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Selection of Maltodextrin and Cornstarch Suppliers Using Procurement Supply Management and Multi-Objective Optimization on The Basis of Ratio Analysis (Moora) Methods at Pt Sari Alam Sukabumi

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Abstract
PT Sari Alam Sukabumi is a natural ingredient processing company that produces herbal extracts in the form of dry powder. In its production process, the company uses the main fillers, namely maltodextrin and cornstarch. This research aims to assist companies in determining the most optimal supplier of maltodextrin and cornstarch raw materials based on various evaluation criteria, namely price, quality, service, timeliness of delivery, and accuracy of delivery quantity. The specific objective of this study is to identify important criteria in supplier selection using the Procurement Supplier Management (PSM) approach and apply the Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA) method to obtain the best ranking of available supplier alternatives. This type of research is descriptive with a quantitative approach. Data was collected through interviews, questionnaires to five internal company respondents, and documentation. The research process included determining five main criteria—price, quality, service, timeliness, and accuracy of delivery quantity—which were then weighted based on respondents' assessments. The suppliers evaluated in this study are PT Gratama Bumi Indonesia, PT Mitra Tsalasa Jaya, PT Tereos FKS Indonesia, PT Sorini Agro Asia, and PT Iniko Karya Persada. The results of the study show that PT Gratama Bumi Indonesia is the best alternative as a raw material supplier with the highest optimization score based on the MOORA method. These findings make a strategic contribution to procurement decision-making and are expected to be able to improve the efficiency of PT Sari Alam Sukabumi's supply chain in a sustainable manner.
Keywords: Suppliers, Maltodextrin, Cornstarch, PSM, MOORA, Procurement.

INTRODUCTION

One of the factors for the success of a company is the selection of suppliers. Selecting the right supplier can guarantee the availability of raw materials to maintain the production trajectory (Kurpjuweit et al., 2021; Safa et al., 2014; Taherdoost & Brard, 2019; Woschank et al., 2022; Zhao et al., 2019). Supplier selection is a multi-criteria problem where each criterion has different importance, and information about it is not known exactly. In this case, the selection of suppliers based on low price quotes is no longer efficient (Acerbi et al., 2023; Banaeian et al., 2015; Demiralay & Paksoy, 2022; Ghosh et al., 2023; Tay & Aw, 2021). To achieve maximum supply chain performance, it must combine other criteria that are relevant to the company's goals. PT Sari Alam Sukabumi is a company engaged in the extraction of natural ingredients, especially in processing natural raw materials into dry herbal products ready to sell. The products are widely used in the food, pharmaceutical, and cosmetic industries. One of the important stages in the production process is *spray* *drying*, which is a method of drying the extract liquid into a dry powder with the help of fillers such as *maltodextrin* and *cornstarch*. These two materials function to maintain the stability of active compounds, increase solubility, and facilitate the packaging and distribution process of products. *Maltodextrin* is a partial hydrolysis of starch, is flavor-neutral, easily soluble, and suitable for use as an encapsulation material for active substances (Cupone et al., 2022; Hofman et al., 2016; van der Sman et al., 2022; Xiao et al., 2022). Meanwhile, *cornstarch* has good thickening and gelling characteristics, and has been commonly used in the formulation of dry herbal products. The selection of the right filler material is very important because it will affect the quality of the final product, such as moisture content, solubility, and stability during storage (Winarno, 2017).

During the 2024 cooperation period, PT Sari Alam Sukabumi recorded three incidents of delays in the delivery of raw materials from Interstarch Ukraine LLC, out of a total of twelve planned delivery schedules throughout the year. This means that as many as 25% of deliveries were delayed. The average delay is in the range of days, while the delivery time promised in the contract is a maximum of five days from the start of the order. However, because shipments come from abroad (Ukraine), logistics risk factors such as port queues, import licensing, and geopolitical conditions cause delays almost every two months. The impact on the company's operations is quite significant. Based on the PPIC report and the production section, this delay has caused production disruptions in the three main batches, forced the company to reschedule the extraction process, and resulted in losses in emergency procurement costs and increased storage costs of substitute materials. The estimated total indirect loss due to delays reaches Rp10–15 million per month, including production and distribution delay costs.

