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Supplier Performance Analysis with Using the Analytical Hierarchy Process (AHP) Method

Agus Riyanto [1]*, Gabriel Sianturi [2], Bayu Adytia Kurniawan [3], Dina Oktafiani [4]

[1]*Departemen Manajemen, Universitas Komputer Indonesia, Indonesia*
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Abstract: This research aims to determine priorities in supplier selection. The determination of this supplier used the Analytical Hierarchy Process (AHP) method by determining the crite-ria and sub-criteria of the supplier selection objectives. Each criterion and sub-criteria are arranged in a hier-archical structure and compared in pairs by determining the priority scale. Selection of suppliers based on the largest global weight values. The select-ed supplier is PT.MMII with a global weight value of 0.280. The global weighted assessment has considered consistency in decision-making based on a consistency index, which must be below 10%. This shows that PT. MMII was selected based on consideration of existing criteria and sub-criteria compared to other suppliers. This study contributes to group deci-sion-making involving experts so that companies can make decisions in choosing the most appropriate supplier.

Keywords: AHP method, supplier, global weight calculation

Introduction

Supplier is an important line that is part of the company, where the supplier can provide raw materials, both raw and semi-finished, for the company. Decisions in supplier selection must be determined by the company [2]. The company's decision in selecting suppliers is a complex problem by considering the criteria and sub-criteria. The criteria for selecting suppliers are price, quality, delivery, quantity, and service.

Research related to the selection of an object has been carried out a lot. The selection uses the Analytical Hierarchy Process as the method used. The selection to determine the appropriate technical software used from 6 alternative engineering software included in the company criteria also uses the AHP method [2]. Selection of the most appropriate technology used by companies with additional considerations using cost-benefit analysis [3]. Applied AHP in the field of project management to select the best contractor. The hierarchical structure for the pre-qualification criteria and the contractors who wish to qualify for the project [4]. AHP is also used in the integrated approach to the warehouse site selection process, where both quantitative and qualitative aspects were considered [5]. AHP is used for vendor selection of a telecommunication system, which is a complex, multi-person, multi-criteria decision problem [6].

Analytical Hierarchy Process can be used for the selection of an object. AHP method is also used to measure productivity. This method is appropriate because it considers the criteria and sub-criteria arranged in a hierarchical structure. This supplier selection problem has clear criteria and sub-criteria known to the company. The AHP method can assist the company in selecting suppliers from several alternatives. The supplier decision was selected by considering

the value of consistency in experts' answers based on pairwise comparisons between existing criteria and sub-criteria. Experts are people who understand and understand in choosing this supplier.

Supplier is a line where to supply raw and finished goods to a company or store; the supplier's performance assessment can be measured using the analytical hierarchy process (AHP) method. AHP is a useful method for selecting which suppliers a company should maintain or not. The choice of this method is considered appropriate compared to other methods because by taking a practical and effective approach, researchers can solve a complex problem that is not structured into several components in a hierarchical arrangement so that they can easily see the performance of existing suppliers. The choice of this method is considered appropriate because it can show the hierarchy of the supplier itself. The AHP method is also able to translate or solve unstructured problems into a model that is easy to understand or simpler. This method also uses pairwise comparative assessment, which is done by experts to get a priority scale [7]. Analysis from AHP will be used by the company to select existing suppliers.

Hypotesis Development

This study does not use a test hypothesis but the implementation of each axiom in the Analytical Hierarchy Process (AHP). The AHP method basically arranges the problem into basic rationality by breaking the existing problem into small parts. In using AHP, it is divided into two phases, namely designing the hierarchy and evaluating the components contained in the hierarchy [8]. Analytic Hierarchical Process (AHP) is one of the most widely used multi-criteria analysis techniques in decision making [9]. The steps that are used as the basis for carrying out the AHP process are as follows.

a. Define a hierarchy of decisions with attributes (criteria) and alternatives (suppliers) that clearly demonstrate their relationship.

b. Comparison between attributes and alternatives using a pairwise comparison scale. Determining the relative importance of attributes and alternatives includes comparing how well the options work on different attributes.

c. Find out the maximum eigenvalues weight (λ max) and CI (consistency index) of attributes and alternatives.

d. Calculate the value of CR (consistency ratio) = CI / RI where RI (randomly generated consistency index).

e. Follow step 4 and find out all weights, collect all and perform calculations using excel software, to normalize the weights so as to produce the best supplier. After the best supplier is found, the company can also make comparisons with other suppliers, by adding or removing some of the existing criteria.

Hierarchical structures do not have a standard or written arrangement in their making, hierarchical creation is generally based on several things ranging from a combination of existing ideas, experiences and views of others. Three things are an event that is in stark contrast between one person and another, therefore the possibility of creating a non-standard hierarchy is very large. The hierarchical structure also differs depending on the level of difficulty or complexity of the problem at hand and the circumstances being experienced by the actor who wants to solve the problem, as well as the results to be obtained from the problem. Because the likelihood of a case being different from one another is very large, so the hierarchical structure is likely to be different [10]. The rating scale used in the pairwise comparison questionnaire generally refers to one literature, where ratings are given ranging from one to nine with their respective descriptions [11]. The rating scale in the odd part has more importance between one criterion and the other criteria. Every increase in the importance level increases and even means the values between two adjacent considerations. The RI value is very important to calculate the CR value in this study, the RI value is adjusted to the needs if there are five criteria used, the RI value used is 1.12.

Methodology

The idea of the analytical hierarchy process (AHP) is based on a world condition that has a complex problem consisting of various overlapping and similar elements where usually each element is interrelated. the application of the Analitycal Hierarchy Proccess (AHP) method as an reinforcer and supports in making a decision based on characteristics that are considered to represent the whole. This series creates various problems related to the resources to be used. Therefore a priority system is needed to facilitate it. Correct solutions are needed to overcome these problems, thereby creating an effective framework later [12]. The analytical hierarchy process (AHP) is also one of the tools most widely used by decision-makers since it was first discovered. AHP is able to describe or solve multi-criteria problems. The AHP method is used to assess performance by considering quality, delivery, price, service, production capability, and characteristics. Among these criteria, the quality criteria are the determining criteria in the selection of suppliers [13]. This is because the pattern of supplier selection will affect business continuity to analyze problems related to supplier selection, so other factors also need to be considered [14]. The advantage of using the AHP method compared to other methods is the ability to manage the number of experts and other problems according to the hierarchy of system difficulty levels from the lowest level (alternative), intermediate (sub-criteria) to the highest level (general). that needs to be considered by the company because 50-90% of the company's turnover is obtained from purchasing activities [15]. AHP's supplier selection uses qualitative and quantitative methods to select the best supplier. There is also a combination of AHP and linear programming, which is useful for seeing tangible and intangible factors. The company gets a list of competent suppliers and the optimal number of orders [16].

Measurements cannot be given absolutely against the criteria being compared. If there is a reduction or increase in one criterion, thus the ranking is irrelevant. The AHP method has a clear principle in which it breaks down the problem into small parts. It is easy to carry out analysis such as determining what the objectives are, the criteria that are used as benchmarks, and whoever or anything meets these criteria. The most important thing in analyzing AHP is to set the parts or variables into a hierarchy and assign a numerical value to each variable and synthesize it to select the variable that has the highest priority [17].Decision-making can run well if you pay attention to several existing factors, such as facts. By looking at the facts, one can make decisions wisely so that the final decision that is obtained will be very precise. Experience, a decision-maker must always involve the experience that has been gained to support his decisions so that later there are no mistakes. Analytical Hierarchy Process (AHP) is a technique that was developed to help overcome this difficulty, because the Analytical Hierarchy Process (AHP) is a form of decision-making model with many criteria.

The AHP method basically arranges the problem into basic rationality by breaking the existing problem into small parts. In using AHP, it is divided into two phases, namely designing the hierarchy and evaluating the components contained in the hierarchy [8]. The steps that are used as the basis for carrying out the AHP process are as follows. The use of the AHP method helps the decision-making process faster and in accordance with company needs.

a. Define a hierarchy of decisions with attributes (criteria) and alternatives (suppliers) that clearly demonstrate their relationship.

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After the best supplier is found, the company can also make comparisons with other suppliers by adding or removing some of the existing criteria. Hierarchical structures do not have a standard or written arrangement in their making. Hierarchical creation is generally based on several things ranging from a combination of existing ideas, experiences, and others' views. Three things are an event that is in the stark contrast between one person and another. Therefore, the

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Results and Discussions
Results

The following is a hierarchy of supplier selection criteria in Figure 1 that has been made based on the interview results.
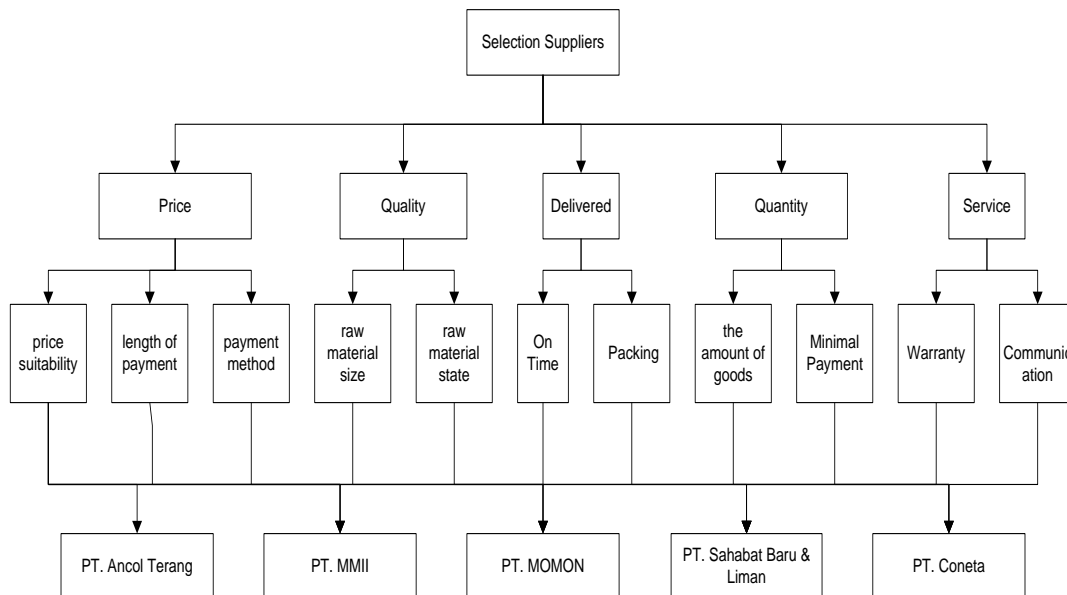

Figure 1. Hierarchy of supplier selection criteria

The criteria and sub-criteria for supplier selection were obtained from direct interviews with the company. After conducting interviews, five main criteria for supplier selection were obtained and 11 sub-criteria. Pairwise comparisons were made between the criteria and criteria and the criteria with their respective sub-criteria. Consistency measurements were made with the criteria that must be below 10%. Consistency is measured by calculating index random. Decision making by leaders is often faced with difficult problems because of the variety of decision-making criteria, weight of considerations and alternative choices

Discussions

After the consistency test has been completed, the next step is to do a global weight calculation. This calculation aims to see the ranking of the five existing suppliers so that the company can make a selection of these suppliers. The global weight calculation focuses on the multiplication performed on each aspect of the hierarchy. The final result that is seen is the sum of each criterion and sub-criteria according to the supplier company (see Table 1).

