

Vendor Selection in E-Commerce Using the Analytical Hierarchy Process Method

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ABSTRACT

The development of the e-commerce business is an opportunity for logistics service providers as third parties who deliver goods sold by the seller to the location intended by the buyer. This study aims to analyze the behavior of fashion e-commerce customers in choosing the best vendor. Data were collected by in-depth interviews with five selected informants for vendor criteria and sub-criteria, then a survey was conducted on 100 respondents. The data were analyzed using the Analytical Hierarchy Process method to determine criteria and sub-criteria in selecting the preferred vendor. The first criterion was reliability of delivery, with the sub-criteria of timeliness, accuracy of delivery destination, and security of the condition of the goods. The second criterion was price. The next criterion was products with regular delivery, express, and same-day sub-criteria. The last criterion was shipping features with its sub-criteria shipping tracking, wide delivery area, and customer service. For the case of Indonesia in this study, the best vendor in delivering products from e-commerce to customers is obtained by Si Cepat in the first place, followed by J&T and JNE in second and third places.

Keywords: e-commerce, logistic process, vendor selection, mix-method, analytical hierarchy process

A. Introduction

The rapid development of economy and business is accompanied by the development of digital-based information technology, as well as the presence of the pandemic factor, forcing the business world and consumers to adapt to rapid and drastic changes (Szász et al., 2022) which then have impacted on changes in consumer behavior, such as buying behavior through online shopping or E-Commerce (Galkin, Obolentseva, et al., 2019; Kim & Park, 2023). The unpredictable volatility in

the evolution of online selling means that sellers have to cope with drastic and frequent changes in demand. This phenomenon is demonstrated by the performance of sales of goods through e-commerce which remained strong in the second quarter of 2022 (Bank Indonesia, 2022).

E-commerce is a form of trade that includes the process of marketing goods to the distribution of goods through electronic or online networks, thus making it an alternative selling media that is appropriate in dealing with changes in buying behavior from the

public in taking advantage of developments in the field of communication technology that is increasingly informative and practical (Ekwoaba, Joy O., Ugochukwu, .U. Ikeije, 2015). E-commerce transactions can be carried out between two Business to Business (B to B) Institutions or directly between Business to Customer (B to C). Kotler et al., (2005) explain the types of E-Commerce based on characteristics including Business to Business (B2B), Business to Customer (B2C), Consumer to Consumer (C2C), and Consumer to Business (C2B). Galkin, Obolentseva, et al. (2019) explained that there were two main ways or distribution channels. To bring goods to consumers, namely directly (B2C) or through B2B2C *first-level* intermediaries (through retail) and second-level (through wholesalers and retailers) B2B2B2C. Indrajit (2016) classifies E-Commerce based on the type of application as follows: I-Market, Customer Care, Vendors Management, and Extended Supply Chain.

The logistics process is an important part and one of the determining factors for the success of online business activities. The development of the e-commerce business in Indonesia is an opportunity for logistics service providers to be able to work together and become a solution to e-commerce logistics management problems. One of the logistics service companies is a freight forwarder or fast goods delivery service. Goods delivery services (vendors) are needed in the process of online business activities as a third party that delivers goods sold by the seller to the location intended by the buyer. Vendors and sellers on e-commerce sites work together to maintain service quality so that products displayed online attract attention and customers buy them, and reach the customers' hands as expected. (Chatrath et al., 2022).

The fashion industry, like other industries, is an industrial system with a broad spectrum of products related to beauty and accessories, which consists of producing distributing, selling, and consuming (Lorenzo-Romero et al., 2020).

In addition, fashion journalism also plays a crucial role in providing the latest fashion trends and developments and making news recipients see to receive important messages regarding the latest fashion trends (Kim & Park, 2023). Several studies have captured various aspects of this phenomenon, such as the study conducted by Szász et al. (2022) who examined the impact of the trend shift caused by the Covid-19 pandemic on the long-term evolution of online retail. Meanwhile, Hallikainen et al. (2022) suspect that online shopping has intensified competition between different providers supported by quite rapid digital developments, allowing consumers to switch from one provide to another (Galkin, Obolentseva, et al., 2019).