So far, PT Sari Alam Sukabumi has only established cooperation in the supply of raw materials for *maltodextrin* and *cornstarch* with one foreign supplier, namely Interstarch Ukraine LLC. This supplier is known as a manufacturer of filler materials with international standard certifications, such as FSSC 22000, ISO, GMP, Halal, and Kosher. Despite having high quality and large production capacity, this cooperation began to experience serious obstacles in 2024, especially in terms of delivery delays due to logistical obstacles and import regulations. On average, delays reach 4–6 days from the agreed delivery schedule, causing production disruptions and an increased risk of stockouts.

Although Interstarch Ukraine LLC is known as a high-quality supplier, the logistical constraints and import regulations that occurred during 2024 have posed a significant risk to the continuity of production. To anticipate the potential for repeated delays and reduce additional costs due to emergency procurement, PT SAS began to consider opening cooperation opportunities with domestic suppliers (Indonesia). The main reason for this consideration is the potential efficiency in terms of delivery times due to geographical proximity, reduced cross-border logistics risks, and the flexibility of faster communication and response from local suppliers. In addition, the company's shift to domestic suppliers is also driven by long-term strategic considerations. The use of local suppliers is considered to reduce dependence on foreign supplies, which are vulnerable to cross-border logistical barriers, exchange rate fluctuations, and geopolitical disruptions. Geographical proximity to local suppliers allows for faster delivery times, more intensive communication, and more efficient procurement and distribution costs[A1].

This condition shows the importance of systematic evaluation and selection of suppliers. Data from GAPMMI (2023) shows that there are still many medium-scale companies in Indonesia, including in the herbal sector, that do not yet have a data-based and performance-based supplier evaluation system. As a result, there are often delays in supply or the use of materials that do not meet quality standards. In fact, the Indonesian Standardization Institute (2023) noted that almost half of the cases of quality failure of herbal products in the domestic market are caused by the use of inappropriate fillers. For this reason, PT SAS needs to develop a supplier selection system that considers various important criteria objectively and structurally.

Based on these conditions, a systematic approach is needed that is able to evaluate suppliers objectively by considering various criteria that are relevant to the company's needs. The supplier comparison data in this study was obtained from PT SAS's internal records, as well as the results of observations on supplier performance during a certain period. The information includes aspects of price, quality, delivery speed, and quality certification that have been standardized in the natural material processing industry. To answer these challenges, the *Procurement Supplier Management* (*PSM*) approach is used in the process of identifying and selecting supplier criteria, as it is able to represent best practices in procurement management. Furthermore, for the decision-making process, the *Multi-Objective Optimization on the Basis of Ratio Analysis* (*MOORA*) method is used because this method is proven to be efficient, flexible, and can process quantitative data objectively to produce the best supplier rankings based on a combination of benefit and cost criteria. Thus, the combination of *PSM* and *MOORA* methods is very relevant to be used in the context of this research to help companies obtain the most optimal suppliers to support the smooth production process.

The research objectives include identifying *PSM*-based criteria, applying *MOORA* for objective supplier selection, and optimizing procurement decisions. The scope is limited to specific raw materials, pre-vetted suppliers, and five weighted criteria (price, quality, delivery timeliness, service, and quantity accuracy), with input from five internal stakeholders. The study focuses solely on *PSM* and *MOORA*, excluding comparative methods like *AHP* or *TOPSIS*, and uses static data from a fixed period.

The study’s limitations include its narrow focus on *maltodextrin* and *cornstarch* suppliers, reliance on historical supplier data, and static dataset constraints. Despite these, the research offers significant benefits: for PT Sari Alam Sukabumi, it provides a systematic framework to enhance procurement efficiency, reduce delays, and ensure quality consistency. Academically, it enriches supply chain literature by demonstrating *PSM* and *MOORA*'s applicability in the natural materials industry, serving as a reference for future multi-criteria decision-making models in manufacturing. The findings aim to balance practical industry needs with theoretical advancements.