Table 1. Overall global weight

Criteria		Sub criteria			Corporate alternative				
					S1	S2	S3	S4	S5
1	0.30	S K1	0.13		0.041	0.032	0.014	0.016	0.024
		S K2	0.11		0.037	0.029	0.013	0.015	0.021
		S K3	0.06		0.018	0.014	0.006	0.007	0.010
2	0.30	S K4	0.08		0.018	0.027	0.015	0.009	0.007
		S K5	0.22		0.053	0.079	0.044	0.027	0.020
3	0.12	S K6	0.10		0.020	0.034	0.017	0.019	0.010
		S K7	0.02		0.004	0.007	0.004	0.004	0.002
4	0.13	S K8	0.11		0.016	0.016	0.016	0.031	0.030
		S K9	0.02		0.003	0.003	0.003	0.006	0.006
5	0.15	S K10	0.04		0.007	0.010	0.005	0.010	0.006
		S K11	0.11		0.021	0.029	0.014	0.031	0.018
Total					0.239	0.280	0.150	0.175	0.156

Table 1 shows the total ranking of each suppli-er where the supplier who got the first rank is PT. MMII with global weight is 0,280. The following is the order of the five companies, which are described us-ing a bar chart. The ranking process was conducted by applying the analytic hierarchy process (AHP) meth-od.

Conclusion

The results of the global weight calculation show that PT. MMII is the supplier company with the best performance, with a total score of 0.280. The score obtained is based on the sum of the criteria, sub-criteria, and alternative suppliers that have been calculated global weight. The results of global weight calculations at PT. Ancol Terang, with a total score of 0.239, the score obtained is based on the sum of the criteria, sub-criteria, and alternative suppliers that have been calculated global weight. The results of global weight calculations at PT.MOMON with a total score of 0.150, the score obtained is based on the sum of the criteria, sub-criteria, and alternative suppliers that have been calculated global weight. The results of global weight calculations at PT. Central Sahabat Baru & Liman with a total score of 0.175, the score obtained is based on the sum of the criteria, sub-criteria, and supplier alternatives that have been calculated global weight. The results of global weight calculations at PT. COMETA with a total score of 0.156, the score obtained is based on the sum of the criteria, sub-criteria, and alternative suppliers that have been calcu-lated global weight. Suppliers also have their advantages on each criterion, so that there are several suppliers that have advantages on certain criteria in the price criteria of PT. Ancol Terang keeps first place with a score of 0.097 on the quality criteria of PT. MMII keeps first place with a score of 0.107 on the criteria for sending PT. MMII keeps first place with a score of 0.041 on the criteria for the quantity of PT. Central Sahabat Baru & Liman came first with a score of 0.037 and the service criteria of PT. Central Sahabat Baru & Liman came first with a score of 0.041.

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This study aims to select suppliers so that companies can accurately determine suppliers from predetermined criteria. In theory, it appears that the analytical hierarchy process method can be used to determine priorities, alternatives or elections. However, in companies, supplier selection is often not determined based on theory. Selection is not based on clear criteria. So that this

research gap can lead companies to choose suppliers by using the right method, namely the analytical hierarchy process. The novelty of this research lies in the calculation of the consistency to the calculation of the overall global weight.

Methodology

The idea of the analytical hierarchy process (AHP) is based on a world condition that has a complex problem consisting of various overlapping and similar elements where usually each element is interrelated. the application of the Analitycal Hierarchy Proccess (AHP) method as an reinforcer and supports in making a decision based on characteristics that are considered to represent the whole. This series creates various problems related to the resources to be used. Therefore a priority system is needed to facilitate it. Correct solutions are needed to overcome these problems, thereby creating an effective framework later [12]. The analytical hierarchy process (AHP) is also one of the tools most widely used by decision-makers since it was first discovered. AHP is able to describe or solve multi-criteria problems. The AHP method is used to assess performance by considering quality, delivery, price, service, production capability, and characteristics. Among these criteria, the quality criteria are the determining criteria in the selection of suppliers [13]. This is because the pattern of supplier selection will affect business continuity to analyze problems related to supplier selection, so other factors also need to be considered [14]. The advantage of using the AHP method compared to other methods is the ability to manage the number of experts and other problems according to the hierarchy of system difficulty levels from the lowest level (alternative), intermediate (sub-criteria) to the highest level (general). that needs to be considered by the company because 50-90% of the company's turnover is obtained from purchasing activities [15]. AHP's supplier selection uses qualitative and quantitative methods to select the best supplier. There is also a combination of AHP and linear programming, which is useful for seeing tangible and intangible factors. The company gets a list of competent suppliers and the optimal number of orders [16].

Measurements cannot be given absolutely against the criteria being compared. If there is a reduction or increase in one criterion, thus the ranking is irrelevant. The AHP method has a clear principle in which it breaks down the problem into small parts. It is easy to carry out analysis such as determining what the objectives are, the criteria that are used as benchmarks, and whoever or anything meets these criteria. The most important thing in analyzing AHP is to set the parts or variables into a hierarchy and assign a numerical value to each variable and synthesize it to select the variable that has the highest priority [17].Decision-making can run well if you pay attention to several existing factors, such as facts. By looking at the facts, one can make decisions wisely so that the final decision that is obtained will be very precise. Experience, a decision-maker must always involve the experience that has been gained to support his decisions so that later there are no mistakes. Analytical Hierarchy Process (AHP) is a technique that was developed to help overcome this difficulty, because the Analytical Hierarchy Process (AHP) is a form of decision-making model with many criteria.

The AHP method basically arranges the problem into basic rationality by breaking the existing problem into small parts. In using AHP, it is divided into two phases, namely designing the hierarchy and evaluating the components contained in the hierarchy [8]. The steps that are used as the basis for carrying out the AHP process are as follows. The use of the AHP method helps the decision-making process faster and in accordance with company needs.

a. Define a hierarchy of decisions with attributes (criteria) and alternatives (suppliers) that clearly demonstrate their relationship.

b. Comparison between attributes and alternatives using a pairwise comparison scale. Determining the relative importance of attributes and alternatives includes comparing how well the options work on different attributes.

c. Find out the maximum eigenvalues weight (λ max) and CI (consistency index) of attributes and alternatives.

d. Calculate the value of CR (consistency ratio) = CI / RI where RI (randomly generated consistency index).

e. Follow step 4 and find out all weights, collect all and perform calculations using excel software, to normalize the weights so as to produce the best supplier.

After the best supplier is found, the company can also make comparisons with other suppliers by adding or removing some of the existing criteria. Hierarchical structures do not have a standard or written arrangement in their making. Hierarchical creation is generally based on several things ranging from a combination of existing ideas, experiences, and others' views. Three things are an event that is in the stark contrast between one person and another. Therefore, the possibility of creating a non-standard hierarchy is very large. The hierarchical structure also differs depending on the level of difficulty or complexity of the problem at hand and the circumstances being experienced by the actor who wants to solve the problem, as well as the results to be obtained from the problem. Because the likelihood of a case differs from one another is very large, the hierarchical structure is likely to be different [10]. The rating scale used in the pairwise comparison questionnaire generally refers to one literature, where ratings are given ranging from one to nine with their respective descriptions [11]. The rating scale in the odd part has more importance between one criterion and the other criteria. Every increase in the importance level increases and even means the values between two adjacent considerations. The RI value is very important to calculate the CR value in this study. The RI value is adjusted to the needs if there are five criteria used. The RI value used is 1.12. The random index value used in this study was 1.12 because there are only five main criteria in the main criterion. The IR value can also change according to usage. Analytical Hierarchy Process applied to evaluate the analytical methods used.

Results and Discussions

Results

The following is a hierarchy of supplier selection criteria in Figure 1 that has been made based on the interview results.
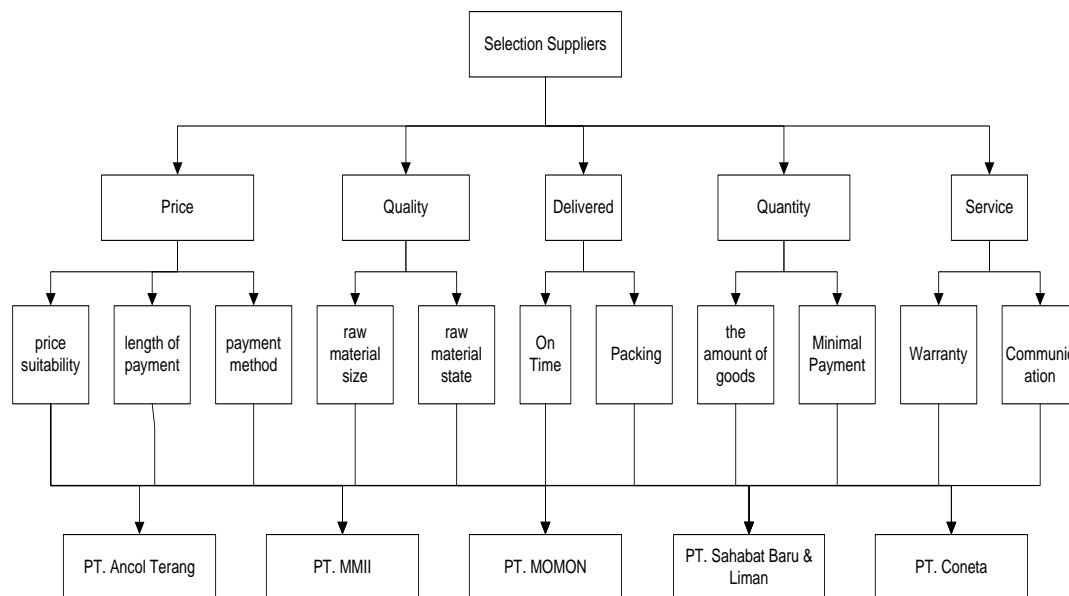

Figure 1. Hierarchy of supplier selection criteria

The criteria and sub-criteria for supplier selection were obtained from direct interviews with the company. After conducting interviews, five main criteria for supplier selection were obtained and 11 sub-criteria. Pairwise comparisons were made between the criteria and criteria and the criteria with their respective sub-criteria. Consistency measurements were made with the criteria that must be below 10%. Consistency is measured by calculating index random. Decision making by leaders is often faced with difficult problems because of the variety of decision-making criteria, weight of considerations and alternative choices

Discussions

After the consistency test has been completed, the next step is to do a global weight calculation. This calculation aims to see the ranking of the five existing suppliers so that the company can make a selection of these suppliers. The global weight calculation focuses on the multiplication performed on each aspect of the hierarchy. The final result that is seen is the sum of each criterion and sub-criteria according to the supplier company (see Table 1).

Table 1. Overall global weight

Criteria		Sub criteria		Corporate alternative				
				S1	S2	S3	S4	S5
1	0.30	K1	0.13	0.041	0.032	0.014	0.016	0.024
		K2	0.11	0.037	0.029	0.013	0.015	0.021
		K3	0.06	0.018	0.014	0.006	0.007	0.010
2	0.30	K4	0.08	0.018	0.027	0.015	0.009	0.007
		K5	0.22	0.053	0.079	0.044	0.027	0.020
3	0.12	K6	0.10	0.020	0.034	0.017	0.019	0.010
		K7	0.02	0.004	0.007	0.004	0.004	0.002
4	0.13	K8	0.11	0.016	0.016	0.016	0.031	0.030
		K9	0.02	0.003	0.003	0.003	0.006	0.006
5	0.15	K10	0.04	0.007	0.010	0.005	0.010	0.006
		K11	0.11	0.021	0.029	0.014	0.031	0.018
Total				0.239	0.280	0.150	0.175	0.156

Table 1 shows the total ranking of each suppli-er where the supplier who got the first rank is PT. MMII with global weight is 0,280. The following is the order of the five companies, which are described us-ing a bar chart. The ranking process was conducted by applying the analytic hierarchy process (AHP) meth-od.

