Analysis of Trucking Company Vendor Selection in Freight Forwarding Companies using VPI, AHP, and TOPSIS Methods

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Abstract. PT Berlian Dumai Logistics Batam branch currently has three trucking vendor companies namely PT Snepac, PT IntiKarya Indotama, and PT Global Project Logistik. This research aims to identify the criteria that are the main priorities for evaluating trucking company vendors and to evaluate and select the best trucking company using the VPI, AHP, and TOPSIS methods. The sampling technique in this study used nonprobability sampling and purposive sampling techniques. Meanwhile, the data collection technique in this study is questionnaire and was processed using the VPI, AHP, and TOPSIS methods. Based on the analysis using the AHP method, the evaluation of criteria in order is as follows; Cost (0.5529), Flexibility (0.1748), Quality (0.1088), Responsiveness (0.1004), and Delivery (0.0631). Furthermore, in the evaluation of the selection of trucking company vendors, the weight values obtained are as follows; PT Intikarya Indotama (9.460); PT Snepac (3.228); PT Global Project Logistik (1.312). Then in the TOPSIS method analysis, the results of the weight value are as follows; PT Intikarya Indotama (0.70); PT Snepac (0.069); PT Global Project Logistics (0.30). So, the biggest criterion in selecting or evaluating trucking company vendors is the cost criterion, and the best trucking company vendor is PT Intikarya Indotama.

Keywords: AHP, VPI, TOPSIS, Freight Forwarding, and Trucking Company Vendor.

1 Introduction

PT Berlian Dumai Logistics Batam branch is a company engaged in freight forwarding services. The company has been active since 2007 in providing services such as offering domestic and international freight forwarding rates, customs clearance, land transportation, warehousing, stevedoring, cargo dooring, marine onshore supply base, and project cargo mobilisation.

In the activities carried out by PT Berlian Dumai Logistics Batam branch, one aspect that affects its operational activities is the delivery of goods by land. Delivery of goods by land at PT Berlian Dumai Logistics Batam branch generally uses trucking

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company vendors who work together by providing truck rental services to PT Berlian Dumai Logistics Batam branch. There are things that PT Berlian Dumai Logistics Batam branch needs to consider to be able to choose a good trucking company vendor but have not been done by PT Berlian Dumai Logistics Batam branch. Thus, it will be difficult for the company to make managerial decisions in selecting the right trucking company vendor for a project. Currently, there are only three trucking vendor companies that PT Berlian Dumai Logistics Batam branch subscribes to, namely PT Snepac, PT Inti Karya Indotama, and PT Global Project Logistik. However, operationally PT. Berlian Dumai Logistics Batam branch uses 95% of trucking vendor company services only from PT Intikarya Indotama.

Then recently PT Intikarya Indotama increased the price of its services by an average of 15.56% from the previous price in 2023. This will certainly make the price offered to customers affected. Thus, PT Berlian Dumai Logistics Batam branch needs to evaluate the performance of trucking company vendors based on certain criteria to be able to provide the right decision.

To evaluate trucking company vendors can be obtained using the Vendor Performance Indicator (VPI) method or approach, Analytical Hierarchy Process (AHP), Technique Order Preference by Similarity to Ideal Solution (TOPSIS). By definition, VPI is a management scheme that measures supplier performance in a comprehensive manner in accordance with company demands and produces results on supplier performance [1]. AHP is a decision-making method that dissects a complex problem into a hierarchical design by considering several levels, namely the results to be achieved, indicators, and solutions [2]. Furthermore, TOPSIS is theoretically used to find ideal alternatives from multiple criteria that have been determined by calculating the smallest distance to the positive ideal solution and the largest distance to the negative ideal solution [3].

Therefore, PT Berlian Dumai Logistics Batam branch needs to evaluate the selection of trucking company vendors by applying VPI, AHP, and TOPSIS methods.

2 Literature Review

2.1 Trucking Company Vendor

Trucking company vendor is also known as Logistic Service Provider (LSP). Trucking company vendor acts as a third party for freight forwarding to deliver the product after the product arrives at the port and then delivered to the destination location using a truck/chassis [4].