RESEARCH METHOD

Types and Research Approaches

In this study, the type of research used is *descriptive research*, which aims to provide a clear and detailed picture of the phenomenon being studied. *Descriptive research* was chosen because it allows researchers to collect rich and diverse data, as well as analyze the characteristics of the population that is the focus of the study. The approach used in this study is a *quantitative approach*, which focuses on collecting and analyzing numerical data to test the established hypothesis. The *quantitative approach* was selected because it can provide objective and measurable results, making it easier to draw valid conclusions. The reason for choosing this type and approach is to ensure that the research can answer the research questions appropriately and provide in-depth insights into the problem being researched. By using the *PSM* and *MOORA* methods, researchers can identify significant patterns and relationships in the data, which in turn can make a meaningful contribution to the development of science in relevant fields.

A *descriptive approach* was used to obtain a systematic overview of the criteria for suppliers of raw materials, *maltodextrin* , and *cornstarch* considered by PT Sari Alam Sukabumi. Meanwhile, the *explanatory approach* is used to analyze the relationship between variables that affect supplier selection decisions.

Variables and Indicators of the Researcher

The variables in this study are supplier evaluation criteria determined based on *PSM* principles, including aspects of cost, quality, delivery, and service. The indicators for each variable are designed to be converted into quantitative values.

The details of the variables and indicators are as follows:

Table 1. Variables and Indicators

Yes	Variable	Assessment Indicators	Rating Scale
1	Price per Kg	Price per kilogram	*Cost* (Lower)
2	Product Quality	Quality standards, specification conformity	Benefit (Getting higher)

3	Service	Speed of response, accuracy of information	Benefit
4	Delay	Average delivery delays	Benefit
5	Total Accuracy	Order Quantity Suitability, Frequency of Quantity Difference	Benefit

Population and Research Sample

The population in this study consists of all suppliers of raw materials for *maltodextrin* and *cornstarch* in collaboration with PT Sari Alam Sukabumi. Sampling was carried out using a *purposive sampling* technique, selecting five suppliers based on historical purchase data and information available in the industrial materials catalog. The criteria for the sampled suppliers include:

1. Having a minimum of one year of experience in supplying raw materials of *maltodextrin* and *cornstarch*.
2. Possessing a production capacity that meets the needs of PT Sari Alam Sukabumi.
3. Demonstrating a track record in delivery timeliness and product quality.
4. Willingness to provide data related to the supplier assessment aspect.
5. Having clear business legality.

The number of samples used in this study was determined by the number of suppliers meeting the above criteria. The study employed a mixed-method data collection approach, combining primary data from *Likert*-scale questionnaires distributed to five key internal stakeholders (procurement manager, warehouse head, production supervisor, PPIC staff, and quality control staff) with secondary data from company procurement records and industry publications. Questionnaire responses measuring five critical criteria (price, delivery time, quality, quantity accuracy, and supply capacity) were converted to a 100-point scale and averaged to create weighted values for the *MOORA* method's decision matrix.

The analysis followed a structured process: initial criteria identification through *Procurement Supplier Management* (*PSM*), data normalization to ensure uniform scaling, and *MOORA* implementation involving matrix optimization, *Yi* value calculation, and final supplier ranking using Microsoft Excel for computational accuracy. This systematic workflow—from problem identification to result interpretation—ensured an objective evaluation of *maltodextrin* and *cornstarch* suppliers at PT Sari Alam Sukabumi.

RESULTS AND DISCUSSION

Data processing with the Maoora Method

Weighting of Criteria

This decision making is based on criteria that have become decisive in determining the best *supplier of maltodextrin* and *cornstarch* products for PT SAS, the following are the criteria data used.

Table 1. Criterion

	Criteria	Code Criteria	Attribute
Criteria	Raw material price	C1	Cost
	Quality of raw materials(%)	C2	Benefit
	Delivery timeliness	C3	Benefit
	Service	C4	Benefit
	Accuracy of Delivery Quantity	C5	Benefit

Table 2. Weight

	Criteria	Weight
Weight: total weight is 1 or 100%.	Raw material price	0.21
	Quality of raw materials(%)	0.21
	Delivery timeliness	0.20
	Service	0.19
	Accuracy of Delivery Quantity	0.19

Table 2 Weights are given based on the consideration of the level of importance of each criterion for the smooth operation of the company. All criteria received different weights, namely 0.21, 0.20, 0.19 because the results of data processing from five respondents showed that each criterion was assessed to have a different level of importance in the supplier evaluation process.

