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Carrier Performance Evaluation at PT. XYZ Based on Vendor Performance Indicator (VPI) with the Analytical Hierarchy Process (AHP) Method

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Abstract

The problem occurring in PT. XYZ's shipping process is that some containers owned by the carriers do not meet the quality standards used by the company. The objective of this study are to determine the performance of carriers used by PT. XYZ and the criteria used in evaluating carrier performance based on the Vendor Performance Indicators framework, which includes Quality, Cost, Delivery, Flexibility, and Responsiveness (QCDFR), using the Analytical Hierarchy Process method. This research is descriptive quantitative and was obtained from questionnaire responses from 5 experts in the SCM Shipping department. The results indicate that the most influential criterion in evaluating carrier performance is quality, with a weight of 0.424, while the least influential criterion is cost, with a weight of 0.048. The carrier with the best performance is CMA, with a weight of 0.953, while the carrier with the lowest performance is SEALAND ASIA, with a weight of 0.535.

Key words: Analytical Hierarchy Process (AHP), Vendor Perormance Indicator (VPI), Shipping, Sea Freight, Carrier Evaluation.

1. Introduction

PT XYZ is a company in the field of manufacturing fabrication which is almost 90% export shipping. When exporting, PT XYZ emphasizes more on sea freight shipping or sea shipping using the 40' FCL scheme because the shipping scheme can accommodate more shipping quantities and relatively cheaper costs compared to land and air shipping schemes. (Rushton et al., 2014). In order to support the smooth export process, companies need to work with logistics service providers in order to deliver their products to the hands of customers properly. (Ansori, 2022).

During 2023, the average number of monthly exports carried out by PT XYZ using 40' containers was 201 shipments. There are several carriers that are used as the main vendors for shipping products from PT XYZ to various destination countries, namely CMA, MAERSK, COSCO, HMM and SEALAND ASIA. Vendor selection is an important aspect to be able to support the smooth business process so that it can provide satisfaction to customers. (Hidayat et al., 2023).

The problem that often occurs is that there are containers belonging to carriers that are not in accordance with the quality standards used by PT XYZ. This makes PT. XYZ's shipping operational process constrained because it has to wait for a change of container unit which takes a long time, resulting in a buildup of products in the warehouse. According to PT XYZ data, in 2023 there were 31 times to change container units from the carrier. Delivery quality is one of the important aspects in building customer loyalty, so companies must pay attention to the quality of product delivery services provided to the company's customers. (Somadi et al., 2020).

Considering the aforementioned background, the author formulates the problem, namely how the performance of the carrier used by PT XYZ. In addition, the authors also formulate problems regarding what are the criteria for evaluating the performance of the carrier to be used by PT. XYZ. The purpose of this research is to find out the performance of the carrier used by PT. XYZ, find out what criteria are used in assessing the performance of the carrier used at PT. XYZ, and to find out which carrier has the best performance at PT. XYZ.

The main reference in this research is research with the title Analysis of Forwarder Service Selection

Using the Analytical Hierarchy Process (AHP) Method at PT.XYZ conducted by Wulan and Hendrawan, 2018 with the results of the criteria that are the top priority is Cost with a value of 0.484. While the lowest criterion is Responsiveness with a value of 0.117. The alternative forwarder produced by this research is forwarder A with a value of 0.535.

This research is expected to be able to provide new insights for readers regarding decision making with the VPI and AHP methods, especially in manufacturing company. In addition, this research is also expected to benefit PT XYZ to evaluate the performance of carriers used in the company.

2. General Instructions

Carrier

The carrier is a party that provides transportation services that will provide the maximum possible transportation rates and minimize labor, fuel, and vehicle operating costs. (Gultom, 2020). Carriers will coordinate with service users in terms of pickup and delivery times so as to achieve efficient operations. (Zaroni, 2017).

Container

Container is a means of transporting goods used in various modes of transportation such as ships and trains. The size of this container has been regulated by the International Standard Organization (ISO) body so that currently the commonly used containers are 20' feet, 40' feet, and 40' high cube containers with different capacities. (Suryono R.P, 2007).

