

CHAPTER II

LITERATURE REVIEW

2.1 Analytic Hierarchy Process (AHP)

Analytical Hierarchy Process (AHP) is a method used to evaluate and choose the best alternative based on considerations of certain criteria the assessment (Mahmudi, 2019). AHP method is a measurement method that was first developed by Thomas Lorie Saaty in 1980. To find a ranking or priority order of various alternatives in the fraction of a problem. (Satria Rizki Arianto, 2020)

The AHP method is one of the most widely used methods in solving problems related to decision making decisions from several alternatives based on criteria such as in research conducted by *Sean A.M P.* With the title of applying the AHP method for the selection of spare parts suppliers at the Bitung Diesel Power Plant, with the criteria of price other f spare parts, availability of goods from spare parts, quality of spare parts, the number of spare parts, and continuity of spare parts. In this study the results of the criteria for the price of spare parts (0.9942), availability of goods from spare parts (0.9893), quality of spare parts, the number of spare parts (1.610), and continuity of spare parts (0.8419). (Sean A.M.Pebakirang, 2017). Then there are other studies using the AHP method which were also carried out by *Sri Widiyanti*. In determining the most important criteria in the selection of suppliers in the family business using the AHP approach, with the criteria of quality, price, delivery, warranty. (Widiyanesti, 2012)

The advantages of the AHP method are many, one of them is that this method is can produce a more consistent weighting value than other methods. The disadvantage of the AHP method is the dependence of the AHP model on its main input. The main input is in the form of an expert's perception so that in this case it involves the subjectivity of the expert. (Diah Permatasari, 2018)

Data analysis stage, calculating the data that has been processed into the AHP method to determine the weight value of the criteria for each alternative.

The steps are:

- a. Create a comparison matrix of the importance of Criteria
- b. Make a comparison table of each criterion
- c. Normalization of the pairwise comparison matrix.
 1. The sum of each value in the columns of the comparison matrix
 2. Each value in the column is divided by the value added using the equation

$$\bar{a}_{jk} = \frac{a_{jk}}{\sum_{l=1}^m a_{lk}} \quad (2.1)$$

Explanation

\bar{a}_{jk} = Normalized matrix value

a_{jk} = The value of each pairwise comparison

a_{lk} = The sum of the values of each paired comparison

- d. make the value weighting with the formula:

$$\frac{\sum_{l=1}^m \bar{a}_{jk}}{m} \quad (2.2)$$

Explanation:

W = Priority weight value

\bar{a}_{jk} = Normalized matrix value

m = Many criteria are used

- e. Doing the sum on each row
- f. Perform consistency testing with the formula:

$$Cl = (\lambda_{max} - n)/(n - 1) \quad (2.3)$$

Explanation:

C = Index Consistency

λ_{max} = Eigenvalue

n = matrix size

Then, the consistency ratio (CR) is calculated using the formula:

$$CR = \frac{Cl}{RI} \quad (2.4)$$

Explanation:

CR = Consistency Ratio

Cl = Consistency Index

RI = Consistency Random

If the CR value is less than 0.1 then the resulting value is consistent. On the other hand, if the CR value is greater than 0.1, the resulting value is inconsistent.

2.2 Simple Additive Weighting (SAW)

Simple Additive Weighting (SAW) method or also known as the weighted addition method. (Eriskon Marbun, 2019). The SAW method can help in making deciding a case and this method is more efficient because the time required for calculations is shorter. (Saprudin, 2019). The SAW method requires the process of normalizing the decision matrix (X) to a scale that can be compared with all existing alternative ratings. (Aldi Yuda Pradipta, 2017)

The advantages of the SAW (Simple Additive Weight) method compared to other methods lie in the ability to select the best alternative from several alternatives because of the ranking process after determining the weight value. (Humisar Hasugian, 2017), unfortunately, the SAW method is the inconsistent weighting, the inconsistent weighting is determined by the decision maker so that the nature of the subjectivity is high. (Diah Permatasari, 2018)

