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Evaluating Analyses Trucking Vendor Performance in Covid-19 Vaccine Delivery: A Strategic Assessment Utilizing Analytic Hierarchy Process And Technic For Order Of Preference By Similarity To Ideal Solution Methodologies (Case Study: Indonesian Freight Forwarder's Role In 2020 Vaccine Shipment)

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Abstrack: The purpose of this study was to determine the results of measurements of the priority vendors of the five vendors used by the company in the process of delivery COVID-19 vaccine shipment. This study uses the AHP-TOPSI (Analytic Hierarchy Process – Technic for Order of Preference by Similarity to Ideal Solution) method where the Likert scale is used as a comparison. Problem solving is done by making research using qualitative research methodology with descriptive elaboration. Data collection is done by giving or making questionnaires to get the weight of the assessment carried out by inferring with AHP and Likert from the data collected through questionnaires shared where the respondents came from respondents who have dedication and direct links as well as have the capability to provide vendor performance assessments. The results of the research that were tested from the level of consistency were divided into 5 criteria, namely, Price, Safety, Service, Reliability and Reputation and from the results of the qualitative calculation method by distributing questionnaires from 10 experts for Five existing vendors with adding quantitative approach in TOPSIS, V.2 out as priority vendors.

Keyword: Priority Vendor Determination, Supply Management, Analytical Hierarchy Proceed, Technic for Order of Preference by Similarity to Ideal Solution Methodologies

INTRODUCTION

The unprecedented challenge of delivering COVID-19 vaccines swiftly and securely has underscored the critical role of freight forwarders in global healthcare logistics. Among the myriad factors influencing successful vaccine distribution, the performance of trucking vendors stands out as a linchpin in ensuring timely and efficient delivery to communities worldwide.

This introduction navigates through the intricate landscape of vendor performance appraisal within the trucking sector, specifically focusing on the Indonesian context and the pivotal role played by a freight forwarder in the 2020 COVID-19 vaccine shipment. Leveraging the analytical rigor of the Analytic Hierarchy Process (AHP) and The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), this study aims to provide valuable insights into optimizing vendor performance and enhancing vaccine supply chain resilience.

Indonesia, like many other nations, faced immense challenges in swiftly distributing COVID-19 vaccines across vast and diverse regions. The successful navigation of these challenges hinged significantly upon the efficacy and reliability of freight forwarders tasked with the transportation of vaccines. In this regard, the case study under examination focuses on a specific Indonesian freight forwarder's role in handling COVID-19 vaccine shipments during the critical period of 2020. By delving into the intricacies of vendor performance especially in trucking within this context, this research aims to shed light on the key drivers and challenges associated with vaccine distribution in Indonesia.

The adoption of AHP and TOPSIS methodologies in this analysis is poised to offer a structured and systematic approach to evaluating trucking vendor performance. AHP facilitates the decomposition of complex decision-making criteria into a hierarchical structure, allowing stakeholders to weigh and prioritize various performance indicators such as reliability, timeliness, safety protocols, and adaptability. Complementing AHP, TOPSIS methodology enables the identification of optimal vendor alternatives based on their similarity to an ideal solution, thus providing a robust framework for vendor selection and performance enhancement.

Moreover, the inclusion of a case study focusing on an Indonesian freight forwarder adds a nuanced perspective to the broader discourse on COVID-19 vaccine distribution. Indonesia's unique geographical and logistical challenges, coupled with the freight forwarder's experiences and strategies in navigating these obstacles, offer valuable insights applicable to similar contexts globally. By elucidating the successes, shortcomings, and lessons learned from this case study, stakeholders can glean actionable insights to inform future decision-making processes and enhance vaccine supply chain resilience.