Table 3. PT SAS's New Supplier Alternatives

	Alternative	Code
Alternative	PT Gratama Bumi Indonesia	SP1
	PT Mitra Tsalasa Jaya	SP2
	PT Tereos FKS Indonesia	SP3
	PT Sorini Agro Asia	SP4
	PT Iniko Karya Persada	SP5

Table 3 explains SP1 to SP5 This is the code for each supplier to make it easier to use in the table and the subsequent calculation process.

Matrix Formation

The questionnaire results data are compiled into a decision matrix based on the performance value of each supplier against five criteria. Each criterion is scored 0–100. For example, the supplier, price, quality, service time and quantity in the form of a table: An assessment of timeliness is carried out to find out how often the supplier delivers raw materials according to the agreed time. The categories of delays are classified by the number of days of delays and are assigned a value according to their severity, as shown in the following table:

Table 4. Punctuality Assessment

Sluggishness	Value
0 Days	100
≤ 1 Day	90
2-3	75
4-5	60
> 5 Days	50

(Source: Sitio (2025) Procurement Performance Standards.)

For quality criteria using assessments that are not numerical ones, it will be adjusted to the assessment scale as below:

Table 5. Quality Criteria Assessment Scale

Suitability Description	Value
≥ 98%	100
95-97%	90
90-94%	85
85-89%	75
< 85%	60

(Source: ABB 2020; GAASI 2023)

The assessment of service criteria aims to evaluate the extent of the quality of communication, response, and support provided by suppliers to the company. The scale of service assessment is presented in the following table:

Table 6. Service Criteria Assessment Scale

Information	Value
Very Satisfying	100
Satisfying	85
Quite Satisfying	75
Less Satisfactory	60
Unsatisfactory	50

(Source: Zendesk 2023; Dialpad 2022)

Quantity accuracy assessment is carried out to measure how often the supplier delivers raw materials according to the quantity ordered. Here is the scale of the assessment:

Table 7. Total Accuracy

Information	Value
Always fit	100
Almost always appropriate	85
Often appropriate	75
Rarely suitable	60
Almost never fit	50

(Source: Veridion 2024 and SAP Help Portal 2023)

Decision Matrix (Xij)

Respondents gave ratings to five suppliers (A–E). The mean value is converted to a scale of 100 and entered into the decision matrix as an input of the MOORA method.

Table 8. PT SAS Supplier Data

Supplier	**Material Type**	**Price (Rp/kg)**	***Lead Time* (days)**	**Quality (%)**	**Delivery Accuracy (%)**	**Supply Capacity (kg/month)**
PT Gratama Bumi Indonesia	*Maltodex Train*	92	91	94	94	77
PT Mitra Tsalasa Jaya	*Cornstarch*	89	91	88	89	72
PT Tereos FKS Indonesia	*Maltodex Train*	94	94	94	94	74
PT Sorini Agro Asia	*Cornstarch*	86	86	86	81	66
PT Iniko Karya Persada	*Cornstarch*	72	89	89	86	67

(Source: Data Processing)

Table 8 Supplier data shows preliminary data on the average results of respondents' assessments of five alternative suppliers for *maltodextrin* and *cornstarch raw materials*. The ratings are given on a scale of 1-100, based on five main criteria:

1. Price *Cost* criteria are measured from the efficiency of the price offered. Higher values indicate a more economical price for the company.
2. *Lead time* benefit criteria describe the speed of delivery from the time of order. Higher values indicate faster delivery time.
3. Quality benefit criteria are based on the suitability of materials with the company's production quality standards.
4. The accuracy of delivery benefit criteria measures the consistency of suppliers in delivering according to the promised time.
5. The supply capacity of the benefit criterion indicates the ability of the supplier to meet the needs of large quantities of raw materials in a sustainable manner.

All scores are the result of average scoring from the PPIC and *Quality Control* sections, which are converted to a scale of 1–100 to standardize the inputs into the decision matrix of the MOORA method. These values will be further processed through the normalization and weighting stages so that the final score (Yi) of each supplier can be calculated.

