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Design of Assessment of Customer Order Acceptance Using Multiple Criteria Decision Analysis Method in Companies Using Make-To-Order Systems

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Abstract

The production system in the manufacturing industry is divided into two types, namely the Make-to-stock (MTS) and Make-to-order (MTO) strategies which are distinguished by the time orders are received and the execution of the production process. In the MTO system, the customer's order becomes a trigger for the next process and becomes a critical point of the system. The decision to accept and reject incoming orders is the most important activity because it will have a long-term impact on the overall profitability and reputation of the company. This activity is a very strategic action, so support is needed in this activity. This study investigates how the method of receiving orders in the MTO strategy is carried out and designs an assessment of order acceptance using the Multiple Criteria Decision Analysis method so that it can be used as a support in making orders for acceptance decisions. The AHP method was used in this study to obtain priority order criteria and risk probabilities of receiving orders with data obtained from expert interviews. The results of AHP show the order of importance in receiving orders, namely the availability of raw materials, prices, production capabilities, market situations, customers, targets, order fulfillment, and external conditions, also the probability of the risk occurring. Expected monetary value is calculated for each criterion and risk which is then used to help make the right decisions in accepting orders. The entire methodology in this study is explained by using cases in the steel coating industry in Indonesia. The case study shows that EMV and AHP can be used to provide a feasibility assessment of orders received.

Keywords
Make-to-order, order acceptance, Analytical Hierarchy Process, Expected Monetary Value

1. Introduction

Customer orders are what every company wants. Without orders from customers, it will be difficult for the company to get income. If there is no income, it means that production costs cannot be met and the company will not be able to survive. In companies that use the MTO system, planning to produce the final product begins when the customer's order is received by the company. Manufacturing of certain products does not start unless certain orders are released from customers (Rafiei and Rabbani, 2014). In an MTO system all supply chain tasks from procurement of materials, parts, and components, to fabrication, subassembly, and assembly, to final delivery, are triggered by the receipt of a customer order or award of a contract (Li and Womer, 2012). Therefore in the MTO system, the stage of receiving customer orders is very crucial because it will trigger the entire series of processes to fulfill customer requests.

For a company that implements an MTO system, accepting a customer order will trigger a whole series of processes, an error in making a decision when receiving a customer order can be very fatal. The decision to accept and reject incoming orders is one of the most important decisions because it will have a long-term impact on the overall profits and reputation of the company (Piya, 2012). For this reason, various considerations are needed when making decisions to accept customer orders to achieve goals and minimize unwanted risks. The decision to accept an order is a very strategic business decision because it will have a direct or indirect impact on the continuity of the company's business. Thus, every decision made to achieve a goal must take into account various aspects of the risks and opportunities that may arise. Therefore, in selecting alternative decisions to be taken, a supporting method is needed that can be used by

decision-makers to evaluate all available alternatives, where generally these alternatives have their advantages and disadvantages, which makes decision-making difficult to do.

Various studies on customer order acceptance in companies that apply the MTO system have been carried out by many researchers including; Yue et al., (2022) who examined the selection of an order-accepting policy that maximized the average revenue per unit capacity cost. Hemmati; Ebadian; Nahvi, (2012). examined an order management decision-making system using the TOPSIS method. Jalora, (2006) developed a method of receiving orders and scheduling by using Revenue Management. Kundu et al., (2021) researched the review and release of MTO orders using the ORR (Order Review and Release) modular method to balance the workload at each stage. Yue et al., (2022) used the Drum Buffer Rope method for order release and scheduling in industries that use multi-item MTO. Wang et al., (2019) used a Markov decision process to develop decision-making on the MTS-MTO system. Rafiei; Rabbani, (2014) used the Analytic Network Process (ANP) adopted from a modified network relative to the AHP hierarchy to make production division decisions into MTO or MTS.

Many studies related to order release and order receiving based on MCDA (Multi-Criteria Decision Analysis) have also been carried out. Based on research conducted previously, there is still little research that discusses risk assessment when accepting orders at MTO companies, especially in Indonesia. This is important to do, considering that more and more companies are implementing the MTO system in providing services to their customers.

One method that is widely used for risk assessment in decision-making is the Analytical Hierarchy Process (AHP) method developed by Thomas L Saaty in the 1970s. AHP is a Multi-Criteria Decision Analysis (MCDA) method that is widely used in various fields such as selection, evaluation, planning and development, and so on as a tool or method of estimating weights. AHP is considered an efficient method for multi-criteria decision-making where AHP provides a rational framework for the decisions required by measuring criteria and choices and relating these elements to the overall goal. Stakeholders compare the importance of criteria, two at a time, through pairwise comparisons. The use of AHP is considered suitable for solving complex business problems and making decisions that consider many different criteria such as the assessment process in receiving orders. AHP can realize a comparative analysis of the criteria that impact decision-making when accepting orders. In this way, he can determine the best available alternative.