2.2 Freight Forwarding

Freight forwarding is known as a freight management company, the role of freight forwarding is to oversee and manage the movement of goods from their origin posi-

tion to their destination position [4]. The duties and responsibilities of Forwarders in Freight Forwarding companies include: 1) Working on customer orders that request delivery of goods to another location; 2) Using other transport services to move cargo, this is because freight forwarding does not have to have its own means of transport; 3) Serves as a liaison between the shipper, carrier, and consignee [5].

2.3 Vendor Performance Indicator

Vendor Performance Indicator (VPI) is a management system related to comprehensive supplier performance assessment in accordance with company needs. Supplier performance measurement in the Vendor Performance Indicator (VPI) involves 5 parameters, namely quality, cost, delivery, flexibility, and responsiveness, to ensure suppliers meet the company's raw material needs [1].

2.4 Analytical Hierarchy Process

Analytical Hierarchy Process (AHP) is a multi-criteria decision-making technique or method, which combines quantitative factors and qualitative factors to determine priorities, positions, and evaluate alternatives. AHP generates its value by simplifying a complex problem into a number of parts [6].

2.5 Technical Order Preference by Similarity to Ideal Solution

Technical Order Preference by Similarity to Ideal Solution (TOPSIS) is one of several methods used in Multi-Criteria Decision Making (MCDM), this method functions in making decisions on a number of available alternatives [7]. In the process of finding the results, the TOPSIS method will determine a solution from several alternatives that have been available by comparing each alternative against the best alternative and the worst alternative [8].

Analysis of research by [9], with *the* title "*Analysis of Parts Supplier Selection Using AHP and TOPSIS Methods in Forwarding Companies*", found the results found using the AHP method in the *expert choice* application are as follows where supplier 1 0.421, supplier 2 0.164, supplier 3 0.12, supplier 4 0.294. Meanwhile, the calculation of the TOPSIS method gives the conclusion of the preference value, namely supplier 1 0.9256, supplier 4 0.5217, supplier 2 0.1829, and supplier 3 0.0180.

Research [10], with the title "*Supplier Performance Evaluation on Regular Raw Material Suppliers by Applying AHP and TOPSIS Approaches (Evidence from the Apple Agroindustry)",* obtained research results showing that service criteria received the highest priority weighting criteria, followed by price, quality, and delivery. Good service will have a positive impact on integration, making it easier to achieve an effective and efficient supply chain. Thus, supplier performance is quite good, it's just that there are still some things that can be improved on supplier performance, namely fruit size and responsiveness to supplier 3 and price to supplier 1 and supplier 2.

Research analysis [11], with the title "*Selecting Green Supplier for Perishable Raw Materials using AHP Method at Nunia Boutique Villa Seminyak"*, this research concluded that in the final ranking of supplier selection criteria relative importance it was found that the Quality criteria (0.472) occupied the top position in the order of priority in the criteria for determining green suppliers. Cost criteria with 0.192, Environmental Management criteria (0.102), Delivery criteria (0.091), Flexibility criteria (0.076) and the last criterion is Responsiveness (0.067).

In the study [7], With the title "*Selection of Manufacturing Industry Suppliers with AHP and TOPSIS Approaches*", the results obtained where the AHP method produces the following criteria weights; quality 28.7%, price 18.2%, warranty and claim policy with a value of 12.2%, delivery 11.1%, performance history 10.9%, flexibility 9.9%, responsive 9.0%. Meanwhile, the TOPSIS method produces results, namely the highest weight on the leather supplier PT. B with a total value of 0.710 and in terms of heels suppliers, PT. G with a total value of 0.537.

3 Research Methods

This research was conducted at PT Berlian Dumai Logistics, Batam branch. The object of this research is permanent employees at PT Berlian Dumai Logistics Batam branch, this object was chosen based on their competence in assessing the criteria for evaluating trucking company vendors [12]. The variables used in the analysis in this study are processed by the VPI method which consists of quality, cost, delivery, flexibility, and responsiveness. The type of data processed is quantitative data. Data collection is carried out through an organised process and a reference point to obtain the necessary data. In this study, a survey method in the form of a questionnaire was used as a data collection tool. Meanwhile, the sampling technique applied in this study is a nonprobability sampling technique with a purposive sampling approach. And for the data processing techniques used in this study can be seen in Figure 1 below.