Here is the formula for finding the normalized matrix:

$$R_{ij} \begin{cases} \frac{X_{ij}}{\text{Max}_i X_{ij}} & \text{If } j \text{ is an attribute of benefit} \\ \frac{\text{Min}_i X_{ij}}{X_{ij}} & \text{If } j \text{ is an attribute of cost} \end{cases} \quad (2.5)$$

The steps for solving using the SAW method:

- Determine the criteria that will be used as a reference in decision making.
- Determine the weight value of each criterion that has been obtained previously
- Determine the suitability rating of each alternative on each criterion.
- Make a decision matrix based on the criteria, then normalize the matrix based on the equation that is adjusted to the type of attribute (profit attribute and cost attributor to obtain a normalized matrix R.
- Give preference value for each alternative (V_i) with the formula:

$$V_i = \sum_{j=1}^n w_j r_{ij} \quad (2.6)$$

Description:

- Vi = ranking for each alternative
- Wj = the value of the weight of each criterion
- Rij = normalized performance rating

SAW method is one of the weighted addition methods used in solving problems related to decision making based on criteria such as the research conducted by *Agustina Heryati*. With the title of the application of the SAW method on the Decision Support System to determine the recipients of new lecturers, with educational qualification criteria, psychological tests, interview tests. In this study, the results of the assessment of determining the acceptance of new lecturers were seen from the highest ranking with the management of the SAW method. (*Agustina Heryati, 2021*). *Nasrun Marpaung* has also conducted research using the SAW method. In the application of the SAW method to a decision support system to determine employee salary charges, with discipline criteria (attendance), years of service, recent education, work skills, and marital status. So based on this research, we get the selected total value with a range of > 2,750. The number of selected alternatives is 3 people or 21.43% of the 24 employee data that has been processed. (*Marpaung, 2018*)

The application of the AHP-SAW Collaborative Method has been carried out in previous research on employee promotions, with the criteria of class, last echelon, last position, and last education. Obtain the results of recommendations for employee promotions according to needs and based on specified criteria. (*Diah Permatasari, 2018*). In addition, other studies use the AHP-SAW method, namely determining the eligibility of *beras miskin* (RASKIN) rice recipients for poor families using the AHP and SAW methods. With the criteria of eating frequency in 1 day, frequency of consuming meat/chicken/milk in 1 week, monthly income, dependents of children, home ownership, a homeownership test results with an accuracy rate of 83.5% using 73 data. The test results for the correlation level of 0.985 this value is included in the strong correlation. (*Elsa Dianita Puspita Dewi, 2014*)

2.3 Previous Research

The following researchers conclude from the results of previous research exposures as follows:

Table 2.3.1 previous research table

No	Title	Writer	Issue raised	Method	Results / conclusion
1	Lending Decision Support System at KOPWALI Tangerang with AHP and SAW metode methods	1. Wahyu Istianto 2. Suparni 3. Achmad Baroqah Pohan (2020)	Because each prospective creditor has different economic conditions, it is necessary to be observant in making decisions. In addition, the implementation of loans often occurs not on target, causing bad credit. The process of determining the recipient of loan funds is still not accurate.	AHP-SAW	the results of this study can be concluded that the decision support system using the AHP-SAW merger method can be used to determine the recipient of cooperative loan funds, where AHP is used to determine the weight of the criteria while SAW used to the determine priority/ranking of loan recipients. And Based on the discussion in above, the acceptable hypothesis is H0, that is, the recipient of loan funds at KOPWALI has a value equivalent to the method Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW).
2	SPK Determination of ATM Locations Using AHP And SAW Methods	1. Gede Surya Mahendra 2. Kadek Yota Ernanda Aryanto (2019)	The purpose of this study is to design, implement, and analyze the results of a decision support system for determining ATM locations using AHP and SAW	AHP-SAW	The design of the SPK for Determining the Location of ATMs using AHP and SAW can be implemented and analyzed on the recommendation results compared to the realization of ATM deployment data and can help decision makers in determining the location of ATMs quickly and easily. The results of the tests carried out on 76 test cases, with the realization

