Supplier Selection Criteria for E-Commerce Based Fashion SME's

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Abstract

The issue of supplier selection becomes a very important aspect in supply chain management, especially for the purchasing function. Supplier selection criteria become the main thing in supplier selection. Currently, the industry of concern in Indonesia is fashion small medium enterprises (SME). In this study, the supplier assessment criteria and sub-criteria are based on the perspective of the 4th party logistics environment. To determine the criteria and sub-criteria for supplier selection, this research conducted a literature study, interviews with experts and a questionnaire survey. Through a literature review and the modified Delphi method to confirm the hierarchical structure of the criteria and sub-criteria for supplier selection, the Analytic Hierarchy Process (AHP) was carried out to determine the weights of the criteria and sub-criteria in the hierarchical structure framework. The results of this study can be used as a reference in supplier selection for each grade quality basic apparel products, thus assisting in making decisions on choosing the right supplier based on the perspective of fashion SMEs in a 4th party logistics environment. This study considers the integration of perspectives between suppliers, 4PL companies, and brands, so that the proposed model determines the aspects of negotiation and fairness as limitations.

Keywords
Fashion, Grade quality, Supplier selection criteria, Modified Delphi method, and Analytical Hierarchy Process.

1. Introduction
The Indonesian fashion industry has significantly evolved, so that fashion become a profitable industry. In 2016, the fashion subsector made the biggest contribution after culinary, which amounted to 18.15% of Rp 166.1 trillion in the Gross Domestic Product (GDP) of Indonesian Creative Economy. The clothing and apparel sector is the second most popular fashion industry category in online shopping in Indonesian, take a 14.6% portion of domestic e-commerce (J. P. Morgan Payments Trends Report 2019).

Figure 1 shows the month of Ramadan, middle of the year, and end of the year are factors that cause an increase in the fashion industry sales. Many basic apparel products whose sales increased by up to 400 percent both offline and online at National Online Shopping Day (Harbolnas) moment. E-commerce enabler company SIRCLO revealed that the transaction value from the implementation of Harbolnas12.12 in 2020 increased by 328 percent from 2019. Data in the 2020 Indonesia Economic Report also shows that the real sales index for the clothing category experienced a spike on holidays. Therefore, business actors in the fashion industry need to determine the right strategy to deal with the phenomenon of sales surges and face competition to seize the market during the holiday and national online shopping day.

The development of the digital world makes the marketing of fashion products currently not only done offline through retail stores but has grown with online marketing. According to the e-Conomy SEA (2020) report by Google, Tamasek, and Bain & Company, the COVID-19 pandemic has accelerated the digital adoption of people using digital services for the first time. Indonesia experienced the highest increase in internet users in Southeast Asia in 2020, with 37% of digital service consumers being new users. 93% of these new users intend to continue using after the COVID-19 pandemic. The value of Indonesia's digital economy in 2020 grew 11% compared to the previous year. In the projection of the Indonesian e-commerce market in 2021 by Statista, the largest market segment since 2017 to date is

fashion. The clothes and apparel sector are the second most popular fashion industry category in online shopping in Indonesia, accounting for 14.6% of domestic e-commerce (J. P. Morgan Payments Trends Report 2019).
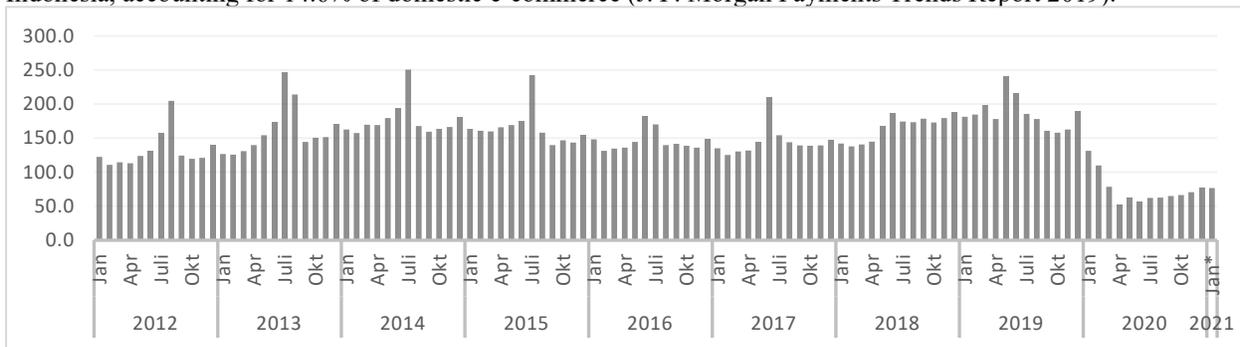