Another method that is also widely used as an assessment method in the decision-making process in business is the EMV calculation method. Expected Monetary Value (EMV) is a concept used in decision-making to evaluate the potential outcome of a decision and assign a monetary value to each result. This method quantifies the potential risks and rewards associated with a decision and helps individuals and organizations choose the option that is most likely to produce the best financial results. The calculation of monetary values can be used in a variety of contexts, including financial planning, risk management, and project management. This method is particularly useful in situations where there is uncertainty or risk involved. By weighing potential outcomes against probabilities and appropriate monetary values, individuals and organizations can make more informed decisions and allocate their resources more effectively. The EMV method is generally combined with decision tree analysis and is used for decision-making on long-term projects. The basis of the EMV method is to calculate the risk value that might occur. The combination of the EMV (Expected Monetary Value) and AHP (Analytical Hierarchy Process) methods used to assess customer order acceptance in the MTO system has never been done before so there is still a knowledge gap that can still be filled by this research. (Kumar Dey, 2002) using a combination of AHP and DTA in risk calculations for oil projects. And
The purpose of this study was to design a recommended method for assessing customer order acceptance on the MTO system in coated sheet steel companies in Indonesia with the application of the EMV method combined with AHP. By knowing the assessment criteria and risks when receiving an order, the right decision can be made when accepting a customer order to reduce risks and losses that may arise due to existing uncertainties. This research is expected to make a scientific contribution to the customer order acceptance process in the MTO system at similar companies and become a reference for similar research in the future.

2. Literature Review

2.1 MTO

The Make To Order (MTO) system is a production system that carries out its production process by responding to orders received. In the MTO model, part or all of the production process is carried out after the order is received from the customer (Hemmati et al., 2012). With this system, the implementation of the production process starting from the

processing of raw materials to finished products is triggered by receiving orders from consumers. The production process has not started when orders are received and customer requests are fulfilled after orders are made. Meanwhile the Make to Stock (MTS) system is a production system that carries out its production process based on forecasting. The production process is carried out starting from processing raw materials to becoming finished products without waiting for orders to be received from consumers. In this system, the production process is complete when orders are received and requests from customers are met from existing stock.

By using the MTO system, the company produces finished goods after receiving order confirmation from its customers so in that way the company gets various advantages when compared to the MTS system. In industries that use the MTO system, the manufacture of certain products does not start unless certain orders are released from customers (Rafiei and Rabbani, 2014). In an MTO system all supply chain tasks from procurement of materials, parts, and components, to fabrication, subassembly, and assembly, to final delivery, are triggered by the receipt of a customer order or award of a contract (Li and Womer, 2012). The decision to accept and reject incoming orders is one of the most important decisions because it will have a long-term impact on the overall profits and reputation of the company (Piya, 2012). Decision-making mistakes can be very fatal for the company. In MTO companies, planning to produce the final product starts when the customer order is received by the company. One of the biggest obstacles of a system that uses MTO is the long waiting time for consumers to get their ordered goods. This can have various impacts that are detrimental to the company, including late penalties from consumers, delays in picking up goods, and cancellations of orders by consumers

2.2 Risk

Risk according to the ISO 31000 management system is the effect of uncertainty in achieving goals while according to the Big Indonesian Dictionary (KBBI), the risk is the result of an unpleasant (harmful, dangerous) action or action. (depending on the specific risk). This is caused by the unpredictable future. "Risk" means different things to different people at different times. one of the elements that characterize risk is the notion of uncertainty, future events, handling, circumstances, etc. Profitable risks are referred to as opportunities, while detrimental risks are referred to as threats. In responding to threats to individuals, society, and the environment, policymakers, regulators, industry and others involved in risk management and control have taken a variety of approaches. Risk management is a decision-making process aimed at achieving predetermined goals by reducing the amount of loss of people, equipment, and material caused by accidents that may occur while trying to achieve these goals. Risk management means managing risks adequately and quickly so that the future is less hazy. It is a proactive and reactive approach to accident and loss reduction. The ultimate goal of risk management is to minimize risk in several areas of the company relative to the opportunities sought, given the limited resources. If the initial risk assessment is not based on meaningful action, risk mitigation methods, while they can be successful, are bound to tackle the wrong problems. Risk Mitigation is the collection of processes that collectively ensure that information risks are adequately reduced to an acceptable level (Sentia et al., 2013).

