OPTIMISATION OF BEST SALES ASSESSMENT USING A COMBINATION OF RANK ORDER CENTROID AND ADDITIVE RATIO ASESSMENT ALGORITHMS

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Abstract - Employee assessment in a company is one of the strategies used to improve employee performance, so that it can benefit the company. One method used to determine the best employees is to use a decision support system (DSS). By using DSS, decision making becomes faster, more accurate, efficient and effective. This study was used to determine the best sales staff at PT SAA. This study uses a combination of the Rank Order Centriod (ROC) Algorithm and Additive Ratio Assessment (ARAS). This combination of algorithms can produce a better level of prediction accuracy and ranking based on the processed data. This study uses 6 (six) criteria and 7 alternatives, the criteria are sales, service, discipline, length of service, absence, and violations. Furthermore, the criteria are sorted based on priority of importance. The ROC algorithm is used to find the weight of each criterion, the weight obtained is processed using the ARAS algorithm so that the alternative ranking results are obtained. The purpose of this study is to make it easier for companies to make decisions to determine the best sales staff based on the results of the ranking recommendations. The research results show that the highest ranking was obtained by alternative AL3 with a value of 0.884.

Keywords – Decission Support System, Rank Order Centroid, Additive Ratio Assessment, Best Sales Rating.

I. INTRODUCTION

A salesperson has a very strategic role in the company. They are not only responsible for selling products or services, but also play a role in building relationships with customers, gathering market information, and contributing to the growth of the company[1]. In addition, sales are valuable assets for the company, not only generating revenue for the company, but also playing an important role in building strong relationships with customers and driving business growth [2]. Generally, in companies, sales that achieve sales targets will get bonuses. Financial awards given to sales as an incentive to achieve or exceed predetermined sales targets. However, the challenge faced is that bonuses are only based on sales targets without considering other supporting factors. [3] said that sales are not the only determining factor in business progress.

A developing and advanced company cannot be separated from the role of information technology, be it hardware or software. Likewise, the development of information technology is growing very rapidly. Like various types of software used for assessment [4]. By utilizing information technology, companies can make decisions quickly in order to compete with other companies [5]. Quick decision-making is crucial for a company to take subsequent actions. Information technology has introduced a variety of innovative solutions, one of which is the recommendation system. This system acts as an intelligent assistant that helps us select and make decisions about various things, ranging from products to crucial choices [6]. Similar to the research conducted by [7] using a recommendation system for tourist destination selection based on 5 criteria. Recommendation systems are part of a Decision Support System (DSS), which can assist decision-makers in making semi-structured and structured decisions, thereby enhancing decision-making effectiveness [8][9][10]. SPK can process large and complex amounts of data, the resulting information is in-depth, and provides alternative solutions that are ranked based on calculations using the mathematical model used.

One of the algorithms that can be applied to the recommendation system is Additive Ratio Assessment (ARAS). The Aras method produces objective alternative rankings based on the weight values and criteria values used, and is easy to understand and interpret [11]. This allows users to clearly understand the reasons behind the ranking of the alternatives generated. In some studies, the weight of the criteria is determined by certain parties, without considering the level of importance of each criterion [12]. It has been proven that research conducted [13] used the ARAS method for determining savings and loan credit, the criteria used used benefits without using costs, so that the results of the method produced may not be objective because there is no clear basis for prioritizing one criterion over another [11].

For that, a combination of ARAS Algorithm with other algorithms is needed to find the weight value of each criterion. In Research [15] using Rank Sum and ARAS algorithms, Rank Sum calculates the weight of the criteria. But it does not pay attention to the relative level of importance in each criterion, so it is less effective to use, and the difference in value in each alternative is very close causing less than optimal results. Research conducted by [21] used a combination of ROC and ARAS methods for selecting point sale applications with an accuracy level of 87.5%. ROC is a powerful tool for determining the weight of criteria and ROC provides assistance in assessing the relevance of criteria [16][17]. The weight of these criteria then paves the way for ranking alternatives [18]. ROC is used to determine the level of importance of the criteria used [19]. Utilizing a combination of ARAS Algorithm and ROC Algorithm is a powerful strategy to improve selection accuracy, sensitivity analysis, visualization, transparency, and accountability in the multi-criteria decision-making process [20]. It can be concluded that the ROC and ARAS algorithms are appropriate for use in cases with MCDM with many alternatives. The combination of these two methods offers flexibility, objectivity and high transparency, thereby improving the quality of decisions taken.