The Association of Indonesia Express, POS, and Logistics Service Companies (Asperindo) noted that the number of companies that are members of this association is 563 companies. The large number of companies that provide logistics services with various advantages and disadvantages, makes this logistics service company important for e-commerce logistics management because it acts as a third party that delivers goods from the seller to the location desired by the buyer. Research conducted by Nuengphasuk & Samanchuen (2019) found that the key to e-commerce success is product delivery carried out by Third Party Logistics Service Providers (LSPs). Operational quality is determined not only by the requirements set by the company but also by applicable conditions or industry standards or specifications as well as environmental economic and financial conditions (Dudek & Śmiałkowska, 2019).

Grondys (2019) stated that changes in the level of transportation needs, due to the development of e-commerce and an increase in the need for courier services, are a source of problems in big cities. This is due to the transportation infrastructure and the distribution of the number of recipients of goods in urban areas, causing the delivery mode of transportation to use vehicles that operate by using roads and highways.

Research conducted by Galkin et al. (2019) analyzed that last-mile delivery is an important function in commercial companies that play an important role in goods distribution, reliability, efficiency, and support of the required level of service. Galkin, Davidich, et al., (2019) also stated in their research that drivers are the main participants who are directly involved in the implementation of delivery and affect the level of productivity, efficiency, and traffic safety. Therefore, the selection of logistics service providers is a very important part of providing effective customer service. The two e-commerce that have the largest market share in Indonesia based on I price data (<https://iprice.co.id/insights/mapofecommerce/>) were Tokopedia with 158 million customers per month, Shopee with 131 million customers per month, and so on. Fashion products are one of the products that have the largest turnover on the e-commerce platform. This study wants to analyze the behavior of e-commerce customers for fashion products in choosing the best vendor by looking at the priority order of criteria, sub-criteria, and order of priority for goods delivery services that should be chosen for consumers of fashion products on the e-commerce platform.

B. Methods

This research used mixed methods with an exploratory sequential research design (Creswell & Creswell, 2018) where qualitative data was obtained through in-depth interviews with informants who use goods delivery services in making transactions in E-commerce for the fashion category. In-depth interviews were conducted to obtain qualitative data from five informants, namely the owner of a fashion commodity online shop with the criteria: having experience more than five years of running a fashion business in e-commerce, having knowledge and experience in choosing goods delivery services in e-commerce, and routinely delivering goods using goods delivery services an average of ten times a week. The research questions in the in-depth

interviews consisted of two instruments, namely: the criteria needed in selecting goods delivery services; and the sub-criteria of each criterion needed in the selection of goods delivery services.

Through in-depth interviews, qualitative data were obtained in the form of criteria and sub-criteria needed in choosing goods delivery services in e-commerce. The results of the qualitative data are used to compile questionnaire and distributed to 100 respondents who live in Jabodetabek according to the research criteria to obtain data to be analyzed using the Analytical Hierarchy Process (AHP) method. The results of the analysis are expected to be able to answer research questions, namely to determine priority criteria and sub-criteria in the selection of goods delivery services or vendors and the best order of goods delivery services based on predetermined criteria and sub-criteria. AHP according to Timperio et al.(2017) and Berawi et al. (2018) is a decision-support model developed by Thomas L. Saaty. This decision-support model decomposes complex multifactor or multi-criteria problems into a hierarchy. A hierarchy is defined as a representation of a complex problem in a multi-level structure where the first level is the goal, followed by the level of factors, criteria, sub-criteria, and so on until the last level of alternative.

In this study, there were three questionnaires, namely: Questionnaires I, regarding the determination of the weight or priority of importance of the criteria in the selection of goods delivery services which will later be processed using the AHP method; Questionnaire II, regarding the determination of the weight or priority of interest for each sub-criteria in the selection of goods delivery services which will later be processed using the method; Questionnaire III, regarding the determination of the eight or priority of importance of each alternative freight forwarding service with each of the sub-criteria for selecting freight forwarding services which will later be processed using

the AHP methods. Then, a consistency test was performed by calculating the Consistency Ratio (CR). If $CR < 0.1$ then the assessment results are consistent.

