Analysis of Logistics Cost of the Maritime
(Case of Tanjung Priok Port)

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Abstract:- This research aims to examine and analyze the factors that cause the low performance of Indonesian logistics. Logistics performance evaluation was a multi-criteria issue in which there were factors that must be considered. This research would use Factor Analysis and AHP (Analitycal Hirarki Process) metods to determine priority of logistic performance and how to reduce maritime costs. Results of Factor Analysis starting from 17 factors into 9 factors which are divided into 3 criteria, namely transportation costs, guarantor costs and shipping costs. The weight of the transportation fee is 0.40645, the weight of the shipping cost is 0.33347 and the weight of the guarantee fee is 0.26008. By running AHP method, it was concluded that the most influenced cost factors for maritime logistics costs were P2 (behandle costs), P3 (online order delivery costs), P7 (compatibility of costs with services obtained), P13 (container guarantee costs), P14 (fees container transfer services). This research has managerial implications where it is suggested for the ministry of maritime coordinator to making new regulations related to the 5 factors that most influenced to logistics costs and coordinate with related parties in reduce maritime logistics costs.

Keywords:- AHP, Logistic Costs, Factor Analysis, MCDM.

I. INTRODUCTION

Indonesia's logistics performance in 2018 is still considered low in the Asean region. Although in that year Indonesia's logistics performance has improved, but still far behind compared to Singapore, Malaysia, and Thailand, even Indonesia is only able to occupy position 46 in the world. The position of Indonesia's logistics performance can be seen in figure 1 below.

Fig.1:- Indonesia's Logistics Performance Position
Source: Logistic Performance Index (2018)

The assessment conducted by LPI is based on six aspects, namely, the efficiency of customs & border management clearance (customs), the quality of trade and transportation infrastructure, ease of international shipping arrangements, the competence and quality of logistics services, the ability to track & tracing, and the frequency of timely deliveries. LPI highlighted the high logistics costs in Indonesia, which is 23.5% in 2018 or still lagging behind other countries in ASEAN. These logistical costs are seen in table 1 below.

Country	% Logistics Costs to GDP
Singapore	8,1 %
Malaysia	13,2 %
Thailand	13,2 %
Vietnam	15 %
Indonesia	**23,5 %**

Table 1:- Percentage of logistics costs to GDP of ASEAN countries, Source: Logistics Performance Index (2018)

The high cost of logistics in Indonesia is not only caused by the high cost of land and sea transportation, but also is caused by other factors related to regulations, human resources, logistics processes and management that have not been efficient, and the lack of professionalism of actors and providers of national logistics services, causing inefficient domestic freight forwarding services.

In Indonesia, currently there are 4 main national ports namely Tanjung Priok, Tanjung Perak, Belawan and Makassar, all of which control the transportation of goods through containers for export and import, and Tanjung Priok port being the largest. Tanjung Priok Port has a total of 78 (seventy eight) berths and 14 (fourteen) containers. Total goods traffic in Tanjung Priok is 36 (thirty six) MT, of which half are for domestic needs and capacity for container operations is 3.6 (three point six) million TEUs. Goods transportation via inter-island shipping far exceeds the volume of international goods transport.

While the development of world cargo transportation is currently around 80% (eighty percent) transported using containers, with ship capacity continuing to increase from the size of 1,500 (one thousand five hundred) TEUs to 9,000 (nine thousand) TEUs. A ship with a size of 9,000 (nine thousand) TEUs requires a minimum of 13 (thirteen) meters berth. Even in 2013 12,000 (twelve thousand) TEUs container transport vessels are expected to operate, which requires a minimum berth depth of 18 (eighteen) meters.

It is indicated that port costs make a major contribution to total logistics costs.

High prices of inter-island logistics costs will affect the final price consumers will receive. Factors affecting logistical costs include inadequate quality of infrastructure / facilities, frequency of ship departure, vessel loading, port location, shipping density at the port, warehousing and administration. Based on this background, the researchers took *"The Maritime Cost Analysis (Case Study of Tanjung Priok Port)"*.

II. RESEARCH OBJECTIVES

The research objectives in this study are as follows:
1) Analyzing the calculation of logistics costs at the Port of Tanjung Priok.
2) Knowing what factors most influence the cost of maritime logistics at Tanjung Priok Port.
3) Proposed recommendations in an effort to improve maritime logistics performance at the Port of Tanjung Priok.

III. LITERATURE REVIEWS

A. Logistics

According to Li, X. (2014: 1) Logistics is the management of the flow of goods movement from a point of origin that ends at the point of consumption to meet certain demands, for example directed to consumers or companies. While the understanding of logistics according to the Council of Supply Chain Management Professionals in Chandra (2013) logistics is part of supply chain management in planning, implementing and controlling the flow and storage of goods, information, and services that is effective and efficient from point of origin to point destination in accordance with consumer demand.

Lambert and Stock (2001) argues that to flow goods from origin to destination will require several activities known as, key activities in logistics including: customer service, demand forecasting, inventory management, logistical communication, traffic and transportation, and warehousing and storage. Bowersox (2002) said that there are 5 components that make up the logistics system, namely: the location of the facility, transportation, inventory procurement, communication, and handling & storage. Furthermore, logistics activities also involve a variety of stakeholders, such as consumers, logistics players, logistics service providers, logistics supporters, and the government. According to Lambert and Stock (1998), effective logistics management enhances the company's marketing efforts by providing efficient transfer of a product to customers, time and place utilities for the product. Based on the above definitions it can be concluded that logistics is the management of the flow of goods movement from the point of origin to the point of consumption through activities in a supply chain that involves various kinds of stockholders in order to increase company marketing.

B. Measurement of Logistics Performance

According to Sorooshian (2013) SCM is a network management of organizations from upstream to downstream that includes relations between two or more companies and material flows, information and resources. While logistics is a process of planning, implementing, and controlling procedures for the transportation and storage of goods efficiently and effectively. Research by Klapper et al. on Hartyorejo (2015) result that the performance of logistics services affect customer satisfaction, which has a relationship with customer loyalty and market share. Customer satisfaction depends on the quality of the management of the flow of goods and services. The role of distribution and management networks is very important to meet consumer demand so as to increase sales and profits, in order to face the integration of the AEC free market.

