Admission Selection Decision Support System New Students Use The Vikor Method

1st Angelita Nawas, 2st Rahmat H. Kiswanto
Sepuluh Nopember University of Papua
Informatics Engineering, Jayapura City, Indonesia
E-mail: angelitanawas994@gmail.com[1], kissonetwo74@gmai.com[2]

Abstract— This study aims to develop a decision support system (SPK) for the selection of new students at YPPK Christ Raja Junior High School in Jayapura using the Vikor (Multi-criteria Decision Analysis) method. The main problem faced by the school is the selection process of new students who still use a manual system, causing errors in decision making. The vikor method was chosen because it is efficient in handling multi-criteria problems. This study involved 15 students as an alternative sample in the selection process. The vikor method is used for normalization, calculation of utility measure (s) and regret measure (r) values, as well as determination of index values. The ranking results are based on the s, r, and q sequences, with the best alternative solution determined based on the minimum q value. The results showed that recommendations for new student admission decisions can be obtained by utilizing the ranking results from the vikor method. The system development process is carried out using the waterfall method with stages of software requirements analysis, design, program code creation, and testing. System design is carried out using structured design, while testing uses the blackbox method. The results of this study are expected to improve the efficiency and accuracy of the selection process for new students at YPPK Christ Raja Junior High School in Jayapura through the implementation of a decision support system with the vikor method.

Keywords: *VIKOR, Decision_Support_System, Student Selection System*

I. INTRODUCTION

Education has now developed into a new culture that contributes to the development of human life. Everyone should now learn. With the development of the times, more problems will arise. that will be faced for decades. In addition, the quality of education of a country affects its progress. A country is considered developed if its education system produces students who are responsible, intelligent, critical, and academically, morally, and intellectually qualified. Education is very important to prepare a superior and quality generation of the nation for the next generation. The progress of the nation will be very difficult if the character building process fails[1].

Christ the King Junior High School is one of the many educational units that offer junior high school (SMP) levels. Established in 1986, this school regularly holds new student admission activities every year. Data shows that in the 2021/2022 school year, there were 86 applicants with 65 accepted, while in the 2022/2023 school year, the number of applicants increased to 117 with 97 accepted, and in the 2023/2024 school year, the number of applicants reached 120 students with 95 students accepted. However, the capacity of students is not limited because of the re-selection process. The selection process was carried out by a committee consisting of 6 teachers/employees under the supervision of the principal, bp hendrikus, s.pd. The time given for the selection process is 2 weeks, but due to errors in the calculation of criteria, the committee takes 3 to 4 weeks to complete the process. The selection of new students is based on several criteria, including national test scores, school test scores, final semester report cards, student presentations, and zoning. However, there are weaknesses in the selection process carried out manually by the committee. This manual assessment often results in errors and inefficient selection processes. Therefore, it is necessary to improve the work system towards a more efficient and accurate selection process to avoid errors in decision making.

The vikor method is one of the methods used in multi-criteria decision analysis (MCDA), which helps overcome complexity in systems with many criteria. This method has the advantage of providing quick recommendations in determining the best alternative, such as the choice of the best supplier in a multi-criteria case. The reasons for choosing the vikor method in this context are as follows; normalization, calculation of utility measure (s) and regret measure (r) values, calculation of index values, ranking, best alternative solutions[2][3]. The criteria used in this study include national test scores, school test scores, final semester report cards, student presentations, and zoning. By using a sample of 10 students as an alternative, the vikor method will provide recommendations to support the decision to admit new students at YPPK Christ Raja Junior High School in Jayapura. The results of this study will result in a ranking of prospective students ranging from those who are accepted to those who are not, thus providing solid recommendations in the selection process of new students.