Conclusion

The results of the global weight calculation show that PT. MMII is the supplier company with the best performance, with a total score of 0.280. The score obtained is based on the sum of the criteria, sub-criteria, and alternative suppliers that have been calculated global weight. The results of global weight calculations at PT. Ancol Terang, with a total score of 0.239, the score obtained is based on the sum of the criteria, sub-criteria, and alternative suppliers that have been calculated global weight. The results of global weight calculations at PT.MOMON with a total score of 0.150, the score obtained is based on the sum of the criteria, sub-criteria, and alternative suppliers that have been calculated global weight. The results of global weight calculations at PT. Central Sahabat Baru & Liman with a total score of 0.175, the score obtained is based on the sum of the criteria, sub-criteria, and supplier alternatives that have been calculated global weight. The results of global weight calculations at PT. COMETA with a total score of 0.156, the score obtained

is based on the sum of the criteria, sub-criteria, and alternative suppliers that have been calculated global weight. Suppliers also have their advantages on each criterion, so that there are several suppliers that have advantages on certain criteria in the price criteria of PT. Ancol Terang keeps first place with a score of 0.097 on the quality criteria of PT. MMII keeps first place with a score of 0.107 on the criteria for sending PT. MMII keeps first place with a score of 0.041 on the criteria for the quantity of PT. Central Sahabat Baru & Liman came first with a score of 0.037 and the service criteria of PT. Central Sahabat Baru & Liman came first with a score of 0.041.

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Catatan:
1. Ada beberapa kesalahan tanda baca di abtrak saya highlight kuning
2. Analytic Hierarchy Process (AHP) is a method or tool for multi-criteria decision making using Expert Choice software [2], kalimat ini sebaiknya ditulis ulang karena AHP sebagai metode dan AHP sebagai tool pada software akan menyederhanakan fungsi metode AHP. Selain itu gunakan literatur terkini, maksimal 10 thn terakhir.
3. Metodologi dituliskan dalam bentuk paragraph deskripsi tentang prosedur AHP, hal ini membuat sulit dimengerti. Sebaiknya gunakan flowchart atau notasi algoritma
4. Tabel 1 sulit dibaca karena format dan font yang terlalu bersar. Lalu ada notasi K dan S tidak dijelaskan. Demikian juga dengan company 1 s.d 5 tidak dijelaskan mewakili apa saja. Dituliskan ada barchart tapi tidak ada gambar bar chart
5. Kesimpulan ditulis dengan pengulangan kalimat: the resulting score is the sum of the criteria, sub-criteria and alternative providers calculated to give a global weight. Hal ini tidak memenuhi kaidah penulisan kesimpulan yang seharusnya Kembali ke formulasi problem dan jalannya metodologi serta dikaitkan dengan hasil, bukan sekedar membaca tabel.
6. Paper ini kuat di awal bab, tapi masuk ke metodologi, hasil dan kesimpulan masih sangat lemah. Seharusnya bisa diperbaiki lagi agar lebih berisi.

Mitra Bebestari Jurnal MATRIX

Supplier Performance Analysis ~~with~~ Using the Analytical Hierarchy Process (AHP) Method

Abstract: This research aims to determine priorities in supplier selection. The determination of this supplier used the Analytical Hierarchy Process (AHP) method by determining the criteria and sub criteria of the supplier selection objectives. Each criterion and sub-criteria are arranged in a hierarchical structure and compared in pairs by determining the priority scale. Selection of suppliers based on the largest global weight values. The selected supplier is PT.MMII with a global weight value of 0.280. The global weighted assessment has considered consistency in decision-making based on a consistency index, which must be below 10%. This shows that PT. MMII was selected based on consideration of existing criteria and sub-criteria compared to other suppliers. This study contributes to group decision-making involving experts so that companies can make decisions in choosing the most appropriate supplier.

Keywords: AHP method, supplier, global weight calculation

Introduction

Supplier is an important line that is part of the company where the supplier can supply raw materials, both raw and semi-finished, for the company. The company is responsible for making decisions about the selection of suppliers [1]. The company's decision when choosing suppliers is a complex issue considering the criteria and sub-criteria. Criteria for the selection of suppliers are price, quality, delivery, quantity and service.

A lot of research has been done related to choosing an object. The selection uses the Analytical Hierarchy Process as a method. Analytic Hierarchy Process (AHP) is a method or tool for multi-criteria decision making using Expert Choice software, tools in the software will simplify the function of the AHP method [2]. The selection for determining the appropriate technical software used from 6 alternative engineering software contained in the company criteria is also made according to the AHP method [1]. Selection of the most suitable technology used by companies with additional considerations based on a cost-benefit analysis [3]. Application of AHP in the field of project management to select the best contractor. The hierarchical structure for the prequalification criteria and the contractors who want to qualify for the project [4]. AHP is also used in the integrated approach of the storage site selection process, where both quantitative and qualitative aspects have been considered [5]. AHP is used for provider selection of a telecommunications system, which is a complex, multi-person, multi-criteria decision problem [6]. AHP compares the importance of each criterion, as well as the values of the candidates on each criterion, in order to calculation for determining or make the best decision [7-8].

The analytical hierarchy process can be used to select an object. The AHP method is also used to measure productivity. This method is suitable because it takes into account the criteria and sub-criteria arranged in a hierarchical structure. This supplier selection problem has clear criteria and sub-criteria that are known to the company. The AHP method can support the com-

pany in selecting suppliers from several alternatives. The supplier decision was made by considering the value of consistency in the experts' answers based on pairwise comparisons between existing criteria and sub-criteria. Experts are people who understand and understand this supplier. Supplier is a line in which raw and finished goods are delivered to a company or store; Supplier performance reviews can be measured using the Analytical Hierarchy Process (AHP) method. AHP is a useful way to select which suppliers a company should or should not maintain. The choice of this method is considered appropriate compared to other methods, since a practical and effective approach allows researchers to solve a complex problem that is not structured into several components in a hierarchical arrangement, allowing them to keep track of -training existing suppliers. The choice of this method is considered appropriate because it can represent the hierarchy of the supplier itself. The AHP method is also capable of translating or solving unstructured problems into an easy to understand or simpler model. This method also uses pairwise comparative assessment performed by experts to obtain a priority scale [9]. AHP's analysis is used by the company to select existing suppliers.

Hypotesis Development

This study did not use test hypotheses. It is the implementation of individual axioms in a hierarchical analysis (AHP) process. AHP methods generally organize problems in the form of underlying reasoning. By dividing the existing problem into smaller parts, when using AHP it is divided into two steps: hierarchical design and hierarchical component evaluation [10]. The Analytical Hierarchical Process (AHP) is one of the methods. The most widely used multi-criteria analysis in decision making [11] is the basis for completing the AHP process:

A. Define the decision hierarchy with attributes (criteria) and alternatives (suppliers) that clearly represent the relationship.

B. Comparison of Features and Alternatives Using a Dual Comparison Scale Determining the relative importance of attributes and alternatives involves comparing how well options perform with different attributes.

C. Find the maximum eigenvalue (λmax) and CI (conformity index) weights of the attribute and its alternatives.

D. Calculate CR (Correspondence Ratio) = CI/RI where RI is (Randomly Generated Conformity Index).

e. Follow step 4 and find the total weight. collect all and perform calculations with Excel software to normalize the weight to get the best supplier. When the best supplier has been found The company can also compare with other suppliers by adding or removing some of the existing criteria.

A hierarchical structure has no standards or hierarchies of creation. Hierarchy is often based on a combination of ideas, experiences, and views of others that exist. Three things are clearly opposites between one person and another. Therefore, the possibility of creating a non-standard hierarchy is very large. The hierarchical structure also differs depending on the degree of complexity or complexity of the problem being considered and the experience of the model to be solved and the outcome of the solution. due to the probability that various cases different is very high Thus, the hierarchical structure tends to differ [12]. The scoring scale used in the pairwise comparison questionnaire often refers to the literature. It provides scores from one to nine with appropriate explanations. [13] The odds-scoring scale is greater between one criterion and another. Each incremental significance increases and also represents a value between two adjacent considerations. The RI value is very important for calculating the CR value. In this study, the RI value was adjusted as needed when the criterion was applied. 5 items. The RI value used is 1.12. This research focuses on the selection of suppliers. for companies Suppliers can be correctly identified based on pre-defined criteria. In theory, it seems that an analytical hierarchical process approach can be used to determine priorities, alternatives, or alternatives. not defined according to theory Selection is not based on clear criteria, so gaps in this research can lead companies to Select suppliers the right way, i.e. an analytical hierarchical process. The novelty of this study lies in calculating the uniformity in global gross weight calculations.

Methodology

The concept of the analytical hierarchical process (AHP) is based on a complex problem state of the world, consisting of contrasting elements and various similar elements. Where individual components are often interrelated, the analytical hierarchy method (AHP) complements and assists in making decisions based on characteristics that are considered representative of all. This set creates various issues related to the resources used. Therefore, a system of priorities is needed to facilitate this. to overcome these problems Appropriate solutions must be found later in order to create an efficient structure [14] since its discovery. Analytical Hierarchical Processes (AHP) are one of the most widely used tools for decision makers. AHP can describe or solve many criteria. AHP methods are used to evaluate performance based on quality, delivery, cost, service, and performance. Features Among these criteria Criteria quality is a supplier selection criterion [15] because supplier selection models affect business continuity when analyzing supplier selection issues. Other factors must also be taken into account [16]. The advantages of using the AHP method over other methods are the number of specialists and other problems. It can be managed in a hierarchy of system complexity levels from the lowest (alternative), intermediate (sub-criteria) to the highest level (general), which should be taken into account by the company as 50-90% of the cost. The company's trade was made possible through purchasing activities [17]. Sourcing AHP uses a qualitative and quantitative approach to select the best suppliers. There is also a combination of AHP and linear programs useful for viewing tangible and intangible factors. The company was provided with a list of suppliers with suitable capacity and number of orders [18].

Criteria that can be compared perfectly cannot be measured. If the threshold is lowered or raised Ratings do not matter The AHP methodology has a clear principle of dividing the problem into smaller parts. It is easy to carry out such an analysis as b. to determine the goal. What criteria are used as benchmarks? and who or what meets those criteria The most important aspect of AHP analysis is placing parts or variables in a hierarchy and assigning numerical values to each variable and synthesizing them to select the variable with the highest priority [19]. If you look at a number of pre-existing factors such like b. We can make wise decisions. Thus, the final decision is very accurate. Experience The decision maker should always take experience into account in his decision. so that you don't make a mistake later. The Analytic Hierarchical Process (AHP) is a method developed to overcome this difficulty. This is because the analytic hierarchical process (AHP) is a form of multi-criteria decision making model.

In general, the AHP approach correlates problems with root causes, dividing existing problems into smaller parts. When using AHP, they are divided into two stages: hierarchical design and

hierarchical component evaluation [10]. The AHP process is as follows in figure 2 using the AHP method allows you to make faster and more business friendly decisions.

A. Define a decision hierarchy with attributes (criteria) and alternatives (suppliers) that clearly represent relationships.

B. Comparison of characteristics and alternatives using a double comparison scale. Determining the relative importance of attributes and alternatives involves comparing how well options perform across attributes.

