Contractors Selection of Warehouse Construction using AHP Method at PT. Bangun Eka Logitama

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Abstract

PT. Bangun Eka Logitma (PT. BEL) is a company engaged as a provider of warehousing services in Indonesia. PT. BEL is currently expanding its assets by building a new warehouse which will then be rented out to its customers. The construction of the warehouse was carried out by the Contractor where there were 4 prospective Contractors for this project. The purpose of this research is to determine the right contractor for the warehouse construction. The method used in the selection of contractors is the Analytical Hierarchy Process (AHP) method. The criteria used in this study consisted of 4 criteria, Task Performance, Contextual Performance, Price, and Network. While the 4 prospective contractors are PT. Mitralanggeng Prama Construction, PT. Sukses Trakindo, PT. Muri Agung Abadi & PT. Gerbang Sarana Baja. This study obtains the proportion of each criterion task performance = 0.339, price = 0.300, contextual performance = 0.293, and network = 0.68. Based on the criteria used in the contractor selection using the AHP method, the contractor with the highest score was PT. Muri Agung Abadi = 0.460, the second highest is PT. Sukses Trakindo = 0.351, the third highest is PT. Mitralanggeng Prama Construction = 0.118, and PT. Gerbang Sarana Baja have the lowest score = 0.071. So that the contractor chosen in the construction of PT. BEL is PT. Muri Agung Abadi.

Keywords: AHP, Criteria, Contractors Selection, Task Performance, Contextual Performance

INTRODUCTION

Industrial development in Indonesia is quite rapid with many investors investing business capital, with the increase in automotive manufacturers. On the other hand, this industry requires standard warehousing for distribution and storage. Because the existence of standardized warehousing can affect the effectiveness and smooth running of the business. To have a standard warehouse building is very important, the construction of the warehouse needs to be carried out by the right contractor so that the planned targets can be achieved such as the completion of the construction on time, the quality of the materials used is standard and the maintenance of the building after construction is complete.

PT. Bangun Eka Logitama (BEL) or better known as Genesis is a company engaged in providing warehousing services throughout Indonesia, one of its biggest assets is in Bekasi Regency, namely in the form of warehousing in the KITIC, Deltasilikon and Jababeka areas.

Decision making is generally a form of selecting from a variety of alternative actions that may be selected. However, before determining an alternative, some accurate data is needed to make the right and accurate decision. Decision makers almost always make decisions even every second of their life. When they make decisions, there is a process in the human brain that affects the quality of the decisions they make. If the decisions to be made are easy, humans can easily make decisions. However, if the decisions to be taken are complex in nature with large risks such as policy formulation, decision makers often need tools in a scientific, logical and structured form.

Contractor selection is one of the most important things in warehouse development project activities, where the activity of determining the winner of a warehouse construction tender is very important considering the work carried out will affect other business targets. In

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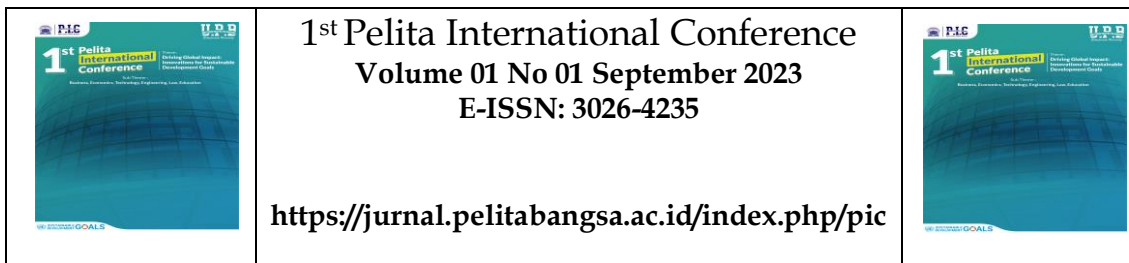
making a decision to select a contractor, decision makers need analytical tools that enable them to solve complex problems so that the decisions taken are of a higher quality. The selection of contractors must be done carefully because selecting the wrong contractor will result in construction failure / being late according to schedule, which will be detrimental to the company. The selection of a contractor in a construction project is very important because it determines the quality of the building itself, in selecting a contractor, high accuracy is required in selecting one contractor at a time.