C. Cross Docking

There are several types of Cross Docking that can generally be applied, among others (http://logistics.about.com): Pre-Packed Cross Docking, and Intermediate Handling Cross Docking. Meanwhile, in the cross docking warehouse management scenario it has 3 types, namely: Manufacturing Cross Docking, Distributor Cross Docking, and Retail Cross Docking.

D. Transportation

According to Ritonga, D., et., al. (2015) Transportation is a process of movement or movement of people or goods from one place to another by using a certain system to meet human needs by moving and interacting. Its function is to connect people with land use, binding activities and providing the use of space and time for the commodities needed. According to Lambert and Stock (1998). There are 2 factors that affect transportation costs, namely: Product-related Factors, and Market-related Factors.

E. Stock

According to Stevenson W. J. & Chuong S.C. (2014:179) inventory is the stock or storage of goods. Companies usually keep hundreds or even thousands of items in stock. Inventory is a vital part of business. Inventories are not only necessary for operations but also contribute to customer satisfaction. In this research , the more emphasized function is regarding protection against out of stock, to take advantage of quantity discounts and to meet estimated customer demand. While Siagian (2006) argues that Inventory owned by the company aims to maintain smooth business. For trading companies, merchandise inventory allows the company to meet buyer demand. As for industrial companies, the supply of raw materials and goods in the process aims to facilitate the production activities, while the inventory of finished goods is intended to meet market needs. The inventory function is divided into four types, namely: the region dividing function, the decoupling function, the balancing function with demand, and the buffer function.

F. Warehouse

Warehouse is an important component of the modern supply chain. The supply chain involves activities in various stages such as sourcing, production and distribution of goods from handling raw materials and processed goods to finished products. Warehouse can be described as part of a company's logistics system that functions to store products and provide information about the status and condition of material or inventory stored in the warehouse so that the information is always up-to-date and easily accessible to anyone with an interest. Warehouse is an integral part of the supply chain. Trending challenges in the supply chain such as increased market volatility, and the need to shorten customer lead times all have an impact on the expected role of warehouses (Rushton, A., et. Al. 2010).

G. Scheduling

According to Stevenson W. J. & Chuong S.C. (2014) In an organization, scheduling or scheduling is related to the timing of the specific use of resources of the organization. Scheduling is related to the use of equipment, facilities, and human activities. Scheduling occurs within each organization regardless of the nature of its activities. Effective scheduling can result in cost savings and increased productivity. In addition, effective scheduling can produce other benefits.

H. Factor Analysis

Factor analysis is an analysis used to reduce or summarize a number of variables to be smaller, but does not reduce the meaning of the original variables. Factor analysis aims to confirm the structure of the factors analyzed based on the concept (theory) or measuring construct validity which shows how well the results obtained from the use of meters are in accordance with theories. Another goal of factor analysis is to obtain a measure (in the form of a score) of latent variables based on several measurable variables. Based on the purpose of factor analysis, there are 2 types of factor analysis namely 1) Exploratory Factor Analysis is a factor analysis that aims to reduce (summarize) a number of variables into one or several factors, 2) Confirmatory Factor Analysis is a factor analysis which is a descriptive model with the aim of describing a situation or a concept or a factor, such as researchers want to get a picture of the structure of brand loyalty and the structure of marketing concepts.

I. Analytical Hierarchy Process

According to Saaty (1993: 25) Analytical Hierarchy Process (AHP). Is a method that details a complex or unstructured situation into components, then organizes parts or variables of these components into a hierarchical arrangement and gives a numerical value to this consideration for determine which variable has the highest priority.

J. Theoretical Framework

The framework for this research can be seen in figure 2 below.
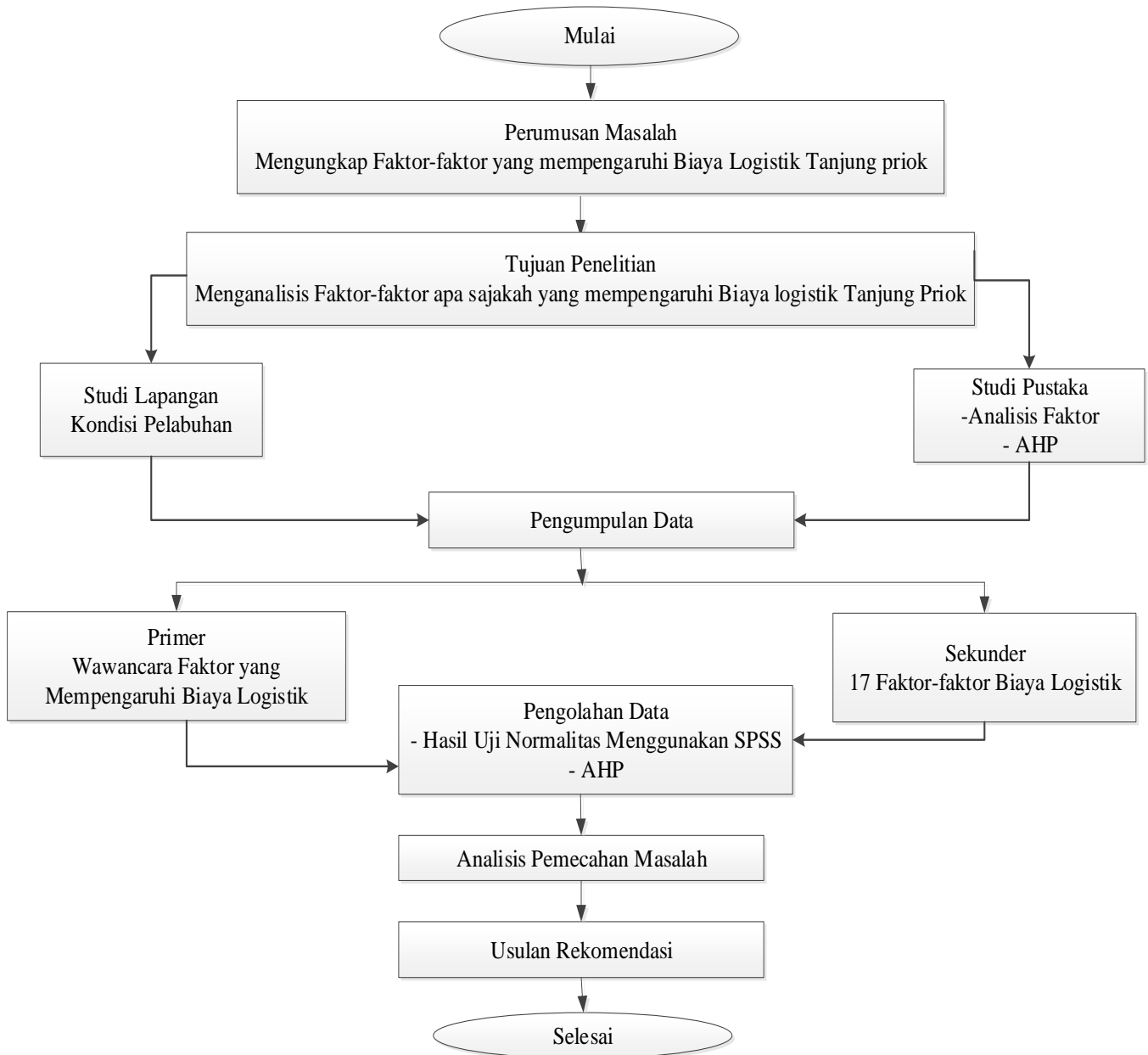
Fig. 2:- Theoretical Framework
Source: Theoretical Reviews

