 asset in Machine and Buildings	Human and Asset Intellectual Capital	Owner and employee both can operate the machine in Mould Maker
Financial	Wages and Tax is Mould Maker only liabilities.	Brand, Company Image, and Reputational Asset	Mould Maker is known as one-stop solution for second-hand metal manufacture machine
Technological	The machine in the workshop can be used to produce spare part for servicing orders	Relationship	Relationship with other manufacturing SME to help produce spare part that Mould Maker cannot produce

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Organizational	Low-cost employee to operating Mould Maker	Company Culture and Incentive System	Customer's satisfaction is Mould Maker's orientation

Source: Author

Table 4. Mould Maker Capabilities Analysis

Capabilities	Is the capability valuable?	Is the capability rare	Is the capability costly to imitate?	Is the capability nonsubstitutable?
Marketing Market themselves as one stop solution for broken machine	yes	yes	yes	no
Distributions Sell the product mostly in Bandung Area	yes	no	yes	no
Operations Repairing broken machine to be sell again	yes	yes	yes	no

Source: Author

After analysing the external factors and internal factors, Mould Maker can determine their next strategy using SWOT Analysis. With this analysis, by combining Mould Maker strength, weakness, opportuinites, and threats, several strategies will be shown that Mould Maker can use to expand their business. The SWOT Matrix for Mould Maker will be shown in Table 5.

Table 5. Mould Maker SWOT Matrix

	Opportunities: • Order may come from everywhere in the digital era • Increasing business activity in manufacturing industry • PMI in Indonesia tend to be stable • Relaxation in import tax • Indonesia still not implementing high tech industry • New market from repairing service	Threat: • High tech industry implemented in Indonesia • Fluctuation in IDR exchange rate causing the price in scrap metal fluctuated • Cost of raw material import is expensive • Uncertainty situation e.g., Pandemic
Strength: • Mould Maker have huge asset • Mould Maker have no debt • Numerous machines can be used for productivity • Low-cost employee • Owner and employee can	• Expanding new market opportunities in repairing service • Boost marketing • Offer machine renting • Train employee to selling machine utilizing internet technology	• Learn and adapt with high tech machine to preparing the implementation of high-tech industry • Learning, be ready, and start branding Mould Maker as a company that ready to adapt the new high-tech machine

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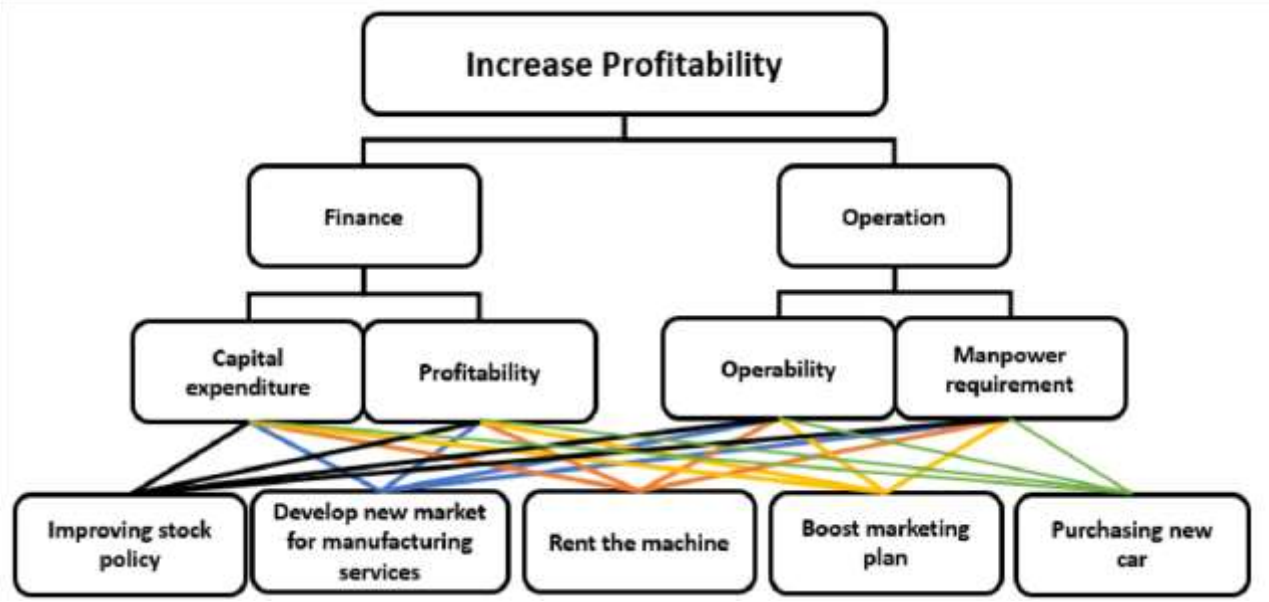
operate and repair the machine • Well-known as one stop solution for broken machine		
Weakness: • The machine cannot sell easily • Lazy employee • Employee easily resigns • Unproductive machine • Don't have any car to deliver	• Create SOP and evaluation for employee performance • Create contract with new employee when employee accepted to work • Investing in transportation mode to deliver machine easily	• Learning high tech machine for high-tech industry
machine • One-man decision makers		

From the combination of the root cause analysis and SWOT analysis, there will be five alternative solutions. The alternative solutions are improving stock policy, develop new market for manufacturing services, rent the machine that Mould Maker have, boost marketing plan, and purchasing car to help operational avtivities.
The alternative solution needs to connect with each criteria that help Mould Maker gain more profit for them to expand their business. The connection between alternative solution and criteria will be shown in the hierarchy tree for proposed solution in Figure 3.