The problem in this research is how to determine the priority weight of each criterion for contractor selection and there are several contractors who are usually not responsible for the infrastructure they have worked on, this happens because the selection of contractors is based on an appointment system or kinship, and construction implementation does not prioritize comfort and safety the user.

Therefore we need a method that can include both in the measurement. One method that can be used for contractor selection is the AHP (Analytical Hierarchy Process) method. AHP takes into account the level of validity up to the tolerance limit with various criteria and alternative methods chosen by a decision maker, the AHP method also has the ability to solve multi-criteria problems based on priority comparisons of each element in the hierarchy so that it becomes a comprehensive decision-making model. Anton in Sandika & Patradhiani, 2019). These criteria contradict each other. For example, one warehouse contractor may prefer to offer lower prices with below average quality, while another warehouse contractor offers good quality goods with uncertain delivery. However, it is difficult to find a warehouse contractor that can cater to all of them.

From the background of the problems above, the researcher is interested in conducting research on the priority order of the factors that influence the selection of warehouse contractors entitled "Selection of Warehouse Construction Contractors Using the AHP Method at PT. Build Eka Logitama (Genesis)

In this study the problems to be analyzed are limited so that they are right on target and not too broad. This research was conducted at the PT BEL (Genesis) Warehouse in making decisions on selecting a Warehouse Contractor. The limitation lies in the problem to be analyzed, namely choosing a Warehouse Contractor to choose good materials so that the warehouse construction also gets maximum results. This is because currently companies want to find the best warehouse contractors. The purpose of this research is to find out the criteria that are taken into consideration for determining the Selection of Warehouse Contractors Using the AHP Method (In PT. BEL's Warehouse Construction) and to find out the best Warehouse Contractors, those who best meet the criteria that Genesis Warehouses should choose based on the AHP method.

RESEARCH METHOD

Analytical Hierarchy Process (AHP) is a decision support model developed by Thomas L. Saaty. This decision support model will describe complex multi-factor or multi-criteria problems into a hierarchy. According to Saaty (1994), hierarchy is defined as a representation of a complex problem in a multi-level structure where the first level is the objective, followed by the factor level, criteria, sub criteria, and so on until the last level of the alternative. With a hierarchy, a complex problem can be broken down into groups which are then arranged into a hierarchical form so that the problem will appear more structured and systematic.

Besides its multi-criteria nature, the Analytical Hierarchy Process (AHP) method is also based on a logical and structured process, because the prioritization is carried out using a logical and structured procedure (Anggesti, 2018).
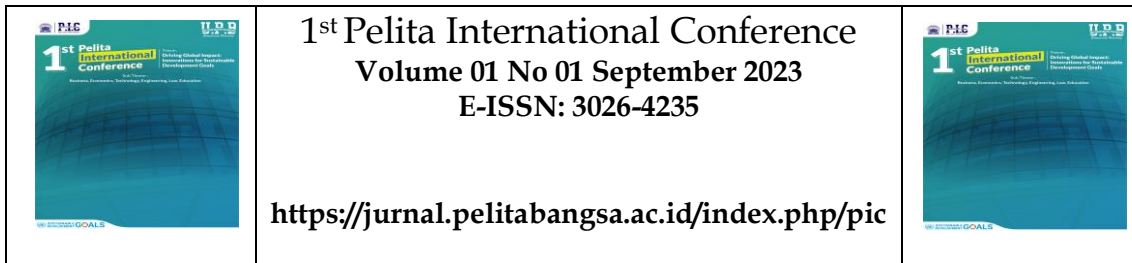
Basically, the decision-making process is having an alternative. The main equipment of AHP is a functional hierarchy with the main input being human perception. The existence of a hierarchy makes it possible to break down complex or unstructured problems into sub-problems, then organize them into a hierarchical form. The AHP method is a model for decision making that can help the human frame of mind. The basic thinking of the AHP method is the process of forming a score numerically to rank each decision alternative, preferably that alternative is matched to the decision maker's criteria.

Method of collecting data

To obtain the information needed, the author used several data collection methods, including:

Observation

Observation data was obtained by the author by direct observation in the field regarding the problems being reviewed. This method is used to be able to find out the circumstances and conditions that occur directly at the object.