Alternative Weight Assessment

Table 9. Weight Assessment

ALTERNATIVE	C1	C2	C3	C4	C5
PT Gratama Bumi Indonesia	92	91	94	94	77
PT Mitra Tsalasa Jaya	89	91	88	89	72
PT Tereos FKS Indonesia	94	94	94	94	74
PT Sorini Agro Asia	86	86	86	81	66
PT Iniko Karya Persada	72	89	89	86	67

Table 9 shows the assessment of five suppliers based on five main criteria. C1 (price) is the Cost criterion so that the value will be minimized, while C2 to C5 is the benefit criterion and will be maximized in the MOORA method and the last row in the table shows the optimization direction for each criterion.

Data Normalization Process

After obtaining performance data from each supplier against the five criteria (C1 to C5), the next step is to carry out a data normalization process. Normalization aims to equalize the scale between criteria so that they can be compared fairly, considering that each criterion has a different unit and range of values.

The normalization method used in this study refers to the formula in *the MOORA (Multi-Objective Optimization on the Basis of Ratio Analysis) method*, which is the formula stated in 2.7.4 part (2).

Table 10. Matrix Normalization

Alternative	**C1**	**C2**	**C3**	**C4**	**C5**
SP1	441.0217	459.0225	459.0213	452.0233	364.0278
SP2	441.0220	459.0220	459.0213	452.0233	364.0225
SP3	441.0213	459.0227	459.0213	452.0233	364.0225
SP4	369.0213	459.0225	459.0217	452.0247	364.0233
SP5	441.0260	459.0278	459.0270	452.0303	364.0299

Matrix Normalization Calculation for:

A. Searching for price ratio (C1)

$$SP1 = \sqrt{92^{\wedge 2} + 89^{\wedge 2} + 94^\wedge2 + 86^\wedge2 + 72^\wedge2 \div 92}) = 441.0217$$

$$SP2 = \sqrt{92^{\wedge 2} + 89^{\wedge 2} + 94^\wedge2 + 86^\wedge2 + 72^\wedge2 \div 89}) = 441.0220$$

$$SP3 = \sqrt{92^{\wedge 2} + 89^{\wedge 2} + 94^\wedge2 + 86^\wedge2 + 72^\wedge2 \div 94}) = 441.0213$$

$$SP4 = \sqrt{92^{\wedge 2} + 89^{\wedge 2} + 94^\wedge2 + 86^\wedge2 + 72^\wedge2 \div 86}) = 369.0213$$

$$SP1 = \sqrt{92^{\wedge 2} + 89^{\wedge 2} + 94^\wedge2 + 86^\wedge2 + 72^\wedge2 \div 72}) = 441.0260$$

B. Searching for Quality Ratio (C2)

$$SP1 = \sqrt{91^{\wedge 2} + 91^{\wedge 2} + 94^\wedge2 + 86^\wedge2 + 89^\wedge2 \div 91}) = 459.0225$$

$SP2 = \sqrt{91^{\wedge 2} + 91^{\wedge 2} + 94^\wedge 2 + 86^\wedge 2 + 89^\wedge 2 \div 91}) = 459.0220$

$SP3 = \sqrt{91^{\wedge 2} + 91^{\wedge 2} + 94^\wedge 2 + 86^\wedge 2 + 89^\wedge 2 \div 94}) = 459.0227$

$SP4 = \sqrt{91^{\wedge 2} + 91^{\wedge 2} + 94^\wedge 2 + 86^\wedge 2 + 89^\wedge 2 \div 86}) = 459.0225$

$SP5 = \sqrt{91^{\wedge 2} + 91^{\wedge 2} + 94^\wedge 2 + 86^\wedge 2 + 89^\wedge 2 \div 89}) = 459.0278$

C. Finding On-Time Ratios (C3)

$SP1 = \sqrt{94^\wedge 2 + 88^{\wedge 2} + 94^\wedge 2 + 86^\wedge 2 + 89^\wedge 2 \div 94}) = 459.0213$

$SP2 = \sqrt{94^\wedge 2 + 88^{\wedge 2} + 94^\wedge 2 + 86^\wedge 2 + 89^\wedge 2 \div 88}) = 459.0213$

$SP3 = \sqrt{94^\wedge 2 + 88^{\wedge 2} + 94^\wedge 2 + 86^\wedge 2 + 89^\wedge 2 \div 94}) = 459.0213$

$SP4 = \sqrt{94^\wedge 2 + 88^{\wedge 2} + 94^\wedge 2 + 86^\wedge 2 + 89^\wedge 2 \div 86}) = 459.0217$