This study presents a timely and comprehensive analysis of trucking vendor performance in the context of delivering COVID-19 vaccines, with a specific focus on Indonesia. Through the integration of AHP and TOPSIS methodologies and a detailed examination of a freight forwarder's role in 2020 vaccine shipments, this research endeavors to provide actionable insights aimed at optimizing vendor performance and fortifying vaccine supply chains against future challenges.

Research Paradigm

The research paradigm related to the topic of evaluating trucking vendor performance in delivering COVID-19 vaccines encompasses both quantitative and qualitative approaches. Quantitatively, the research adopts an analytical framework integrating methodologies such as the Analytic Hierarchy Process (AHP) to assess vendor performance based on predefined criteria such as reliability, timeliness, safety protocols, and adaptability. This quantitative approach allows for the systematic evaluation of The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) and ranking of trucking vendors, providing actionable insights into performance optimization. Qualitatively, the research paradigm involves a case study methodology focusing on a specific freight forwarder in Indonesia handling COVID-19 vaccine shipments in 2020. Through qualitative data collection techniques such as interviews, observations, and document analysis, this approach facilitates a nuanced understanding of the freight forwarder's experiences, challenges, and strategies in vaccine distribution. By integrating both quantitative and qualitative paradigms, this research endeavors to offer a

comprehensive assessment of trucking vendor performance in the context of COVID-19 vaccine delivery, providing valuable insights for decision side of freight forwarder during assignment of their trucking vendor include with enhancing supply chain resilience and pandemic response strategies:

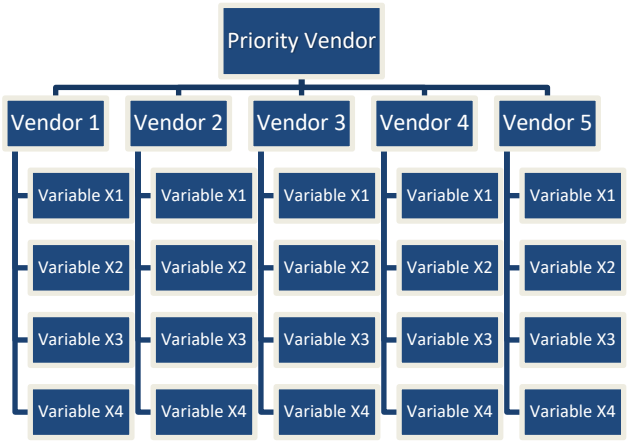

Figure 1. Research Paradigm

METHOD

The research method uses the AHP - Likert Scale method as the right method in getting superior vendors who are priorities, and this method is easy to understand and implement where the AHP method itself is taken to obtain decisions from several problems or assessments that are multicriteria in nature. With the Likert Scale method to be able to measure attitudes and opinions by giving questionnaires to respondents where respondents were asked to be able to complete the questionnaire in order to be able to indicate the level of approval of a series of questions given. (Thomas L. Saaty, 1999).

The population in this study was all employees from one dedicated Freight Forwarder in Indonesia which handle COVID-19 vaccine shipment as many as 10 employees (Decision Maker). All 10 employees (decision maker) were sampled (saturated samples). Research data were obtained using the survey method, by distributing questionnaires to respondents.

The data collection method is carried out by the questionnaire method, the way it gives a questionnaire to the participants and instructs them to choose different responses from the five-option at questionnaire I and paired matrix menu for questionnaire II until questionnaire IV when responding to a question. The data were analyzed using the Analytical Hierarchy Process method with the help of the SPSS for Windows version 26 program and Microsoft Excel data calculation by Power Pivot.

RESULT AND DISCUSSION

Respondents

As stated above, in this study respondents totaled 10 employees consisting of men and women who were from one dedicated Freight Forwarder in Indonesia which handle COVID-19 vaccine shipment.

Determination of priority vendors from the assessment indicators which include 5 criteria, namely: price, safety, service, reliability and reputation. In the trucking operational activities carried out, Freight Forwarder divides air cargo into 5 main truckers (most often used

in the domestic transportation division) which the author will examine. Evaluation of trucker performance using the analytical hierarchy process method will look at the indicators for each variable. Questionnaire I contain the weight of importance of each indicator or sub-criteria on carrier performance in supporting export operations carried out by Freight Forwarders.