					<p>as many as 38 test cases, resulting in 66 suitable test cases and 10 cases that are not suitable, with an accuracy of 86.84%, and after the significance test the accuracy increases to 92.11%. ATM Location Determination SPK using AHP and SAW can be used on various operating system platforms and browsers. The results of the recommendations for determining the location of ATMs become more objective because the user does not specify alternative to be chosen directly. Determination of the weighting of the criteria and sub-criteria in AHP greatly affects the results of ranking calculaToW. To obtain better results, it is hoped that in formulating the criteria and sub-criteria can search better from literature studies, improving the quality and quantity of resource persons, expanding the study of problems in the field, so it is necessary to add criteria or sub-criteria such as customer/population density, disputed conditions of landowners/ATM buildings, and conditions of disaster-prone locations.</p>
3	Selection of New	1. Yuniarti Lestrari	the selection is done manually such as using a	AHP- SAW	a) The decision support system for student

	Students Using AHP and SAW Methods	2. Sunardi 3. Abdul Fadil	spreadsheet or a processor numbers still cause several problems, including the length of the time selection process.		admissions selection can help and simplify the selection process for high school student admissions which was previously still done manually. b) The Analytic Hierarchy Process (AHP) and Simple Additive Weighting (SAW) methods can be applied to decision support systems selection of high school student admissions to provide alternative ranking results and determine the alternative that has the best preference from other alternatives.
4	Integration of AHP and SAW for completion of Green Supplier Selection	1. Teguh Baroto 2. Main Marsetiya Fund (2020)	This problem is referred to as green supplier selection. This study aims to integrate the AHP and SAW methods for the green supplier selection problem. A case study was conducted on the Plastic Manufacturing Industry.	AHP-SAW	This study integrates the AHP and SAW methods for green supplier problems selection. This research has succeeded in applying the AHP and SAW methods to plastic comp accompanied manufacturing results showed that the product price (C1) had the highest weight, followed by the sub-criteria Conformity of material with specifications (Q1), accuracy of the order quantity (D1), and On time delivery (D2). Environment-related certificates (ERC) occupy the most end on green supplier selection. The results of the study are also able to show the ranking of green supplier selection. This study has limitations on the criteria used.

					Further research needs to add several other criteria that are by the company's needs and examine the relationship between criteria in green supplier selection.
5	Analysis of the AHP and SAW methods on decision support for the selection of the head of the student association department	1. Prisa Marga Kusumantara 2. M, Ilfadz Alfian 3. Yolanda Yodistina (2019)	The evaluation of the Chair and Deputy Chair of HIMASIFO on the selection process for prospective Department Chair candidates is still done manually, so there is a chance for inconsistencies in the assessment standards, and have the opportunity to result in a subjective decision-making process (less objective). The accumulation of some of these problems can eventually cause the selection process to experience difficulties	AHP-SAW	After the ranking calculation process was carried out using the SAW and AHP methods for the selection case for the candidate for the head of the HIMASIFO department, then the ranking results were compared and measured with the ranking of respondents using the hamming distance technique. The measurement results show that the level of difference for the SAW method is 81.5%, while for the AHP method it is 43.75%. This implies that the AHP method approach is considered relatively more relevant to be implemented in this type of case compared to the SAW method.
6	Application of AHP and SAW Methods for determining employee promotions.	1. Diah Permatasari 2. Dewi Sartika 3. Suryati (2018)	This study aims to determine the promotion of employees at the Office of The Health of South The health Province using the AHP (Analytic Hierarchy Process) and SAW (Simple Additive Weight) methods.	AHP-SAW	Based on the results obtained, it can be concluded, namely: 1. The decision support system for determining promotions for employees at the Health Service using the AHP and SAW methods can help companies make decisions. 2. The AHP and SAW methods can produce recommendations for employee promotions according to needs and based on