Communication

In communication, interviews were conducted during thesis writing, the interviews were to the vice president of engineering, engineering supervisor, manager & procurement. Through interviews obtained information about Contractor selection process. The process of determining the contractor to be used.Which contractors have good or bad performance.

Questionnaire

Based on the problems that have been identified, questionnaire sheets are distributed to respondents, namely to decision makers. Based on the results of filling out the questionnaire, the following information was obtained Performance data and sub-criteria for selection and evaluation of contractors. Pairwise comparison data of criteria, subcriteria and alternatives. The questions asked in the questionnaire sheet are attached (data can be seen in the attachment)

Data analysis method

The collected data can be calculated manually using Microsoft Excel or using the Expert Choice Software. The steps for selecting a contractor are as follows:

Arranging a Hierarchical Structure Once a problem has been identified, a hierarchy is then arranged along with the desired solution or goal. The objectives and criteria that need to be considered in the selection of spare parts suppliers are as follows:

Task Performance

Task performance, namely expertise or ability to carry out specific jobs and differentiated from one to another. The criteria used in evaluating task performance are general mental behavior, job knowledge, job skills or abilities and job experience (Van Scotter & Motowidlo in Sattung et al. ., 2018).

Contextual Performance

The emergence of contextual performance is due to the fact that someone working in an organization usually requires communicating with others, coordinating, following instructions and depending on the job description. There are five criteria used to evaluate contextual

performance, namely conscientiousness, initiative, social skills, commitment and controllability. (Borman & Motowidlo in Sattung et al., 2018).

Price

Price is the contractor's professional fee which, in many cases, is the most important part in choosing a contractor. With the hypothesis that with lower bids, those offered by contractors have a higher probability of winning the tender, thereby increasing the contractor's chances of winning the contract.

Network

The selection of contractors depends not only on their performance and price, but also on relationships, known as network factors. Companies are not only seen based on profit and market relations, but also concentrate on social relations (Granovetter in Sattung et al., 2018).

Network theory states that economic action is a social network relationship. The actors do not act or decide like small things outside a social context but their efforts in a real action instead form a system of sustainable social relations. Achieving economic goals is usually associated with non-economic goals such as social relations, recognition, status and power.

Network theory also states that companies must have direct and indirect relationships. Its members maintain clean standards of behavior and maintain one another's behavior. Such incidents of abuse of position are quickly detected via the network. Important evidence of networking for companies includes the tendency to maintain reputation, past relationships, ongoing relationships and possibly future relationships in deciding economic transactions (Granovetter in Sattung et al., 2018). Figure 1 describe hierarchy of selection of warehouse construction contractors.

Figure 1. Hierarchy of Selection of Warehouse Construction Contractors
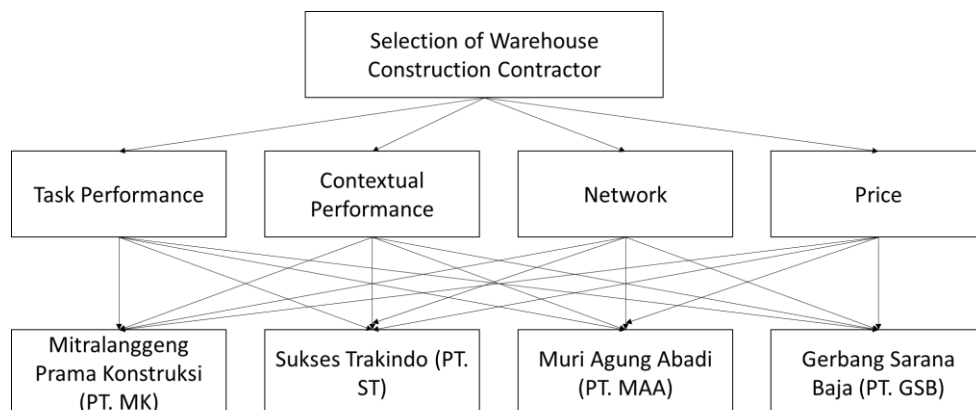
Source: Data Processed by Author

In the contractor selection stage, the project owner will select a contractor based on the suitability of the contractor's bid with the specified criteria. To reduce risk, project owners need to know the factors that will have a significant influence on project performance so that the selected contractor can carry out the project on time, at the right cost and with appropriate quality.