Figure 1. Indonesia fashion real sales index (Bank Indonesia 2020)

Successful collaboration between suppliers is hampered due to various interests and competition can be overcome by using a fourth-party logistics service (4PL) (Hingley et al. 2011). A 4PL provider is a logistics provider that designs and builds logistics process services using all the resources of other companies. The operation mode of logistics based on the 4PL platform can respond to a market opportunity and consumer demands quickly via business management processes, logistics service control and optimization, and information spread, control of logistics service transaction processes, identification of logistics execution processes, formulation of logistics integration schemes, etc (Jiang and Kaiming 2013).

Most entrepreneurs in the Indonesian fashion industry determine vendors and suppliers of production only based on the best performance. In fact, to develop their business further, 4PL fashion industry players need to ensure that their production capacity can meet market demand at any time.

Supplier selection is the companies process to identify, screens, evaluates, analyzes, and contracts with suppliers. Collaborating with multiple suppliers will increase negotiation costs and monitoring costs, whereas if the number of suppliers is too few then the risk of the entire supply chain being disrupted will increase.

The good supplier selection is look for the right supplier who can serve the buyer with the right quality, quantity product, and give the right price at the right time. It's hard to follow the same strategy in different company because they have different financial capability, competencies, capacity, and reputation. Even by producing products with the same specifications and quality, it is still difficult.

In the clothes and apparel sector, there are basic apparel product variants that can be mixed and matched with various appearance styles. Variations in income from consumers of basic apparel products make brand owners design products with a certain level of quality of basic ingredients. The use of raw materials with different quality levels will affect the selling price of the product, so that it can be in accordance with the targeted consumer income segmentation. The various basic apparel products have an impact on production vendors and suppliers of various raw materials for products, depending on their skills and abilities to meet product quality levels.

Product orders from the Basic Apparel Brands can be grouped into several classes based on the quality of the products, so that suppliers belonging to the lower class can be prioritized to work on lower grade orders. This is done because low-end vendors and suppliers can only work on lower-class products, while top-class vendors and suppliers can work on the quality of all ordered products.

1.1 Objectives
The objective of this study is to determined supplier selection's criteria and sub-criteria for each grade quality basic apparel products, these criteria can specifically represent the e-commerce small medium enterprises (SME's) brand of fashion products in fourth-party logistics environment. One of the contributions made by this research among others is the hybrid of Delphi method and AHP in the offline and online fashion retail, which these two methods are used in

metal industry (Mahaputra 2020). This study uses issues related to characteristics of apparel products in fourth-party logistics environment.

2. Literature Review
The supplier selection and evaluation process are multi-objective in nature and has continued to evolve since Dickson's (1966) study. The selection of suppliers does not have a standard, so it must be applied based on the situation. While the wrong choice can cause the supply chain to suffer losses and will directly affect the company's performance (Frej et al. 2017).