Decision-making is an action that must be carried out by everyone, both consciously and unconsciously, and is carried out in different circumstances and opportunities (Meyers, Reiniers, 2022). However, in essence, the decisions taken by a person will have meaning, goals, and consequences that vary greatly depending on many factors, such as the level of importance of the problem at hand, the external environment in the decision-making process, and the internal conditions of the individual decision maker himself. Decision-making for some people is an art because it combines many qualitative factors which are combined with the situation in which the decision will play a role.

2.3 AHP

The Analytical Hierarchy Process (AHP) method was originally developed by (Saaty, 2008), a mathematician from the University of Pittsburg, United States, in the early 1970s. The AHP method is a device for making choices from various difficult alternatives. This method works based on a combination of inputs from various considerations from decision makers based on information about the elements supporting the decision, namely to determine a set of priority measurements to evaluate various alternatives to be taken in a decision product. AHP has been widely used in research. Dey (2002) in his research uses AHP to quantify by determining probability.

2.3 EMV

Expected Monetary Value (EMV) is a concept used in decision-making to evaluate the potential outcome of a decision and assign a monetary value to each result. This method is a statistical concept analysis method that calculates the

average future expenditure that may or may not occur and calculates the potential risks and benefits associated with a decision and helps individuals and organizations choose the most likely option to produce the best financial results. (Dey, 2002.)

The calculation of monetary values can be used in a variety of contexts, including financial planning, risk management, and project management. This is particularly useful in situations where there is uncertainty or risk involved. By weighing potential outcomes against probabilities and appropriate monetary values, individuals and organizations can make more informed decisions and allocate resources more effectively.

A positive EMV value indicates an opportunity, while a negative EMV value indicates a threat or threat that can harm the company. EMV is calculated by multiplying the probability value of each risk multiplied by the possibility of money being spent when the risk occurs. Expected Monetary Value (EMV) is used to calculate the portion of the cost, which is nominalized in the form of risk costs. EMV is the result of multiplying the probability of an event by the magnitude of the consequence.

$EMV = Probability * \text{Consequences}$

Where :

EMV : (Expected Monetary Value) or the expected money when the risk occurs.

Probability: The probability value of the risk.

Consequences: The value of the impact caused by the risk, (the value is in the form of a financial value)

3. Methods

The method used in this research is EMV assisted by AHP. The AHP method was considered suitable for this study since the analytical hierarchical process (AHP) developed by Saaty (2008) provides a way of risk analysis that is flexible and easy to understand. It is a multi-criteria decision-making methodology that allows both subjective and objective factors to be considered in the risk analysis. AHP enables the active participation of decision-makers in reaching agreements and provides managers with a rational basis for making decisions. Formulating a decision problem in the form of a hierarchical structure is the first step. In a typical hierarchy, the top levels reflect the overall objective or focus of the decision problem. Elements that influence decisions are represented at the intermediate level. The lowest level consists of decision choices. Once the hierarchy is established, the decision maker begins a prioritization procedure to determine the relative importance of the elements at each hierarchical level.

Weighting with Analytical Hierarchy Processes (AHP) is the next step. Weighting was done using pairwise comparisons on all aspects contained at this level, namely targets, production, orders, consumers, market, raw materials, prices, and external conditions along with their attributes and indicators. Data processing using the AHP method was carried out to assist the process of calculating a score where the weight is given to each business process and each indicator of an existing business process. The stages of AHP analysis in this study include the factor identification stage. To measure the trend of factors used a questionnaire. The next stage of analysis is to measure the geometric values of the variables studied) then do the Eigen Vector priority analysis with the AHP to assist the program with a tolerance value of 0.01. The synthesis of the model is obtained by ranking the weights of the factors of acceptance of orders and testing for consistency (CR) with a tolerance <0.01. Factors that influence the decision to accept orders are sorted from the highest to the lowest weight.

The calculation of the risk value was the final stage in processing this data. This final value was obtained by calculating the value of the probability of occurrence for each criterion attribute, which then calculated the total EMV value for incoming orders. Expected Monetary Value (EMV) is a concept used in decision-making to evaluate the potential outcome of a decision and assign a monetary value to each result. This method is a statistical concept analysis method that calculates the average future expenses that may or may not occur and calculates the potential risks and benefits associated with a decision and helps individuals and organizations choose the most likely option to produce the best financial results. The calculation of monetary values can be used in a variety of contexts, including financial planning, risk management, and project management. This is particularly useful in situations where there is uncertainty or risk involved. By weighing potential outcomes against probabilities and appropriate monetary values, individuals and organizations can make more informed decisions and allocate resources more effectively.