IV. METHODELOGY

This research is quantitative by using factor analysis and Analytical Hierarchy Process methods. The population in this study is the logistics service users of priority lane, red lane, yellow lane and green lane as many as 120 companies using Tanjung Priok Port logistics services. While the sample used in this study is a sample of logistics service users on the red line as many as 30 companies because the path is the most expensive path of the entire line of logistics service users.

V. RESULT

A. Validity and Reliability

Based on the results of the validity test, it was found that the entire value of r results > r table (0.3610). This means that all statement items are declared valid. The results of the validity test of this study can be seen in figure 3 below.

Correlations

		P1	P2	P3	P4	P5	P6
P1	Pearson Correlation	1	-,065	,103	,207	,379*	,419*
	Sig. (2-tailed)		,734	,590	,272	,039	,021
	N	30	30	30	30	30	30
P2	Pearson Correlation	-,065	1	,309	,275	-,083	,280
	Sig. (2-tailed)	,734		,097	,142	,662	,133
	N	30	30	30	30	30	30
P3	Pearson Correlation	,103	,309	1	,272	,513**	,255
	Sig. (2-tailed)	,590	,097		,145	,004	,174
	N	30	30	30	30	30	30
P4	Pearson Correlation	,207	,275	,272	1	,152	,380*
	Sig. (2-tailed)	,272	,142	,145		,423	,038
	N	30	30	30	30	30	30
P5	Pearson Correlation	,379*	-,083	,513**	,152	1	,319
	Sig. (2-tailed)	,039	,662	,004	,423		,086
	N	30	30	30	30	30	30
P6	Pearson Correlation	,419*	,280	,255	,380*	,319	1
	Sig. (2-tailed)	,021	,133	,174	,038	,086	
	N	30	30	30	30	30	30
P7	Pearson Correlation	,301	,394*	,253	-,002	,212	,519**
	Sig. (2-tailed)	,106	,031	,177	,992	,262	,003
	N	30	30	30	30	30	30
P8	Pearson Correlation	,230	,071	,484**	,222	,256	,135
	Sig. (2-tailed)	,222	,711	,007	,239	,172	,476
	N	30	30	30	30	30	30

Correlations

		P7	P8	P9	P10	P11	P12
P1	Pearson Correlation	,301	,230	,330	,365*	,211	,430*
	Sig. (2-tailed)	,106	,222	,075	,047	,264	,018
	N	30	30	30	30	30	30
P2	Pearson Correlation	,394*	,071	,050	-,050	,234	,170
	Sig. (2-tailed)	,031	,711	,794	,793	,214	,370
	N	30	30	30	30	30	30
P3	Pearson Correlation	,253	,484**	,131	,026	-,125	,229
	Sig. (2-tailed)	,177	,007	,491	,890	,510	,223
	N	30	30	30	30	30	30
P4	Pearson Correlation	-,002	,222	-,046	,372*	-,028	,207
	Sig. (2-tailed)	,992	,239	,809	,043	,883	,272
	N	30	30	30	30	30	30
P5	Pearson Correlation	,212	,256	-,042	,244	-,080	,467**
	Sig. (2-tailed)	,262	,172	,827	,193	,676	,009
	N	30	30	30	30	30	30
P6	Pearson Correlation	,519**	,135	,220	,344	,302	,158
	Sig. (2-tailed)	,003	,476	,243	,063	,105	,405
	N	30	30	30	30	30	30
P7	Pearson Correlation	1	,256	,279	-,051	,326	,286
	Sig. (2-tailed)		,172	,135	,788	,079	,126
	N	30	30	30	30	30	30
P8	Pearson Correlation	,256	1	,503**	,177	,027	-,008
	Sig. (2-tailed)	,172		,005	,350	,888	,967
	N	30	30	30	30	30	30