Data Processing

The first step is to calculate the eigenvectors of each pairwise comparison matrix by adding up the values of each column of the matrix. The second step is to divide each value from the column by the total of the column concerned to obtain matrix normalization. The third step, sum up the values of each row and divide by the number of elements to get the average. The fourth step, measure consistency. In making decisions, it is important to know how good the consistency is because we do not want decisions based on judgments with low consistency. The fifth step, calculate the equation for (Consistent Ratio). If the results of CR ≤ 0.1 then the data in the comparison matrix is consistent and the vector eigenvalues are acceptable.

Consistency

The data obtained must be consistent so that consistency determines whether the data will be used or repeated data collection. Data is declared consistent if it is known that the value of the consistency ratio (CR) is <0.1 or 10%.

Table 1. Random Consistency Index Table

Tabel Index Random Konsistensi															
RCI values corresponding to the order of the matrix															
No. of criteria	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RCI	0	0	0,58	0,9	1,12	1,24	1,32	1,41	1,45	1,49	1,51	1,48	1,56	1,57	1,59

Source: Data Processed by Author

Based on the table 1, because this research uses four criteria and four alternatives, it can be determined that the random consistency is 0.90. To determine the priority of the criteria, calculate the comparative synthesis, measure consistency, calculate the Consistency Index (CI), and calculate the Consistency Ratio. Ratio (CR) in this research, researchers used the help of the expert choice application.
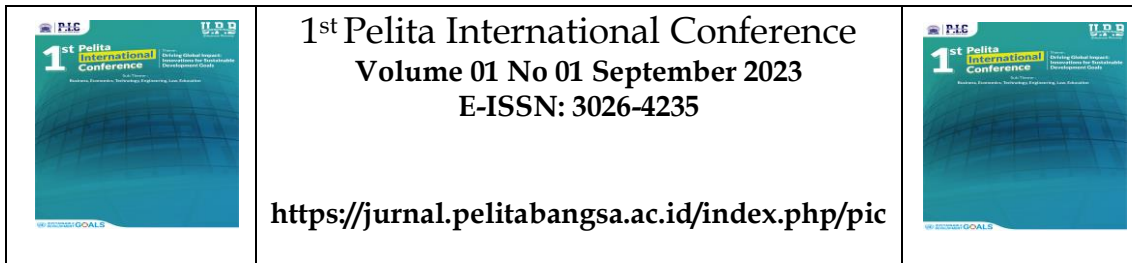
RESULTS AND DISCUSSIONS
Warehouse Contractor Selection Criteria Using the AHP Method (In PT. BEL Warehouse Construction)

In selecting a warehouse contractor, of course there are criteria that have been set as priorities. The prioritization of these criteria or what is called level one consists of task performance, contextual performance, price and network criteria from the assessment results of six respondents, a combined matrix was created using calculations assisted by expert choice and excel applications. The results of the geometric mean pairwise comparisons of six respondents are displayed in table 2. as follows:

Table 2. Calculation of Priority Criteria

| Criteria	Criteria Weight						Total Weight	Weight Average	Priority
	R1	R2	R3	R4	R5	R6			
Task Performance	0,408	0,296	0,308	0,313	0,343	0,438	2,106	0,351	1
Contextual Performance	0,229	0,312	0,308	0,313	0,393	0,159	1,713	0,285	3
Network	0,069	0,064	0,077	0,063	0,063	0,069	0,401	0,067	4
Price	0,295	0,328	0,308	0,313	0,217	0,334	1,780	0,297	2

Information:

R: Respondent

Source: Data Processed by Author

From the analysis of the AHP method using the calculations in table 2 above, the results obtained are that the first criterion that is a priority in selecting a warehouse contractor is task performance with a weight of 0.351, the second criterion is price with a weight of 0.297, the third criterion is contextual performance with a weight of 0.285 and network criteria is last with a weight of 0.067.

While the analysis of the AHP method uses the expert choice application, the results obtained are the first criteria that become a priority in selecting warehouse contractors, which can be seen in Figure 2 below.