Vendor Performance Indicator (VPI)

According to (Li et al., 1997) in (Firza & Zakaria, 2021) Vendor Performance Indicator (VPI) is a method for evaluating supplier performance based on specified indicators. The framework of the VPI is often known as QCDFR, namely Quality, Cost, Delivery, Flexibility, Responsiveness.

Analytical Hierarchy Process (AHP)

AHP is a decision support model focused on solving problems involving multiple factors or criteria. According to Saaty (1993) defines a hierarchy as a structural representation of a complex problem, consisting of various levels, starting from the goal at the top level, followed by factors, criteria, sub-criteria, and so on down to alternatives at the last level. (Supriadi et al., 2014).

3. Style Guidelines and Topics

The flow in this study is as follows:

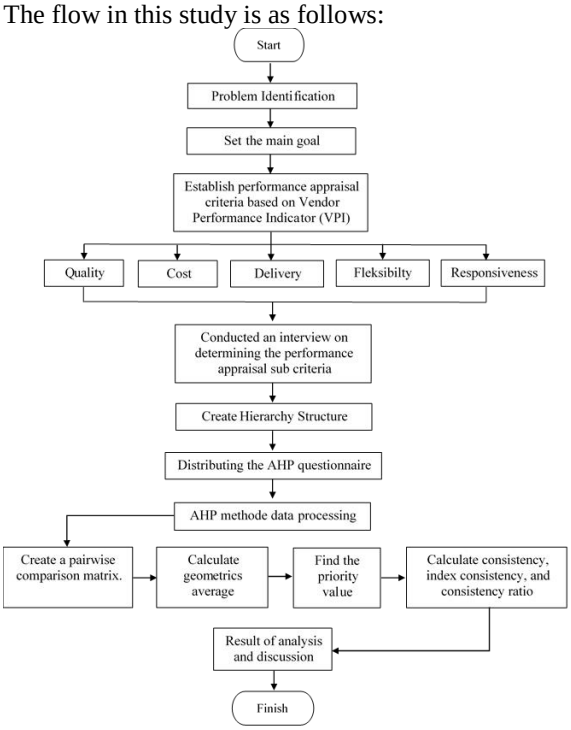

Figure 1: Research Flow

Source: Data processed, 2024.

This research uses a quantitative descriptive research approach. Data collection techniques were carried out by observation, interviews, and distributing research questionnaires to respondents (SCM Shipping Manager, Group Leader Shipping Operation, SCM Supply Chain Departement Assistant, Shipping Executive Assistant, and Shipping Planner Staff). There are 5 *carrier* vendors who are the object of research, namely CMA, MAERSK, COSCO, HMM and SEALAND ASIA.

The data processing method in this research uses the *Analytical Hierarchy Process* (AHP) method with the help of *Microsoft Excel* application. The main variables in this study use the framework of the *Vendor Performance Indicator* (VPI) known as the QCDFR framework (*Quality, Cost, Delivery, Flexibility*, and *responsiveness).* Stages in the AHP method in (Pramita & Wirawan, 2019) namely:

1. Develop a hierarchical structure with the main objectives of the research.
2. Create a pairwise comparison matrix.

TABLE 1
PAIRWISE COMPARISON MATRIX

C	A1	A2	A3	A4	A5
A1	1				
A2		1			
A3			1		
A4				1	
A5					1

Source: (Wulan & Hendrawan, 2018)

Filling in the comparison matrix uses a comparison scale that has been determined in the AHP method, namely:

TABEL 2
COMPARISON MATRIX

Intensity of Interest	Definition
1	Equally important
3	A little more important
5	More important
7	Very important
9	Absolutely more important
2,4,6,8	Center value

Source: (Pramita & Wirawan, 2019)