C. Results and Discussion

1. Criteria and Sub-Criteria

This research began by conducting in-depth interviews to determine the criteria and sub-criteria that will be used in generating decision support models in determining delivery services for fashion products in e-commerce. The results obtained are in the form of four criteria and nine sub-criteria as follows:

Criteria and sub-criteria were obtained from in-depth interviews with informants and then compiled into a questionnaire that surveyed 100 respondents with certain criteria. Determining the sample size in

this study used the Lemeshow formula. The Lemeshow formula was used because the population size was unknown. Based on the Lemeshow formula calculation, the number of samples needed in this research is 96 respondents which will be rounded up to 100 respondents. Researchers use the Lemeshow formula because the population is unknown and the numbers change. The first criterion was that the respondents have shopped for fashion products in e-commerce. This criterion was determined because the experience of shopping for fashion products in e-commerce can provide insight into respondents' preferences in choosing goods delivery services when making transactions in e-commerce. The second criterion was that the respondents are domiciled in Jabodetabek. In the questionnaire, respondents will be asked to fill in the weight of each criterion, sub-criteria, and alternatives for goods delivery

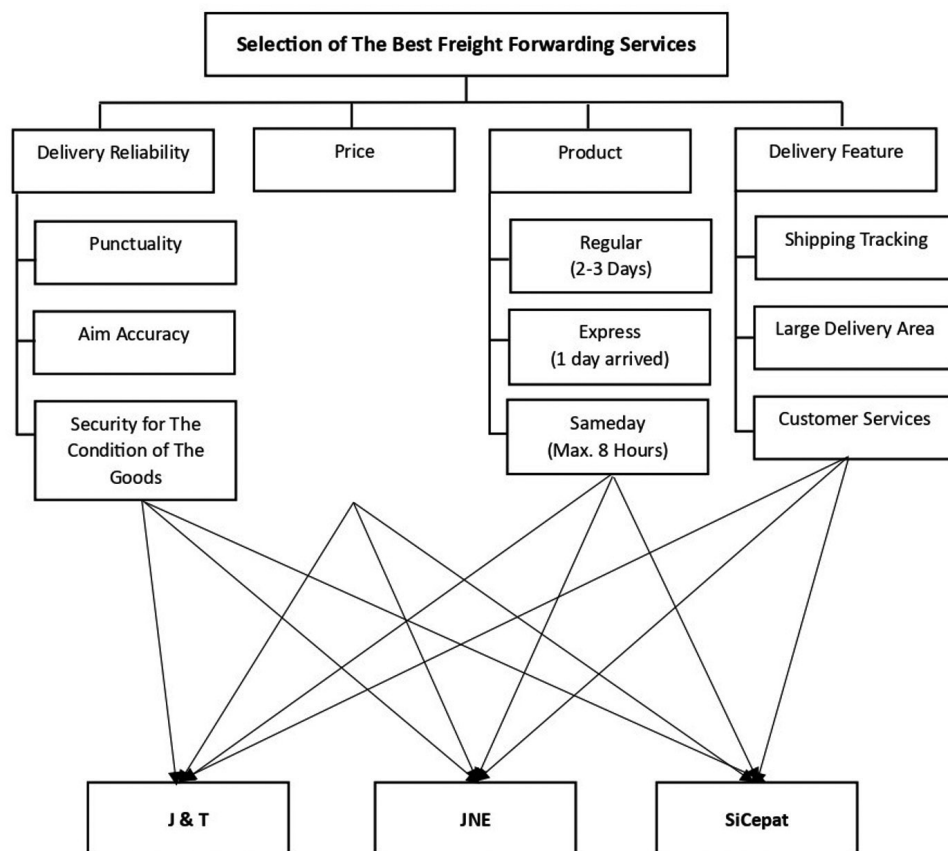


Figure 1 Hierarchical Structure of Vendor Selection in E-Commerce

Table 1 List of Criteria and Sub-Criteria

No	Criteria	Sub-Criteria	
1	Delivery Reliability	1.	Punctuality
		2.	Destination Address Accuracy
		3.	Safety Condition of Goods
2	Price	-	
3	Product	1.	Regular (2-3 days)
		2.	Express (one day delivery)
		3.	Same Day (maximum 8 hours)
4	Delivery Features	1.	Shipment Tracking
		2.	Wide Coverage Area
		3.	Customer Service

services. The questionnaire used in this study uses the pairwise comparison scale introduced by Thomas L Saaty in the AHP Method.

Figure 1 above, explains the hierarchical structure of the selection of goods delivery services in e-commerce which is arranged in three hierarchical levels. Level 0 was the goal

of using the AHP method, namely selecting the best freight forwarder in e-commerce. Furthermore, the First Level was the criteria for selecting the best freight forwarding services in e-commerce, the Second Level was a sub-criterion which was the elaboration of the First Level in selecting the best shipping

Table 2 Pairwise Comparison Matrix Between Criteria

Criteria	Delivery Reliability	Price	Product	Delivery Features