Fallahpour et al. (2017) stated that product quality, production costs, early payment discounts, responsiveness, and bulk order discounts were the top five supplier selection criteria. Kim et al. (2013) applied the Delphi-AHP method to select WEE priorities for recycling in a waste management decision-making tool. The Delphi method was used to conduct an expert survey for appropriate evaluation criteria and AHP calculated the relative importance of decision making through stratification and class analysis. Polat and Eray (2015) conducted an integrated approach using AHP-ER for supplier selection in railway projects. The AHP method is used to find the weight of the selection criteria and the Evidential Reasoning (ER) method is used to rank alternative suppliers. Dweiri et al. (2016) examines a supplier selection decision support model based on the analytic hierarchy process (AHP) using the case of the automotive industry in the developing country of Pakistan. The use of AHP in supplier selection gives decision makers confidence in consistency and resilience throughout the process. Delbari et al. (2016) investigated the investigation of key competitiveness indicators and full-service airline drivers using Delphi and AHP techniques. The Delphi method was used as a qualitative stage and followed by a quantitative stage (AHP technique) to identify and prioritize key competitiveness indicators. Kumar et al. (2019) examines a model for supplier objective assessment by integrating three methods, namely, Taguchi loss function, AHP, and TOPSIS by considering the advantages of these methods. AHP is the most popular and widely used method for assigning weights to criteria by expert consistency checks. Nirmala and Uthra (2019) investigated the problem of supplier selection using AHP based on Triangular Intuitionistic Fuzzy Number (TIFN). AHP is handled in a fuzzy environment where the comparison matrix element is a fuzzy number. Mahaputra (2020) examined the criteria and sub-criteria for supplier selection for downstream metal products using the Modified Delphi and AHP methods based on the Industrial 4.0 perspective. A lot of research on supplier selection has been done before. Table 1 shows the state of the art of this research.

Table 1. State-of-the-art methods

Autor		Kim et al. (2013)	Polata and Eray (2015)	Dweiri et al. (2016)	Delbari et al. (2016)	Kumar et al. (2019)	Nirmala and Uthra (2019)	Mahaputra (2020)	This research (2021)
Selection's Criteria	Common	✓	✓	✓	✓	✓	✓	✓	✓
	Development	✓	-	-	✓	-	✓	✓	✓
Data		Hypothetical	Empirical	Empirical	Empirical	Hypothetical	Hypothetical	Empirical	Empirical
Methods	Delphi	✓	-	-	✓	-	-	✓	✓
	AHP	✓	✓	✓	✓	✓	✓	✓	✓
Application		-	Railway Industry	Automotive Industry	Airlines Industry	-	-	Metal Products – downstream metal	Offline and online fashion retail

3. Methods
The data would be processed using Modified Delphi Method and Analytical Hierarchy Process (AHP). The Delphi method is used to collect the most important factors that influence the selection of an organization's resource planning system with experts consisting of several rounds and feedback loops (Linstone and Turoff 2002). The Delphi method will determine the appropriate criteria. The Modified Delphi started with a second round of exploration with structured questionnaire subjects (Huang et al. 2013). This is because the problems in the first round of the Delphi method have been sufficiently determined by the researchers by conducting a literature review and interviews with selected experts

then collecting their opinions and submitting strategic issues or opinions. In addition to saving time and money, structured questionnaires allow the panel to immediately focus on the research problem.

This study takes a case study in a 4PL industry fashion. This study survey 6 experts in procurement basic apparel products of that 4PL fashion industry. Experts were asked to determine the level of importance. The selection criteria were based on five scales from 1 (very unimportant) to 5 (very important). Referring to (Hong 2000), this study uses a modified Delphi method of questionnaire analysis whose standard selection uses a mean limit of 3.5 because the value is between a scale of 3 and 4 which is the boundary between the medium scale and the important scale. with 3.5 already representing an important scale. While the standard deviation of 1 which is the standard normal distribution, shows the limits of the distribution of the questionnaire data.

Then the criteria selected from the Delphi arc method were determined using the Analytical Hierarchy Process (AHP) method. The AHP method is the organization of information and prioritization based on the distribution of criteria in the form of a simple hierarchy and pairwise comparisons for decision making on complex problems (Saaty 1980). Decisions are made using derived weights from the evaluative criteria. The combination of all qualitative and quantitative factors is carried out using AHP in the decision-making process. AHP uses pairwise comparisons of important criteria with respect to objectives. Such comparisons make it possible to find the relative weights of the criteria with respect to the main objective.