$SP5 = \sqrt{94^\wedge 2 + 88^{\wedge 2} + 94^\wedge 2 + 86^\wedge 2 + 89^\wedge 2 \div 89}) = 459.0270$

D. Finding Service Ratio (C4)

$SP1 = \sqrt{94^2 + 89^2 + 94^\wedge 2 + 81^\wedge 2 + 66^\wedge 2 \div 94}) = 452.0233$

$SP2 = \sqrt{94^2 + 89^2 + 94^\wedge 2 + 81^\wedge 2 + 66^\wedge 2 \div 89}) = 452.0233$

$SP3 = \sqrt{94^2 + 89^2 + 94^\wedge 2 + 81^\wedge 2 + 66^\wedge 2 \div 94}) = 452.0233$

$SP4 = \sqrt{94^2 + 89^2 + 94^\wedge 2 + 81^\wedge 2 + 66^\wedge 2 \div 81}) = 452.0247$

$SP5 = \sqrt{94^2 + 89^2 + 94^\wedge 2 + 81^\wedge 2 + 66^\wedge 2 \div 66}) = 452.0303$

E. Finding the Quantity Accuracy Ratio (C5)

$SP1 = \sqrt{77^2 + 72^2 + 74^\wedge 2 + 66^\wedge 2 + 67^\wedge 2 \div 77}) = 364.0278$

$SP2 = \sqrt{77^2 + 72^2 + 74^\wedge 2 + 66^\wedge 2 + 67^\wedge 2 \div 72}) = 364.0225$

$SP3 = \sqrt{77^2 + 72^2 + 74^\wedge 2 + 66^\wedge 2 + 67^\wedge 2 \div 74}) = 364.0225$

$SP4 = \sqrt{77^2 + 72^2 + 74^\wedge 2 + 66^\wedge 2 + 67^\wedge 2 \div 66}) = 364.0233$

$SP5 = \sqrt{77^2 + 72^2 + 74^\wedge 2 + 66^\wedge 2 + 67^\wedge 2 \div 67}) = 364.0299$

Ternomalized Matrix

Based on the calculation above, the following is a normalized performance matrix that will be calculated based on the values in columns C1, C2, C3, C4, and C5 which are divided by the value of each of the criteria ratios that have been obtained in the calculation above, so that the results are obtained as follows:Xij

This table shows the results of normalization of the decision matrix using the MOORA method, where each value is obtained from the result of the division between the original value in each criterion and the square root of the number of squared values in the divisor column. Xij

Table 11. Normalized Matrix

Alternative	**Criteria**				
	C1	**C2**	**C3**	**C4**	**C5**
SP1	0.473	0.451	0.466	0.473	0.483
SP2	0.458	0.451	0.436	0.448	0.451
SP3	0.483	0.466	0.466	0.473	0.464

SP4	0.442	0.426	0.426	0.407	0.414
SP5	0.370	0.441	0.441	0.432	0.420
Dividers	194	202	202	199	159

The values in table 11 above are the result of normalization of the Xij decision matrix, which is obtained by dividing each value in the criteria (C1 to C5) by its respective divisor value. The divisor value is the root of the square of the value in each criterion column.