Like PT SAA. This company is involved in the distribution of Rucika pipes and Mulia ceramics. In increasing product sales in the company, the role of sales is very important. Quality sales is the main key for companies to achieve success. With its performance and achievements, sales is able to increase profits, improve the company's image and strengthen the company's position in the market [9]. Therefore, it is necessary to give recognition to competent.

Currently, the company has assessed the best sales using several criteria, such as a recap of sales data where the data is taken from the admin, attendance data obtained from Personnel, and service data obtained from collaborating stores. The criteria used are still not relevant. Another problem is that every data processing uses semi-computerisation. And there is often data fraud by certain elements. Therefore, a software is needed to speed up decision making and avoid fraud. the advantage of using this recommendation system is to increase the efficiency of operations [15]. Many studies have been conducted to solve decision problems using different methods. One of them is the Additive Ratio Assesment (ARAS) algorithm, which is a widely used algorithm for decision making in recommendation systems [11].

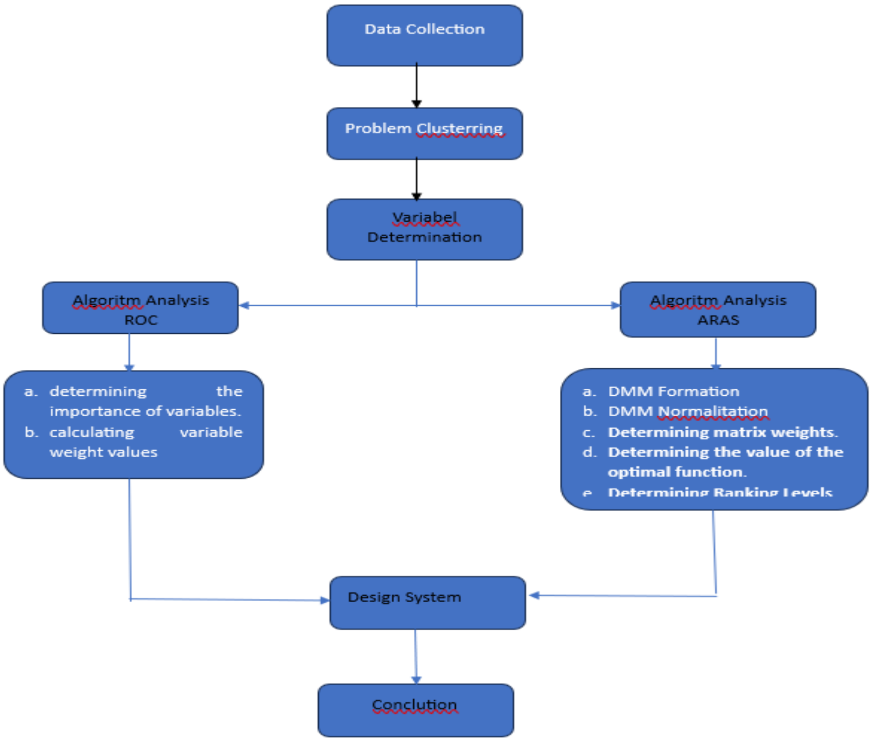
ARAS is one of the algorithms in the decision Support System (DSS) [16]. The advantages of the ARAS method are that it produces results that are easy to understand and interpret [17]. This allows users to clearly understand the reasons behind the ranking of alternatives generated by the system [18]. The weakness of ARAS is that the weights of the criteria are determined by the decision makers, which can lead to biased and unobjective ranking results, especially if the weights are not determined quickly or do not correspond to reality [9][19][13]

Evidence from research using [13] the ARAS method for determining savings and loans shows that the criteria used use benefits without using costs, so the results of the resulting method may not be objective because there is no clear basis for prioritising one criterion over another [18]. For this reason, it is necessary to combine the ARAS algorithm with other algorithms, one of which is the Rank Order Centroid (ROC) algorithm [20]. ROC is a powerful tool for assigning weights to criteria, and ROC helps to assess the relevance of criteria [21][22]. These criteria weights then pave the way for ranking alternatives [23]. ROC is used to determine the degree of importance of the criteria used [24]. The use of a combination of ARAS and ROC algorithms is a surefire strategy for improving selection accuracy, sensitivity analysis, visualisation, transparency and accountability in multi-criteria decision making [25].