3. Calculate the results of the assessment that has been carried out by dividing each value in a column by the total of all values in that column.
4. Normalize the matrix by averaging the number of rows against the number of criteria so that it will produce the priority weight of the criteria.
5. Perform consistency calculations by means of:
   - Multiplies the value of the comparison matrix with the associated weights.
   - Multiplying the total of each row by the corresponding weight.
   - Calculate λmax by summing the results of the multiplication, then dividing by the number of elements (n).

$$\lambda_{maks} = \frac{\sum VB}{n}$$

6. Calculate the consistency index with the formula:

$$CI = \frac{\lambda_{maks} - n}{n - 1}$$

Where:
CI = *Consistency Index*
λ_{maks} = Average eigenvalue
n = Number of criteria

7. Calculate the consistency ratio with the formula:

$$CR = \frac{CI}{RI}$$

Where:
CR = *Consistency Ratio*
CI = *Consistency Index*
RI = *Random Index*

The consistency of the results will be considered fulfilled if the consistency ratio (CR) value is less than 0.1. If the CR value is more than 0.1, the results are said to be inconsistent so you have to do repetition in filling in the pairwise matrix values for criteria and also for alternatives. The average value of the random index can be seen in the following table:

TABLE 3
RI VALUE TABLE

N	RI
1	0
2	0
3	0.52
4	0.89
5	1.11
6	1.25
7	1.35
8	1.40
9	1.45
10	1.49

Source: (Pramita & Wirawan, 2019)

8. Determine the importance or priority value for each variable at level 2 (sub-criteria) of each criterion.
9. Perform relative calculations or priority assessments for each variable at level 3 (alternative), which involves comparing the weights between each vendor and each sub-criteria.
10. After knowing the weight for each sub-criteria and the weight associated with each vendor, the next step is to calculate the total value of each vendor. The best vendor performance can be selected based on the total value obtained.

Data Processing

The preparation of the hierarchical structure starts from level 0, namely the determination of research objectives, namely *carrier* performance evaluation. At level 1 there are criteria that form the basis of the *carrier* performance assessment used, level 2 there are sub-criteria of each criterion that becomes the *carrier* performance assessment. While at level 3 there are alternatives consisting of the names of *carrier* vendors who are the object of this research.

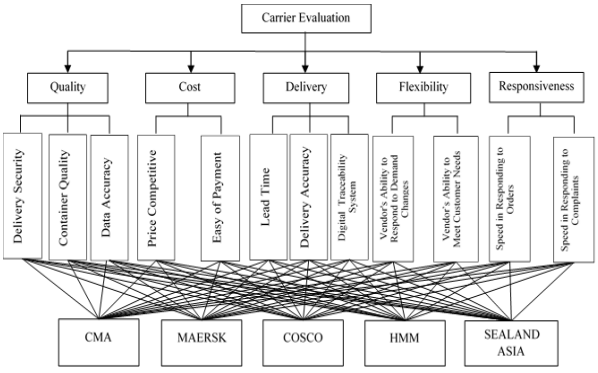

Figure 2: Hierarchical Structure

Source: Data processed, 2024.

Weight Calculation between Criteria

Create a comparison matrix between criteria based on the results of the assessment carried out by respondents as shown in the table below:

TABLE 4
INTER-CRITERIA COMPARISON MATRIX

Criteria	Qua-lity	Cost	Deli-very	Flexi-bility	Respon-siveness
Quality	1	7	2	5	**4**
Cost	0.14	1	0.14	0.5	**0.5**
Delivery	0.5	7	1	5	**3**
Flexi-bility	0.2	2	0.25	1	**6**
Responsi-veness	0.25	0.5	0.33	0.17	**1**
Total	**2.09**	**17.50**	**3.73**	**11.67**	**14.5**

Source: Data processed, 2024.

Perform calculations based on a pairwise comparison matrix to obtain priority weights. The results of the criteria weights obtained are:

TABLE 5
CRITERIA PRIORITY WEIGHT

Criteria	Priority Weight	%
Quality	0,424	42%
Cost	0,048	5%
Delivery	0,309	31%
Flexibility	0,155	16%
Response	0,064	6%

Source: Data processed, 2024.