					<p>predetermined criteria. Accuracy test results in 3 test cases obtained, for testing case 1 the results of the AHP & SAW method are 100%, the result of the AHP method is 0% and the result of the SAW method is 100%. For testing case 2 the results of the AHP & SAW method are 100%, the results of the AHP method are 0% and the results of the SAW method are 100%. While testing in case 3 the results of the AHP & SAW method are 50%, the results of the AHP method are 0% and the results of the SAW method are 50%.</p>
7	<p>Application of analytical hierarchy process (AHP) and simple additive weighting (SAW) methods in the decision support system for selecting superior red chili seeds.</p>	<p>Usep Saparudin (2019)</p>	<p>Based on the background stated above, a problem formulation can be made, namely "How to apply the combination of Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW) methods in a Decision Support System for Selection of Superior Red Chili Seeds.</p>	<p>AHP-SAW</p>	<p>Chili seed selection decision support system superior red chilies using the AHP and SAW methods can help red chili farmers in making decisions.</p>
8	<p>Comparison of SAW, AHP, and TOPSIS algorithms in determining tuition fees (UKT)</p>	<p>1.Wawan Psychic 2.Nuralam sah Zulkarnaim 3.Sugiarto cokrowibowo (2019)</p>	<p>1. Determine the priority scale of work by the criteria that have been determined based on alternative work projects selected from the List of Work Packages issued by PT. PLN (Persero) Samarinda Area – East Kalimantan, using AHP and SAW.</p>	<p>AHP, SAW, TOPSIS</p>	<p>From the experiment on the problem of determining the Single Tuition Fee (UKT) using the SAW, TOPSIS, and AHP methods, it was found that the AHP method was a good method to use compared to the other</p>

			<p>2. Planning alternative decisions using B/C analysis based on the priority scale of each cluster B (Benefits) and C (Costs) that have been obtained using AHP and SAW.</p> <p>3. Comparing the AHP and SAW methods related to point 1). and 2). to determine better method.</p>		<p>2 methods tested. The selection of the AHP method as the recommended optimal solution sees the level of proximity of the distance close to zero compared to the SAW and TOPSIS methods with an average value of 0.10. Then the second alternative is the TOPSIS method with a value of 0.44, then the SAW . method with a value of 0.53</p>
9	<p>Determination of the eligibility of recipients of rice for poor families (RASKIN) using the AHP and SAW methods</p>	<p>1.Elsa Dianita puspita goddess 2.Dian Eka Ratnawati 3.Ir heru nurwisto (2014)</p>	<p>Determination of eligibility for Raskin recipients by officers in the field is considered ineffective and efficient because they still use estimates and talk from other people.</p>	AHP-SAW	<p>Conclusions that can be given in this study include: 1. In determining the eligibility of Raskin recipients, the AHP method is used to determine the weight of each criterion, while the SAW method is used for the final results and ranking. Where the eligibility limit for Raskin recipients that has been determined by experts is > 0.6 using 6 criteria, namely frequency of eating in 1 day, frequency of consuming chicken/meat/milk in 1 week, monthly income, depends of children, home ownership and health. The AHP method is carried out by determining the weight of each criterion. Then the SAW method is carried out by converting the alternative values of each criterion, calculating the</p>