The scale in the AHP is called the nine-point scale. Saaty (1987) suggested that factor comparisons were made in the range of 1 to 9. 1 for both elements have the same level of importance, 3 for one element have a little more level of importance than the other, 5 for one element have very level of important than the other, 7 for one element have more level of important than the other, 9 for one element have absolutely more level of important than the other, and 2, 4, 6, 8 for the value between two adjacent considerations. After creating a pairwise comparison matrix, the next step is to check the consistency of the matrix. This is done by calculating the consistency ratio for each matrix. To measure the degree of inconsistency in the criterion comparison matrix, Consistency Ratio (CR) is used. The Saaty CR is the result of the comparison between Consistency Index (CI) with Random Index (RI). The recommended CR is equal to or less than ten percent (10%). If it is greater than ten percent (10%), then the matrix is considered inconsistent and the weighted pairwise comparisons must be revised.

4. Results
4.1 Evaluation Criteria by The Modified Delphi Method
Previous research has improved understanding of the general criteria and sub-criteria for selecting suppliers. These criteria are most often agreed upon among experts based on a literature review. From that literature review, the first round of this research resulted in 6 criteria and 35 sub-criteria, as shown in Table 2. The six main criteria are: economy, quality, and service, social, environment, technology, communication.

Table 2. Criteria and sub-criteria supplier selection

No	Criteria	Sub-Criteria	References
1	Economy	Price (Cost)	(Zhou and Xu 2018) (Thanaraksakul and Phruksaphanrat 2009) (Sarkar & Mohapatra 2006) (Lopez 2007) (Xia and Wu 2007) (Wadhwa and Ravindran 2007) (Watt et al. 2007)
		Financial position	(Zhou and Xu 2018)
		Warranties and claims	(Thanaraksakul and Phruksaphanrat 2009) (Xia and Wu 2007) (Dickson 1966)
		Packaging ability	(Dickson 1966)
		Reciprocal arrangements	(Dickson 1966)
2	Quality and Service	Quality	(Zhou and Xu 2018) (Thanaraksakul and Phruksaphanrat 2009) (Hsu and Hu 2009) (Wang et al. 2008) (Yu 2008) (Cakir and Canbolat 2008) (Ustun and Demirtas 2008) (Lopez 2007) (Wadhwa and Ravindran 2007) (Xia and Wu 2007 (Chan and Kumar 2007) (Jharkharia Shankar 2007) (Gencer and Gürpinar 2007) (Sarkar and Mohapatra 2006) (Shyur and Shih 2006)
		Delivery	(Zhou and Xu 2018) (Thanaraksakul and Phruksaphanrat 2009) (Ustun and Demirtas 2008) (Wadhwa and Ravindran 2007) (Lopez 2007) (Shyur and Shih 2006) (Sarkar and Mohapatra 2006)

		Product appearance	(Abdolshah 2013)
		After-sales service	(Ware et al. 2012) (Thanaraksakul and Phruksaphanrat 2009) (Lopez 2007) (Xia and Wu 2007)
		Technology standards	(Hussain and Al-aomar 2017)
		Maintainability	(Sureeyatanapas et al. 2018)
		Production capacity	(Thanaraksakul and Phruksaphanrat 2009) (Xia and Wu 2007) (Sarkar and Mohapatra 2006)
		Flexibility	(Wang et al. 2008) (Jing 2008) (Ustun and Demirtas 2008) (Chan and Kumar 2007)
		Percentage of defects	(Wang et al. 2008)
3	Social	Worker safety and labor health	(Zhou and Xu 2018)
		Governmental relations	(Kannan et al. 2015)
		Attitude	(Dickson 1966)
		Performance history	(Dickson 1966)
		Impression	(Dickson 1966)
4	Environment	Geographical location	(Cengiz et al. 2017)
5	Technology	Equipment infrastructure	(Lichtblau et al. 2015)
		Digital modeling	(Lichtblau et al. 2015)
		Integrated product lifecycle	(Singapore Economic Development Board 2017)
		Vertical and horizontal integration	(Singapore Economic Development Board 2017)
		Automation	(Singapore Economic Development Board 2017)
		Intelligence process	(Singapore Economic Development Board 2017)
		Smart products	(Lichtblau et al. 2015)
6	Communication	Data and communications security	(Lichtblau et al. 2015)
		Cloud services	(Lichtblau et al. 2015)
		Connectivity	(Singapore Economic Development Board 2017)
		Catalog technology	(Abdolshah 2013)
		Data-driven services	(Lichtblau et al. 2015)
		Inter and intra-company collaboration	(Singapore Economic Development Board 2017)
		Mutual trust	(Ustun and Demirtas 2008) (Ha and Krishnan 2008) (Bottani and Rizzi 2008)
		Easy communication	(Ustun and Demirtas 2008) (Ha and Krishnan 2008) (Bottani and Rizzi 2008)