Based on the above problems, it is necessary to build a decision support system (SPK) for student selection using the vikor method, and the system development method using waterfall with 4 stages, namely software needs analysis, design, program code creation, and examining, while for the design method that uses a structured design method. The test method uses the blackbox test method. Such as Gede Suwardika and DDK with the title Application of the Vikor Method in Making Selection Decisions for Prospective Bidikmisi Scholarship Recipients of Open University with the conclusion of the use of the Vikor method of selection and determining recipients of Bidikmisi scholarships based on predetermined criteria[4], then Fuad Surya Mawir and DDK's research entitled Decision Support System for Selecting the Best Honorary Employee Using the Visekriterijumsko Compromise Method Rangiranje said that the results of ranking using the Vikor method in the best honorary employee decision support system, the Vikor method recommended honorary employee 5 as a candidate for honorary employee 5 with a Vikor index value of 0.045 and getting a rank of 1[5], Research on the decision support system for the selection of management using the visakrijumsko Compromise method Rangiranje (Vikor) from Aula Rahman and DDK said that a decision support system for the election of student council administrators that the system that assists the decision to elect new student council administrators in Man 2 Samarinda can provide ranking from candidates for administrators who have been registered and entered into the system. The data accuracy value is 70.59% of 68 field data, which means that 48 data correspond to field data[6].

II. RESEARCH METHODS

2.1 Research Flow

The data analysis of this study contains current systems, functionality needs, and non-functionality needs. Analysis using the waterfall method which is at the design stage until management is carried out in stages, and data analysis aims to make readers understand and understand directly[7].
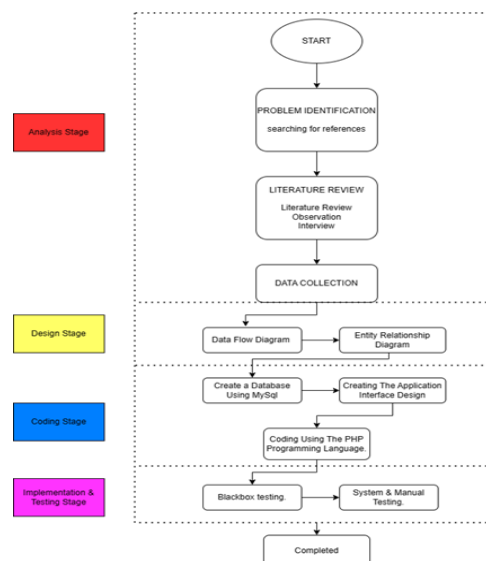

Figure 1. Research Flow

The waterfall method is a software development model that is carried out sequentially and very systematically. The waterfall method has several stages as follows;
1. Needs analysis
    At this stage, an in-depth analysis of data needs is carried out, collecting data to be processed such as alternative data, criteria data, student data, and weighting criteria values.
2. Design
    At this stage will focus on the design process that will be carried out by the system. The design process is described using flowcharts for the running system and the design design to be built using context diagrams, tiered diagrams, overview diagrams and entity relationship diagrams (ERDs).
3. Coding
    Coding is an advanced stage of design in order to be implemented in coding. The programming languages used by researchers to build websites are PHP (Hypertext Preprocessor) and Java Script. For database creation using MySQL.
4. Testing
    To reduce errors and ensure that the output produced is as desired, the Black Box method is used to test the software functionally.

2.2 Decision Support System

A Decision Support System (DSS) is a computer system designed to aid decision making in a semi-structured or unstructured environment. DSS assists decision makers in analyzing information, evaluating alternatives, and making better and more informed decisions[8].

2.3 Vikor (*Višekriterijumsko Kompromisno*)

VIKOR method (*VlseKriterijumska optiziacija i kompromisno resenje*) is one approach in multi-criteria decision analysis used to overcome complexity in decision making. This method is designed to help decision makers evaluate and select the best alternative from a number of different criteria[9].