C. Find the maximum eigenvalue weight (λmax) and CI (match index) of the attribute and its alternatives.

D. Calculate CR (Consistency Ratio) = CI / RI where RI (Randomly Generated Consistency Index).

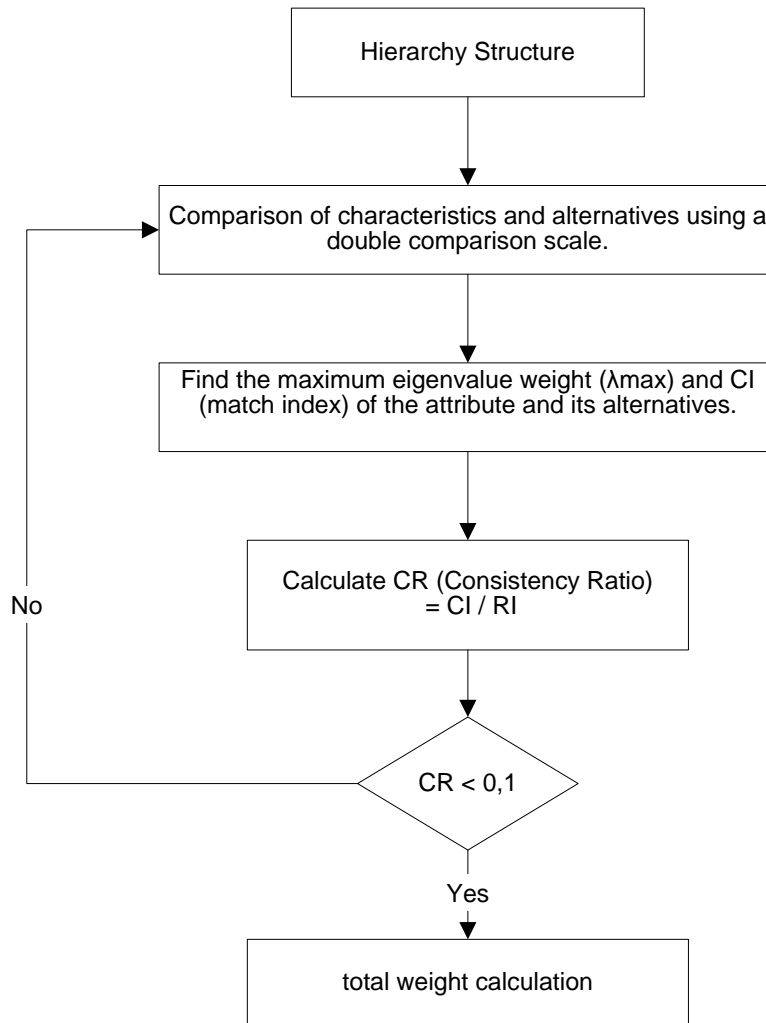e. Follow step 4 and find all the weights.

Figure 2. Step AHP method

collect everything and perform calculations using Excel software to normalize the weights to get the best suppliers.After finding the best suppliers, the company can compare with other suppliers by adding or removing some of the existing criteria. When hierarchical structures are made there is no standardized or written structure. Hierarchical structure is usually based on a variety of topics, ranging from the combination of existing ideas, experiences and perspectives of others. Three things are an extreme contrast between one person and another. Therefore, the likelihood of creating a non-standard hierarchy is very high. Hierarchical structure differs depending on the difficulty or complexity of the problem and the circumstances in which the actor wants to solve the problem and the results obtained from the problem. Since the probability that one case differs from another is very high, the hierarchical structure should be different [12]. The rating scale used in the paired comparison questionnaire usually refers to the literature in which the ratings

are given from one to nine with appropriate explanations [13]. The odd fraction rating is the value between one criterion and another criterion. Each increment of significance increases and also means the values between the two adjacent considerations. The RI value is very important for calculating the CR value in this study. The RI value is adjusted according to needs using five criteria. The RI value used is 1.12. The random index value used in this study was 1.12 because there were only five main criteria in the main sample. The IR value may also vary depending on usage. Analytical hierarchy is the process used to evaluate the analytical methods used.

Results and Discussions
Results

The following is a hierarchy of supplier selection criteria in Figure 2 that has been made based on the interview results.
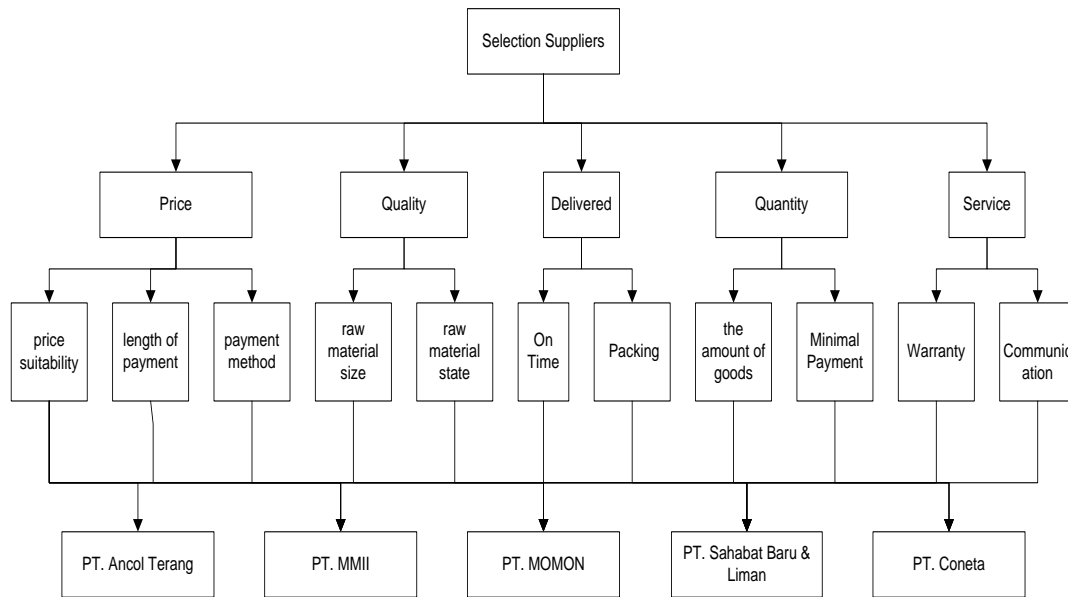

Figure 2. Hierarchy of supplier selection criteria

The criteria and sub-criteria for supplier selection were obtained from direct interviews with the company. After conducting interviews, five main criteria for supplier selection were obtained and 11 sub-criteria. Pairwise comparisons were made between the criteria and criteria and the criteria with their respective sub-criteria. Consistency measurements were made with the criteria that must be below 10%. Consistency is measured by calculating index random. Decision making by leaders is often faced with difficult problems because of the variety of decision-making criteria, weight of considerations and alternative choices

Discussions

After the consistency test has been completed, the next step is to do a global weight calculation. This calculation aims to see the ranking of the five existing suppliers so that the company can make a selection of these suppliers. The global weight calculation focuses on the multiplication performed on each aspect of the hierarchy. The final result that is seen is the sum of each criterion and sub-criteria according to the supplier company (see Table 1).

Table 1. Overall global weight

Criteria	Sub criteria	Corporate alternative				
		S 1	S 2	S 3	S 4	S 5

				S1	S2	S3	S4	S5
1	0.30	SK1	0.13	0.041	0.032	0.014	0.016	0.024
		SK2	0.11	0.037	0.029	0.013	0.015	0.021
		SK3	0.06	0.018	0.014	0.006	0.007	0.010
2	0.30	SK4	0.08	0.018	0.027	0.015	0.009	0.007
		SK5	0.22	0.053	0.079	0.044	0.027	0.020
3	0.12	SK6	0.10	0.020	0.034	0.017	0.019	0.010
		SK7	0.02	0.004	0.007	0.004	0.004	0.002
4	0.13	SK8	0.11	0.016	0.016	0.016	0.031	0.030
		SK9	0.02	0.003	0.003	0.003	0.006	0.006
5	0.15	SK10	0.04	0.007	0.010	0.005	0.010	0.006
		SK11	0.11	0.021	0.029	0.014	0.031	0.018
Total				0.239	0.280	0.150	0.175	0.156

Table 1 shows the total ranking of each supplier where the supplier who got the first rank is PT. MMII with global weight is 0,280. Code S1-S5 are the five companises (alternative) and code Sk1-SK11 are sub criteria supplier. The following is the order of the five companies, which are described using a bar chart in figure 3. The ranking process was conducted by applying the analytic hierarchy process (AHP) method.
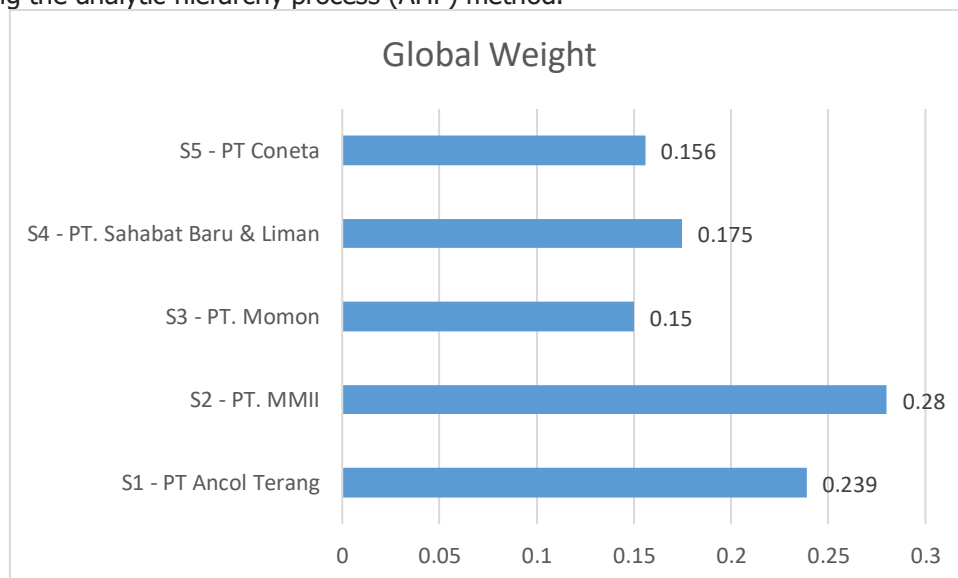

Figure 3. Global weight score

Conclusion

The total weight calculation results show that PT. MMII is the top performing supplier company with a total score of 0.280. The resulting score is based on the sum of the criteria, sub-criteria and alternative providers, the total weight of which has been calculated. Results of global weight calculations in PT. Ancol Terang, with a total score of 0.239, the resulting score is based on the

sum of the criteria, sub-criteria, and alternative providers that have calculated the global weight. Results of global weight calculations in PT.MOMON with a total score of 0.150, the resulting score is based on the sum of the criteria, sub-criteria and alternative providers that calculated the total weight. Results of global weight calculations in PT. Central Sahabat Baru & Liman with a total score of 0.175, the resulting score is based on the sum of criteria, sub-criteria and supplier alternatives calculated as a global weight. Results of global weight calculations in PT. COMETA with an overall score of 0.156, the resulting score is the sum of the criteria, sub-criteria and alternative providers calculated to give a global weight. Suppliers also have their own advantages on each criterion, so there are several suppliers that have advantages on certain criteria in PT's pricing criteria. Ancol Terang retains first place with a score of 0.097 in PT quality criteria. MMII retains first place with a score of 0.107 on the PT submission criteria. MMII retains first place with a score of 0.041 in PT count. Central Sahabat Baru & Liman ranked first with a score of 0.037 and a service criterion of PT. Central Sahabat Baru & Liman took first place with a score of 0.041.