					<p>normalization matrix and then calculating the preference value of each alternative. Then, a ranking is obtained based on alternative values.</p> <p>2. Based on the results of the accuracy test, obtained an accuracy rate of 83.5% by using data as much as 73 data recipients of Raskin. Accuracy testing is done by comparing the results of the system calculations with the results of expert calculations. From this test, this system can be used to help distribute the distribution of Raskin aid recipients.</p> <p>3. Based on the results of the ranking correlation test, the correlation level was 0.985. The value of 0.985 is included in a strong correlation, where the ranking system using the SAW method has a strong relationship.</p> <p>Based on the results of the ranking correlation test, the correlation level was 0.985. The value of 0.985 is included in a strong correlation, where the ranking system using the SAW method has a strong relationship.</p> <p>Based on the results of the ranking correlation test, the correlation level was 0.985. The value of 0.985 is included in a strong correlation, where the ranking system using the SAW method has a strong relationship.</p>
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					with expert ranking decisions.
10	Application of analytical hierarchy process-simple additive weighting (AHP-SAW) method in determining superior rice varieties	1. Dona adittia 2. Nurul admitted 3. Fitra abdurrachman bachtiar (2018)	The many aspects that must be taken into account to find superior varieties that suit these conditions sometimes make farmers wrong in making decisions. As a result, rice production decreases and sometimes it can also lead to crop failure. Therefore, we need a system that can help farmers determine the varieties that are most suitable for the growing environment.	AHP-SAW	Based on the research and test results in the previous chapter, the following conclusions can be drawn. The application of the AHP-SAW method using an android-based application is implemented by determining the value of the weight vector generated by the AHP method. To implement the SAW method, we need data with attributes according to the weights that have been determined in the previous AHP process. The value of the weight vector is used as a reference for the calculation of SAW which results in ranking. So that the AHP-SAW method can be applied as a decision support in determining superior rice varieties. Based on the test results "Application of the Analytical Hierarchy Process-Simple Additive Weighting (AHP-SAW) Method in Determining Superior Rice Varieties" the accuracy value is 68.8% for the weight given by the expert and 75.5% for the experimental weight with the best accuracy.
11	Implementation of the Combination of AHP and SAW Methods	Yustina Meisella Kristania (2018)	Consumers who want to buy a house have many considerations before deciding to buy, seeing this, consumers need to make the right choice to match what they want. To be able	AHP-SAW	Conclusions that can be drawn from the analysis and tests carried out in the previous chapter is in the use of a combination of

	in Supporting Decisions for Determining Public Housing Loans		to fulfill this, housing data information is needed along with rankings that will help determine the feasibility of various alternative housing options offered.		analytical methods Hierarchy Process (AHP) can give weight to each criterion in determining housing options and the Simple Additive Weighting (SAW) method can determine the ranking of housing choice data and be able to provide convenience in determining home purchases based on the needs of each consumer.
12	Application of analytical hierarchy process (AHP) and simple additive weighting (SAW) methods to determine recipients of social assistance for the COVID-19 pandemic	Nidya Kusumawardhani (2020)	the mechanism for the distribution of aid is complicated and often not well-targeted due to inappropriate criteria for recipients of assistance and inaccurate/incompatible data on the ground. Until there were protests from residents who were supposed to get help but they didn't get the help, and vice versa	AHP-SAW	Application of the Analytical Hierarchy Process (AHP) method and Simple Additive Weighting (SAW) is proven to be able to determine the rank of recipients of social assistance during the Covid-19 pandemic by the criteria set by the local RT/RW with a weighted value of the criteria for the work status of the head of the family of 0.425, the wife's employment status of 0.166, the house is 0.094, the number of dependents is 0.056 and the ID card is 0.259 with a consistency ratio value of 0.09.
13	Comparison of analytical hierarchy process (AHP) and simple additive weighting (SAW) methods in determining the priority	Achmad Jaya Adhi Nugraha (2019)	<ol style="list-style-type: none"> 1. How to determine the priority scale of work projects by criteria determined using AHP and SAW. 2. How to plan alternative decisions using B/C analysis based on the Priority Scale obtained from the AHP and SAW methods. 	AHP-SAW	From the results of the case studies in this study, several things can be obtained that can be used as research conclusions, namely as follows: 1. In the AHP method, the assessment of the weight of importance occurs twice, namely the Assessment of Weights/Inter-Criteria Interest (Local Priority

	scale of work projects (case study: CV.EUK Samarinda)				Level 2) and Inter-Alternative Interest Weight Assessment against each Criterion. In this case, the AHP method underwent two Consistency Tests. 2. In the SAW method, the assessment of the weight of importance only occurs once, namely the Assessment of WeightsInterests Between Criteria. In this case, the SAW method is only experienced once Consistency Testing. 3. Because the MCDM method used refers to the aspect of the ability to assessuncerassess uncertainty) that arise due to personal judgments, perceptions, and experiences of decision makers whose results can be measured properly, quickly, and quite accurately, so from points 1 and 2 it can be stated that the AHP method is much better than the SAW method .
14	Comparison of AHP with SAW in a decision support system for choosing a house as a place to live	1.Nadda Akilka Uliman Nurhajanti Muljadi 2.Waris Widekso 3. Revelation Tisno Atmojo (2021)	This problem is researched and then a Decision Support System is made that can assist property agents in finding the most suitable house for the buyer	AHP-SAW	Conclusion From the calculation results of the two methods above, it can be concluded that the accuracy of the calculation results using the SAW method with expert recommendations is higher than the calculation results of the AHP method. The weighting process in the AHP method is considered less effective because it is too subjective,