Correlations

		P13	P14	P15	P16	P17	Total
P1	Pearson Correlation	,144	,263	,332	,072	,066	,556**
	Sig. (2-tailed)	,448	,160	,073	,706	,729	,001
	N	30	30	30	30	30	30
P2	Pearson Correlation	,158	,148	,201	,247	,277	,428*
	Sig. (2-tailed)	,404	,434	,286	,189	,138	,018
	N	30	30	30	30	30	30
P3	Pearson Correlation	,105	,261	,312	,366*	,268	,565**
	Sig. (2-tailed)	,580	,164	,093	,047	,152	,001
	N	30	30	30	30	30	30
P4	Pearson Correlation	,540**	,362*	-,091	,274	,434*	,528**
	Sig. (2-tailed)	,002	,049	,631	,142	,016	,003
	N	30	30	30	30	30	30
P5	Pearson Correlation	,143	,170	,150	,098	,281	,492**
	Sig. (2-tailed)	,450	,369	,428	,608	,133	,006
	N	30	30	30	30	30	30
P6	Pearson Correlation	,290	,190	,281	,258	,149	,656**
	Sig. (2-tailed)	,120	,316	,133	,169	,433	,000
	N	30	30	30	30	30	30
P7	Pearson Correlation	-,011	-,049	,577**	,098	,160	,542**
	Sig. (2-tailed)	,953	,798	,001	,606	,398	,002
	N	30	30	30	30	30	30
P8	Pearson Correlation	,197	,410*	,311	,175	,144	,539**
	Sig. (2-tailed)	,297	,025	,094	,355	,448	,002
	N	30	30	30	30	30	30

Correlations

		P1	P2	P3	P4	P5	P6
P9	Pearson Correlation	,330	,050	,131	-,046	-,042	,220
	Sig. (2-tailed)	,075	,794	,491	,809	,827	,243
	N	30	30	30	30	30	30
P10	Pearson Correlation	,365*	-,050	,026	,372*	,244	,344
	Sig. (2-tailed)	,047	,793	,890	,043	,193	,063
	N	30	30	30	30	30	30
P11	Pearson Correlation	,211	,234	-,125	-,028	-,080	,302
	Sig. (2-tailed)	,264	,214	,510	,883	,676	,105
	N	30	30	30	30	30	30
P12	Pearson Correlation	,430*	,170	,229	,207	,467**	,158
	Sig. (2-tailed)	,018	,370	,223	,272	,009	,405
	N	30	30	30	30	30	30
P13	Pearson Correlation	,144	,158	,105	,540**	,143	,290
	Sig. (2-tailed)	,448	,404	,580	,002	,450	,120
	N	30	30	30	30	30	30
P14	Pearson Correlation	,263	,148	,261	,362*	,170	,190
	Sig. (2-tailed)	,160	,434	,164	,049	,369	,316
	N	30	30	30	30	30	30
P15	Pearson Correlation	,332	,201	,312	-,091	,150	,281
	Sig. (2-tailed)	,073	,286	,093	,631	,428	,133
	N	30	30	30	30	30	30
P16	Pearson Correlation	,072	,247	,366*	,274	,098	,258
	Sig. (2-tailed)	,706	,189	,047	,142	,608	,169
	N	30	30	30	30	30	30
P17	Pearson Correlation	,066	,277	,268	,434*	,281	,149
	Sig. (2-tailed)	,729	,138	,152	,016	,133	,433
	N	30	30	30	30	30	30
Total	Pearson Correlation	,556**	,428*	,565**	,528**	,492**	,656**
	Sig. (2-tailed)	,001	,018	,001	,003	,006	,000
	N	30	30	30	30	30	30

Fig.3:- Result of Validity Test
Source: Analysis Result with SPSS version 24

From the results of the reliability test, the Cronbach's Alpha coefficient value of 0.814 was obtained which indicates the price is greater than the value set at 0.70. The reliability test results of this study can be seen in Table 2 below.

Cronbach's Alpa	N of Item
814	17

Table 2:- Result of Reliability Test
Source: Analysis Result with SPSS version 24

B. Measure of Sampling Adequacy (MSA)

Measure of Sampling Adequacy (MSA) is used to determine whether the variable is sufficient for further analysis. This value can be seen in the anti-image correlation matrix value. If the MSA value is greater than 0.5 then the variable is sufficient for further analysis. If there is an MSA value of initial variables less than 0.5, one must be excluded one by one from the analysis, sorted from the variable with the smallest MSA value and not used again in subsequent analyzes. MSA Test Results can be seen in figure 4 below.

Anti-image Matrices

		P1	P2	P3	P4	P5	P6
Anti-image Covariance	P1	,466	,076	,099	-,042	-,037	-,099
	P2	,076	,506	-,098	-,072	,082	-,026
	P3	,099	-,098	,324	-,057	-,125	-,044
	P4	-,042	-,072	-,057	,370	,128	-,131
	P5	-,037	,082	-,125	,128	,281	-,113
	P6	-,099	-,026	-,044	-,131	-,113	,311
	P7	,023	-,108	,058	,093	,039	-,181
	P8	-,023	,057	-,073	-,107	-,103	,131
	P9	-,072	,007	-,044	,141	,157	-,087
	P10	-,025	,074	,069	-,120	-,117	,002
	P11	,081	-,103	,080	,090	,080	-,089
	P12	-,140	-,016	-,039	-,096	-,159	,171
	P13	,040	,029	,111	-,084	,013	-,109
	P14	-,035	-,116	-,052	,059	,088	-,031
	P15	-,144	,013	-,102	-,017	-,027	,060
	P16	,013	-,037	-,166	,077	,102	-,033
	P17	-,001	-,106	-,038	-,143	-,109	,123
Anti-image Correlation	P1	,709a	,157	,256	-,100	-,103	-,260
	P2	,157	,614a	-,242	-,167	,218	-,065
	P3	,256	-,242	,591a	-,165	-,413	-,137
	P4	-,100	-,167	-,165	,529a	,398	-,387
	P5	-,103	,218	-,413	,398	,405a	-,383
	P6	-,260	-,065	-,137	-,387	-,383	,485a
	P7	,058	-,267	,179	,270	,131	-,570
	P8	-,062	,149	-,236	-,325	-,359	,435
	P9	-,172	,016	-,128	,381	,484	-,255
	P10	-,067	,192	,224	-,365	-,410	,005
	P11	,179	-,218	,212	,224	,227	-,242
	P12	-,347	-,039	-,116	-,269	-,509	,520
	P13	,086	,061	,291	-,204	,037	-,291
	P14	-,083	-,262	-,148	,157	,267	-,091
	P15	-,324	,028	-,275	-,043	-,077	,166
	P16	,023	-,067	-,371	,162	,245	-,076
	P17	-,001	-,201	-,089	-,316	-,277	,297