Figure 2. Priority Between Criteria
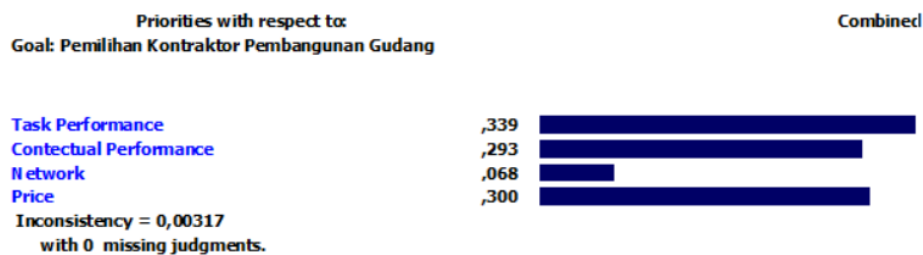
Source: Data Processed by Author

Based on the analysis of the AHP method using the expert choice application in Figure 2 above, the first priority criterion in selecting warehouse contractors is task performance with a weight of 0.339, the second criterion is price with a weight of 0.300, the third criterion is contextual performance with a weight of 0.293, and network is the last criterion with a weight of 0.068. Apart from that, the consistency value obtained from the calculation results is 0.003.

This shows that the value is consistent and does not need to be corrected/repeated. From these two analyses, it can be concluded that the priority criterion is task performance.

After calculating the weight for each criterion and alternative, a synthesis is then carried out to obtain the overall alternative weight from the previously existing criteria. The local weight/priority must be searched for the global value first. To get global priority by switching local priority. The results of the weighting of criteria and alternatives can be seen in table 3 below.

Table 3. Global Priority

Objectives (Level 1)	Criteria (Level 2)	Weight	Alternative	Average	Global Priorities
Selecting the Optimal Contractor	Task Performance	0,351	Mitralanggeng Prama Kontruksi	0,118	0,042
			Trakindo's success	0,367	0,129
			Muri Agung Abadi	0,448	0,157
			Saranabaja Gate	0,067	0,023
	Contextual Performance	0,285	Mitralanggeng Prama Kontruksi	0,159	0,045
			Trakindo success	0,307	0,087
			Eternal Great Disciple	0,391	0,112
			Saranabaja Gate	0,143	0,041
	Network	0,067	Mitralanggeng Prama Kontruksi	0,280	0,019

			Trakindo success	0,360	0,024
			Eternal Great Disciple	0,257	0,017
			Saranabaja Gate	0,103	0,007
Price	0,279		Mitralanggeng Prama Kontruksi	0,063	0,018
			Trakindo's success	0,344	0,096
			Muri Agung Abadi	0,538	0,150
			Saranabaja Gate	0,055	0,015

Source: Data Processed by Author

After the global priority is obtained, the overall weight of each alternative can be calculated by adding up all the overall weights (global priority) for each contractor, the results are shown in table 4 below:

Table 4. Global Priority Alternative Weights (Global Priority)

Alternative	Global Priority Weight	Priority
Mitralanggeng Prama Kontruksi	0,155	3
Trakindo success	0,345	2
Eternal Great Disciple	0,408	1
Saranabaja Gate	0,092	4

Source: Data Processed by Author

Based on Table 4 it shows that overall, the contractor Muri Agung Abadi with a weight value of 0,408 is the first priority to be selected. The second priority is the contractor Sukses Trakindo with a weight value of 0,345, the third priority is the Mitralanggeng Prama Kontruksi contractor with a weight value of 0,155, while the Gerbang Saranabaja contractor is the last priority with a weight value of 0,092.
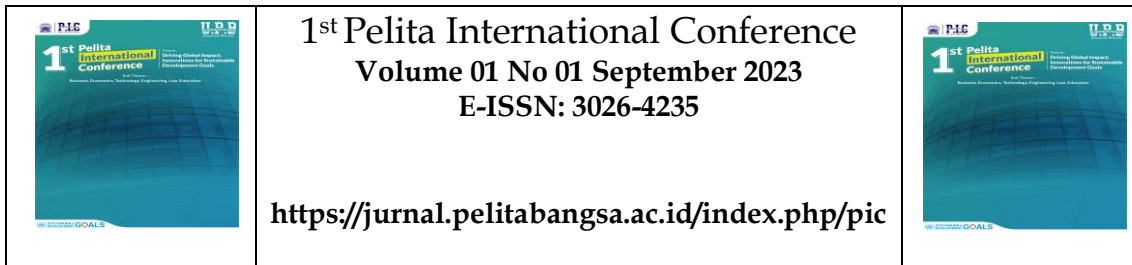
Warehouse Contractor Selection Using AHP Method (In Genesis Warehouse Development)

Currently, Warehousing plays a very important role in the industrial world, where for the distribution and storage of goods there must be a standardized warehouse, for that PT BEL is here to provide Warehousing needs for its clients . Warehouse construction needs to be carried out by the right contractor, for this reason it is necessary to make decisions in selecting the contractor. PT BEL is a company engaged in the field of Warehousing service providers.