Research conducted by [26]uses a combination of ROC and ARAS methods for the selection of Point of Sale applications with an accuracy rate of 87.5%. ROC and ARAS are also used to select the best fuel from 12 types of fuel with the best fuel result being Liquefied Propane Gas (LPG) with a value of 0.314 [27]. Comparison of entrepreneurial performance of Asia-Oceania countries using multi-criteria decision making techniques: Critic, Aras, Waspas, Mairca and Borda The results showed that Qatar, United Arab Emirates and Thailand were in the top three countries with high global entrepreneurial performance. Therefore, researchers are interested in conducting research using a combination of ARAS and ROC algorithms. The aim is that the results obtained can improve selection accuracy, sensitivity analysis, visualisation, transparency and accountability in multi-criteria decision making.[28]

II. STUDY SIGNIFICANCE

The combination of ROC and ARAS algorithms is used to maximise the advantages and minimise the disadvantages of each of the algorithms. ROC is used to determine the weighting of the criteria used by determining costs and benefits, and ARAS is used to calculate the rankings using the weights obtained from the ROC algorithm. This makes the results of the best sales recommendations more accurate, interpretable and simple. Picture 1 below shows a research framework.



Picture 1. Research framework

TABEL I
BEST SALES DETERMINATION CRITERIA

Criteria	**Description**
Sales	Sales in 1 Mont
Service Assessment	Sales service to consumers
Offence	Violations within 1 month
Working Period	Years Service
Diciplin	Discipline at work
Store Visit	Intensity of visits to the store

TABEL II
ALTERNATIVE CONSISTING OF 7 SALESMEN

Alternative	**Sales**
A1	S1
A2	S2
A3	S3
A4	S4
A5	S5
A6	S6
A7	S7

To identify the best sales requires several steps, as shown in Figure 1. Starting from problem grouping to system development. The implementation of the ROC method is used to determine the level of importance of each criteria, and each criteria used is given a weight according to the priority-based value ranking [29][30].

A. Problem Grouping.

The grouping of problems carried out in the research was made in such a way that the research was not too extensive. Conducted through direct observation by interviewing related effective.

B. Data Collection

In this research, the data used are the 7 data of salesman. The following data is also in accordance with the criterias determined to determine the best sales, namely sales data collected from the admin, offense data, length of service and discipline values obtained from the human resources department (HRD), for service ratings and store visits obtained from the confirmation of store assessment in cooperation with the company.

C. Rank Order Centroid (ROC) Algorithm

One way to determine the weight values needed for ranking in decision support systems is to use the Rank Order Centroid (ROC) technique. The ROC method is easy to apply. ROC emphasises that the first criterion is more important than the second criterion and so on [31]

$$Cr_1 > Cr_2 > Cr_3 > Cr_{4.........} > Cr_n$$

So as to produce a weight value (W)

$$W_1 > W_2 > W_3 > W_{4.........} > W_n$$

With the weight value (W) obtained:

$$W(n) = \frac{1}{n}\sum_{1=1}^{n} \left(\frac{1}{i}\right) \quad (1)$$

D. Ratio Assessment (ARAS) Algorithm

One of the multi-criteria decision methods used in the DSS approach is the ARAS method, which focuses more on the process of rankings [32]. The calculation flow of the ARAS calculation method determines the best alternative [33]. It is then compared with the over-all value of each alternative [34]. The utility function value of the ARAS method determines the result by incorporating the best option into the calculation process before using it as the basis for finding the best option [35]. The ARAS algorithm compares the utility function of the alternative used with the optimal value of the utility function [6] In addition, the ARAS algorithm performs a ranking by comparing the value of each criterion with the value of the optimal alternative and other alternatives [36]. To generate ideal alternatives, each criteras is also considered by taking into the consideration the weight of each criterion [3]. The steps of the ARAS method is :