Anti-image Matrices

		P13	P14	P15	P16	P17
Anti-image Covariance	P1	,040	-,035	-,144	,013	-,001
	P2	,029	-,116	,013	-,037	-,106
	P3	,111	-,052	-,102	-,166	-,038
	P4	-,084	,059	-,017	,077	-,143
	P5	,013	,088	-,027	,102	-,109
	P6	-,109	-,031	,060	-,033	,123
	P7	,088	,059	-,143	,008	-,104
	P8	-,100	-,143	,004	-,007	,054
	P9	,058	,103	-,017	,044	-,092
	P10	,060	-,201	,068	-,125	-,019
	P11	-,025	,094	-,180	,035	-,012
	P12	-,103	-,099	,093	-,048	,062
	P13	,454	-,050	,000	-,187	-,149
	P14	-,050	,383	-,004	,067	,079
	P15	,000	-,004	,424	-,022	,096
	P16	-,187	,067	-,022	,615	,015
	P17	-,149	,079	,096	,015	,553
Anti-image Correlation	P1	,086	-,083	-,324	,023	-,001
	P2	,061	-,262	,028	-,067	-,201
	P3	,291	-,148	-,275	-,371	-,089
	P4	-,204	,157	-,043	,162	-,316
	P5	,037	,267	-,077	,245	-,277
	P6	-,291	-,091	,166	-,076	,297
	P7	,231	,168	-,385	,019	-,246
	P8	-,275	-,428	,010	-,017	,135
	P9	,141	,274	-,043	,092	-,203
	P10	,165	-,601	,194	-,296	-,047
	P11	-,056	,230	-,418	,068	-,024
	P12	-,260	-,271	,243	-,103	,140
	P13	,603a	-,120	-,001	-,353	-,297
	P14	-,120	,507a	-,010	,139	,172
	P15	-,001	-,010	,613a	-,044	,199
	P16	-,353	,139	-,044	,611a	,026
	P17	-,297	,172	,199	,026	,554a

a. Measures of Sampling Adequacy(MSA)

Fig.4:- Result of MSA Test
Source: Analysis Result with SPSS version 24

From the table above it can be seen that because there are 6 variables that do not have an MSA of more than 0.5, it is attempted to be smoothed again with 11 variables whose MSA is above 0.5. And from the second run, there are 9 variables with MSA above 0.5, while P1 has MSA smaller than 0.5. each has an MSA value of more than 0.5. So that P1 is not included for the next stage. And try running third because there are still variables whose value is below the MSA value of 0.5. From the third running, 9 variables have MSA values above 0.5. So it can be concluded that the variables are sufficient for further analysis.

C. Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test

Steps taken after each initial variable to be included in the analysis were obtained, namely testing the adequacy of the sample through the Kaiser Meyer-Olkin (KMO) Measure of Sampling Adequacy index and the significance value of Bartlett's Test of Sphericity. This index is used to examine the accuracy of the use of factor analysis. If the KMO value is between 0.5 to 1 and the significance of Bartlett's Test of Sphericity is less than the level of significance (?) used it can be interpreted that the factor analysis is appropriate. From the SPSS 24 output, the KMO value is 0.509 and the significance value of Bartlett's Test of Sphericity is 0.016 so that it can be concluded that the proper factor analysis is used to simplify the collection of 9 variables. The following is table 3 Results of KMO and Bartlett's Test of Sphericity.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	,658
Bartlett's Test of Sphericity ApproP. Chi-Square	56,394
Df	36
Sig	,016

Table 3:- Result of KMO and Barletts Test
Source: Analysis Result with SPSS version 24

D. Factor Formation

After the variables are determined and selected and the correlation calculation has met the requirements for analysis, the next step is to form a factor to find the structure that underlies the relationship between the initial variables. The method used in factor formation is the principal component analysis method. The two main steps in forming factors are determining the number of factors and rotating the factors formed. These results can be seen in figure 5 below.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,785	30,947	30,947	2,785	30,947	30,947
2	1,857	20,638	51,585	1,857	20,638	51,585
3	1,043	11,586	63,171	1,043	11,586	63,171
4	,785	8,723	71,894			
5	,727	8,073	79,968			
6	,674	7,489	87,456			
7	,461	5,117	92,574			
8	,352	3,912	96,486			
9	,316	3,514	100,000			

Fig. 5:- Total Explained variance
Source: Analysis Result with SPSS version 24

The first criterion used is the eigenvalue is a factor that has an eigenvalue of more than 1 will be maintained and factors that have an eigenvalue of less than 1 will not be included in the model. From the picture above we get an eigenvalue greater than 1 at a factor of 1,2,3. With this criterion, the number of factors used is 3 factors.

The second criterion is determination based on the percentage value of total variance which can be explained by the number of factors to be formed. From the table above, interpretation can be made relating to the cumulative total variance of the sample. If the variables are summarized into several factors, the total value of variance that can be explained is as follows:

1) If all 8 variables are extracted into 1 factor, the total variance that can be explained is 2.785 ⁄ 9 x100% = 30.947%.
2) If all 8 variables are extracted into 2 factors, the total variance that can be explained is 1.857 ⁄ 9 X 100% = 20.638%,
3) If all 8 variables are extracted into 3 factors, the total variance that can be explained is 1.043 ⁄ 9 X 100% = 11.5886%, and the cumulative total variance for 3 factors is 30.947% + 20.638% + 11.586 = 63.171% by extracting the variable - initial variables into 3 factors resulted in a cumulative total variance that was quite large, namely 63.171%, meaning that of the 3 factors that were formed could represent 9 variable reduction in logistics costs

which explained approximately 63,171 logistical costs. Thus the extraction of 3 factors obtained can be stopped and has met the second criterion.