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FORM PENILAIAN ARTIKEL & REKOMENDASI

MATRIX Jurnal Manajemen Teknologi dan Informatika

Politeknik Negeri Bali, Bukit Jimbaran, Kuta Badung-Telp. (0361) 701981, Fax (0361) 701128

Judul Paper : Supplier Performance Analysis Using the Analytical Hierarchy Process (AHP) Method

A. Penilaian

No	Aspek Penilaian	Ya	Tidak
1	Artikel pernah dimuat pada media cetak lain? *)		√
2	Judul tepat, singkat dan jelas	√	
3	Abstrak menggambarkan isi artikel	√	
4	Kata kunci dipilih/dirumuskan dengan tepat	√	
5	Metode dan rancangan sesuai tujuan penelitian	√	
6	Analisis dan sintesis dilakukan secara kritis	√	
7	Ada bagian yang perlu dikembangkan/~~diringkas~~ **)	√	
8	Gambar dan Tabel cukup jelas dan fungsional		√
9	Kesimpulan dituangkan secara akurat dan berpedoman pada kaidah ilmiah		√
10	Hasil penelitian memberi kontribusi untuk pengembangan IPTEK	√	
11	Lebih dari 80% pustaka adalah terbitan 10 tahun terakhir	√	
12	Lebih dari 80% pustaka merupakan hasil penelitian atau artikel dalam jurnal	√	
13	Penulis merujuk pustaka yang diperlukan		

B. Rekomendasi *(pilih salah satu)*

Naskah dapat dimuat tanpa perubahan	
Naskah dapat dimuat dengan ada revisi sesuai catatan	√
Naskah dapat dimuat dengan ada revisi bahasa	
Naskah tidak dapat dimuat	

Catatan:
1. Hypotesis development sebaiknya digabungkan ke dalam methodolody untuk menyelaraskan dengan metodologi yang diusulkan.
2. Gambar 2 mohon diperbesar fontnya sehingga informasinya mudah terbaca.
3. Belum ditemukan formula perhitungan untuk mendapatkan Global weight score, mohon ditambahkan demikian pula dengan Overall global weight mohon diberikan penjelasan Tabel 1 didapatkan.
4. Kesimpulan mohon diperbaiki sehingga bias menampilkan peran AHP dalam penentuan supplier, bukan penjelasan dari Gambar 3.
5. Mohon dirapikan penulisan daftar pustaka dan sitasinya/rujukannya bisa menggunakan Mandelay atau tools yang lain, masih ditemukan ada sumber pustaka yang tidak dirujuk namun dicantumkan di daftar pustaka, atau sebaliknya.

Mitra Bebestari Jurnal MATRIX

Supplier Performance Analysis ~~with~~ Using the Analytical Hierarchy Process (AHP) Method

Abstract: This research aims to determine priorities in supplier selection. The determination of this supplier used the Analytical Hierarchy Process (AHP) method by determining the criteria and sub criteria of the supplier selection objectives. Each criterion and sub-criteria are arranged in a hierarchical structure and compared in pairs by determining the priority scale. Selection of suppliers based on the largest global weight values. The selected supplier is PT.MMII with a global weight value of 0.280. The global weighted assessment has considered consistency in decision-making based on a consistency index, which must be below 10%. This shows that PT. MMII was selected based on consideration of existing criteria and sub-criteria compared to other suppliers. This study contributes to group decision-making involving experts so that companies can make decisions in choosing the most appropriate supplier.

Keywords: AHP method, supplier, global weight calculation

Introduction

Supplier is an important line that is part of the company where the supplier can supply raw materials, both raw and semi-finished, for the company. The company is responsible for making decisions about the selection of suppliers [1]. The company's decision when choosing suppliers is a complex issue considering the criteria and sub-criteria. Criteria for the selection of suppliers are price, quality, delivery, quantity and service.
A lot of research has been done related to choosing an object. The selection uses the Analytical Hierarchy Process as a method. Analytic Hierarchy Process (AHP) is a method or tool for multi-criteria decision making using Expert Choice software, tools in the software will simplify the function of the AHP method [2]. The selection for determining the appropriate technical software used from 6 alternative engineering software contained in the company criteria is also made according to the AHP method [1]. Selection of the most suitable technology used by companies with additional considerations based on a cost-benefit analysis [3]. Application of AHP in the field of project management to select the best contractor. The hierarchical structure for the prequalification criteria and the contractors who want to qualify for the project [4]. AHP is also used in the integrated approach of the storage site selection process, where both quantitative and qualitative aspects have been considered [5]. AHP is used for provider selection of a telecommunications system, which is a complex, multi-person, multi-criteria decision problem [6]. AHP compares the importance of each criterion, as well as the values of the candidates on each criterion, in order to calculation for determining or make the best decision [7-8].
The analytical hierarchy process can be used to select an object. The AHP method is also used to measure productivity. This method is suitable because it takes into account the criteria and sub-criteria arranged in a hierarchical structure. This supplier selection problem has clear criteria and sub-criteria that are known to the company. The AHP method can support the com-

pany in selecting suppliers from several alternatives. The supplier decision was made by considering the value of consistency in the experts' answers based on pairwise comparisons between existing criteria and sub-criteria. Experts are people who understand and understand this supplier. Supplier is a line in which raw and finished goods are delivered to a company or store; Supplier performance reviews can be measured using the Analytical Hierarchy Process (AHP) method. AHP is a useful way to select which suppliers a company should or should not maintain. The choice of this method is considered appropriate compared to other methods, since a practical and effective approach allows researchers to solve a complex problem that is not structured into several components in a hierarchical arrangement, allowing them to keep track of -training existing suppliers. The choice of this method is considered appropriate because it can represent the hierarchy of the supplier itself. The AHP method is also capable of translating or solving unstructured problems into an easy to understand or simpler model. This method also uses pairwise comparative assessment performed by experts to obtain a priority scale [9]. AHP's analysis is used by the company to select existing suppliers.

Methodology

This study did not use test hypotheses. It is the implementation of individual axioms in a hierarchical analysis (AHP) process. AHP methods generally organize problems in the form of underlying reasoning. By dividing the existing problem into smaller parts, when using AHP it is divided into two steps: hierarchical design and hierarchical component evaluation [10]. The Analytical Hierarchical Process (AHP) is one of the methods. The most widely used multi-criteria analysis in decision making [11] is the basis for completing the AHP process:

A. Define the decision hierarchy with attributes (criteria) and alternatives (suppliers) that clearly represent the relationship.

B. Comparison of Features and Alternatives Using a Dual Comparison Scale Determining the relative importance of attributes and alternatives involves comparing how well options perform with different attributes.

C. Find the maximum eigenvalue (λmax) and CI (conformity index) weights of the attribute and its alternatives.

D. Calculate CR (Correspondence Ratio) = CI/RI where RI is (Randomly Generated Conformity Index).

e. Follow step 4 and find the total weight. collect all and perform calculations with Excel software to normalize the weight to get the best supplier. When the best supplier has been found The company can also compare with other suppliers by adding or removing some of the existing criteria.

A hierarchical structure has no standards or hierarchies of creation. Hierarchy is often based on a combination of ideas, experiences, and views of others that exist. Three things are clearly opposites between one person and another. Therefore, the possibility of creating a non-standard hierarchy is very large. The hierarchical structure also differs depending on the degree of complexity or complexity of the problem being considered and the experience of the model to be solved and the outcome of the solution. due to the probability that various cases different is very high Thus, the hierarchical structure tends to differ [12]. The scoring scale used in the pairwise comparison questionnaire often refers to the literature. It provides scores from one to nine with appropriate explanations. [13] The odds-scoring scale is greater between one criterion and another. Each incremental significance increases and also represents a value between two adjacent considerations. The RI value is very important for calculating the CR value. In this study, the RI value was adjusted as needed when the criterion was applied. 5 items. The RI value used is 1.12. This research focuses on the selection of suppliers. for companies Suppliers can be correctly identified based on pre-defined criteria. In theory, it seems that an analytical hierarchical process approach can be used to determine priorities, alternatives, or alternatives. not defined according to theory Selection is not based on clear criteria, so gaps in this research can lead companies to Select suppliers the right way, i.e. an analytical hierarchical process. The novelty of this study lies in calculating the uniformity in global gross weight calculations.

The concept of the analytical hierarchical process (AHP) is based on a complex problem state of the world, consisting of contrasting elements and various similar elements. Where individual components are often interrelated, the analytical hierarchy method (AHP) complements and assists in making decisions based on characteristics that are considered representative of all. This set creates various issues related to the resources used. Therefore, a system of priorities is needed to facilitate this. to overcome these problems Appropriate solutions must be found later in order to create an efficient structure [14] since its discovery. Analytical Hierarchical Processes (AHP) are one of the most widely used tools for decision makers. AHP can describe or solve many criteria. AHP methods are used to evaluate performance based on quality, delivery, cost, service, and performance. Features Among these criteria Criteria quality is a supplier selection criterion [15] because supplier selection models affect business continuity when analyzing supplier selection issues. Other factors must also be taken into account [16]. The advantages of using the AHP method over other methods are the number of specialists and other problems. It can be managed in a hierarchy of system complexity levels from the lowest (alternative), intermediate (sub-criteria) to the highest level (general), which should be taken into account by the company as 50-90% of the cost. The company's trade was made possible through purchasing activities [17]. Sourcing AHP uses a qualitative and quantitative approach to select the best suppliers. There is also a combination of AHP and linear programs useful for viewing tangible and intangible factors. The company was provided with a list of suppliers with suitable capacity and number of orders [18].

Criteria that can be compared perfectly cannot be measured. If the threshold is lowered or raised Ratings do not matter The AHP methodology has a clear principle of dividing the problem into smaller parts. It is easy to carry out such an analysis as b. to determine the goal. What criteria are used as benchmarks? and who or what meets those criteria The most important aspect of AHP analysis is placing parts or variables in a hierarchy and assigning numerical values to each variable and synthesizing them to select the variable with the highest priority [19]. If you look at a number of pre-existing factors such like b. We can make wise decisions. Thus, the final decision is very accurate. Experience The decision maker should always take experience into account in his decision. so that you don't make a mistake later. The Analytic Hierarchical Process (AHP) is a method developed to overcome this difficulty. This is because the analytic hierarchical process (AHP) is a form of multi-criteria decision making model.

In general, the AHP approach correlates problems with root causes, dividing existing problems into smaller parts. When using AHP, they are divided into two stages: hierarchical design and

hierarchical component evaluation [10]. The AHP process is as follows in figure 2 using the AHP method allows you to make faster and more business friendly decisions.

A. Define a decision hierarchy with attributes (criteria) and alternatives (suppliers) that clearly represent relationships.

B. Comparison of characteristics and alternatives using a double comparison scale. Determining the relative importance of attributes and alternatives involves comparing how well options perform across attributes.