1. *Compilative Decision Making Matrix.*

$$= \begin{bmatrix} x_{01} \cdots \cdots x_{oj} \cdots \cdots x_{0n} \\ \vdots \\ x_{ij} \cdots \cdots x_{ij} \cdots \cdots x_{nj} \\ \vdots \\ x_{ni} \cdots \cdots x_{mj} \cdots \cdots x_{mn} \end{bmatrix} \quad (2)$$

Here it is shown that "X" is a decision matrix, where "m" is the number of alternatives, "n" is the number of criterias used, "X_{ij}" is the performance value of alternative "I", and "X_{oj}" is the optimal value of criterias "j". If the optimal value of variable j (X_{0j}) is unknown, then :

$$x_{0j} = \frac{max}{i}, x_{ij}, If\ \frac{max}{i}, x_{ij}, is\ pre\ ferable \quad (3)$$

$$x_{0j} = \frac{min}{i}, x_{ij}, If\ \frac{min}{i}, x_{ij}, is\ pre\ ferable \quad (4)$$

2. *Normalitation Matrix For Criterias.*
   If used criteria beneficial whit formula :

$$x_{ij} = \frac{x_{ij}}{\sum_{i=0}^{m} x_{ij}} \quad (5)$$

   If used criteria not beneficial whit formula :

$$\text{Cost } x_{ij} = \frac{1}{x_{ij}} \quad (6)$$

$$\text{Benefit } x_{ij} = \frac{x_{ij}}{\sum_{i=0}^{m} x_{ij}} \quad (7)$$

3. *Weigth Matrix That Have Been Normalizihm*

$$D = [dij]\ mxn = rij\ .w \quad (8)$$

Where wj is criteria weigth j

4. *Caculated Value Of The Optimalitation Fuction Normalizhm*

$$Si = \sum_{j=1}^{n} dij; (i = 1,2 \dots, m; j = 1,2 \dots, n) \quad (9)$$

The value of "S" indicates how good the ith alternative is. The higher the value of "S", the better the alternative. The final result is heavily influenced by the calculations and weights given to each criteria.

5. *Determine The Utility Value*

$$U\,I = \frac{Si}{So} \quad (10)$$

The optimality values si and so are obtained from the predefined equations. The utility value Ui, which is binary (0 or 1), represents the preference for a particular criteria. Thus, the relative efficiency of each alternative can be determined based on the value of the utility function, which takes into account both the optimality value and the preference for criteria.

III. RESULTS AND DISCUSSION

A. Criteria Detemination

There are 7 (seven) Criteia used in the research. The variables are based on the provisions of the supervisor's best sales assessment. The variables are detailed in Table 3.

TABEL III
CRITERIA

Criteria	Description	Type
CR1	Sales	Benefit
CR2	Service Salesmen	Benefit
CR3	Offence	Cost
CR4	Tenure	Benefit
CR5	Diciplin	Benefit
CR6	Store Visit	Benefit

In Table 3 there are 7 with 5 types of benefit criteria, namely sales, service salesmen, tenure, discipline and store visits. The benefit criteria are determined based on the profit value determined by the company, While there is 1 cost criterion, namely offence, where offences can lead to additional costs . For example, negligence in the delivery of goods. Each criterion obtained is also determined by the sub-criteria, which can be seen in Table 4.

TABEL IV
SUB CRITERIA

Criteria	Description	Sub Criteria	Weight
CR1	Sales	1-25 unit	1
		26-50 unit	2
		51-75 unit	3
		76-100 unit	4
		>100 unit	5
CR2	Service Salesmen	Not Good	1
		Not Good Enough	2
		Quite Good	3
		Good	4
		Very Good	5
CR3	Offence	>3 Times	1
		3 Times	2
		2 Times	3
		1 Times	4
		Never	5
CR4	Tenure	1 Year - 2 Year	1
		2 Year - 3 Year	2
		3 Year - 4 Year	3
		4 Year - 5 Year	4
		>5 Year	5
CR5	Diciplin	Not Diciplin	1
		Not Diciplin Enough	2
		Quite Diciplin	3
		Diciplin	4
		Very Diciplin	5
CR6	Visit Store	Not Good	1
		Not Good Enough	2
		Quite Good	3
		Good	4
		Very Good	5