To calculate EMV, it is necessary to consider two factors, namely:

a. Possibility

b. Monetary value

A positive EMV value indicates an opportunity, while a negative EMV value indicates a threat or threat that can harm the company. EMV is calculated by multiplying the probability value of each risk multiplied by the possibility of money being spent when the risk occurs. Expected Monetary Value (EMV) is used to calculate a large portion of costs, which are nominalized in the form of risk costs. EMV is the result of multiplying the probability of an event by the magnitude of the consequence.

$EMV = Probabil\text{ity} * \text{Consequences}$
Where :
EMV : (Expected Monetary Value) or the expected money when the risk occurs.
Probability: The probability value of the risk.
Consequences: The value of the impact caused by the risk, (the value is in the form of a financial value)

The research was carried out through several stages systematically. Broadly speaking, the steps to be carried out in conducting research were as follows:

1. Initial Stage
This stage began with determining the topic of the problem. After that, a literature study was carried out through publications or similar previous research so that an overview and research gaps were obtained. Then we studied the problem statement, objectives, and set the limitations of the research. The selection of the right method to solve the problem was then carried out through references from several related scientific journals.

2. Data Collection Stage
The data collection stage was divided into two main parts, namely primary data collection and secondary data collection. Primary data were collected from discussions and direct interviews with stakeholders in the company, while secondary data were obtained from documents and records in the company.

3. Design and Data Processing Stage
At this stage, the process of designing an assessment of customer orders was carried out, and processing raw data into data ready for analysis. Then, the data analysis process was carried out using the AHP and EMV methods. In this stage, we have done some calculations including weighting criteria, weighting alternatives, pairwise comparisons, and calculating the consistency ratio. Then the calculation of the impact of risk with the EMV method was conducted.

4. Final Stage
At this stage, an analysis of the results of the design was carried out and after that, a conclusion and determination of suggestions for further research were carried out to produce better and more comprehensive research.

4. Data Collection

The data collection stage was divided into two main parts, namely primary data collection and secondary data collection. Primary data was collected from discussions and direct interviews with stakeholders in the company, while secondary data was obtained from documents and records in the company

a. Primary data
Primary data is data taken directly from the research object. The following are primary data conducted by researchers: Interview and carried out by way of direct discussion and question and answer to obtain data. Interviews and questionnaires are conducted on respondents who have the capacity and capability in the process of receiving customer orders. In this case, it was done to the General Manager, Manager, and Sales Account in the Company. Interviews were conducted related to the procedure for accepting customer orders, influencing factors, the basis for decision-making, constraints, and risks related to the process of accepting customer orders. Direct observation, this data collection method was carried out through careful direct observation or observation at the research location. Observations and reviews were carried out around the activity of receiving orders. This was done to obtain a clear picture of the problems that occur and enable answers to these problems.

b. Secondary Data

Secondary data, namely data obtained indirectly where the data will be useful as support in the preparation of this study. Secondary data is data obtained through documents and records at the research location as well as related literature.

5. Results and Discussion

5.1 Importance and Probability

The AHP method is used in this study to provide a priority sequence of significant risks. The AHP results show the weight of the criteria to be considered in accepting customer orders. The result of this weighting is a ranking of importance as well as a risk weight when receiving an order. The highest rating from this AHP weighting process sequentially to the smallest is raw material availability, price provided, production capability and allocation, market conditions, consumer conditions, target fulfillment, order fulfillment, and external conditions. If we examine these results further, these results are considered to be quite reasonable where:

Table 1. AHP for Order Acceptance Criteria

Criteria	Target	Productiom	Order	Customer	Price	Market	Raw Material	External Condition	Priority
Target	0.108	0.147	0.104	0.096	0.181	0.104	0.087	0.064	0.111
Productiom	0.101	0.138	0.136	0.173	0.159	0.138	0.142	0.096	0.135
Order	0.095	0.094	0.092	0.082	0.053	0.148	0.097	0.148	0.101
Customer	0.139	0.099	0.139	0.124	0.118	0.118	0.122	0.133	0.124
Price	0.081	0.118	0.237	0.143	0.136	0.132	0.161	0.134	0.143
Market	0.126	0.122	0.076	0.128	0.125	0.122	0.110	0.212	0.127
Raw Material	0.217	0.169	0.165	0.178	0.147	0.192	0.175	0.132	0.172
External Condition	0.134	0.115	0.050	0.075	0.081	0.046	0.106	0.080	0.086