The selection of a contractor in a construction project is very important because it determines the quality of the building itself, in selecting a contractor, high accuracy is required in selecting one contractor at a time. The results of the average pairwise comparison geometry of six respondents in determining alternatives Warehouse construction contractors at PT BEL are shown in Table 5 as follows:

Table 5. Alternative Calculations

Alternative	Criteria Weight						Total Weight	Weighted Average	Priority
	R1	R2	R3	R4	R5	R6			
Mitralanggeng Prama Kontruksi	0,153	0,164	0,214	0,201	0,153	0,108	0,992	0,165	3
Trakindo's success	0,377	0,376	0,345	0,360	0,273	0,279	2,010	0,335	2
Muri Agung Abadi	0,390	0,377	0,336	0,283	0,511	0,531	2,428	0,405	1

| Saranabaja Gate	0,081	0,083	0,105	0,157	0,062	0,083	0,570	0,095	4

Information:
R : Respondent

Source: Data Processed by Author

From the analysis of the selection of warehouse construction contractors at PT BEL (Genesis) using the AHP method calculations in Table 5 above, it shows that the priority for contractor selection, namely contractor Muri Agung Abadi, is the first priority to be selected with a weight of 0,405 , Success Trakindo contractor with a weight of 0,335 being the second priority, contractor Mitralanggeng Prama Kontruksi with a weight of 0,165 being the third priority, and the contractor Gerbang Saranabaja with a weight of 0,095 being the last priority.

The expert choice application , the results of the analysis which is the first priority in selecting a warehouse construction contractor at PT BEL (Genesis) can be seen in Figure 3 below:

Figure 3. Combined Priorities
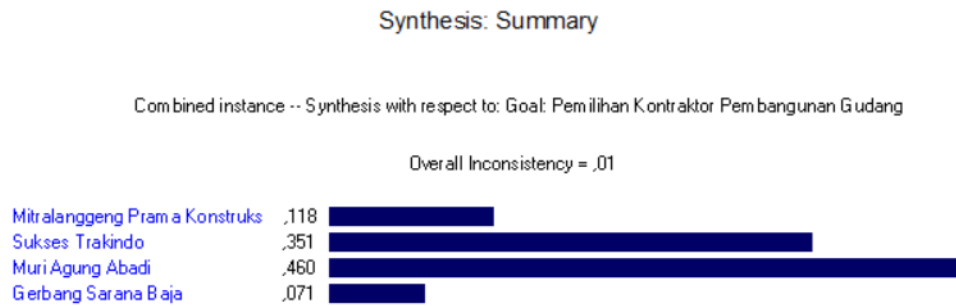

Source: Data Processed by Author

Based on the AHP method analysis using the expert choice application in Figure 4.1 above, the first priority in selecting PT BEL 's warehouse construction contractor was the Muri Agung Abadi contractor with a weight of 0.46 0 , the second priority was the Sukses Trakindo contractor with a weight of 0.35 1 , the third priority is the Mitralanggeng Prama Kontruksi contractor with a weight of 0.118, and the Gate Saranabaja contractor is the last priority with a weight of 0.0 71 . In addition, the overall consistency value is 0.0 1 . These results indicate that the assessment is consistent and does not need to be corrected/repeated because the consistency value is 0.0 1 < 0.1.

Discussion
Warehouse Contractor Selection Criteria Using the AHP Method (In PT. BEL Warehouse Construction)

In choosing a contractor, of course it is not easy and just choose straight away. However, there are criteria that need to be considered. According to psychology and economics literature, it is stated that the criteria that influence contractor selection are divided into four main factors, namely task performance, contextual performance, price, and network. (Sattung et al., 2018) .