C. Find the maximum eigenvalue weight (λmax) and CI (match index) of the attribute and its alternatives.

D. Calculate CR (Consistency Ratio) = CI / RI where RI (Randomly Generated Consistency Index).

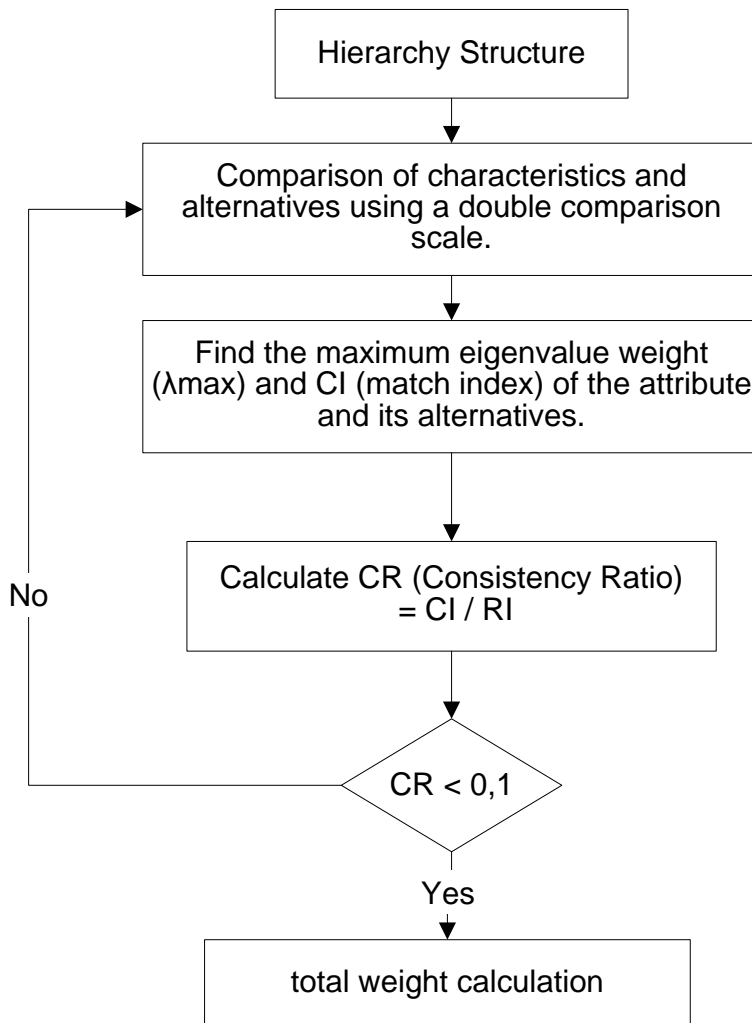e. Follow step 4 and find all the weights.

Figure 2. Step AHP method

collect everything and perform calculations using Excel software to normalize the weights to get the best suppliers.After finding the best suppliers, the company can compare with other suppliers by adding or removing some of the existing criteria. When hierarchical structures are made there is no standardized or written structure. Hierarchical structure is usually based on a variety of topics, ranging from the combination of existing ideas, experiences and perspectives of others. Three things are an extreme contrast between one person and another. Therefore, the likelihood of creating a non-standard hierarchy is very high. Hierarchical structure differs depending on the difficulty or complexity of the problem and the circumstances in which the actor wants to solve the problem and the results obtained from the problem. Since the probability that one case differs from another is very high, the hierarchical structure should be different [12]. The rating scale used in the paired comparison questionnaire usually refers to the literature in which the ratings

are given from one to nine with appropriate explanations [13]. The odd fraction rating is the value between one criterion and another criterion. Each increment of significance increases and also means the values between the two adjacent considerations. The RI value is very important for calculating the CR value in this study. The RI value is adjusted according to needs using five criteria. The RI value used is 1.12. The random index value used in this study was 1.12 because there were only five main criteria in the main sample. The IR value may also vary depending on usage. Analytical hierarchy is the process used to evaluate the analytical methods used.

Results and Discussions
Results

The following is a hierarchy of supplier selection criteria in Figure 2 that has been made based on the interview results.
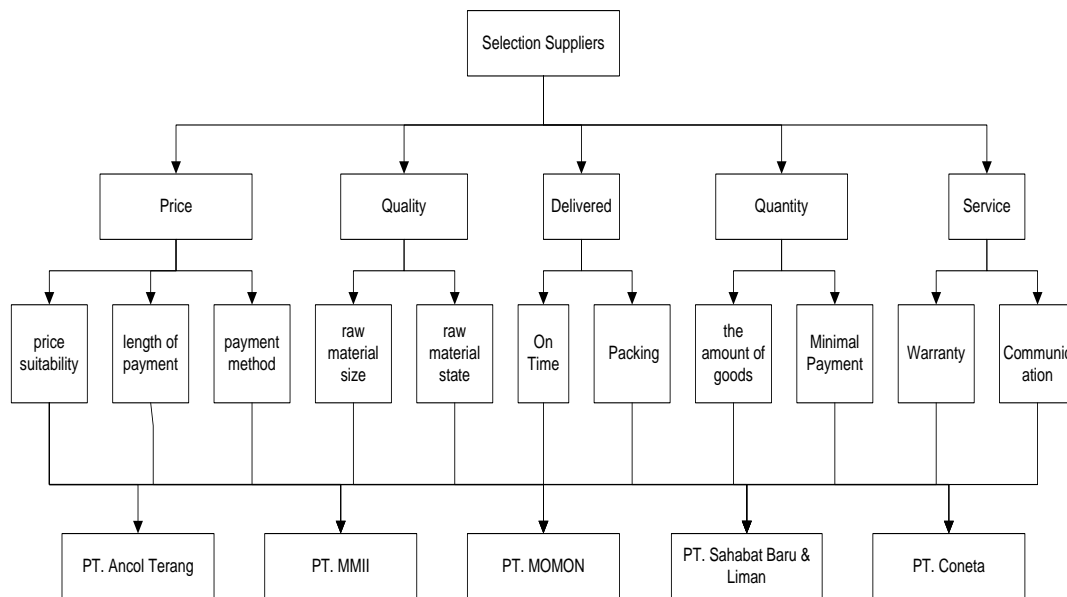

Figure 2. Hierarchy of supplier selection criteria

The criteria and sub-criteria for supplier selection were obtained from direct interviews with the company. After conducting interviews, five main criteria for supplier selection were obtained and 11 sub-criteria. Pairwise comparisons were made between the criteria and criteria and the criteria with their respective sub-criteria. Consistency measurements were made with the criteria that must be below 10%. Consistency is measured by calculating index random. Decision making by leaders is often faced with difficult problems because of the variety of decision-making criteria, weight of considerations and alternative choices

Discussions

After the consistency test has been completed, the next step is to do a global weight calculation. The global weight calculation is obtained by multiplying all the weights on the criteria, sub-criteria and alternatives.This calculation aims to see the ranking of the five existing suppliers so that the company can make a selection of these suppliers. The global weight calculation focuses on the multiplication performed on each aspect of the hierarchy. The final result that is seen is the sum of each criterion and sub-criteria according to the supplier company (see Table 1).

Table 1. Overall global weight

Criteria		Sub criteria			Corporate alternative				
					S1	S2	S3	S4	S5
1	0.30	SK1	0.13		0.041	0.032	0.014	0.016	0.024
		SK2	0.11		0.037	0.029	0.013	0.015	0.021
		SK3	0.06		0.018	0.014	0.006	0.007	0.010
2	0.30	SK4	0.08		0.018	0.027	0.015	0.009	0.007
		SK5	0.22		0.053	0.079	0.044	0.027	0.020
3	0.12	SK6	0.10		0.020	0.034	0.017	0.019	0.010
		SK7	0.02		0.004	0.007	0.004	0.004	0.002
4	0.13	SK8	0.11		0.016	0.016	0.016	0.031	0.030
		SK9	0.02		0.003	0.003	0.003	0.006	0.006
5	0.15	SK10	0.04		0.007	0.010	0.005	0.010	0.006
		SK11	0.11		0.021	0.029	0.014	0.031	0.018
Total					0.239	0.280	0.150	0.175	0.156

Table 1 shows the total ranking of each supplier where the supplier who got the first rank is PT. MMII with global weight is 0,280. Code S1-S5 are the five companises (alternative) and code Sk1-SK11 are sub criteria supplier. The following is the order of the five companies, which are described using a bar chart in figure 3. The ranking process was conducted by applying the analytic hierarchy process (AHP) method.
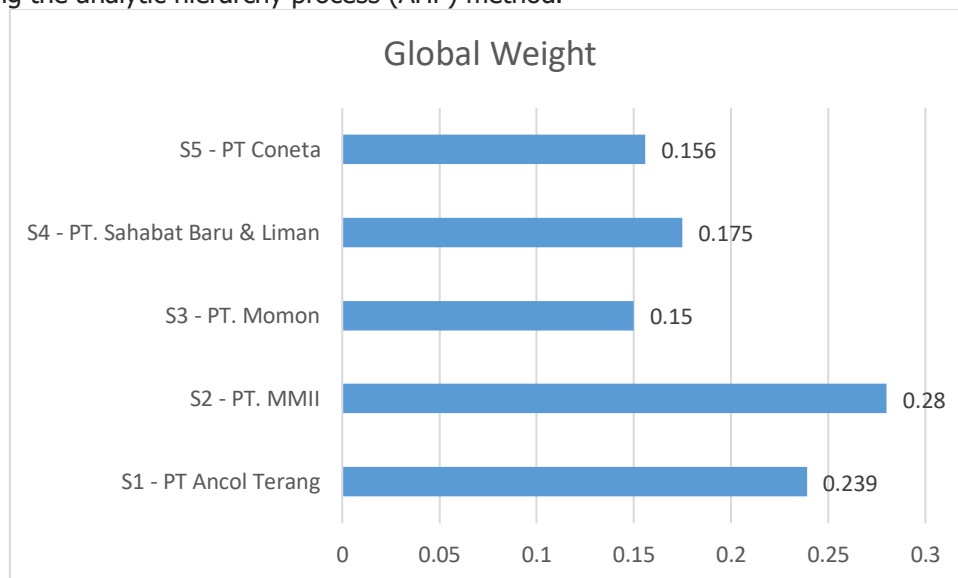

Figure 3. Global weight score

Conclusion

AHP can be used in the method for making decisions to choose suppliers. The company can choose a supplier based on several criteria of price, quality, delivered, quantity and service. The results show in the total weight calculation that PT. MMII is the top performing supplier company with a total score of 0.280. The resulting score is based on the sum of the criteria, sub-criteria and alternative providers, the total weight of which has been calculated. Results of global weight calculations in PT. Ancol Terang, with a total score of 0.239, the resulting score is based on the sum of the criteria, sub-criteria, and alternative providers that have calculated the global weight. Results of global weight calculations in PT.MOMON with a total score of 0.150, the resulting score is based on the sum of the criteria, sub-criteria and alternative providers that calculated the total weight. Results of global weight calculations in PT. Central Sahabat Baru & Liman with a total score of 0.175, the resulting score is based on the sum of criteria, sub-criteria and supplier alternatives calculated as a global weight. Results of global weight calculations in PT. COMETA with an overall score of 0.156, the resulting score is the sum of the criteria, sub-criteria and alternative providers calculated to give a global weight. Suppliers also have their own advantages on each criterion, so there are several suppliers that have advantages on certain criteria in PT's pricing criteria. Ancol Terang retains first place with a score of 0.097 in PT quality criteria. MMII retains first place with a score of 0.107 on the PT submission criteria. MMII retains first place with a score of 0.041 in PT count. Central Sahabat Baru & Liman ranked first with a score of 0.037 and a service criterion of PT. Central Sahabat Baru & Liman took first place with a score of 0.041.

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Supplier Performance Analysis Using the Analytical Hierarchy Process (AHP) Method

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Abstract: This research aims to determine priorities in supplier selection. The determination of this supplier uses the Analytical Hierarchy Process (AHP) method by determining the criteria and sub-criteria of the supplier selection objectives. Each criterion and sub-criteria are arranged in a hierarchical structure and compared by determining the priority scale. The selection of suppliers is based on the largest global weight values. The selected supplier is PT.MMII with a global weight value of 0.280. The global weighted assessment has considered consistency in decision-making based on a consistency index, which must be below 10%. It shows that PT. MMII is selected based on existing criteria and sub-criteria compared to other suppliers. This study contributes to group decision-making involving experts to choose the most appropriate supplier.

Keywords: AHP method, supplier, global weight calculation

How to Cite: Provide intext citation in IEEE style, e.g., The theory was first put forward in 1998 [1].