Delivery Reliability	1	2.29	2.21	2.33
Price	0.44	1	2.26	2.06
Product	0.45	0.44	1	0.87
Delivery Features	0.43	0.48	1.15	1
Total	2.32	4.22	6.63	6.26

Table 3 Calculation of Consistency Ratio (CR) Between Criter

$\lambda \max$	CI	RI	CR
4.0976	0.03254	0.90	0.0362

Source: processed

Table 4 Priority Interest Criteria

Criteria	Delivery Reliability	Price	Product	Delivery Features	Total	Weight	Priority
Delivery Reliability	0.4314	0.5428	0.3338	0.3725	1.6806	0.4201	I
Price	0.1885	0.2372	0.3411	0.3294	1.0963	0.2741	II
Product	0.1951	0.1049	0.1509	0.1383	0.5892	0.1473	IV
Delivery Features	0.1850	0.1150	0.1742	0.1597	0.6339	0.1585	III
Total					4	1.000	

services in e-commerce, and the Third Level was an alternative freight forwarding service that should be selected in conducting online transactions in e-commerce.

Based on the results of the questionnaire, the priority of importance between criteria in the selection of goods. Delivery services in e-commerce were averaged using the geometric mean in each pairwise comparison matrix as shown in Table 2 below:

Then, the consistency test (consistency ratio) in the Analytical Hierarchy Process (AHP) method was intended to see the consistency given by the respondents. If $CR \leq 0,1$ then pairwise comparison value on the criteria matrix given is consistent and vice versa if $CR > 0,1$ then the pairwise comparison value on the criteria matrix given is considered inconsistent. To get the Consistency Ratio (CR) value, it is necessary to calculate $\lambda_{\max}$ and Consistency Index (CI) first. Based on the calculation of the Consistency Ratio (CR) value generated between the criteria of 0.0362,

this value states that the criteria were stated to be consistent because the $CR \leq 0.1$.

The next process was to normalize the matrix by dividing each value from the column by the total column in question. This calculation is done to find out the weight owned by each criterion.

Based on the results of the weight calculation in determining priority criteria in Table 4, the selection of goods delivery services on e-commerce which is the first priority is the delivery reliability criterion with a weight of 0.4201, this is also reinforced by the results of in-depth interviews with informants that in the selection of delivery services goods in e-commerce, the factor if delivery reliability was the most important factor influencing e-commerce sellers or buyers in deciding their choice to use vendors, where customers tend to be very concerned about the timeliness of delivery of goods. The second priority is the price criterion with a weight of 0.2741. Furthermore, the third priority is