The third criterion is determination based on scree plot. Scree plot is a plot of the eigenvalue of the number of factors extracted. The point at which the scree begins occurs indicates the exact number of factors. This point occurs when the scree begins to look horizontal. In Figure 6 it is known that the scree plot begins to level off at the extraction of the initial variables into 3 factors.
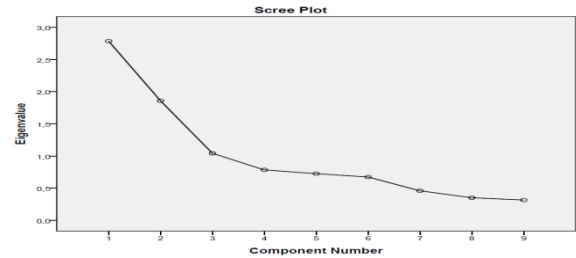

Fig.6:- Scree Plot Test
Source: Analysis Result with SPSS version 24

E. Communality

Communality is basically the amount of variance of a variable that can be explained by existing factors. The results of the communality test in this study can be seen in table 4 below.

	P2	P3	P4	P7	P13	P14	P15	P16	P17
Initial	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Extraction	,490	,547	,656	,741	,621	,687	,718	,468	,757

Table 4:- Result of Communalities Test
Source: Analysis Result with SPSS version 24

F. Component Matrix

After knowing that 3 factors are the most optimal number, the matrix component table shows the distribution of 9 variables on 3 factors formed while the figures in the table are factor loadings, which shows the correlation between a variable with factor 1 factor 2 and factor 3. The process of determining which variables will be included into which factors, carried out by making a large comparison of correlations for each row. Component Matrix test results in this study can be seen in table 5 below.

Factor	P2	P3	P4	P7	P13	P14	P15	P16	P17
1	,594	,622	,704	,360	,641	,470	,218	,620	,596
2	,320	,294	-,387	,758	-,448	-,268	-,801	-,062	-,159
3	-,187	,271	-,0,99	-,193	-,093	,628	,167	,283	-,613

Table 5:- Result of Component Matrix Test
Source: Analysis Result with SPSS version 24

G. Rotation

The process of rotation in the results of this research aims to obtain factors with loading factors that are clear enough for interpretation. Rotated component matrix

component is a correlation matrix that shows the distribution of variables that are clearer and more real than the component matrix. Rotation test results in this study can be seen in Table 6 below.

Factor	P2	P3	P4	P7	P13	P14	P15	P16	P17
1	0,556	0,511	-,040	,851	-,123	-.086	,803	,188	,156
2	,403	,145	,688	,0,83	,665	,028	-,257	,269	0,851
3	,137	,555	,425	-,102	,405	,824	,084	,600	-,088

Table 6:- Result of Rotation Test
Source: Analysis Result with SPSS version 24

H. Interpretation of Factor Analysis Results

The next step is to determine the significance of the loading factor value to determine the grouping of variables into the corresponding factors. According to experts in the multivariate field, a loading factor value of 0.55 has been considered significant for a sample size of 100 respondents at a significance level $\alpha = 0.05$. Based on this, in the interpretation of all loading factors will be considered significant if the value is 0.55 or more. The following is the grouping of initial variables into 2 factors that have been formed.

Based on table 6 it can be seen that the variable P15 has the highest loading factor value at factor 1 which is 0.803. According to the guidelines above, the value has been considered significant because it is greater than 0.55. While the loading factor value by a factor of 3 is very small, so this variable is included in factor 1. The P17 variable has the highest factor loading value in factor 2, which is 0.851. According to the guidelines above, the value has been considered significant because it is greater than 0.55. While

the value of the loading factor with a factor of 3 is very small, so this variable is included in factor 2. Likewise, the determination of other variables. The following is table 7 results of grouping variables into factors.

Factor	Variable
1. Transportation	P2, P7, P15
2. Guarantee	P4, P13, P17
3. Delivery	P3, P14, P16

Table 7: Results of Grouping Variables into Factors
Source: Analysis Result with SPSS version 24

I. Hierarchy Structure Evaluation of Maritime Logistics Costs

The hierarchical structure is used to determine the cost factors that most influence the current maritime logistics costs. The costs obtained by grouping using factor analysis in the previous stage are then arranged into a hierarchical form as can be seen in figure 7 below.
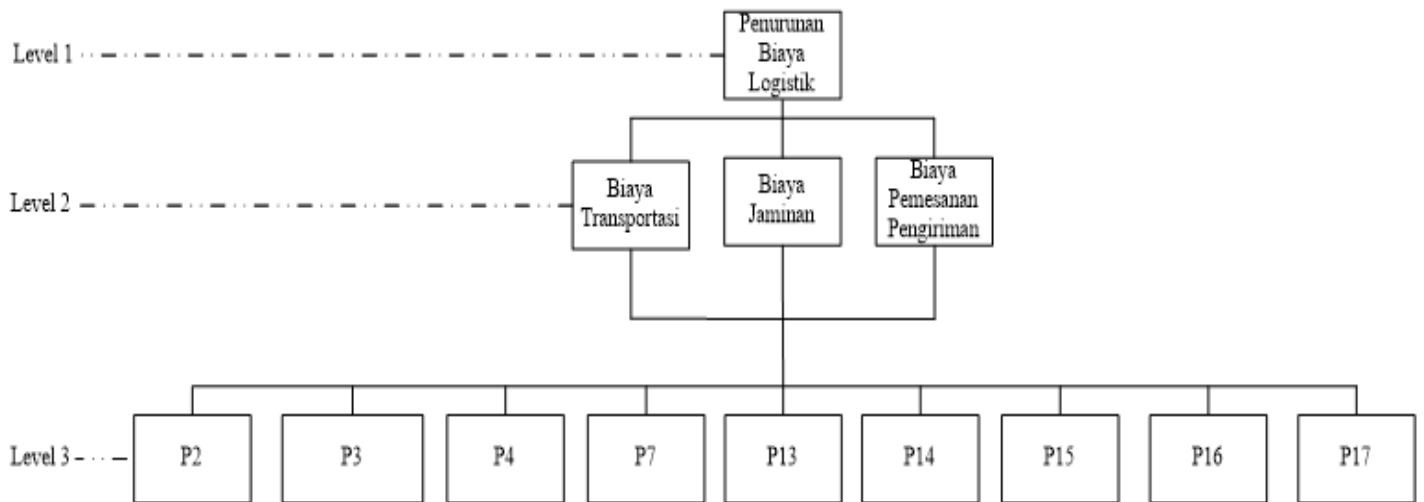

Fig.7:- Hierarchical Structure of Maritime Logistics Cost Analysis
Source: AHP Method

J. Pairwise Comparison Matrix

Paired comparison matrices at level 2 are obtained from the results of a questionnaire that is part of the AHP. This

matrix aims . The interests of each cost. The results of the comparison of the pairs of level 2 matrix can be seen in Table 8 below.