B. Rank Order Centroid (ROC) Algotirhm

The ROC algorithm is used to calculate the weight value of each criteria based on the priority of each criteria. In other words, the criterias are sorted in order of priority, from the most important to the least important. In the research, the criterias are presented in order of priority in Table 3. Furthermore, the weight value of each criteria is calculated using the formula (1).

$$CR1 = \frac{\frac{1}{1}+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}}{6} = 0.408$$

$$CR2 = \frac{0+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}}{6} = 0.242$$

$$CR3 = \frac{0+0+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}}{6} = 0.158$$

The results are to be obtained as indicated in Table 6 below. The number of weights obtained is 1.

TABLE VI
WEIGHT CRITERIA

Criteria	**Weignt**
CR1	0.408
CR2	0.242
CR3	0.158
CR4	0.103
CR5	0.061
CR6	0.028
In Total	**1**

C. Additive Ratio Assessment (ARAS) Algorithm

After getting the weight value of each criteria, the ARAS algorithm is used to calculate the overall score. This is done by arranging the data in a table with the criteria and alternatives on one side and the weight value of the sub-criteria on the other. See Table 7 for an example.

TABLE VII
ALTERNATIVE AND CRITERIA WEIGHTED

Alternatif	**Criteria**					
	CR1	**CR2**	**CR3**	**CR4**	**CR5**	**CR6**
AL1	3	4	5	5	4	3
AL2	5	4	5	3	4	5
AL3	5	4	4	4	3	4
AL4	4	3	4	5	4	3
AL5	3	5	4	4	4	4
AL6	4	4	3	3	3	4
AL7	3	4	3	5	4	3
Total	**32**	**33**	**-**	**34**	**30**	**31**

After the criteria and alternative tables are filled with weights, the next step by step calculation of the ARAS algorithm is carried out.

1. Preparation Decision Making Matrix

The preparation of the decision making matrix is carried out by determining alternative assessments for each criterion.

$$\times = \begin{bmatrix} 5 & 5 & 3 & 5 & 4 & 5 \\ 3 & 4 & 5 & 5 & 4 & 3 \\ 5 & 4 & 5 & 3 & 4 & 5 \\ 5 & 4 & 4 & 4 & 3 & 4 \\ 4 & 3 & 4 & 5 & 4 & 3 \\ 3 & 5 & 4 & 4 & 4 & 4 \\ 4 & 4 & 3 & 3 & 3 & 4 \\ 3 & 4 & 3 & 5 & 4 & 3 \end{bmatrix}$$

2. Normalisation Matrix

The process of normalising the data ensures that each criterion is given equal weight in the decision-making process. This prevents situations where variables with very high or very low values have disproportionate effects on the final result. As a result, the final result is more accurate, reliable and representative of all aspects under consideration.

Normalise the matrix with benefit type criteria using the formula (7).

$$X_{IJ}\ AL0\ CR1 = \frac{5}{32} = 0.156$$

$$Xij\ AL0\ CR2 = \frac{5}{33} = 0.152$$

$$Xij\ AL0\ CR4 = \frac{5}{34} = 0.147$$

$$Xij\ AL0\ CR5 = \frac{4}{30} = 0.133$$

$$Xij\ AL0\ CR6 = \frac{5}{31} = 0.161$$

Normalise the matrix with Cost-type criteria using formula (6).

$$Xij\ AL\ 0\ CR3 = \frac{1}{3} = 0.333$$

The results of matrix normalisation can be seen in table 8

TABLE 8.
THE RESULTS OF MATRIX NORMALISATION

Alternative	Criteria					
	CR1	**CR2**	**CR3**	**CR4**	**CR5**	**CR6**
AL0	0.156	0.152	0.333	0.147	0.133	0.161
AL1	0.094	0.121	0.2	0.147	0.133	0.097
AL2	0.156	0.121	0.2	0.088	0.133	0.161
AL3	0.156	0.121	0.25	0.118	0.1	0.129
AL4	0.125	0.091	0.25	0.147	0.133	0.097
AL5	0.094	0.152	0.25	0.118	0.133	0.129
AL6	0.125	0.121	0.333	0.088	0.1	0.129
AL7	0.094	0.121	0.333	0.147	0.133	0.097

3. *Normalised Weight Matrix*

The weighted normalisation matrix is calculated using formula 8. The weights used are based on the results of the ROC method.