Table 4 Pairwise Comparison Matrix Between Delivery Reliability Sub-Criteria

Sub Criteria	Punctuality	Destination Address Accuracy	Safety Condition of Goods	Total	Weight	Priority
Punctuality	0.2728	0.3353	0.2524	0.8605	0.2868	II
Destination Address Accuracy	0.1639	0.2014	0.2266	0.5919	0.1973	III
Safety Condition of Goods	0.5633	0.4632	0.5210	1.5476	0.5159	I
Total				3	1	

Table 5 Priority of Interest (Weight) Between Delivery Reliability Sub-Criteria

Sub-Criteria	Punctuality	Destination Address Accuracy	Safety Condition of Goods
Punctuality	1	1.66	0.48
Destination Address Accuracy	0.60	1	0.43
Safety Condition of Goods	2.06	2.30	1
Total	3.67	4.96	1.92

the delivery feature with a weight of 0.1585, which indicates that the delivery feature would provide value-added for customers in using goods delivery services. Customer service was very helpful in answering the needs of customers when using these delivery services. The last priority is the product in the criteria for selecting goods delivery services with a weight of 0.1473, which shows that with the diversity of delivery products, it can meet the various needs of its customers, this was evidenced by the existence of various products from delivery service operators such as regular products (2-3 day), Express (one-day delivery) and Same Day (Maximum 8 hours), which are the choices for customers when using good delivery services.

2. Delivery Reliability Sub-Criteria

Based on the data from the results of questionnaires that have been distributed to respondents regarding the priority of sub-criteria interest with alternatives in

the selection of goods delivery services on e-commerce, then the results of the respondents' assessments were averaged using the geometric mean in each pairwise comparison matrix. The following is the result of calculating the pairwise comparisons of the sub-criteria for each criterion:

Based on Table 5, it can be concluded that in the delivery reliability criteria in the selection of goods delivery in e-commerce, the security sub-criteria for the condition of the goods was the first priority with a weight of 0.5159, this is evidenced by the results of in-depth interviews with experts that customers expect the goods they receive to be in a safe condition and the responsibility for keeping the goods in a safe condition during the delivery process is the responsibility of the delivery service operator. Furthermore, the punctuality sub-criteria was the second priority with a weight value of 0.2868. This shows that the timeliness factor of the delivery service is an important factor for customers in

Table 6 Priority of Interest (Weight) Between Product Sub-Criteria

Sub-Criteria	Regular (2-3 days)	Express (One day delivery)	Same-day (Max 8 hours)	Total	Weight	Priority
Regular (2-3 days)	0.1714	0.2505	0.1355	0.5574	0.1858	III
Express (One day delivery)	0.2342	0.3422	0.3947	0.9712	0.3237	II
Same-day (Max 8 hours)	0.5944	0.4073	0.4698	1.4714	0.4905	I
Total				3	1	

Table 7 Pairwise Comparison Matrix Between Product Sub-Criteria

Sub-Criteria	Regular (2-3 days)	Express (One day delivery)	Same-day (maks 8 hours)
Regular (2-3 days)	1	0.73	0.29
Express (one day delivery)	1.37	1	0.84
Same-day (max 8 hours)	3.47	1.19	1
Total	5.83	2.92	2.13

Table 8 Priority of Interest (Weight) between Delivery Feature Sub-Criteria

Sub-Criteria	Shipping Tracking	Wide Area Coverage	Customer Service	Total	Weight	Priority
Shipping Tracking	0.4992	0.5535	0.4420	1.4947	0.4982	I
Wide Area Coverage	0.2291	0.2540	0.3175	0.8006	0.2669	II
Customer Service	0.2717	0.1925	0.2405	0.7047	0.2349	III
Total				3	1	

Table 9 Paired Matrix Between Delivery Feature Sub-Criteria

Sub-Criteria	Shipping Tracking	Wide Area Coverage	Customer Service
Shipping Tracking	1	2.18	1.84
Wide Area Coverage	0.46	1	1.32
Customer Service	0.54	0.76	1
Total	2.00	3.94	4.16

selecting goods delivery services. Meanwhile, the third priority was the accuracy of the destination with a weight value of 0.1973, meaning that customers expect that there will be no wrong delivery address because this makes the processing time longer and vendors will lose the trust of customers who will not use the delivery service again.