The AHP results are shown in Table 1 which shows the weight of the factors to be considered in accepting customer orders. The results of this weighting apart from being an importance rating also reflect the risk weight of each criterion when receiving an order. The highest rating from this AHP weighting process sequentially to the smallest is the availability of raw materials, prices provided, production capability and allocation, market conditions, consumer conditions, target fulfillment, order fulfillment, and external conditions. If we examine these results further, these results are considered to be quite reasonable where:

Raw material criteria took the first rank in the weight of importance in this study. The raw material criterion which weighs 17.20% shows that raw materials have a very important role in accepting customer orders. Based on the discussions conducted with the informants, the difficulty of available raw materials both in quantity and specifications that can be provided in this industry has caused the availability of raw materials to be the key to receiving customer orders. Without the appropriate raw materials, there are no raw materials that can be processed into products to meet consumer demand. The special raw materials needed by this company are raw materials that are specially ordered according to the demands of each customer so the availability of raw materials is a critical factor for receiving customer orders.

Price is the second most important factor in receiving customer orders with a weight of 14.26%. The main goal of a company is to make a profit. According to Philip Kotler, "Price is the amount of money that consumers exchange for the benefits of having or using products and services. Price acts as the main determinant of the buyer's choice. Price is the only element of the marketing mix that generates revenue, whereas other elements generate costs. Price itself is a game in marketing, if the price set by the seller is too high then the price cannot be reached by the consumer or customer, which will eventually have an impact on the sluggish or declining marketing of a product in the company. Conversely, when the price set by the company is too low, it will have an impact on the low level of profitability and consumers consider the goods offered at low prices to be old goods or goods of poor quality. Because the price of an item can reflect the quality it has. Price agreements with consumers are the result of a fairly long negotiation. In these negotiations not only the profit factor to be achieved but also how to maintain relationships with customers. In determining the selling price, the company has a tool called the "Margin Calculator". This tool takes into account

various things, including raw material prices, variable costs, fixed costs, production costs, shipping costs, exchange rates, interest, hedging costs, margins, discounts given, yields, and terms of payment which are then offered to consumers.

Production criteria contributed 13.53% of the weight of importance in this study. The condition of production equipment must be seriously considered in accepting customer orders. Machine technical capability, production capacity, and available production allocation are the main components to support success in fulfilling customer orders in this criterion.

Market conditions have an influence of 12.75% in considering the interests of receiving customer orders. Market conditions are conditions of the economic environment for business, investment, and employment. Favorable market conditions make it easy to start a business whereas unfavorable conditions make the market more competitive and challenging. Therefore, knowing market conditions is very necessary to determine the right order acceptance strategy for products because each market condition will give a different response from each consumer.
Consumer criteria with an interest contribution of 12.41%, have a slight difference from market criteria. Every consumer is unique, and maintaining customer loyalty is not an easy thing. It takes hard work and is consistent with what has been given before. The consumer's response to what is provided by the company is a consideration for the company in accepting orders from consumers because each consumer is unique so each consumer has a different treatment with different risks.

The target company has an interesting weight of 11.14% in receiving customer orders. The company's target is the target that must be achieved by the company to gain profit and fulfill its operations. The sales unit in the company is the spearhead for meeting the company's targets through sales targets. Directly or indirectly, demands to achieve this target will be a burden on the sales unit and affect consideration in accepting customer orders.

Consumer orders weigh 10.11%. This criterion consists of various aspects requested by consumers such as specifications, quantity, delivery date, and other requests. Compliance with these aspects is a factor for the company's consideration in accepting orders because it will have a direct impact on production capabilities and also the ability to fulfill orders.

External conditions rank last and get an importance weight of 8.59%. Many external factors can affect company performance including external business environment factors such as government policies, legal and political forces, technology, resources, and others. These factors will affect the strategic plan that has been formulated and then affect the company's performance. For this reason, external conditions are considered by the company in accepting customer orders. The criteria for external conditions are the last priority in the interest of accepting customer orders because the MTO company has a definite sales contract with an initial purchase contract. Therefore the condition when the order is received is considered a normal condition.