2.4 Context Diagram

A context diagram is a type of diagram in system modeling techniques used to provide a high-level visual picture of how a system interacts with outside entities. It helps in understanding the context in which the system operates without paying attention to its internal details. A context diagram consists primarily of one main entity, the system itself, and the outside entities that interact with that system[10].
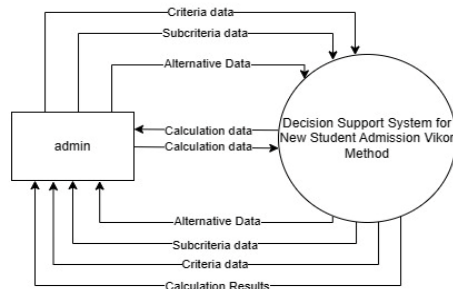

Figure 2. Context Diagram

2.5 Data Flow Diagram (DFD)

DFD stands for Data Flow Diagram, or Data Flow Diagram in Indonesian. It is a visual tool used to describe the flow of data in an information system. DFDs consist of various symbols that represent processes, entities, data flows, and data stores. Its purpose is to describe how data is processed in the system, from input to output[11].
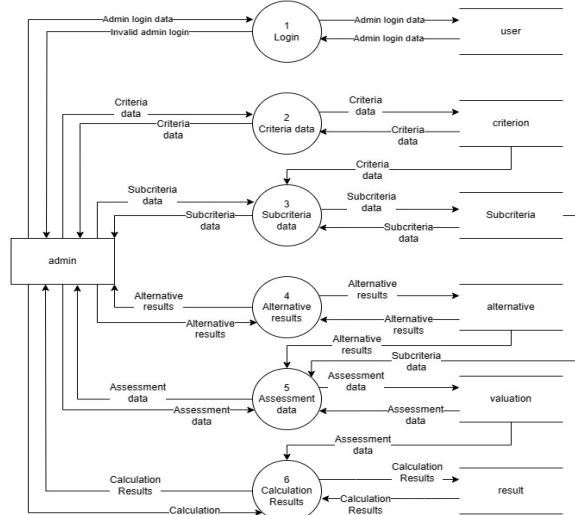

Figure 3. Diagram DFD

2.6 Entity Relationship Diagram (ERD)

Entity-Relationship Diagram (ERD) is a visual tool used to model the relationships between entities in a database. In an ERD, there are various entities, attributes, as well as relationships between them, which helps in designing the database in more detail and provides a better understanding of the structure of relationships between entities[12].
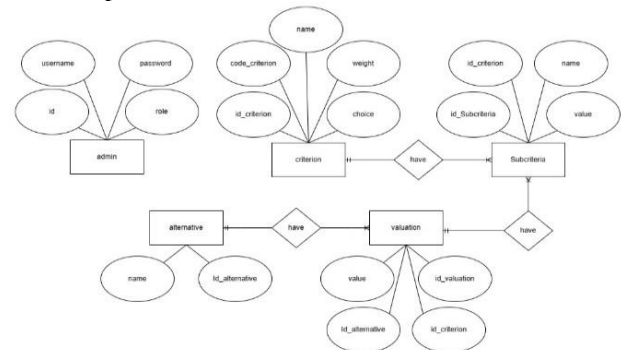

Figure 4. Diagram ERD

III.   RESULT AND ANALYSIS

A. Determination of Criteria

In this system, 5 criteria are used, these criteria are

Table 1. Criterion

Code Criteria	Value Description	Weight value	Types of Criteria
C_1	National Test Scores	0,30	*Benefits*
C_2	School Test Scores	0,25	*Benefits*
C_3	Niai Final Semester report card	0,20	*Benefits*
C_4	Student achievement	0,15	*Benefits*
C_5	Zoning	0,10	*Cost*

B. Data

From data collection at SMP YPPK KRITUS RAJA From February to July, the following data were obtained;