Figure 3. Hierarchy Tree for Alternative Solutions



Source: Author

After knowing the alternative solution, the next step is to determine the best solution using AHP method. The value for each criterion and category gained by interviewing the owner. The Pairwise questionnaire for AHP implementation shown in Figure 4. Until Figure 8.

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Figure 4. Pairwise Questionnaire for Criterion

Criterion																	
Criteria	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Criteria
Profitability							x											Capital Expenditure
Capital Expenditure						x												Operability
Operability							x											Manpower Requirement
Manpower Requirement												x						Profitability
Profitability							x											Operability
Capital Expenditure										x								Manpower Requirement

Source: Author

Figure 5. Pairwise Questionnaire for Capital Expenditure

Capital Expenditure																		
Alternative Solution	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Alternative Solution
Improving stock policy							x											Search manufacture order
Search manufacture order								x										Rent the machine
Rent the machine						x												Boost marketing plan
Boost marketing plan						x												Improving stock policy
Improving stock policy								x										Rent the machine
Search manufacture order						x												Boost marketing plan
Purchasing car																x		Improving stock policy
Purchasing car														x				Search manufacture order
Purchasing car														x				Rent the machine
Purchasing car														x				Boost marketing plan

Source: Author

Figure 6. Pairwise Questionnaire for Profitability

Profitability																		
Alternative Solution	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Alternative Solution
Improving stock policy																	x	Search manufacture order
Search manufacture order							x											Rent the machine
Rent the machine						x												Boost marketing plan
Boost marketing plan															x			Improving stock policy
Improving stock policy																	x	Rent the machine
Search manufacture order							x											Boost marketing plan
Purchasing car				x														Improving stock policy
Purchasing car															x			Search manufacture order
Purchasing car												x						Rent the machine
Purchasing car										x								Boost marketing plan

Source: Author

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Figure 6. Pairwise Questionnaire for Operability

Operability																	
Alternative Solution	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Alternative Solution
Improving stock policy								x										Search manufacture order
Search manufacture order							x											Rent the machine
Rent the machine					x													Boost marketing plan
Boost marketing plan																		Improving stock policy
Improving stock policy				x														Rent the machine
Search manufacture order				x														Boost marketing plan
Purchasing car																	x	Improving stock policy
Purchasing car																	x	Search manufacture order
Purchasing car																x		Rent the machine
Purchasing car												x						Boost marketing plan

Source: Author

Figure 7. Pairwise Questionnaire for Manpower Requirement

Manpower Requirement																	
Alternative Solution	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Alternative Solution
Improving stock policy						x												Search manufacture order
Search manufacture order						x												Rent the machine
Rent the machine								x										Boost marketing plan
Boost marketing plan																	x	Improving stock policy
Improving stock policy			x															Rent the machine
Search manufacture order	x																	Boost marketing plan
Purchasing car				x														Improving stock policy
Purchasing car												x						Search manufacture order
Purchasing car						x												Rent the machine
Purchasing car						x												Boost marketing plan

Source: Author

After calculating the result from questionnaire using AHP method as shown in Literature review, the result for AHP shown in Figure 9.

Figure 9. AHP Result

Improving stock policy	0.40	0.03	0.44	0.52			0.2476
Search manufacture order	0.25	0.46	0.29	0.26		0.10	0.3646
Rent the machine	0.22	0.28	0.17	0.06	x	0.49	0.2149
Boost marketing plan	0.10	0.14	0.07	0.04		0.29	0.1018
Purchasing car	0.03	0.09	0.03	0.13		0.13	0.0712

Source: Author

From the result, seen that the best solution to improve Mould Maker profit is to search manufacture order. With this solution, Mould Maker will not need to add other investment in machine. Mould Maker also can maintain their machine periodically and they not need to improve the employee ability in using machine because the employee and the owner both can operate the machine.

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CONCLUSION

The conclusions for this research are:

What is the root cause of the Mould Maker Low Profit Margin?

From the analysis, the root cause problem is the overstocks machine and owner cannot hire high value employee. The owner needs to increase the profit to hire high value employee, so the decision makers in Mould Maker does not lay on one man decision maker. Mould Maker can utilize their machine to increase their profit.

What are the proposed solutions for the Mould Maker Low Profit Margin?

From the analysis, the root cause problem is the overstocks machine and owner cannot hire high value employee. The owner needs to increase the profit to hire high value employee, so the decision makers in Mould Maker does not lay on one man decision maker. Mould Maker can utilize their machine to increase their profit.

What is the best solution to solve the Mould Maker Low Profit Margin?

The proposed solution for Mould Maker to increasing their profit must lay on four considering factors, they are:

1. Capital expenditure. Mould Maker can utilize their asset to improve their revenue.
2. Develop new market for manufacturing service, or search manufacture order. This factor will open new opportunities for Mould Maker.
3. Operability. The solution needs to be operable with Mould Maker asset, the machines and human resources need to be able to execute the solution.
4. Manpower requirement. Since there are only three employee in Mould Maker, the strategy need to be operable with as less manpower as it can.

From the four consideration factors, the alternative solutions are:

1. Improving stock policy.
2. Develop new market for manufacturing service, or search for manufacture orders.
3. Rent Mould Maker machines.
4. Boost Marketing plan.
5. Purchasing car

After the alternative solution analysed using AHP method with the consideration of the four factors, the best solution for Mould Maker to be implement immediately is to develop new market for manufacturing service. With this solution, Mould Maker can control their stock, maintain their machine, and utilize their machine to gain more profit.

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