Element	Respondent 1		
	Transportation	Guarantee	Shopping Orders
Trasportation	1	5	7
Guarantee	1/5	1	3
Shipping Orders	1/7	1/3	1
Element	Respondent 2		
	Transportation	Guarantee	Shopping Orders
Trasportation	1	3	5
Guarantee	1/3	1	3
Shipping Orders	1/5	1/3	1
Element	Respondent 3		
	Transportation	Guarantee	Shopping Orders
Trasportation	1	5	5
Guarantee	1/5	1	5
Shipping Orders	1/5	1/5	1

Table 8:- Pairwise Level Comparative Matrix
Source: AHP Method

Paired comparison matrices at level 3 are obtained from the results of a questionnaire that is part of the AHP. This matrix aims to see the comparison of each of the factors of each cost and the level of importance of each of these factors. The results of the comparison level matrix pair 3 can be seen in Table 9 below.

Element	Respondent 1								
	P2	P7	P15	P4	P13	P17	P3	P14	P16
P2	1	3	7	5	1/3	9	3	3	7
P7	1/3	1	3	3	1/3	9	1/3	5	7
P15	1/7	1/3	1	1/3	1/5	3	1/5	3	3
P4	1/5	1/3	3	1	1/2	5	1/3	5	5
P13	3	3	5	2	1	9	3	1/3	9
P17	1/9	1/9	1/3	1/5	1/9	1	1/9	1/5	1/5
P3	1/3	3	5	3	1/3	9	1	3	9
P14	1/3	1/5	3	1/5	1/3	5	1/3	1	5
P16	1/7	1/7	1/3	1/5	1/9	5	1/9	1/5	1
Element	Respondent 2								
	P2	P7	P15	P4	P13	P17	P3	P14	P16
P2	1	3	9	3	7	9	1/3	5	9
P7	1/3	1	5	3	1/2	7	1/3	3	5
P15	1/7	1/5	1	1/3	1/3	3	1/7	1/5	3
P4	1/3	1/3	3	1	1/3	6	1/3	3	7
P13	1/7	2	3	3	1	9	1/5	1/3	5
P17	1/9	1/7	1/3	1/6	1/9	1	1/9	1/3	1/5
P3	3	3	7	3	5	9	1	3	7
P14	1/9	1/3	5	1/7	3	3	1/3	1	1/2
P16	1/9	1/5	1/3	1/7	1/5	5	1/7	2	1
Element	Respondent 3								
	P2	P7	P15	P4	P13	P17	P3	P14	P16
P2	1	3	9	3	5	9	3	5	9
P7	1/3	1	4	3	1/2	7	1/3	3	5
P15	1/9	1/4	1	1/3	1/3	3	1/3	1/5	1/3
P4	1/3	1/3	3	1	1/3	5	1/3	3	3
P13	1/5	2	3	3	1	5	1/3	1/3	3
P17	1/9	1/7	1/3	1/5	1/5	1	1/9	1/5	7
P3	1/3	3	3	3	3	9	1	3	9
P14	1/5	1/3	5	1/3	3	5	1/3	1	5
P16	1/9	1/5	3	1/3	1/3	1/7	1/9	1/5	1

Table 9:- Pair 3 Element Level Comparative Matrices
Source: AHP Method

K. Calculation of Average Weighting for Each Cost and Cost Factors

In AHP, weighting average calculation is done using geometric averages. The geometric mean values are considered as the results of group assessments of the values given by respondents. Table 10 below is the result of calculating the weighted average.

	Transportation	Quality Guarantee	Shipping Orders
Transportation	1,000	4,217	5,593
Quality Guarantee	0,237	1,000	3,557
Shipping Orders	0,179	0,281	1,000

Table 10:- Calculation of Average Weighting for Costs
Source: AHP Method

Calculation of the weighting average for each cost factor is done using the same method as the weighting calculation for the criteria. The results can be seen in table 11 below.

	P2	P7	P15	P4	P13	P17	P3	P14	P16
P2	1,0000	3,0000	8,2768	3,5569	2,2680	9,0000	1,4422	4,2172	8,2768
P7	0,3333	1,0000	3,9149	3,0000	0,4368	7,6117	0,3333	3,5569	5,5934
P15	0,1314	0,2554	1,0000	0,3333	0,2811	3,0000	0,2120	0,4932	1,4422
P4	0,2811	0,3333	3,0000	1,0000	0,3816	5,3133	0,3333	3,5569	4,7177
P13	0,4409	2,2894	3,5569	2,6207	1,0000	7,3986	0,5848	0,3333	5,1299
P17	0,1111	0,1314	0,3333	0,1882	0,1352	1,0000	0,1111	0,2371	0,6542
P3	0,6934	3,0000	4,7177	3,0000	1,7100	9,0000	1,0000	3,0000	8,2768
P14	0,1949	0,2811	4,2172	0,2120	1,4422	4,2172	0,3333	1,0000	2,3208
P16	0,1208	0,1788	0,6934	0,2120	0,1949	1,5286	0,1208	0,4309	1,0000

Table 11:- Calculation of Average Weighting for Cost Factors
Source: AHP Method

L. Calculation of Partial Weight and Matrix Consistency for Level 2 Elements (Cost)

Calculation of the average number of weights for level 2 elements is presented in table 12 below.