3. Product Sub-Criteria

Table 6 presents the product criteria

for selecting vendors in e-commerce, where the same-day sub-criteria (maximum 8 hours) was the first priority with a weight value of 0.4905. While the Express Sub-Criteria was the second option with a weight value of 0.3237 and the regular sub-criteria was the last option with a weight value of 0.1858.

4. Delivery Features Sub-Criteria

Table 8 presents the Delivery Feature Criteria in selecting vendors in e-commerce,

Table 10 Rating of Sub-Criteria for selecting Freight Forwarding Services

Order	Sub-Criteria	Weight of Each Sub Criteria
1	Safety Condition of Goods (DR)	0.5159
2	Shipping Tracking (DF)	0.4982
3	Same-day (8 hours) (P)	0.4905
4	Express (one day delivery) (P)	0.3237
5	Punctuality (DR)	0.2868
6	Wide Area Coverage (DF)	0.2669
7	Customer service (DF)	0.2349
8	Destination Address Accuracy (DR)	0.1973
9	Regular (2 – 3 days) (P)	0.1858

where DR (Delivery Reliability), P (Product), DF (Delivery Feature)

where the delivery tracking sub-criteria was the first priority with a weight value of 0.4982. While the Delivery Area Coverage was the second option with a weight value of 0.2669 and the Customer Service sub-criteria was the last option with a weight value of 0.2349.

5. Analytical Hierarchy Proses (AHP) Method Calculation

From the results of the Analytical Hierarchy Process (AHP) analysis above, the most influential sub-criteria in the selection of goods delivery services in e-commerce from the priority to the last (Table 10).

Overall, based on the criteria and sub-criteria in selecting goods delivery services on E-commerce for fashion products, SiCepat Good Delivery Service was rated as the best delivery service with a value of 0.4773, then for the second priority, namely J&T Good Delivery Service with a value of 0.2968; and JNE Good Delivery Services with a value of 0.2259 becomes the third priority. From the analysis, SiCepat Delivery Services is a top priority, this was different from the results of a survey conducted by Populix in 2021 regarding consumer choice of good delivery services, namely J&T Delivery Services occupying the first position, this is due to the different commodities examined in the study.

The consistency test in the Analytical Hierarchy Process (AHP) method is intended to see the consistency given by the respondents. If $CR \leq 0.1$ then the pairwise comparison value on the criteria matrix given was consistent and vice versa if $CR > 0.1$ then the pairwise comparison value on the criteria matrix given is considered inconsistent. So, if the CR results are inconsistent, it is necessary to fill in the values for the criteria and sub-criteria. The overall Consistency Ratio (CR) value was consistent. After each criterion, sub-criteria, and alternative were known for their weight value and the overall Consistency Ratio value is consistent, the next step was to provide a final score for each alternative value for the goods delivery service. To get the overall value (global priority) is done by a calculation

that is multiplying the average local priority (local priority) with the average priority level above it (parent criterion). Example of Global Priority Calculation: Global Priority = (Delivery Reliability Criterion Weight x Weight of Punctuality x Weight of Alternative J&T Shipping Service) is $0.4201 \times 0.2868 \times 0.2893$ is 0.0349. Global Priority Values can be seen in Table 11 (as attached). Based on Table 11 in the attachment of this article, the overall weight of each alternative is obtained by adding up the global priority value for each alternative freight forwarding service (Table 12).

Table 12 Overall Alternative Weight

Alternative	Weight	Priority
J&T	0.2968	II
JNE	0.2259	III
SiCepat	0.4773	I

Table 12 shows that overall, from the results of calculating the overall alternative weights, SiCepat Good Delivery Service occupies the first position, namely with a value of 0.4773, then for the second priority, namely J&T Good Delivery Services with a value of 0.2968, and finally, the third priority was JNE Good Delivery Services with a value of 0.2259. The results of this study differ from research conducted by Populix in 2021 where J&T Delivery services were at the top priority, while in this study SiCepat ranks first. This was caused by the different commodities studied, where there were no restrictions on the commodities used, while in this study using fashion commodities, there were differences in the priority of delivery services.