Introduction

Supplier is an important line that is part of the company where the supplier can supply raw materials, both raw and semi-finished, for the company. The company is responsible for making decisions about the selection of suppliers [1]. When choosing suppliers, the company's decision is complex, considering the criteria and sub-criteria. Criteria for selecting suppliers are price, quality, delivery, quantity, and service.

Much research has been done related to choosing an object. The selection uses the Analytical Hierarchy Process as a method. Analytic Hierarchy Process (AHP) is a method or tool for multi-criteria decision making using Expert Choice software, tools in the software will simplify the function of the AHP method [2]. The selection for appropriate technical software used from 6 alternative engineering software in the company criteria is also made according to the AHP method [1]. Companies select the most suitable technology and use additional considerations based on a cost-benefit analysis [3]. Application of AHP in project management to select the best contractor. The hierarchical structure for the prequalification criteria and the contractors who qualify for the project [4]. AHP is also used in the integrated approach of the storage site selection process, where both quantitative and qualitative aspects have been considered [5]. AHP is used for provider selection of a telecommunications system. It is a complex, multi-person, multi-criteria decision problem [6]. AHP compares each criterion's importance and the candidates' values on each criterion to calculate for determining or making the best decision [7-8].

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Supplier is a line in which raw and finished goods are delivered to a company or store; Supplier performance reviews can be measured using the Analytical Hierarchy Process (AHP) method. AHP is a useful way to select which suppliers a company should or should not maintain. The choice of this method is considered appropriate compared to other methods since a practical and effective approach allows researchers to solve a complex problem that is not structured into several components in a hierarchical arrangement, allowing them to keep track of -training existing suppliers. This method is considered appropriate because it can represent the hierarchy of the supplier itself. The AHP method can also translate or solve unstructured problems into an easy-to-understand or simpler model. This method also uses pairwise comparative assessment performed by experts to obtain a priority scale [9]. The company uses AHP's analysis to select existing suppliers.

Methodology

This study did not use test hypotheses. Instead, it implements individual axioms in a hierarchical analysis (AHP) process. AHP methods generally organize problems in the form of underlying reasoning. By dividing the existing problem into smaller parts, when using AHP, it is divided into two steps: hierarchical design and hierarchical component evaluation [10]. The Analytical Hierarchical Process (AHP) is one of the methods. The most widely used multi-criteria analysis in decision making is the basis for completing the AHP process [11]:

a. Define the decision hierarchy with attributes (criteria) and alternatives (suppliers) representing the relationship.

b. Comparison of Features and Alternatives Using a Dual Comparison Scale Determining the relative importance of attributes and alternatives involves comparing how well options perform with different attributes.

c. Find the maximum eigenvalue (λmax) and CI (conformity index) weights of the attribute and its alternatives.

d. Calculate CR (Correspondence Ratio) = CI/RI where RI is (Randomly Generated Conformity Index).

e. Follow step d, find the total weight, collect all, and perform calculations with Excel software to normalize the weight to get the best supplier. When the best supplier has been found, the company can also compare with other suppliers by adding or removing existing criteria.

A hierarchical structure has no standards or hierarchies of creation. Hierarchy is often based on a combination of ideas, experiences, and views of others that exist. Three things are opposites between one person and another. Therefore, the possibility of creating a non-standard hierarchy is very large. Due to the probability that various cases are very high, thus, the hierarchical structure tends to differ [12]. The scoring scale used in the pairwise comparison questionnaire often refers to the literature. It provides scores from one to nine with appropriate explanations [13]. The odds-scoring scale is greater between one criterion and another. Each incremental significance increases and also represents a value between two adjacent considerations. The RI value is very important for calculating the CR value. In this study, the RI value is adjusted as needed when the criterion is applied for five items. The RI value used is 1.12.

This research focuses on the selection of suppliers. For companies, Suppliers can be correctly identified based on pre-defined criteria. In theory, it seems that an analytical hierarchical process approach can be used to determine priorities, alternatives, or alternatives not defined according to theory Selection is not based on clear criteria, so gaps in this research can lead companies to select suppliers the right way, i.e., an analytical hierarchical process. The novelty of this study lies in calculating the uniformity in global gross weight calculations.

The analytical hierarchical process (AHP) concept is based on a complex problem state of the world, consisting of contrasting elements and various similar elements. Where individual components are often interrelated, the analytical hierarchy method (AHP) complements and assists in making decisions based on characteristics considered representative of all. This set creates various issues related to the resources used. Therefore, a system of priorities is needed to facilitate this. Appropriate solutions must be found later to create an efficient structure [14]. Analytical Hierarchical Processes (AHP) are among the most widely used tools for decision-makers. AHP can describe or solve many criteria. AHP methods to evaluate performance are based on quality,

delivery, cost, service, and performance. Features among these criteria Criteria quality is a supplier selection criterion because supplier selection models affect business continuity when analyzing supplier selection issues [15]. Other factors must also be taken into account [16]. The advantages of using the AHP method over other methods are the number of specialists and other problems. It can be managed in a hierarchy of system complexity levels from the lowest (alternative), intermediate (sub-criteria) to the highest level (general), which should be taken into account by the company as 50-90% of the cost. The company's trade was made possible through purchasing activities [17]. Sourcing AHP uses a qualitative and quantitative approach to select the best suppliers. A combination of AHP and linear programs is also useful for viewing tangible and intangible factors. The company was provided with a list of suppliers with suitable capacity and some orders [18].

Criteria that can be compared perfectly cannot be measured. If the threshold is lowered or raised, ratings do not matter. The AHP methodology has a clear principle of dividing the problem into smaller parts. It is easy to carry out such analysis to determine the goal. The most important aspect of AHP analysis is placing parts or variables in a hierarchy and assigning numerical values to each variable, and synthesizing them to select the variable with the highest priority [19]. Thus, the final decision is very accurate. Figure 1 shows the steps of the AHP method.
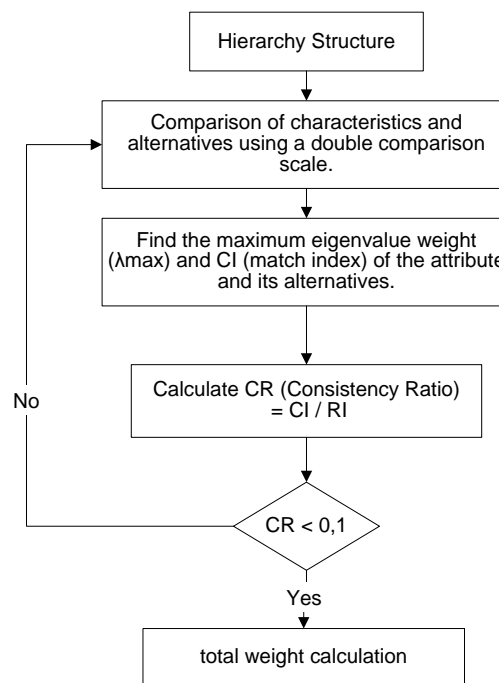

Figure 1. Step AHP method

Results and Discussions

Results

The following is a hierarchy of supplier selection criteria in Figure 2 that has been made based on the interview results.
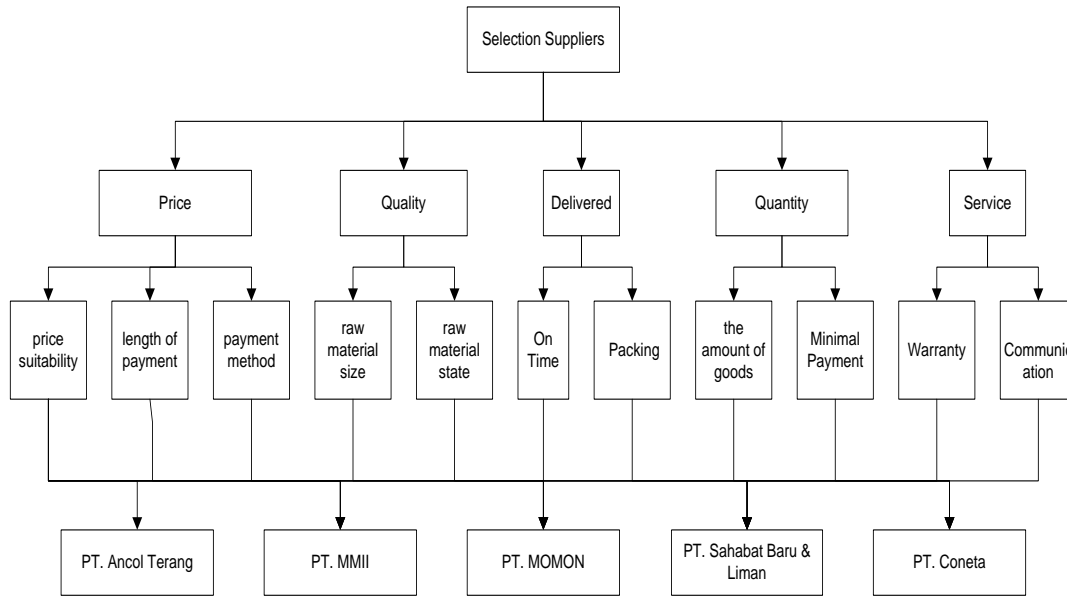
Figure 2. Hierarchy of supplier selection criteria

The criteria and sub-criteria for supplier selection are obtained from direct interviews with the company. After conducting interviews, five main criteria for supplier selection are obtained and 11 sub-criteria. Next, pairwise comparisons are made between the criteria with other criteria, and the criteria with their respective sub-criteria. Finally, consistency measurements are made with the criteria below 10% by calculating index random. Decision-making by leaders is often faced with difficult problems because of the variety of decision-making criteria, the weight of considerations, and choices.

Discussions

After the consistency test has been completed, the next step is to calculate a global weight. The global weight calculation is obtained by multiplying all the weights on the criteria, sub-criteria, and alternatives. This calculation aims to see the ranking of the five existing suppliers to select these suppliers. Therefore, the global weight calculation focuses on the multiplication performed on each aspect of the hierarchy. The final result is the sum of each criterion and sub-criteria according to the supplier company (see Table 1). Table 1 shows the total ranking of each supplier where the supplier who got the first rank is PT MMII with a global weight of 0.280. Code S1-S5 are the five companies (alternative), and SK1-SK11 are the sub-criteria suppliers. The following is the order of the five companies, described using a bar chart in Figure 3. The ranking process was conducted by applying the analytic hierarchy process (AHP) method.
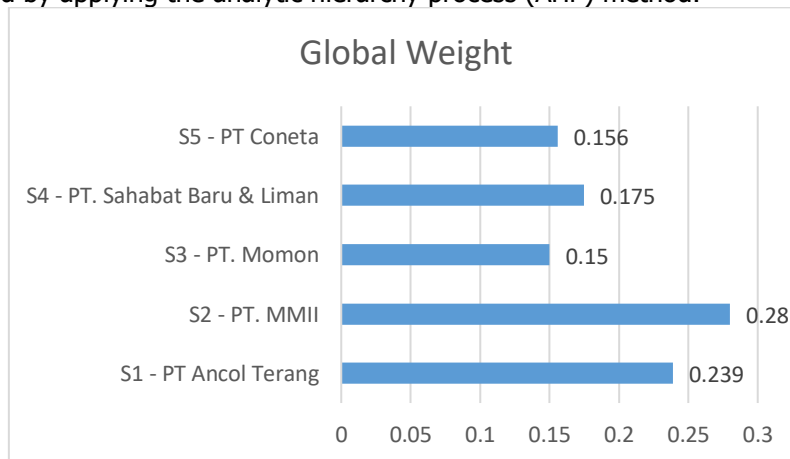