Table 2 Risk Probability

Criteria	Risk	Probability
Raw Material	Right time - Right amount	51%
	Right time - Wrong amount	24%
	Delayed - Right amount	11%
	Delayed - Wrong amount	14%
Price	Price is stable	34%
	Price is increase	28%
	price is decrease	37%
Production	Current production	63%
	Stunted production	37%
Market	A little of import	61%
	A lot of import	39%
Customer	Product received without problems	18%
	Product received with claim	51%
	Product received by delayed	15%
	Product rejected	16%
Target	Target achieved	50%
	Target not achieved	50%
Order	Order fulfilled	65%
	Order cannot fullfiled	35%
External Condition	Normal Condition	76%
	Abnormal Condition.	24%

5.3 Risk Calculation

EMV is generally used to calculate the risk of a project. The characteristic of a project is that the contract from the customer starts all the work and the handover of work is carried out after the work is completed, similar to the characteristics of a make-to-order system. Therefore the EMV method is considered suitable for use in this study to assess the risk of customer orders. To calculate EMV two main components are needed, namely the probability of the event and the impact that occurs. The absence of company records related to existing conditions to calculate probabilities makes estimating probabilities more challenging, therefore determining the probability of occurrence and the weight of each criterion uses the AHP method. The results of AHP calculations for the probability of occurrence of risks are shown in Table 2. By looking at the probability values in the table, it can be seen that the uncertainty factor for each risk event is very large. Based on the results of the discussions that have been carried out, these risk factors start from the time the order is received until the product is delivered to consumers and used by them. These risks are divided into each criterion with different impacts.

In the example calculation used in Table 4, by taking a sample of company data, it is calculated using the "margin calculator" where for X orders the cost of production is USD 1.295/MT, the minimum price is USD 1.150/MT and the product selling price is USD 1.185/MT. With this value, the company sells products below the HPP but still gets a marginal profit of USD 35/MT. Using EMV calculations, if the order is accepted, a risk level of USD -24.93 is obtained, whereas if the order is rejected, the risk level is USD 0.

By looking at the EMV acc < EMV rej, there is a potential risk that is quite large if the order is accepted. With these results, the order price should be renegotiated up to EMV acc > EMV rej. However, if no agreement is found with the consumer regarding the new price, then the company should reject the order. The results of risk calculations using EMV are smaller than the marginal profit expected by the company. However, this cannot be directly compared with the marginal profit to be achieved by the company and the final calculation obtained from accounting data. EMV calculations are used to make decisions by taking into account the probabilities of risks that may occur. A positive EMV value means that there is an opportunity to benefit from orders received, while a negative EMV value means that there is a risk of loss for orders received when compared to rejecting orders with an EMV value = 0 which means the company gets neither profit nor loss. if you refuse the order.

the results of risk calculations based on EMV which are carried out are smaller than the marginal profit expected by the company. However, this does not reflect the actual profit achieved by the company. The EMV calculation only takes into account the probability of the risks that may occur. A positive EMV value means that there is a potential profit from the order received, while a negative EMV value means that there is a potential loss for the order received.

The difference between the expected marginal profit and the EMV value can be considered as a contingency cost that needs to be prepared if things outside normal conditions occur.

Table 3. Expected Monetary Value Calculation

Criteria	Importance	Risk	Probability	Consequence		EMV	
				Accepted	Rejected	Accepted	Rejected
Raw Material	17.20%	Right time - Right amount	51%	35.00	0	3.06	0
		Right time - Wrong amount	24%	-13.34	0	-0.55	0
		Delayed - Right amount	11%	-8.15	0	-0.16	0
		Delayed - Wrong amount	14%	-24.45	0	-0.58	0
					EMV	1.76	0
Price	14.26%	Price is stable	34%	35.00	0	1.71	0
		Price is increase	28%	35.00	0	1.42	0
		price is decrease	37%	-69.85	0	-3.73	0
					EMV	3.12	0
Production	13.53%	Current production	63%	35.00	0	2.96	0
		Stunted production	37%	-8.15	0	-0.41	0
					EMV	2.55	0
Market	12.75%	A little of import	61%	35.00	0	2.74	0
		A lot of import	39%	-97.79	0	-4.82	0
					EMV	-2.08	0
Customer	12.41%	Product received without problems	18%	35.00	0	0.79	0
		Product received with claim	51%	-64.25	0	-4.05	0
		Product received by delayed	15%	-8.15	0	-0.15	0
		Product rejected	16%	-1397.00	0	-27.29	0
					EMV	-30.70	0
Target	11.14%	Target achieved	50%	35.00	0	1.95	0
		Target not achieved	50%	-6.71	0	-0.37	0
					EMV	1.58	0
Order	10.11%	Order fulfilled	65%	35.00	0	2.28	0
		Order cannot fullfiled	35%	-139.70	0	-5.01	0
					EMV	-2.73	0
External Condition	8.59%	Normal Condition	76%	35.00	0	2.29	0
		Abnormal Condition.	24%	-35.00	0	-0.72	0
					EMV	1.57	0
					Total EMV	-24.93	0