A. Criteria (C1)

$$SP1 = \frac{92}{194} = 0.473$$

$$SP2 = \frac{89}{194} = 0.458$$

$$SP3 = \frac{94}{194} = 0.483$$

$$SP4 = \frac{86}{194} = 0.442$$

$$SP5 = \frac{72}{194} = 0.370$$

B. Quality (C2)

$$SP1 = \frac{91}{202} = 0.451$$

$$SP2 = \frac{91}{202} = 0.451$$

$$SP3 = \frac{94}{202} = 0.466$$

$$SP4 = \frac{86}{202} = 0.426$$

$$SP5 = \frac{89}{202} = 0.441$$

C. Delivery Timeliness (C3)

$$SP1 = \frac{94}{202} = 0.466$$

$$SP2 = \frac{88}{202} = 0.436$$

$$SP3 = \frac{94}{202} = 0.466$$

$$SP4 = \frac{86}{202} = 0.426$$

$$SP5 = \frac{89}{202} = 0.441$$

D. Service (C4)

$$SP1 = \frac{94}{199} = 0.473$$

$SP2 = \frac{89}{199} = 0.448$

$SP3 = \frac{94}{199} = 0.473$

$SP4 = \frac{81}{199} = 0.407$

$SP5 = \frac{86}{199} = 0.432$

E. Delivery Accuracy (C5)

$SP1 = \frac{77}{159} = 0.483$

$SP2 = \frac{72}{159} = 0.451$

$SP3 = \frac{74}{159} = 0.464$

$SP4 = \frac{66}{159} = 0.414$

$SP5 = \frac{67}{159} = 0.420$

4.6.8 Optimization of Attribute Values (Normalization Matrix multiplied by weight)

Optimization is an attribute value with the formula xij* wj, where xij is the value of the Normalized Matrix result while Wj is the weight value of each criterion.

Table 12. Attribute Value Optimization

Alternative	**Criteria**				
	C1	**C2**	**C3**	**C4**	**C5**
SP1	0.099	0.095	0.093	0.090	0.092
SP2	0.096	0.095	0.087	0.085	0.086
SP3	0.102	0.098	0.093	0.090	0.088
SP4	0.093	0.090	0.085	0.077	0.079
SP5	0.078	0.093	0.088	0.082	0.080
Weight	Cost	Benefit	Benefit	Benefit	Benefit
	0.21	0.21	0.20	0.19	0.19

1. Price (C1)

$SP1 = 0.473 \div 0.21 = 0.099$

$SP2 = 0.458 \div 0.21 = 0.096$

$SP3 = 0.483 \div 0.20 = 0.102$

$SP4 = 0.442 \div 0.19 = 0.093$

$SP5 = 0.370 \div 0.19 = 0.078$

2. Quality (C2)

$SP1 = 0.451 \div 0.21 = 0.095$

$SP2 = 0.451 \div 0.21 = 0.095$

$SP3 = 0.466 \div 0.21 = 0.098$
$SP4 = 0.426 \div 0.21 = 0.090$
$SP5 = 0.441 \div 0.21 = 0.093$

3. Delivery Timeliness (C3)
$SP1 = 0.446 \div 0.20 = 0.093$
$SP2 = 0.436 \div 0.20 = 0.087$
$SP3 = 0.466 \div 0.20 = 0.093$
$SP4 = 0.426 \div 0.20 = 0.085$
$SP5 = 0.441 \div 0.20 = 0.088$
4. Service (C4)
$SP1 = 0.473 \div 0.20 = 0.090$
$SP2 = 0.448 \div 0.20 = 0.085$
$SP3 = 0.473 \div 0.20 = 0.090$
$SP4 = 0.407 \div 0.20 = 0.077$
$SP5 = 0.432 \div 0.20 = 0.082$
5. Delivery Accuracy (C5)
$SP1 = 0.483 \div 0.20 = 0.092$
$SP2 = 0.451 \div 0.20 = 0.086$
$SP3 = 0.464 \div 0.20 = 0.088$
$SP4 = 0.414 \div 0.20 = 0.079$
$SP5 = 0.420 \div 0.20 = 0.080$

After obtaining the results of attribute optimization, the process of calculating the Yi value is then carried out and the final stage of ranking.

The following is the process of calculating the value of Yi.

Table 13. Ternomalized Matrix

Alternative	Maximization (Benefit)	Minimum (Cost)	Yield (Max - Min)	
SP1	0.369	0.099	0.369 - 0.099	0.270
SP2	0.353	0.096	0.353 - 0.096	0.257
SP3	0.369	0.102	0.369 - 0.102	0.267
SP4	0.331	0.093	0.331 - 0.093	0.238
SP5	0.343	0.078	0.343 - 0.078	0.265

In table 4.12 The final value is obtained from the subtraction between the total value of the benefit and cost criteria. The highest-rated alternative is the best supplier according to the MOORA method. In the calculation Yi is divided into two, namely maximum and minimum following the explanation of maximum and minimum:

1. Finding Value Maximization (C2-C5)
$SP1 = \sqrt{0.095 + 0.093 + 0.090 + 0.092} = 0.369$
$SP2 = \sqrt{0.095 + 0.087 + 0.085 + 0.086} = 0.353$
$SP3 = \sqrt{0.098 + 0.093 + 0.090 + 0.088} = 0.369$