After the assessment is carried out, the assessment results given are consistent assessments. The most influential criteria in evaluating *carrier* performance in the first rank are quality criteria with a total weight of 0.424. The second rank is the delivery criteria with a total weight of 0.309. The third rank is the flexibility criteria with a total weight of 0.155. The fourth rank is the response criteria with a total weight of 0.064. While in the last rank, the cost criteria with a total weight of 0.048.

Calculation of Weights between Sub-Criteria and *Carrier* Alternatives

TABLE 6
CARRIER SUB-CRITERIA AND ALTERNATIVE WEIGHTS

Sub Criteria	Priority Weight	*Carrier*	Weight
Delivery Security	0,655	CMA	0,490
		MAERSK	0,047
		COSCO	0,159
		HMM	0,257
		SEALAND ASIA	0,047
Container Quality	0,158	CMA	0,494
		MAERSK	0,203
		COSCO	0,093
		HMM	0,158
		SEALAND ASIA	0,052
Data Quality (*Data Accuracy*)	0,187	CMA	0,200
		MAERSK	0,200
		COSCO	0,200
		HMM	0,200
		SEALAND ASIA	0,200
Competitive Price	0,900	CMA	0,160
		MAERSK	0,437
		COSCO	0,094
		HMM	0,122
		SEALAND ASIA	0,187
Ease of payment	0,100	CMA	0,200
		MAERSK	0,200
		COSCO	0,200
		HMM	0,200
		SEALAND ASIA	0,200
Lead Time	0,275	CMA	0,515
		MAERSK	0,206
		COSCO	0,135
		HMM	0,101
		SEALAND ASIA	0,043
Delivery Accuracy	0,657	CMA	0,468
		MAERSK	0,264
		COSCO	0,140
		HMM	0,093
		SEALAND ASIA	0,035
Digital *Traceability* System	0,068	CMA	0,318
		MAERSK	0,073
		COSCO	0,024
		HMM	0,338
		SEALAND ASIA	0,247
Vendor's Ability to Respond to Demand Changes	0,875	CMA	0,035
		MAERSK	0,078
		COSCO	0,262
		HMM	0,513
		SEALAND ASIA	0,111
	0,125	CMA	0,066

Vendor's Ability to Meet Customer Needs		MAERSK	0,094
		COSCO	0,184
		HMM	0,440
		SEALAND ASIA	0,216
Speed in Responding to Orders	0,500	CMA	0,148
		MAERSK	0,025
		COSCO	0,071
		HMM	0,270
		SEALAND ASIA	0,486
Speed in Responding to Complaints	0,500	CMA	0,150
		MAERSK	0,029
		COSCO	0,296
		HMM	0,098
		SEALAND ASIA	0,427

Source: Data processed, 2024.

Carrier Performance Assessment Analysis

The results of the calculation of the *carrier* performance weight assessment used by PT. XYZ from each criterion are as follows:

TABLE 7
INTER CARRIER PRIORITY WEIGHT

Criteria	Carrier	Weight
Quality	CMA	1,184
	MAERSK	0,450
	COSCO	0,452
	HMM	0,615
	SEALAND ASIA	0,299
Cost	CMA	0,360
	MAERSK	0,637
	COSCO	0,294
	HMM	0,322
	SEALAND ASIA	0,387
Delivery	CMA	1,301
	MAERSK	0,543
	COSCO	0,299
	HMM	0,532
	SEALAND ASIA	0,324
Flexibility	CMA	0,101
	MAERSK	0,172
	COSCO	0,446
	HMM	0,954
	SEALAND ASIA	0,328
Response	CMA	0,298
	MAERSK	0,054
	COSCO	0,367
	HMM	0,368
	SEALAND ASIA	0,913

Source: Data processed, 2024.