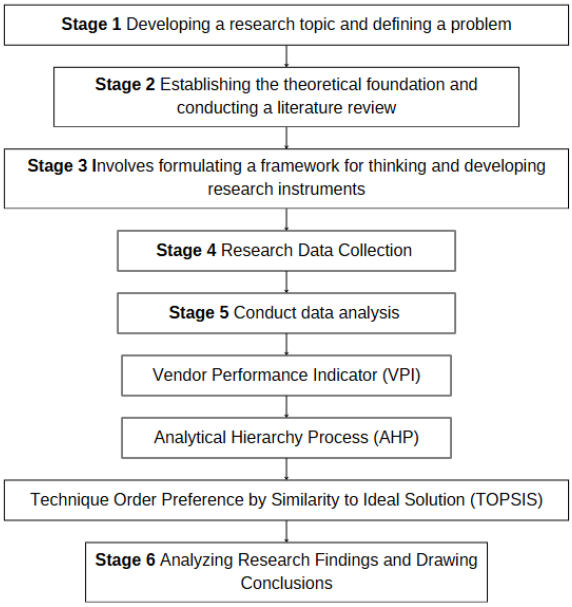

Fig. 1. Stages of Data Processing.

4 Result and Discussion

4.1 Analytical Hierarchy Process

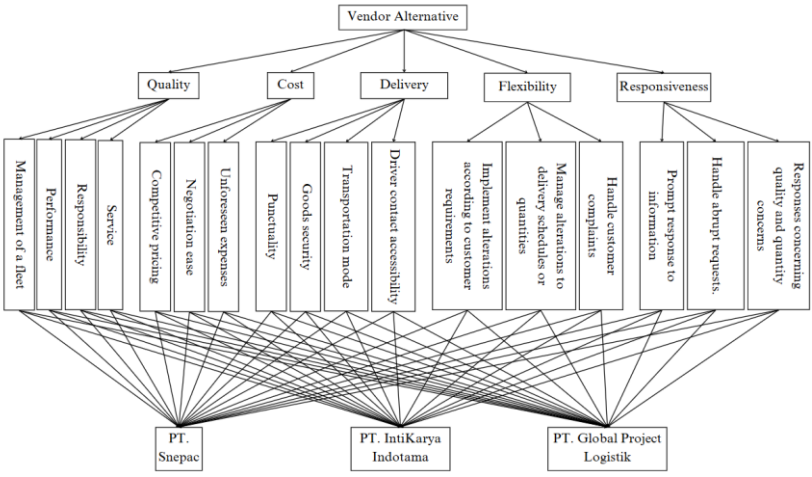

Fig. 2. Decomposition.

In Figure 2, is the decomposition used in this study. Which consists of 5 main criteria, 17 sub-criteria, and 3 alternatives.

Table 1. Criteria Priority Weight.

Criteria	Priority Weight	%	Rangking
Quality	0.1088	11%	3
Cost	0.5529	55%	1
Delivery	0.0631	6%	5
Flexibility	0.1748	17%	2
Responsiveness	0.1004	10%	4

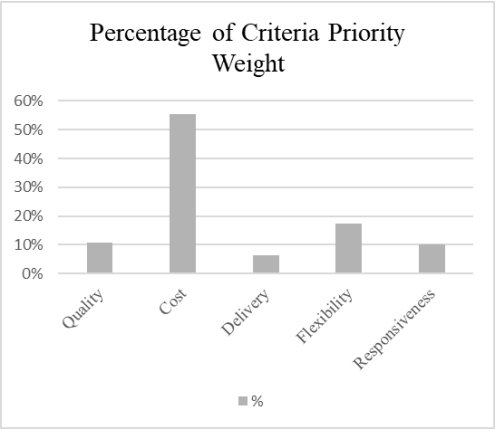

Fig. 3. Percentage of Criteria Priority Weight.

Based on the results of the acquisition of weights in the Analytical Hierarchy Process method, it is known that the main criterion in this study is the Cost criterion with a priority weight value of 0.5529, based on the analysis of the priority weight of the quality criteria presented about 55% of the decision to select the vendor trucking company, then followed by Flexibility with a priority weight value of 0.1748, which presented about 17% of the decision results, the third position is the Quality criteria with a priority weight value of 0.1088 presented 11% of the decision results, the fourth is the Responsiveness criteria with a priority weight value of 0.1004 presented 10% of the results of the decision to select the vendor trucking company, and in the last position is delivery with a priority weight value of 0.0631 presented 6% of the results of the assessment of the decision to select a trucking company vendor at PT Berlian Dumai Logistics Batam branch.