					especially in the price section. While in the SAW method, the price weights do not change, so it can be concluded that this method is better used for decision-making systems that have a cost attribute on the weighted criteria. In addition, the SAW method can also determine the best alternative from several alternatives because there is a ranking process after determining the weight of each attribute.
15	Comparison of simple additive weighting (SAW) and analytical hierarchy process (AHP) methods in determining the best badminton shuttlecock recommendations	1.Suhardi 2.Muhammad Siddik Hasibuan 3.Erwin Nasution 4. Ichsan Rafisyah (2021)	The purpose of this study is to select a badminton coach who is truly the best among the existing candidates with quality and transparent methods or means. The use of the AHP method has also been carried out in the selection of badminton coaches with a case study: Jaya Yakapi Development Vocational High School. Criteria that used are responsibility, skill discipline, communication and physical.	AHP-SAW	application of the Simple Additive Weighting (SAW) method and Analytical Hierarchy Process (AHP) produces a good assessment in terms of calculating the criteria values and completion in choose a shuttlecock, so that accurate results are obtained in the selection of badminton shuttlecocks. After the assessment process using the SAW and AHP methods, it was found that two shuttlecock candidates were suitable and after use, namely Yonex Shuttlecock Aerosena 50 (code: S3) and Shuttlecock Victore Master Ace (code: S13)

2.4 Lembaga Penelitian dan Pengabdian Masyarakat (LPPM)

The Institute for Research and Community Service (LPPM) of *Universitas Muhammadiyah Kalimantan Timur* is a institutions that regulate the process of

conducting research and lecturer service in UMKT, through the LPPM the process of disbursing funds for lecturers who receive DIKTI grants, not only that LPPM UMKT has an internal research and service grant program sourced from funds from the *Universitas Muhammadiyah Kalimantan Timur* every year, to assist lecturers who wish to conduct research and community service. elements of academic organizers who coordinate, monitor, and assess the implementation of research and community service activities, as well as seek and control the implementation of the necessary resources. LPPM functions as a consultation center on community development issues, particularly entrepreneurship consultation and small and medium enterprise development. who have canned income. LPPM provides grants every year. (LPPM UMKT, 2021)

There are 5 LPPM research schemes, namely;

1. *Penelitian Pemula (PERELA)*

Beginner regular research as a research activity in the context of fostering and directing novice researchers to improve their ability to carry out research in universities. The purpose of PERELA is to provide facilities for lecturers in UMKT who are still in the early stages of self-development as professional researchers to be able to carry out research with an internal funding limit.

2. *Penelitian Kompetitif (PEKOM)*

Competitive research is developed to improve the quality of research in UMKT, the follow-up is expected to be achieved by research funds from the Directorate of Research and Community Service (Ditlitabmas Dikti)/ PKPT/ Basic Research/ Applied Research/INSINAS.

3. *Penelitian Unggulan (PENGGUL)*

Superior research is research that is interdisciplinary between study programs or between architectures. This research is proposed and carried out by lecturers who have a vision & mission for research development and community service.

4. *Penelitian Kolaborasi Dosen Mahasiswa (KDM)*

Student Lecturer Collaborative Research research activities are directed and developed to improve the quality of research for lecturers and students at UMKT, the follow-up is expected to achieve research funds from the Directorate of Research and Community Service (Ditlitabmas Dikti) / PKPT / Basic Research / Applied Research / INSINAS.

5. *Penelitian Internasional (PINTER)*

International research is a multi-year research scheme which is a collaboration between UMKT lecturers and lecturers from partner universities abroad who have collaborated with UMKT