Further calculations for other orders that the company has received are shown in Table 3-4. The table shows that the company receives many orders with EMVacc < EMVrej, which is very risky for the company and EMVacc <EMVrej. Further investigation of these orders revealed the fact that the company still accepts orders from consumers even though it is known that these orders provide low-profit margins and are generally risky for various considerations such as to meet the company's targets and maintain good relations with consumers. The EMV calculations carried out in this study are not intended to replace price calculations carried out by the company. This EMV calculation is a tool to assess the feasibility of the price of an order based on the level of risk that will be faced.

Table 4.Orders Risk

Customer	Specification	Production price	Min Price	Sales Price	Marginal Profit	EMV
PT AG	D	$ 986	$ 832	$ 884	$ 52	$ (2.88)
PT AG	E	$ 998	$ 844	$ 907	$ 63	$ 2.75
PT AG	F	$ 977	$ 823	$ 874	$ 51	$ (3.14)
PT AG	G	$ 960	$ 806	$ 815	$ 9	$ (25.51)
PT AG	H	$ 1,004	$ 850	$ 917	$ 67	$ 4.74
PT AG	I	$ 996	$ 842	$ 908	$ 66	$ 4.44
PT AG	J	$ 999	$ 845	$ 915	$ 70	$ 6.53
PT AG	K	$ 1,023	$ 869	$ 941	$ 72	$ 6.88
PT AG	L	$ 947	$ 793	$ 825	$ 32	$ (12.57)
PT AG	M	$ 957	$ 803	$ 835	$ 32	$ (12.88)
PT AG	N	$ 954	$ 800	$ 835	$ 35	$ (11.15)
PT CSB	O	$ 998	$ 861	$ 971	$ 110	$ 28.13
PT CSB	P	$ 1,021	$ 884	$ 971	$ 87	$ 14.87
PT CSB	Q	$ 995	$ 858	$ 962	$ 104	$ 24.93
PT CSB	R	$ 1,018	$ 881	$ 956	$ 75	$ 8.38
PT CSB	S	$ 1,032	$ 895	$ 953	$ 58	$ (1.32)
PT CSB	T	$ 1,023	$ 886	$ 953	$ 67	$ 3.86
PT CSB	U	$ 1,020	$ 883	$ 948	$ 65	$ 2.88
PT CSB	V	$ 1,020	$ 883	$ 948	$ 65	$ 2.88
PT CSB	W	$ 1,020	$ 883	$ 948	$ 65	$ 2.88
PT CSB	X	$ 1,017	$ 879	$ 948	$ 69	$ 5.15
PT CSB	Y	$ 1,015	$ 878	$ 945	$ 67	$ 4.09
PT CSB	Z	$ 985	$ 848	$ 945	$ 97	$ 21.38
PT CSB	AA	$ 1,005	$ 867	$ 945	$ 78	$ 10.40
PT MMI	AB	$ 1,397	$ 1,250	$ 1,285	$ 35	$ (24.93)
PT MMI	AC	$ 1,358	$ 1,213	$ 1,358	$ 145	$ 36.24
PT MMI	AD	$ 1,322	$ 1,177	$ 1,350	$ 173	$ 52.63
PT MMI	AE	$ 1,316	$ 1,171	$ 1,200	$ 29	$ (25.69)
PT MMI	AF	$ 1,301	$ 1,156	$ 1,185	$ 29	$ (25.23)
PT MMI	AG	$ 1,295	$ 1,150	$ 1,185	$ 35	$ (21.77)
PT IP	AH	$ 1,233	$ 1,079	$ 1,360	$ 281	$ 114.28
PT IP	AI	$ 1,233	$ 1,079	$ 1,360	$ 281	$ 114.28
PT IP	AJ	$ 1,233	$ 1,079	$ 1,366	$ 287	$ 117.32
PT IP	AK	$ 1,233	$ 1,079	$ 1,366	$ 287	$ 117.32

5.3 Proposed Improvement

Martínez and Arredondo, (2010)in their research summarize the reasons for getting a value for receiving orders, providing an illustration for receiving orders using the Rgain value as shown in Figure 1. By taking this basic flow and adapting to existing conditions, to reduce existing risks and increase company profits, this study proposes to integrate risk calculations using EMV with daily order-receiving activities. The proposed change is to change the company's order acceptance procedure to the one shown in Figure 1.