Table 2. Vendor Performance Assessment Weigth

Vendor Performance Assessment							
Vendor	**Criteria**					**Total**	**Ranking**
	Quality	**Cost**	**Delivery**	**Flexibility**	**Responsiveness**		
PT Snepac	0,755	1,706	0,955	0,400	0,466	4,282	2
PT IntiKarya Indotama	2,242	0,434	1,974	1,817	1,813	8,280	1
PT Global Project Logistik	0,253	0,360	0,321	0,283	0,221	1,438	3

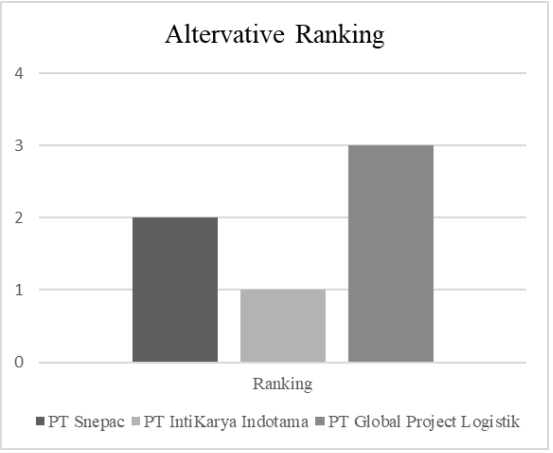

Fig. 4. Alternative Ranking

Table 2 shows how the situation in the market occurs. In terms of quality variables, for example, PT Intikarya Indotama shows a higher number than PT Snepac and PT Global Project Logistik, this is because PT Intikarya Indotama is indeed more qualified than its other competitors, for example in terms of fleet management.

Furthermore, in terms of the cost variable, PT Snepac is superior when compared to the other two vendors. This is indeed due to PT Snepac's more competitive prices when compared to the other two vendors.

Then, on the delivery variable, the total weight is superior to PT Intikarya Indotama, which is due to PT Intikarya Indotama which is consistent in its punctuality in delivery when compared to other vendors, although in terms of completeness of transportation modes PT Snepac is superior, but in terms of total weighting PT Intikarya Indotama is still far superior.

Furthermore, the flexibility variable where PT Intikarya Indotama also still positions itself in the first rank. This is also in accordance with the practice in the field where PT Intikarya Indotama can adjust to changes that occur in the field very straightforwardly, for example by lending its private piling field for the needs of its customers so that in urgent situation containers are easily moved when compared to the piling field at the port.

Finally, namely on the responsiveness criteria. In these criteria, PT Intikarya Indotama also outperforms the total value obtained. This is because in practice in the field, PT Intikarya Indotama is faster in responding to urgent situations and problems when compared to other vendors.

Furthermore, in the evaluation of the selection of trucking company vendors, the results show that PT Intikarya Indotama is ranked first with a total weight value of 8,280, then in second place is PT Snepac with a total weight value of 4,282, and in the last rank is PT Global Project Logistik with a total weight value of 1,438. In this case, if we look at the total weight gain, PT Intikarya gets the highest score, but PT Intikaya Indotama in this case occupies the second position on the cost criteria, where this cost criterion dominates by 55% of the total value of the criteria. This occurs as a result of differences in expert respondents who give weight to the criteria and who give weight to the trucking company vendors on the cost criteria so that there is a phenomenon where although the weight of the Cost criteria dominates the weighting of the criteria, but in the weighting results of the first ranked trucking company vendor, the vendor actually occupies the second position on the Cost criteria.

4.2 Analytical Hierarchy Process

The assessment of the criteria assessed in the TOPSIS method is carried out by applying the criteria to the VPI, namely Quality, Cost, Delivery, Flexibility, and Responsiveness. Furthermore, these criteria will be divided into 2 types, namely Benefit and Cost. Benefit is a criterion where the higher the value will have a better impact on the company. Meanwhile, Cost is an analogy given when the higher the value of the criteria has a worse impact on the company.

And the alternatives chosen are 3 companies that have become trucking company vendors at PT Berlian Dumai Logistics Batam branch, namely PT Snepac, PT Intikarya Indotama, and PT Global Project Logistik.

Assigning Preference Weight Values. The weights and percentages of criteria in the TOPSIS method are taken from the results of the AHP assessment. This is done to maintain consistency in priority weights and not just based on mere assumptions. [13].