Based on the value of priority weights between criteria related to *carrier* performance assessment, the results of *carrier* performance evaluation used by PT XYZ based on global priority weights between criteria are as follows:

TABLE 8
CARRIER PERFORMANCE EVALUATION RESULTS

Crite-ria	Weight (%)	*Carrier*				
		CMA	**MAERSK**	**COSCO**	**HMM**	**SEALAND ASIA**
Qua-lity	**42%**	0,497	0,189	0,190	0,258	0,125
Cost	**5%**	0,018	0,032	0,015	0,016	0,019
Deli-very	**31%**	0,403	0,168	0,093	0,165	0,101
Flexi-bility	**16%**	0,016	0,027	0,071	0,153	0,052
Respon-siveness	**6%**	0,018	0,003	0,022	0,022	0,055
Total		**0,953**	**0,420**	**0,391**	**0,614**	**0,353**
Rating		**1**	**3**	**4**	**2**	**5**

Source: Data processed, 2024.

The carrier that has the first best performance based on the criteria used by PT XYZ is CMA with a total weight value of 0.953. The second best performance is obtained by the HMM carrier with a total weight value of 0.614. The third best performance is obtained by MAERSK carrier with a total weight value of 0.420. The fastest best performance is obtained by the COSCO carrier with a total weight value of 0.391. The lowest performance is obtained by the SEALAND ASIA carrier with a total weighted value of 0.353.

These results are said to be consistent if the consistency *ratio* (CR) value generated is <0.1 if the consistency ratio (CR) value generated is >0.1 then the assessment will be considered inconsistent. The resulting CR values for the criteria and sub-criteria of *carrier* performance evaluation are as follows:

TABLE 9
CONSISTENCY RATIO

Pairwise Comparison	CR	Description
Between Criteria	0,10	Consistent
Between Quality Sub-Criteria	0,03	Consistent
Between Cost Sub-Criteria	0,00	Consistent
Between Delivery Sub-Criteria	0,04	Consistent
Between Flexibility Sub-Criteria	0,00	Consistent
Between Response Sub-Criteria	0,00	Consistent

Source: Data processed, 2024.

4. Conclusions

Based on the results of research and data processing that has been carried out, it can be concluded that the main criteria that are most influential in assessing carrier performance at PT XYZ are *quality* criteria with a total weight of 0.424 or 42% of other criteria, while the criteria with the lowest weight are *costs* with a total weight of 0.048 or 5%. This shows that the main priority of PT XYZ in assessing *carrier* performance is to prioritize the quality provided by the *carrier* over the costs incurred in accordance with the vision and mission of the company. However, delivery criteria, flexibility and response are also important factors in assessing *carrier* performance.

Based on the assessment for *carrier* performance, the *carrier* that has the best performance used at PT XYZ is CMA with a total weighted value of 0.953, while the *carrier* that has the lowest performance is SEALAND ASIA with a total weighted value of 0.353. This result is in accordance with the assessment carried out on the *carrier*, where the main priority in evaluating *carrier* performance at PT XYZ is seen from the quality provided by the *carrier*. CMA has the best quality value compared to other carriers which is 0.497 while SEALAND ASIA only gets a value of 0.125 which makes the *carrier* has the lowest quality value compared to other *carriers*.

The results of this study have differences compared to previous studies. Research conducted by Wulan and Hendrawan, 2018 with the title Analysis of *Forwarder* Service Selection Using the *Analytical Hierarchy Process* (AHP) Method at PT. XYZ results in that the most influential criterion is *cost with* a total weight of 0.484 while the lowest criterion is *responsiveness* with a total weight of 0.117. This is in accordance with the *Vendor Performance Indicator* theory described by Fun and Hung in the research *A New Measure For Supplier Performance Evaluation* where each company has specific requirements in conducting *vendor* assessments used to achieve effectiveness in *vendor* use. So that in this study, PT XYZ is more concerned with *quality* than the *costs* incurred. This difference is caused by the condition of each company that has a different level of importance in assessing the *vendors* used by the company in accordance with the standards owned by the company.

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