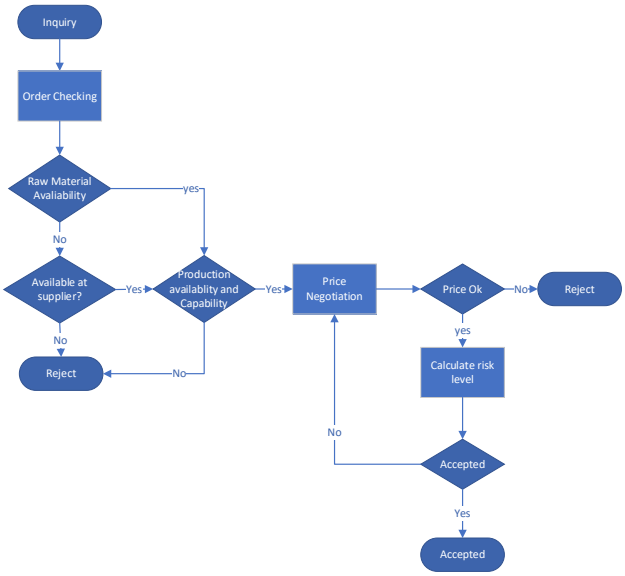

Figure 1. Order acceptance flow recommendation

In this flow, the following steps are taken:
1. If when the order is received, raw materials are available in the warehouse, consideration of raw materials can be skipped and directly checks the allocation and production capacity.
2. If raw materials are not available in the warehouse, then a raw material availability check is carried out at the raw material supplier. If the raw material is not available at the raw material supplier, then the order is immediately rejected. If raw materials are available at raw material suppliers, proceed to the stages of checking allocation and production capacity.
3. If the production capacity is not available, then the order is rejected.
4. If production capacity is available, then proceed with price negotiations.
5. The price negotiation process still uses the "Margin Calculator" owned by the company. This price calculation still uses the old procedure, namely using a margin calculator which takes into account the cost of production, the minimum price, the selling price to consumers, and the expected margin.
6. If the price submitted by the consumer cannot be agreed upon and will be detrimental to the company, then the order is rejected. However, if the order can still provide a margin, a risk calculation is performed.
7. The calculation of this risk value is carried out to assess whether the expected margin can still cover the amount of risk that may occur. The risk calculation uses the EMV value as a contingency fee for the risk of orders received. If the EMV value is positive then the order can be accepted by the company. If the EMV is negative, then a renegotiation will be carried out on the price submitted. If after renegotiation a price cannot be agreed upon that covers the risk value, then the order should be rejected.
This recommendation for accepting customer orders does not eliminate or replace the price calculation method that is already running in the company. This method adds risk calculation as an additional assessment criterion in accepting customer orders. The price given to consumers is calculated by the level of risk, using EMV. If the price is still not acceptable, proceed with price renegotiation with the customer.

6. Conclusion

Even though the target of the company is to make a profit, the price factor is not a major factor in the decision to accept customer orders. The most dominant consideration factor for the company when receiving an order is the aspect of availability of raw materials. In the AHP calculation that has been carried out, the raw material criteria have the highest weight of 17.20%. While the price criterion ranks second with a weight value of 14.26%. Therefore in making decisions when receiving customer orders, the first thing to consider is the availability of raw materials and then the price factor. Other consideration factors then follow, such as production capability and allocation, market conditions, consumer conditions, target fulfillment, order fulfillment, and external conditions.

Calculation of risk by using EMV can be done to calculate the risk of orders received even though the value of the expected marginal profit by the company is different from the risk value calculated by EMV. This EMV calculation does not replace the price calculation carried out by the company, but this EMV calculation can be used as a tool to complete the assessment of the feasibility of the price of the order to be received.

To reduce the risk of incoming orders, a new customer order acceptance flow recommendation has been made. The company should try to implement this flow and set EMV standards/limits for orders received. Therefore it can be easier to evaluate incoming customer orders. Measuring the performance of evaluating customer order acceptance with EMV can be carried out again or periodically after the proposed strategy has been successfully implemented by the company. This is useful to see whether the proposed improvements that have been implemented can improve the company's performance in terms of receiving customer orders or not. Suggestions for improvements to weight, opportunity, and impact on EMV calculations can be made by looking at the existing conditions to continue to get better EMV calculation results. Recommendations for further research can be carried out, especially in other industries that implement MTO to obtain a comparison of the results of EMV assessment performance and also continuous improvement for companies in industries that implement the MTO system.

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