$SP4 = \sqrt{0.090 + 0.085 + 0.077 + 0.079} = 0.331$
$SP5 = \sqrt{0.093 + 0.088 + 0.082 + 0.080} = 0.343$

2. Finding Minimum Values (C1)
   $SP1 = 0.099$
   $SP2 = 0.096$
   $SP3 = 0.102$
   $SP4 = 0.093$
   $SP5 = 0.078$
3. Finding Yi from Results (MAX-MIN)
   $SP1 = 0.369 - 0.099 = 0.270$
   $SP2 = 0.353 - 0.096 = 0.257$
   $SP3 = 0.369 - 0.102 = 0.267$
   $SP1 = 0.331 - 0.093 = 0.238$
   $SP1 = 0.343 - 0.078 = 0.265$
   The Yi value is obtained from the result of subtracting the total score of *the Cost criterion* (C1) by the sum of the benefit criterion score (C2–C5) that has been weighted. The highest Yi value indicates the best alternative.

Finding YI and Ranking

Table 14. YI and Ranking

Code	Supplier	Yi	Ranking
SP1	PT Gratama Bumi Indonesia	0.270	1
SP2	PT Mitra Tsalasa Jaya	0.257	4
SP3	PT Tereos FKS Indonesia	0.267	2
SP4	PT Sorini Agro Asia	0.238	5
SP5	PT Iniko Karya Persada	0.265	3

After the Yi value of all suppliers is calculated, the last step is to do a ranking where the supplier with the highest Yi value is ranked 1 (best) then the supplier with a Yi value lower than one will rank 2nd and next. Based on the results of the calculation of the MOORA method, PT Gratama Bumi Indonesia (SP1) ranks first with a Yi value of 0.280, which shows that this supplier has the most optimal performance compared to other alternatives. Followed by PT Tereos FKS Indonesia (SP3) with a Yi value of 0.277 in second place, and PT Iniko Karya Persada (SP5) in third place with a value of 0.273, both show competitive supplier performance and deserve consideration. Furthermore, PT Mitra Tsalasa Jaya (SP2) is in fourth position with a Yi value of 0.266, while PT Sorini Agro Asia (SP4) ranks fifth with the lowest value of 0.246. These results show that SP1 is the best alternative in the supplier selection process, while SP4 has the lowest performance and is less recommended as the main supplier without any significant improvement in the aspects evaluated.

CONCLUSION

This study aims to determine the best supplier of raw materials of *maltodextrin* and *cornstarch* at PT Sari Alam Sukabumi by using the *Procurement Supplier Management* (*PSM*) approach to determine criteria and methods of *Multi-Objective Optimization on the Basis of Ratio Analysis* (*MOORA*) for supplier ranking. Based on the results of the study, it was found that the main problems in the procurement of raw materials in this company include delivery delays, inconsistency in the quality of raw materials, and the absence of a structured supplier evaluation system, which has the potential to disrupt the smooth production process. The determination of supplier evaluation criteria is carried out through the *PSM* approach, resulting in five main criteria, namely raw material price (C1), raw material quality (C2), delivery timeliness (C3), service (C4), and delivery quantity accuracy (C5), with weights adjusted based on the company's operational priorities. Furthermore, the *MOORA* method was used to assess five supplier alternatives through the process of data normalization, attribute optimization, *Yi* value calculation, and alternative ranking. The evaluation was carried out on five companies: PT Tereos FKS Indonesia, PT Gratama Bumi Indonesia, PT Sorini Agro Asia Corporindo, PT Mitra Tsalasa Jaya, and PT Iniko Karya Persada. The results of the analysis showed that PT Gratama Bumi Indonesia obtained the highest *Yi* value of 0.280, so it was recommended as the best supplier based on all criteria. Therefore, PT Sari Alam Sukabumi is advised to make the company the main partner in the procurement of raw materials, as well as apply the *PSM* and *MOORA* methods periodically so that the evaluation process remains objective and adaptive. In addition, the weight of evaluation criteria needs to be dynamically updated according to the company's strategic direction. For further research, it is recommended to consider aspects of supply risk, environmental sustainability, or use other multicriteria methods such as *Analytic Network Process* (*ANP*) or *TOPSIS* to compare the effectiveness of the methods used.

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