$D\ AL0\ CR1$ = 0.I56 * 0.408 = 0.064

$D\ AL0\ CR2$ = 0.I52 * 0.242 = 0.037

$D\ AL0\ CR3$ = 0.333* 0.158 = 0.053

$D\ AL0\ CR4$ = 0.I47 * 0.103 = 0.015

$D\ AL0\ CR5$ = 0.133 * 0.061 = 0.01

$D\ AL0\ CR6$ = 0.161 * 0.028 = 0.004

So that the results are obtained as table 9 below.

TABLE 9
THE RESULT OF NORMALISED WEIGHT MATRIIX

Alternative	Criteria					
	CR1	**CR2**	**CR3**	**CR4**	**CR5**	**CR6**
AL0	0.064	0.037	0.053	0.015	0.01	0.004
AL1	0.038	0.029	0.032	0.015	0.008	0.003
AL2	0.064	0.029	0.032	0.009	0.008	0.004
AL3	0.064	0.029	0.04	0.012	0.006	0.004
AL4	0.051	0.022	0.04	0.015	0.01	0.003
AL5	0.038	0.037	0.04	0.012	0.008	0.004
AL6	0.051	0.029	0.053	0.009	0.006	0.004
AL7	0.038	0.029	0.053	0.015	0.008	0.003

4. *Calculation The Value Of The Normalisation Function*

The normalisation function value to determine the optimum value using formula 9.

AL0 = 0.064 + 0.037 + 0.053 + 0.015 + 0.02 + 0.004 = 0.182

The same calculation is done for AL1 to AL7. The results can be seen in Table 10.

TABLE 10.
THE VALUE OF THE NORMALISATION FUNCTION

Alternative	**Si**
AL0	0.182
AL1	0.125
AL2	0.146
AL3	0.154
AL4	0.14
AL5	0.138
AL6	0.151
AL7	0.146

5. *Calculation the degree of Normalised Utility.*

The utility degree value is calculated using formula 10. This is the last step in the ARAS algorithm.
AL1 = AL1 / AL0
AL1 = 0.125 / 0.182
AL1 = 0.684
So that the results are obtained as shown in Table 11.

TABLE 11.
DEGREE OF NORMALISED UTILITY.

Alternative	Si
AL0	0
AL1	0.684
AL2	0.800
AL3	0.845
AL4	0.768
AL5	0.756
AL6	0.831
AL7	0.7996

The final step is to perform the rankings that are presented in the table 12.

TABLE 12
RANGKINGS

Alternative	Si	Rangkings
AL0	0	
AL1	0.684	7
AL2	0.800	3
AL3	0.845	1
AL4	0.768	5
AL5	0.756	6
AL6	0.831	2
AL7	0.7996	4

Table 12 shows the results of the ranking where alternative AL3 gets the highest value of 0.884, the second AL 6 with a value of 0.831, the third AL2 with a value of 0.800, the fourth AL7 with a value of 0.799, for the fifth AL4 with a value of 0.768, the sixth AL5 with a value of 0.756, and the last rank is AL1 with a value of 0.684.

IV. CONCLUSION

Based on the results of the analysis in this study it can be concluded that the combination of ROC and ARAS algorithms can be used to optimize the ranking of the best sales selection using 6 criteria and 7 alternative people. the ranking / order obtained is used for recommendations or decision support for the leadership in selecting the best sales, by sorting priority criteria and benefit and cost criteria. The ROC algorithm is used for weighting criteria and the ARAS algorithm is used for ranking. so that the highest ranking result is achieved by the AL3 alternative with a value of 0.845. for that AL3 deserves to be recommended as the best sales.

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