Element	Total
Transportation	1,416
Guarantee	5,498
Shipping Orders	10,150

Table 12:- Sum of Average Weightings for Level 2 Elements
Source: AHP Method

Each cell is processed in the same way, the weight calculation is done by finding the average of each row of the normalized matrix. The results can be seen in table 13 below.

	Transportation	Quality Guarantee	Shipping Orders	Partial Weight
Transportation	0,7063	0,7670	0,5511	0,6748
Quality Guarantee	0,1675	0,1819	0,3504	0,2333
Shipping Orders	0,1263	0,0511	0,0985	0,0920
Total	1,0000	1,0000	1,0000	1,0000

Table 13:- Normalization Matrix and Weight of Each Row of Level 2 Elements
Source: AHP Method

M. Calculation of Partial Weight and Matrix Consistency for Level 3 Elements (Cost Factors)
   Calculation of the average number of weights for level 2 elements is presented in table 14 below.

Element	Total
P2	3,3070
P3	4,4710
P4	14,1231
P7	10,4695
P13	7,8499
P14	16,8225
P15	29,7101
P16	37,4119
P17	48,0693

Table 14:- Sum of Average Weightings for Level 3 Elements
Source: AHP Method

Each cell is processed in the same way, the weight calculation is done by finding the average of each row of the normalized matrix. The results can be seen in table 15 below.

	P2	P7	P15	P4	P13	P17	P3	P14	P16	Partial Weight
P2	0,3024	0,2865	0,2786	0,2518	0,2889	0,1872	0,3226	0,2506	0,22123	0,2656
P7	0,1008	0,0955	0,1318	0,2124	0,0556	0,1583	0,0746	0,2114	0,14951	0,1322
P15	0,0397	0,0244	0,0337	0,0236	0,0358	0,0624	0,0474	0,0293	0,03855	0,0372
P4	0,0850	0,0318	0,1010	0,0708	0,0486	0,1105	0,0746	0,2114	0,1261	0,0955
P13	0,1333	0,2187	0,1197	0,1856	0,1274	0,1539	0,1308	0,0198	0,13712	0,1363
P17	0,0336	0,0125	0,0112	0,0133	0,0172	0,0208	0,0249	0,0141	0,01749	0,0183
P3	0,2097	0,2865	0,1588	0,2124	0,2178	0,1872	0,2237	0,1783	0,22123	0,2106
P14	0,0589	0,0269	0,1419	0,0150	0,1837	0,0877	0,0746	0,0594	0,06203	0,0789
P16	0,0365	0,0171	0,0233	0,0150	0,0248	0,0318	0,0270	0,0256	0,02673	0,0253
Total	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000

Table 15: - Normalization Matrix and Weight of Each Level 3 Element Line
Source: AHP Method

N. Determination of Priority Weight
   After obtaining the values of the geometric mean, the partial weight and the consistency of the matrix, we will look for the partial weight which is the output of this AHP step. To get the priority weight in this research, the Super Decisions software is used. The initial step taken in this software is to build the AHP hierarchy. Then the hierarchy and relationships between levels in the hierarchy are determined and the matrix of geometric averages that have been obtained in the previous manual calculation will be input to the software. After all geometric averages have been entered then priority weighting results obtained from the study using the AHP method are as in table 16 below.

Element	Partial Weight
P2	0,22889
P3	0,19583
P4	0,10744
P7	0,14165
P13	0,13309
P14	0,11005
P15	0,03591
P16	0,02759
P17	0,01955

Table 16:- AHP Priority Weight
Source: AHP Method

From table 16, it can be seen that 3 cost factors with the highest weight and evaluation materials on maritime logistics costs are the factor cost of behavior (P2), online order delivery costs (P3), and ship service costs (P7). And for the highest cost weighting is the weight of transportation costs where: P2 + P7 + P15 = 0.22889 + 0.14165 + 0.03591 = 0.40645

VI. CONCLUTION AND SUGGESTIONS

A. Conclusion

Based on the results of the study related to the factors of transportation, guarantor and shipping, each individually and jointly influencing the reduction in logistics costs at the Tanjung Priok port, the conclusions of this study are as follows:

1) The results of the factor analysis that started from 17 cost factors into 9 cost factors are divided into 3 criteria, namely:

a) Transportation costs: Behavior costs (P2), ship service costs (P7) and the appropriateness of costs with services obtained (P15).

b) Guarantor Cost: The cost of ocean going containers (P4), container guarantee costs (P13), and the need to improve the quality of human resources and equipment at the port seen from the costs incurred (P17).

c) Shipping Costs: Online order delivery costs (P3), container transfer service fees (P14), and the need to improve the quality of service by the port if viewed from the costs incurred (P16).

2) The results of AHP obtained the most important cost is transportation costs when viewed from the total priority weights. The weight of transportation costs is P2 (0.22889) + P7 (0.14165) + P15 (0.03591) = 0.40645, then the weight of the Shipping cost is P3 (0.19583) + P14 (0.11005) + P16 (0.02759) = 0.33347 and the weight of the Guarantee fee is P13 (0.13309) + P4 (0.10744) + P17 (0.01955) = 0.26008. AHP results also obtained the most influencing cost factors for maritime logistics costs are P2 (be handle costs), P3 (online order delivery costs), P7 (ship service costs), P13 (container guarantee costs), P14 (container transfer fees box).

3) The establishment of new regulations related to the 5 logistical cost factors most influence maritime logistics so as to reduce maritime logistics costs.

B. Suggestion

Based on the research results described and discussed in the previous chapter related to the factors that affect logistics costs there are 9 variables that affect logistics costs and after AHP returns there are 5 variables that affect logistics costs, so the suggestions / recommendations made are as following:

1) Research development is not only in red lines.

2) Explore other cost factors for maritime logistics beyond the cost factors carried out in this study.

3) Explore and compare this research using other decision support methods such as ANP, Topsis, etc.

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