Questionnaire respondents are considered to have good experience and judgment regarding the issues being analyzed (Operation, Finance and Procurement). In research using this Likert scale, variables are measured and described from 1 (Not Important) to 4 (Very Important)

Table 1

Kriteria	*Average*	Total
Price		
Clear pricing outline all costs associated with the transportation services	3.1	31
Details quotes itemize all costs and provide a breakdown of charge	3.4	34
Able to explain the various components of their pricing and how they calculate charges	3.1	31
No hidden fees or unexpected charges in the final invoice	3.3	33
Contract Clarity and Terms are conducted	3.4	34
Safety		
A low accident rate are shows and recorded in the good manner	3.2	32
Compliance with regulations set by Indonesian government agencies	3.2	32
Good safety records of the drivers employed by the trucking vendor	3.4	34
Proper vehicle maintenance conducted frequent and regular	3.2	32
High safety ratings assigned by regulatory agencies or industry organizations	3.4	34
Service		
Responsive to inquiries via all communication channels	3.3	33
Provide timely updates on delivery schedules, transit times, and any unexpected delays or disruptions	3.2	32
Easily accessible and reachable during business hours	3.2	32

Demeanor, courtesy, and professionalism in all communications	3.2	32
Effectively resolve problems or issues that may arise during the transportation process	3.5	35
Reliability		
Good track record for meeting delivery deadlines and fulfilling commitments to customers	3.7	37
Provide realistic estimates for the time it takes to transport goods from pickup to delivery	3.6	36
Real-time tracking updates, electronic proof of delivery (POD), and online portals or platforms	3.6	36
Promptly notify of any unforeseen delays, providing clear explanations and estimated timeframes for resolution	3.7	37
Ability to implement alternative routes, transportation modes, or strategies to minimize delays and meet delivery commitments	3.6	36

From Questionnaire I, it can be seen that the average respondent believes that the criteria and sub-criteria stated in the questionnaire are important as criteria for assessing truckers. The average respondent assessment result was 3.6, which shows that all criteria are important and can be included in the paired matrix.

Table 2

Criteria	Partial Weight	Sub-Criteria	Partial Weight
Price	26.41%	Clear pricing outline all costs associated with the transportation services	15.34%
		Details quotes itemize all costs and provide a breakdown of charge	22.42%
		Able to explain the various components of their pricing and how they calculate charges	15.78%
		No hidden fees or unexpected charges in the final invoice	21.09%
		Contract Clarity and Terms are conducted	25.36%
Safety	14.75%	A low accident rate are shows and recorded in the good manner	15.29%

		Compliance with regulations set by Indonesian government agencies	22.61%
		Good safety records of the drivers employed by the trucking vendor	15.68%
		Proper vehicle maintenance conducted frequent and regular	21.22%
		High safety ratings assigned by regulatory agencies or industry organizations	25.24%
Service	22.84%	Responsive to inquiries via all communication channels	11.35%
		Provide timely updates on delivery schedules, transit times, and any unexpected delays or disruptions	15.89%
		Easily accessible and reachable during business hours	34.75%
		Demeanor, courtesy, and professionalism in all communications	24.44%
		Effectively resolve problems or issues that may arise during the transportation process	13.57%
Reliability	20.07%	Good track record for meeting delivery deadlines and fulfilling commitments to customers	16.25%
		Provide realistic estimates for the time it takes to transport goods from pickup to delivery	13.03%
		Real-time tracking updates, electronic proof of delivery (POD), and online portals or platforms	29.43%
		Promptly notify of any unforeseen delays, providing clear explanations and estimated timeframes for resolution	16.12%
		Ability to implement alternative routes, transportation modes, or strategies to minimize delays and meet delivery commitments	25.17%
Reputation	15.94%	Positive feedback from Industries use the vendor services	16.61%
		Longevity and experience in the trucking industry	13.00%
		Industry certifications and accreditations owned by vendor	29.70%
		Track record of success in delivering on their promises and meeting customer expectations	16.22%