Table 3. AHP Top Priority Weights.

Criteria	Priority Weigth	%	Rangking
Quality	0.1088	11%	3
Cost	0.5529	55%	1
Delivery	0.0631	6%	5
Flexibility	0.1748	17%	2
Responsiveness	0.1004	10%	4

Then the weight of the criteria against alternatives is also collected from the results of the assessment carried out in the AHP method. The following in table 4 is the weight of criteria against alternatives based on the results of AHP analysis.

Table 4. Weighting of Criteria against Alternatives.

Vendor Performance Assessment							
Vendor	**Criteria**					**Total**	**Ranking**
	Quality	**Cost**	**Delivery**	**Flexibility**	**Responsiveness**		
PT Snepac	0,755	1,706	0,955	0,400	0,466	4,282	2
PT IntiKarya Indotama	2,242	0,434	1,974	1,817	1,813	8,280	1
PT Global Project Logistik	0,253	0,360	0,321	0,283	0,221	1,438	3

Calculating Normalised Matrix (Matrix R). In calculating the Normalised Matrix, the formula 1 below is used:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\Sigma_{i=1}^{m} x_{ij}^2}} \qquad (1)$$

After the value of R is obtained, the next step is to divide the weight value of the criteria against the alternatives by the value of R. The assessment results obtained are shown in table 5.

Table 5. Normalisation Matrix.

R	2,38	1,76	2,22	1,88	1,89
	Quality	Cost	Delivery	Flexibility	Responsiveness
PT Snepac	3,15	2,70	2,32	4,71	4,04
PT IntiKarya Indotama	1,06	1,09	1,12	1,04	1,04
PT Global Project Logistik	9,41	7,50	6,91	6,64	8,54
Total	13,62	11,28	10,35	12,39	13,62

Calculating the Weighted Normalised Matrix (Matrix Y). The next step is to calculate Matrix Y using the formula 2 below:

$$y_{ij} = w_i . r_{ij} \quad (2)$$

Table 6 below is the result of the Y Matrix calculation:

Table 6. Weighted Matrix Normalisation (Y Matrix).

Y	0.34	1.49	0.15	0.82	0.41
	0.12	0.60	0.07	0.18	0.10
	1.02	4.15	0.44	1.16	0.86

Calculating Positive Ideal Solution Matrix and Negative Ideal Solution Matrix. Calculating the positive ideal solution matrix and negative ideal solution matrix is by using the formula 3 and 4 below:

$$A^+ = (y_1^+, y_2^+, \ldots\ y_n^+) \quad (3)$$

$$A^- = (y_1^-, y_2^-, \ldots\ y_n^-) \quad (4)$$

The results of the formula calculation are as shown in Table 7:

Table 7. Matrix of Positive Ideal Solution and Negative Ideal Solution

A+	1.02	0.60	0.07	1.16	0.86
A-	0.12	4.15	0.44	0.18	0.10

Calculating the Distance from the Positive Ideal Solution Matrix and Negative Ideal Solution Matrix results. Calculation of the distance from the positive ideal solution matrix and negative ideal solution matrix results is done using the formula 5 and 6 below:

$$D_i^+ = \sqrt{\Sigma_{j=i}^{n}(y_1^+ - y_{ij})^2} \quad (5)$$

$$D_i^- = \sqrt{\Sigma_{j=i}^{n}(y_1^+ - y_i^-)^2} \quad (6)$$

The results of the above formula calculations are listed in table 8 below:

Table 8. Distance Results of Positive Ideal Solution Matrix and Negative Ideal Solution Matrix.

D1+	1.26	**D1-**	2.77
D2+	1.53	**D2-**	3.56
D3+	3.56	**D3-**	1.53

Assigning Alternative Preference Values. At this stage is to determine the alternative preference value, which can be done using formula 7 below:

$$V_1 = \frac{D_1^-}{D_1^- - D_1^+} \quad (7)$$

The results of these calculations can be seen in table 9 below:

Table 9. Preference Value.

			Ranking
Preference Value	**V1**	0.69	2
	V2	0.70	1
	V3	0.30	3

So, from the above results, we can conclude that V2, PT Intikarya Indotama, ranks first as the most ideal alternative with a value of 0.70. Furthermore, V1, PT Snepac, is ranked second as the ideal alternative with a value of 0.69. And V3 or PT Global Project Logistik occupies the third position with a value of 0.30.