Figure 3. Global weight score

Table 1. Overall global weight

Criteria		Sub criteria		Corporate alternative				
				S1	S2	S3	S4	S5
K1	0.30	SK1	0.13	0.041	0.032	0.014	0.016	0.024
		SK2	0.11	0.037	0.029	0.013	0.015	0.021
		SK3	0.06	0.018	0.014	0.006	0.007	0.010
K2	0.30	SK4	0.08	0.018	0.027	0.015	0.009	0.007
		SK5	0.22	0.053	0.079	0.044	0.027	0.020
K3	0.12	SK6	0.10	0.020	0.034	0.017	0.019	0.010
		SK7	0.02	0.004	0.007	0.004	0.004	0.002
K4	0.13	SK8	0.11	0.016	0.016	0.016	0.031	0.030
		SK9	0.02	0.003	0.003	0.003	0.006	0.006
K5	0.15	SK10	0.04	0.007	0.010	0.005	0.010	0.006
		SK11	0.11	0.021	0.029	0.014	0.031	0.018
			Total	0.239	0.280	0.150	0.175	0.156

Conclusion

AHP can be used in the method for making decisions to choose suppliers. The company can choose a supplier based on several prices, quality, delivered, quantity, and service criteria. The results show in the total weight calculation that PT MMII (S2) is the top-performing supplier company with a total score of 0.280. The resulting score is based on the sum of the criteria, sub-criteria, and alternative providers, the total weight calculated. The results of global weight calculations in PT Ancol Terang (S1) with a total score of 0.239. PT MOMON (S3) with a total score of 0.150, PT Central Sahabat Baru & Liman (S4) with a total score of 0.175, and PT CONETA (S5) with an overall score of 0.156.

Suppliers also have their advantages on each criterion, so several suppliers have advantages on certain criteria in companies pricing criteria. PT Ancol Terang (S1) retains first place with a score of 0.097 in quality criteria of company. PT MMII (S2) retains first place with a score of 0.107 on the submission criteria of company. PT MMII retains first place with a score of 0.041 in the count of company. PT Central Sahabat Baru & Liman ranked first with a score of 0.037 and a service criterion of PT Central Sahabat Baru & Liman took first place with a score of 0.041.

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Supplier Performance Analysis Using the Analytical Hierarchy Process (AHP) Method

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Abstract: This research aims to determine priorities in supplier selection. The determination of this supplier uses the Analytical Hierarchy Process (AHP) method by determining the criteria and sub-criteria of the supplier selection objectives. Each criterion and sub-criteria are arranged in a hierarchical structure and compared by determining the priority scale. The selection of suppliers is based on the largest global weight values. The selected supplier is PT.MMII with a global weight value of 0.280. The global weighted assessment has considered consistency in decision-making based on a consistency index, which must be below 10%. It shows that PT. MMII is selected based on existing criteria and sub-criteria compared to other suppliers. This study contributes to group decision-making involving experts to choose the most appropriate supplier.

Keywords: AHP method, supplier, global weight calculation

How to Cite: Provide intext citation in IEEE style, e.g., The theory was first put forward in 1998 [1].

Introduction

Supplier is an important line that is part of the company where the supplier can supply raw materials, both raw and semi-finished, for the company. The company is responsible for making decisions about the selection of suppliers [1]. When choosing suppliers, the company's decision is complex, considering the criteria and sub-criteria. Criteria for selecting suppliers are price, quality, delivery, quantity, and service.

Much research has been done related to choosing an object. The selection uses the Analytical Hierarchy Process as a method. Analytic Hierarchy Process (AHP) is a method or tool for multi-criteria decision making using Expert Choice software, tools in the software will simplify the function of the AHP method [2]. The selection for appropriate technical software used from 6 alternative engineering software in the company criteria is also made according to the AHP method [1]. Companies select the most suitable technology and use additional considerations based on a cost-benefit analysis [3]. Application of AHP in project management to select the best contractor. The hierarchical structure for the prequalification criteria and the contractors who qualify for the project [4]. AHP is also used in the integrated approach of the storage site selection process, where both quantitative and qualitative aspects have been considered [5]. AHP is used for provider selection of a telecommunications system. It is a complex, multi-person, multi-criteria decision problem [6]. AHP compares each criterion's importance and the candidates' values on each criterion to calculate for determining or making the best decision [7-8].

The analytical hierarchy process can be used to select an object. The AHP method is also used to measure productivity. This method is suitable because it considers the criteria and sub-criteria arranged in a hierarchical structure. This supplier selection problem has clear criteria and sub-criteria known to the company. The AHP method can support the company in selecting suppliers from several alternatives. The supplier decision was made by considering the value of consistency in the experts' answers based on pairwise comparisons between existing criteria and sub-criteria. Experts are people who understand and understand this supplier.

Supplier is a line in which raw and finished goods are delivered to a company or store; Supplier performance reviews can be measured using the Analytical Hierarchy Process (AHP) method. AHP is a useful way to select which suppliers a company should or should not maintain. The choice of this method is considered appropriate compared to other methods since a practical and effective approach allows researchers to solve a complex problem that is not structured into several components in a hierarchical arrangement, allowing them to keep track of -training existing suppliers. This method is considered appropriate because it can represent the hierarchy of the supplier itself. The AHP method can also translate or solve unstructured problems into an easy-to-understand or simpler model. This method also uses pairwise comparative assessment performed by experts to obtain a priority scale [9]. The company uses AHP's analysis to select existing suppliers.

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a.   Define the decision hierarchy with attributes (criteria) and alternatives (suppliers) representing the relationship.

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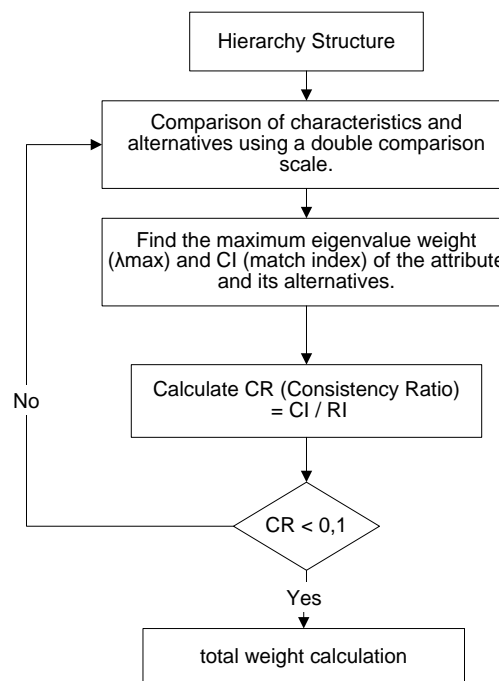

Figure 1. Step AHP method

Results and Discussions

Results

The following is a hierarchy of supplier selection criteria in Figure 2 that has been made based on the interview results.
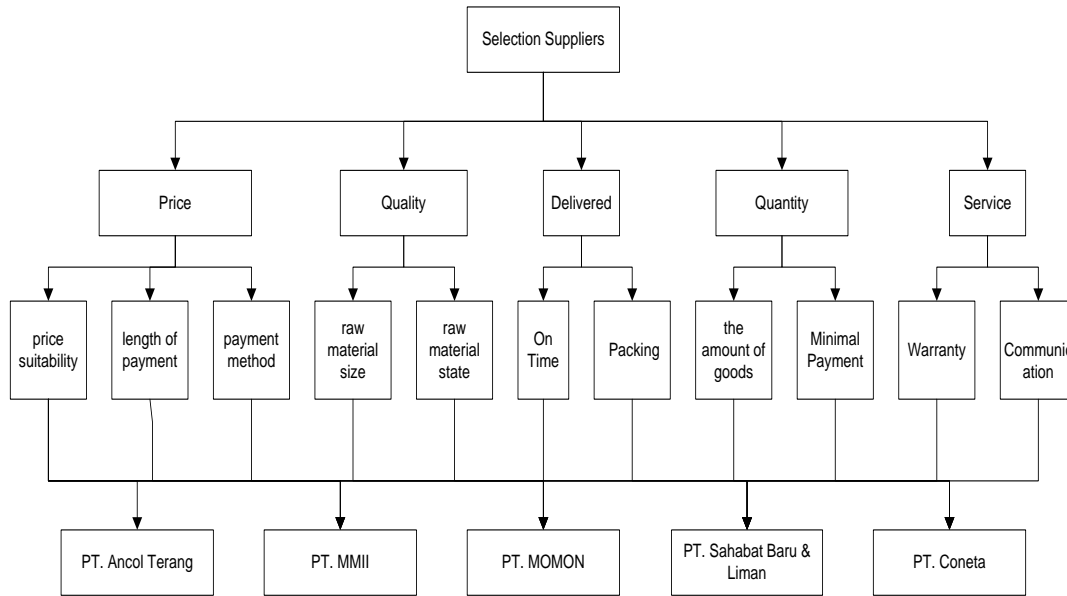
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Discussions

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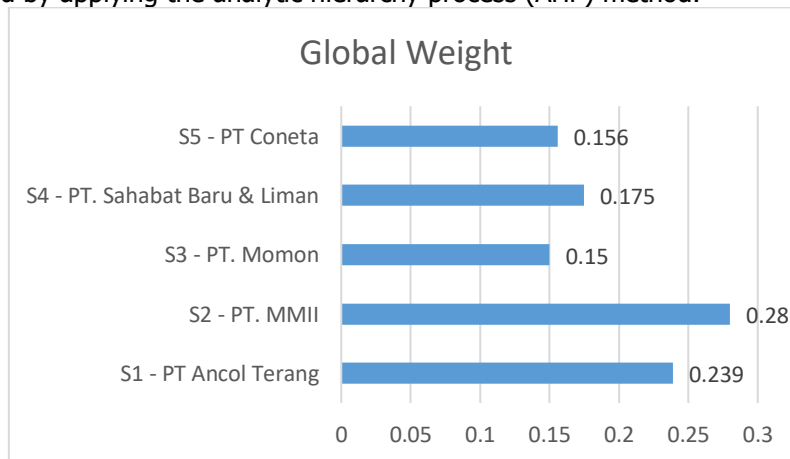

Figure 3. Global weight score

Table 1. Overall global weight

Criteria		Sub criteria		Corporate alternative				
				S1	S2	S3	S4	S5
K1	0.30	SK1	0.13	0.041	0.032	0.014	0.016	0.024
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		SK9	0.02	0.003	0.003	0.003	0.006	0.006
K5	0.15	SK10	0.04	0.007	0.010	0.005	0.010	0.006
		SK11	0.11	0.021	0.029	0.014	0.031	0.018
		Total		0.239	0.280	0.150	0.175	0.156

Conclusion

AHP can be used in the method for making decisions to choose suppliers. The company can choose a supplier based on several prices, quality, delivered, quantity, and service criteria. The results show in the total weight calculation that PT MMII (S2) is the top-performing supplier company with a total score of 0.280. The resulting score is based on the sum of the criteria, sub-criteria, and alternative providers, the total weight calculated. The results of global weight calculations in PT Ancol Terang (S1) with a total score of 0.239. PT MOMON (S3) with a total score of 0.150, PT Central Sahabat Baru & Liman (S4) with a total score of 0.175, and PT CONETA (S5) with an overall score of 0.156.

Suppliers also have advantages on each criterion, so that some suppliers have advantages on certain criteria in the company's pricing criteria. Other suppliers can improve and improve the quality, service, quantity and delivered in providing services to the company. One of the supplier selections can be approached with the Analytical Hierarchy Process method.

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