D. Conclusion

In this study, the most important criterion in selecting goods delivery services on e-commerce is Delivery Reliability, then the second priority was the Price, and the third

priority is Delivery Features and the criterion with the last priority is the Product. The delivery reliability criteria used in this study have three sub-criteria, namely Punctuality, Destination Address Accuracy, and Safety Condition of the Goods. Of the three sub-criteria, the security condition of the goods was the most important sub-criteria for the respondents. This illustrates that in the selection of freight forwarding services, the reliability of freight forwarding service operators in handling the security of the condition of the goods they send was an important consideration for the respondents. Then, the second priority, namely the punctuality, and the destination address accuracy sub-criteria was the last.

The product criteria used in this study had three sub-criteria, namely Regular (2 – 3 days), Express (One-day delivery), and Same-day (Max 8 hours). Of the three sub-criteria, Same-day was the most important sub-criterion. This illustrates that in the selection of goods delivery services, products that have faster delivery times would be the priority choices of the respondents. Furthermore, the second priority, namely the Express, and Regular was the priority of the last sub-criteria. The Delivery Features criteria used in this study have three sub-criteria, namely Shipping Tracking, Wide Area Coverage, and Customer Service. Of the three sub-criteria, shipping tracking was the most important sub-criterion for respondents who described their curiosity about the whereabouts of their delivery position. Furthermore, the priority of the second sub-criteria was Wide Area Coverage, and Customer Service was the priority of the last sub-criteria.

Overall, based on the criteria and sub-criteria in selecting goods delivery services on e-commerce for fashion products, SiCepat Goods Delivery Services were rated as the best delivery services. Furthermore, the second priority was J&T Goods Delivery Service; and JNE Goods Delivery Service was the third priority. Further research can be carried out using different commodities other than fashion commodities.

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APPENDIX

Table 11 Global Priority Selection of Freight Forwarding Services

Level 0 (Goal)	Level 1 (Criteria)	Weight	Level 2 (Sub-Criteria)	Weight	Level 3 (Alternatives)		Global Priority
Selection of the Best Freight Forwarding Services	Delivery Reliability	0.4201	Punctuality	0.2868	J&T	0.2893	0.0349
					JNE	0.1743	0.0210
					SiCepat	0.5364	0.0646
			Destination Address Accuracy	0.1973	J&T	0.2856	0.0237
					JNE	0.2084	0.0173
					SiCepat	0.5060	0.0419
			Safety Condition of Goods	0.5159	J&T	0.2639	0.0572
					JNE	0.2133	0.0462
					SiCepat	0.5227	0.1133
	Price	0.2741			J&T	0.2968	0.0814
					JNE	0.2328	0.0638
					SiCepat	0.4704	0.1289
	Product	0.1473	Regular	0.1858	J&T	0.2957	0.0081
					JNE	0.2039	0.0056
					SiCepat	0.5003	0.0137
			Express	0.3237	J&T	0.3016	0.0144
					JNE	0.2033	0.0097
					SiCepat	0.4951	0.0236
			Same-day (8 hours)	0.4905	J&T	0.3809	0.0275
					JNE	0.2224	0.0161
					SiCepat	0.3967	0.0287
	Delivery Features	0.1585	Shipping Tracking	0.4982	J&T	0.3047	0.0241
					JNE	0.2569	0.0203
					SiCepat	0.4383	0.0346
			Wide Area Coverage	0.2669	J&T	0.3039	0.0129
					JNE	0.3872	0.0164
					SiCepat	0.3089	0.0131
			Customer Service	0.2349	J&T	0.3436	0.0128
					JNE	0.2591	0.0096
					SiCepat	0.3974	0.0148

Source: Processed