Furthermore, if the results and discussion are compared with previous research described in the research method, some fundamental differences are obtained, namely where the four studies each mention that the highest weight value on the criteria is quality or service, while in this study the highest weight value on the criteria is cost. Then in terms of vendor or supplier selection there is a very big difference in the type of supplier where none of these studies have raised discussions related to trucking company vendors and only centred on raw material suppliers. Furthermore, in terms of similarity, one study was found that raised the case of the same object, namely forwarding, which also used the same research methods, namely AHP and TOPSIS but did not use the VPI criteria method. Therefore, this research is very different from those found in previous studies.

5 Conclusions

Based on the results of the analysis carried out, it is concluded that the evaluation of criteria in order is as follows; Cost with a value of 0.5529, Flexibility with a value of 0.1748, Quality with a value of 0.1088, Responsiveness with a value of 0.1004, and Delivery with a value of 0.0631. Thus, the criteria with the highest value and the highest weight in evaluating the selection of trucking company vendors based on AHP analysis is Cost with a percentage of the weight of 55% of 100%.

Table 10. Comparison of Test Results of AHP and TOPSIS Methods.

Vendor	AHP	TOPSIS
PT Snepac	4.28	0.69
PT Intikarya Indotama	8.28	0.70
PT Global Project Logistik	1.44	0.30

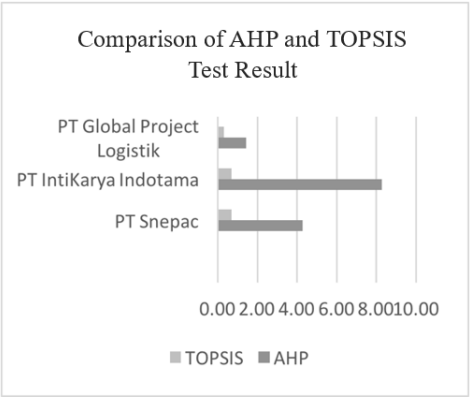

Fig. 5. Comparison of AHP and TOPSIS Test Result.

Furthermore, in the evaluation of the selection of trucking company vendors using the AHP method, the values obtained are as follows; PT Intikarya Indotama with a total assessment weight of 8,280; PT Snepac with a total assessment weight of 4,282; PT Global Project Logistik with a total assessment weight of 1,438. Thus, the trucking company vendor with the highest score and can be the main vendor is PT Intikarya Indotama.

Then in the TOPSIS method analysis, the following results were obtained; PT Intikarya Indotama with a value of 0.70; PT Snepac with a value of 0.069; PT Global Project Logistics with a value of 0.30. The results of the analysis of the TOPSIS method conclude that PT Intikarya is the most ideal solution in the selection evalua-

tion based on the acquisition of the total weight value of the trucking company vendor.

So based on the results of the AHP and TOPSIS methods that have been tested, PT Intikarya Indotama is an alternative and ideal solution as a trucking company vendor for PT Berlian Dumai Logistics Batam branch based on the acquisition of the highest total weight value. However, it should be noted that PT Intikarya Indotama occupies the second position on the cost criterion, which is the criterion with the highest value, so PT Berlian Dumai Logistics Batam branch may be able to offer PT Intikarya Indotama services to customers who want quality, delivery, flexibility and responsiveness with good performance and have no problem with high prices. Meanwhile, for customers with limited financing and no problem with performance degradation in quality, delivery, flexibility and responsiveness, PT Berlian Dumai Logistics Batam branch may offer the services of PT Snepac as a solution.

6 Advice

The researcher suggested that PT Berlian Dumai Logistics Batam branch can use PT Intikarya Indotama as the main and most ideal vendor based on consideration of the total score in the AHP and TOPSIS methods, but with a note that PT Intikarya Indotama has a record in a fairly high cost when compared to the vendor PT Snepac. So that when the customer wants a cheaper service cost but may decrease its performance on other criteria, PT Berlian Dumai Logistics Batam branch in using PT Snepac.

In addition, the researcher suggested to PT Berlian Dumai Logistics Batam branch to increase the number of trucking company vendors, so that it does not only depend on the three existing trucking company vendors. Thus, when the main vendor is unable to provide services for one reason or another, PT Berlian Dumai Logistics Batam branch has a wider choice with consideration of more varied criteria.

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