		Good Online Reputation and Ratings	24.48%

Based on the criteria implemented in the paired matrix, it can be seen that price has the largest percentage with 0.26 or 26%. It can be seen that price is the most prioritized and monitored criterion by the company. Next in sequence are capacity, service, time and product. The five criteria used have a percentage above 0.10 or 10%. This shows that the four criteria have an important role.

Achievement of Rates/KG in the Price Criteria component in the full 1 year in 2019, the number of incidents that occurred during the full 1 year in 2019 in the Safety Criteria, percentage of on time delivery in the full 1 year in 2019 in the Reliability Criteria, percentage of KPI inquiry and complaint response lead-time in the full 1 year in 2019 in the Service Criteria, and the rating on the marketplace for the full 1 year in 2019 in Reputation criteria will be used as a quantitative approach for the five trucking vendors in this research.

Table 3

Vendors	Criteria				
	X1	X2	X3	X4	X5
V.1	43,056	7	204,020	97.65%	99.80%
V.2	27,316	7	244,824	95.44%	98.79%
V.3	38,481	4	204,020	99.54%	98.83%
V.4	21,464	3	306,030	93.21%	98.35%
V.5	33,617	2	122,412	99.30%	97.80%

The data that has been tabulated is then adjusted to the class interval that was created previously. Then it is tabulated into an Evaluation Matrix based on existing criteria, namely X1 as price, X2 as Safety, X3 as Service, X4 as Reliability and X5 as Reputation.

Table 4

Vendors	Criteria				
	X1	X2	X3	X4	X5
V.1	10	30	20	30	30
V.2	30	30	20	20	20
V.3	10	20	20	30	20
V.4	30	10	30	10	20
V.5	20	10	10	30	10

This Evaluation Matrix data will then be used in calculating the normalization matrix in TOPSIS calculations.

Table 5

	X1	X2	X3	X4	X5
r_{ij}	49	49	47	57	47

Vendors	Criteria				
	X1	X2	X3	X4	X5
V.1	0.2	0.61	0.43	0.53	0.64
V.2	0.61	0.61	0.43	0.35	0.43
V.3	0.2	0.41	0.43	0.53	0.43
V.4	0.61	0.2	0.64	0.18	0.43
V.5	0.41	0.2	0.21	0.53	0.21

Data normalization in trucker assessments is the basis for calculating a normalized decision matrix with the weights obtained in the previous AHP calculation.

Table 6

	X1	X2	X3	X4	X5
AHP	0.26	0.15	0.23	0.2	0.16

Vendors	Criteria				
	X1	X2	X3	X4	X5
V.1	0.05	0.09	0.1	0.11	0.1
V.2	0.16	0.09	0.1	0.07	0.07
V.3	0.05	0.06	0.1	0.11	0.07
V.4	0.16	0.03	0.15	0.04	0.07
V.5	0.11	0.03	0.05	0.11	0.03

After getting the normalized matrix with weights, then determine the matrix of the positive ideal solution (A^+) and the negative ideal solution (A^-). Next, calculate the distance of each alternative from the positive ideal solution and negative ideal solution and calculate the preference value (RC^+) for each alternative. The final step is then to rank each existing preference value.