By the subject of a structured questionnaire, the second round of exploration resulted in 23 important sub-criteria are considered, where for this research refers to the industry of fashion SMEs in a 4th party logistics environment.

4.2 Analysis of AHP Investigation

After taking the AHP questionnaire, Excel was used for data analysis. The geometric means and paired weights at different levels are obtained. The results of the analysis are as follows in Table 3.

Table 3. The total analysis of the factors

Criteria	Sub-Criteria	Grade 1 (High)		Grade 2 (Middle)		Grade 3 (Low)	
		Weights	Rank	Weights	Rank	Weights	Rank
Economy	Price (Cost)	0.05436	7	0.020147	13	0.068248	6
	Financial position	0.050033	10	0.011429	17	0.051328	9
	Warranties and claims	0.079347	3	0.058559	6	0.055525	7
	Packaging ability	0.061533	6	0.014749	15	0.029338	13

	Reciprocal arrangements	0.075036	4	0.02447	11	0.035312	12
Quality and Service	Quality	0.191655	1	0.252259	1	0.114328	2
	Delivery	0.050877	9	0.106111	3	0.126979	1
	Product appearance	0.030699	12	0.052799	8	0.055351	8
	After-sales service	0.052911	8	0.06325	5	0.029011	14
	Maintainability	0.025343	13	0.058457	7	0.03699	11
	Production capacity	0.037804	11	0.066425	4	0.083682	4
	Flexibility	0.01703	16	0.031205	10	0.040168	10
	Percentage of defects	0.083575	2	0.12057	2	0.109369	3
Social	Worker safety and labor health	0.013288	18	0.011207	18	0.015342	16
	Governmental relations	0.016779	17	0.014529	16	0.012514	18
	Attitude	0.066639	5	0.038178	9	0.074916	5
	Performance history	0.012984	19	0.016774	14	0.014453	17
	Impression	0.024268	14	0.021323	12	0.02331	15
Environment	Geographical location	0.007941	23	0.005803	19	0.00724	19
Technology	Equipment infrastructure	0.008384	21	0.004121	20	0.004077	22
	Data-driven services	0.007953	22	0.001381	23	0.002529	23
	Mutual trust	0.012482	20	0.002665	22	0.00412	21
	Easy communication	0.01908	15	0.00359	21	0.005867	20

After a hierarchical analysis, based on the weighting of the sub-criteria, the sub-criteria leading to the selection of suppliers in each product grade have different weights.

6. Conclusion

The purpose of this study is to determine supplier selection's criteria and sub-criteria for each grade quality basic apparel products in the e-commerce small medium enterprises (SME) brand based on fourth-party logistics environment. This study seeks to develop a comprehensive selection of elections by asking for expert opinion through the Modified Delphi method and the selected AHP method. Expert survey was conducted to determine the important criteria and sub-criteria The evaluation criteria were first selected based on the results of the literature review, and then the important criteria and sub-criteria from the modified Delphi survey, and then the results were classified hierarchically, grouped by similarity for the calculation of AHP.

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