Based on the results of the AHP that has been carried out, the main criteria that influence the selection of PT BEL (Genesis) warehouse construction contractors are task performance with a weight of 0.3 3 9, the second criterion is price with a weight of 0.300 , the third criterion is contextual performance with a weight of 0. .2 93 , and network is the final criterion with a weight of 0.6 8 . Apart from that, the consistency value obtained from the calculation results is 0.03. In
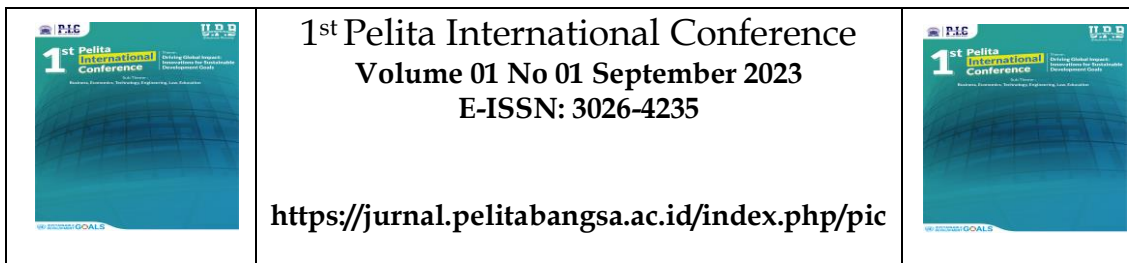
other words, the results of the AHP analysis show that the assessment is consistent and does not need to be corrected/repeated because the consistency value is 0.0 3 < 0.1.

The high weight of task performance in selecting warehouse construction contractors shows that PT BEL (Genesis) prioritizes contractors who are experts, have the ability to carry out specific work, have knowledge of the work and work experience.

Selection of Warehouse Contractor Using AHP Method (In PT. BEL Warehouse Construction)

Contractor selection is one of the important things in warehouse construction project activities, where the activity of determining the winner of the warehouse construction tender is very important considering that the work carried out will affect other business targets . In making a decision to choose a contractor, decision makers need analytical tools that enable them to solve complex problems so that the decisions taken are of higher quality.

The selection of a contractor must be done carefully because selecting the wrong contractor will cause construction to fail/be late and not meet the schedule, thereby causing loss to the company. Selecting a contractor in a construction is a very important thing because it determines the quality of the building itself. In selecting a contractor, high accuracy is required in selecting the predetermined contractors one by one.

Based on the results of the AHP analysis that has been carried out, the contractor who is the first priority in the selection of PT BEL warehouse construction contractors is the contractor Muri Agung Abadi with a weight of 0.46 0 , the second priority is the contractor Sukses Trakindo with a weight of 0.35 1 , the third priority is the contractor Mitralanggeng Prama Kontruksi with a weight of 0.118, and the Saranabaja Gate contractor is the last priority with a weight of 0.0 71 . Apart from that, the overall consistency value is 0.03. These results indicate that the assessment is consistent and does not need to be corrected/repeated because the consistency value is 0.0 1 < 0.1. These results indicate that overall the best contractor that will be selected by PT BEL to be used as a warehouse construction contractor is Muri Agung Abadi contractor because overall this contractor has the highest weight value compared to other contractors.

CONCLUSION

Based on the results of the research and discussion above, it can be concluded the first criterion in selecting PT BEL's warehouse construction contractor is task performance with a weight of 0.339, the second criterion is price with a weight of 0.300, the third criterion is contextual performance with a weight of 0.293, and network is the final criterion with a weight of 0.68. In addition, the consistency value obtained with the calculation results is 0.003. The contractor with the first priority in selecting PT BEL's warehouse construction contractor is the Muri Agung Abadi contractor with a weight of 0.460, the second priority is the Sukses Trakindo contractor with a weight of 0.351, the third priority is the Mitralanggeng Prama Kontruksi contractor with a weight of 0.118, and the Gate Saranabaja contractor is the priority last with a weight of 0.071. In addition, the overall consistency value is 0.01. These results indicate that the assessment is consistent and does not need to be corrected/repeated because the consistency value is 0.01 <0.1. These results indicate that overall the best contractor that PT BEL will choose to become the warehouse construction contractor is the Muri Agung Abadi contractor because overall this contractor has the highest weight value compared to other contractors.

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