Table 7

	X1	X2	X3	X4	X5
A^+	0.16	0.09	0.15	0.11	0.1
A^-	0.05	0.03	0.05	0.04	0.03

Vendors	D^+	D^-	RC_+	RANK
V.1	0.11	0.07	0.4	3
V.2	0	0.13	0.96	1
V.3	0.12	0.04	0.25	5
V.4	0.07	0.12	0.64	2
V.5	0.09	0.06	0.38	4

The next method used is to combine the results from questionnaire I (at the level of importance) with the results from questionnaire IV (in the comparison diagram). The results of questionnaire I will be used as a weight component, while the results of questionnaire IV will be used as a value component (rating). The result of multiplying the two will produce a weight score which will be calculated for each level of the trucker.

Table 8

Sub-Criteria	V.1	V.2	V.3	V.4	V.5	Weight
X1.1	0.15	0.25	0.21	0.21	0.17	3.5
X1.2	0.15	0.27	0.2	0.2	0.17	3.6
X1.3	0.15	0.25	0.21	0.21	0.17	3.6
X1.4	0.14	0.31	0.19	0.21	0.15	3.6
X1.5	0.18	0.22	0.21	0.19	0.19	3.3
X2.1	0.19	0.22	0.18	0.23	0.17	4
X2.2	0.13	0.24	0.21	0.21	0.21	3.9
X2.3	0.17	0.29	0.17	0.2	0.17	3.7

X2.4	0.16	0.23	0.15	0.22	0.23	3.8
X2.5	0.22	0.21	0.21	0.21	0.15	3.6
X3.1	0.19	0.2	0.18	0.21	0.22	3.4
X3.2	0.16	0.28	0.18	0.2	0.17	3.4
X3.3	0.17	0.29	0.17	0.2	0.17	3.4
X3.4	0.2	0.22	0.17	0.18	0.24	3.2
X3.5	0.18	0.23	0.2	0.21	0.17	3.4
X4.1	0.16	0.22	0.21	0.21	0.2	3.4
X4.2	0.18	0.26	0.18	0.21	0.16	3.4
X4.3	0.17	0.23	0.19	0.22	0.18	3.3
X4.4	0.16	0.31	0.18	0.17	0.18	3.4
X4.5	0.19	0.23	0.19	0.22	0.17	3.5
X5.1	0.17	0.21	0.21	0.23	0.18	3.7
X5.2	0.19	0.24	0.19	0.22	0.17	3.6
X5.3	0.18	0.24	0.2	0.19	0.18	3.8
X5.4	0.16	0.25	0.17	0.24	0.17	3.9
X5.5	0.18	0.24	0.2	0.17	0.2	3.6

Weight score calculated with rating.

Table 9

Sub-Criteria	V.1	V.2	V.3	V.4	V.5
X1.1	0.54	0.88	0.73	0.75	0.6
X1.2	0.55	0.98	0.73	0.71	0.63
X1.3	0.56	0.9	0.75	0.77	0.62
X1.4	0.5	1.11	0.69	0.74	0.56
X1.5	0.61	0.74	0.7	0.64	0.62
X2.1	0.78	0.87	0.71	0.93	0.7
X2.2	0.51	0.93	0.83	0.81	0.81
X2.3	0.64	1.06	0.63	0.75	0.62
X2.4	0.62	0.86	0.59	0.85	0.88
X2.5	0.8	0.76	0.77	0.74	0.53
X3.1	0.66	0.67	0.61	0.71	0.76
X3.2	0.55	0.97	0.63	0.67	0.59
X3.3	0.58	0.97	0.58	0.69	0.57
X3.4	0.63	0.72	0.53	0.56	0.76
X3.5	0.61	0.79	0.69	0.71	0.59
X4.1	0.56	0.74	0.71	0.71	0.69
X4.2	0.61	0.88	0.63	0.73	0.56
X4.3	0.56	0.76	0.63	0.74	0.61
X4.4	0.55	1.05	0.61	0.58	0.61
X4.5	0.66	0.81	0.68	0.76	0.59
X5.1	0.62	0.78	0.79	0.85	0.66
X5.2	0.67	0.85	0.7	0.79	0.6
X5.3	0.7	0.92	0.77	0.73	0.68
X5.4	0.64	0.97	0.67	0.93	0.68
X5.5	0.65	0.87	0.73	0.61	0.73
Total	**15.33**	**21.84**	**17.1**	**18.46**	**16.27**

Result of calculation shows below.

Table 10

	V.1	V.2	V.3	V.4	V.5
X1	2.76	4.61	3.6	3.61	3.03
X2	2.99	4.61	3.59	3.79	3.12
X3	3.02	4.11	3.04	3.35	3.28

X4	2.93	4.24	3.26	3.51	3.05
X5	3.28	4.4	3.66	3.9	3.36

From the results of the assessment carried out, it is necessary to determine the maximum and minimum values because the assessment results are not round numbers for the purpose of grouping assessment intervals. The maximum score is obtained if all assessments are worth 4 while the minimum score is obtained if all assessments are worth 1.

Maximum Score : 21.84
Minimum Score : 15.33
Score Range (Max – Min) : 6.51
Class (1+3.3*Log(n)) : 3.00
Score Per Interval (Range/Class) : 3.00

Table 11

Interval	*Range*	Hasil
1	14.85 - 16.85	Bad
2	16.86 - 19.86	Good
3	19.87 - 21.87	Excellent

Then, we can conclude as below.

Table 12

Rank	*Trucker*	Score	Result
1	V.2	21.84	Excellent
2	V.4	18.46	Good
3	V.3	17.10	Good
4	V.5	16.27	Bad
5	V.1	15.33	Bad

The differences that occur between the methods used require the author to measure the accuracy of the research using the Hamming distance and Euclidean distance measurement methods. The accuracy level for the Hamming distance was obtained at 84% and the Euclidean distance was obtained at 0.80 for the 5 alternatives so that the methods used in this research can be used as a tool to assess trucker performance with a confidence percentage above 75%. The measurement results for AHP-TOPSIS and AHP-Likert at an accuracy level of 100% show V.2 as the priority trucker.

Table 13

Method	AHP-TOPSIS	Likert-AHP	Hamming	Euclidean Distance
V.1	3	5	60%	2
V.2	1	1	100%	0
V.3	5	3	60%	2
V.4	2	2	100%	0
V.5	4	4	100%	0
Average			84%	0.8

CONCLUSION

The trucker assessment using the AHP-TOPSIS method is based on what the company is currently doing in assessing truckers. In a sense, it is not much different from what already exists but is further specified in the assessment. The assessment method uses the criteria and sub-criteria used in the questionnaire and weighting is carried out for these criteria and sub-criteria. The ranking on the criteria for alternatives (truckers) is determined using the TOPSIS method. On the other hand, indicator weighting with a Likert scale is also used to assess and rank alternatives (truckers). This trucker assessment method/model can be used as a reference or recommendation in improving the company's trucker performance assessment to achieve the targets set by the company.

The recommendation for using this assessment is of course because it is prepared based on the opinions or selection of experts in the company, especially the Purchasing and Procurement, Quality, Operations, Clearance and Finance departments who are the decision makers (stake holders) in the trucker assessment. To realize improvements in trucker performance, of course commitment is also needed from each stakeholder in the department to get the best results. Apart from that, it is necessary to focus on assessing what needs to be done first. For example, in the results of a questionnaire, the criteria that are considered most important at the moment are price and service. So we can focus on these two things, which can then be seen in terms of indicators or sub-criteria, which truckers need to improve their performance.

Apart from looking at it from the perspective of the trucker itself, it is recommended that the company can make a long-term contract with the V.2 trucker because with its good performance, good cooperation can also be established, both in terms of competitive prices and the development of innovative delivery products. Then the Etihad carrier can be used as a centralized trucker for the development of critical components that are important for the company (such as regular deliveries and large projects). Meanwhile, for Oman Air and Emirates, it is recommended that the companies carry out audits and performance improvement strategies for these truckers.

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