Table 2. Initial Data

No	Alternative	C_1	C_2	C_3	C_4	C_5
1	Alesandro F.R umbekwan	7.72	7.80	4.0	7.49	1.5
2	Alfinski G.P. Bantong	7.50	8.00	2.0	7.33	1.2
3	Anac T.X. Offal	7.6	7.75	4.0	7.34	3.5
4	Arnaldo F.V. Medellu	8.00	7.60	2.0	7.02	1.2
5	Ayunda P. Rumadual	7.32	7.40	1.0	7.15	2.3
6	Boas K.A.M. Yufuwai	7.53	7.30	1.0	7.43	2.5
7	Chelsea C. Santoso	8.50	7.80	2.0	7.49	2.2
8	Damian C. Bitbir	7.95	8.00	4.0	7.30	3
9	Elshaday N.J. Chaay	7.45	7.40	5.0	7.79	2.9
10	Fina Logo	7.25	8.00	2.0	7.43	2.5

C. Account

To calculate the Vikor method for performance appraisal can be described as follows;

a. Decision Matrix

This decision material is prepared based on the data above. (Table 2)

b. Assessment Weights

Based on need, this assessment measure is created and applies to all subjects. The weight of the assessors is the National Examination at 30%, School Examination at 25%, Final Semester at 20%, Achievement at 15%, Zoning at 10%. That weighting, can be described by w = [0.30, 0.25, 0.20, 0.15, 0.10]

Furthermore, based on the data (table 2). List the highest and lowest assessments of each criterion as described in the following table;

Table 3. Assessment Weights

Criterion	Highest	Lowest
C_1	8.50	7.25
C_2	8.00	7.30
C_3	5.0	1.0
C_4	7.79	7.02
C_5	3.5	1.2

After determining the highest and lowest assessments above (table 3), then make a normalization matrix using the formula.

$$R_{ij} = \left(\frac{X_j^+ - X_{ij}}{X_j^+ - X_j^-} \right)$$

R1.1 = $\left(\frac{8.50-7.72}{8.50-7.25} \right)$ = 0.624   R1.4 = $\left(\frac{8.50-8.00}{8.50-7.25} \right)$ = 0.4

R1.2 = $\left(\frac{8.50-7.5}{8.50-7.25} \right)$ = 0.8   R1.5 = $\left(\frac{8.50-7.32}{8.50-7.25} \right)$ = 0.944

R1,3 = $\left(\frac{8.50-7.6}{8.50-7.25} \right)$ = 0.72   R1.6 = $\left(\frac{8.50-7.53}{8.50-7.25} \right)$ = 0.776

Next use the same formula so that the end of the data is R5.10

Table 4. Normalization Matrix

No	Alternative	C_1	C_2	C_3	C_4	C_5
1	Alesandro F.R umbekwan	0.624	0.286	0.25	0.39	0.87
2	Alfinski G.P. Bantong	0.8	0	0.75	0.597	1
3	Anac T.X. Offal	0.72	0.357	0.25	0.584	0
4	Arnaldo F.V. Medellu	0.4	0.571	0.75	1	1
5	Ayunda P. Rumadual	0.944	0.857	1	0.831	0.522
6	Boas K.A.M. Yufuwai	0.776	1	1	0.468	0.435
7	Chelsea C. Santoso	0	0.286	0.75	0.39	0.565
8	Damian C. Bitbir	0.44	0	0.25	0.636	0.217
9	Elshaday N.J. Chaay	0.84	0.857	0	0	0.261
10	Fina Logo	1	0	0.75	0.468	0.435

D. Weighted Normalization

This weighting, normalized material (table 5) is multiplied by each weight and the following results are obtained;

Table 5. Weighted Normalization

No	Alternative	C_1	C_2	C_3	C_4	C_5
1	Alesandro F.R umbekwan	0.187	0.072	0.05	0.59	0.087
2	Alfinski G.P. Bantong	0.24	0	0.15	0.09	0.1
3	Anac T.X. Offal	0.216	0.089	0.05	0.088	0
4	Arnaldo F.V. Medellu	0.12	0.143	0.15	0.15	0.1
5	Ayunda P. Rumadual	0.283	0.214	0.2	0.125	0.052
6	Boas K.A.M. Yufuwai	0.233	0.25	0.2	0.07	0.044
7	Chelsea C. Santoso	0	0.072	0.15	0.059	0.057
8	Damian C. Bitbir	0.132	0	0.05	0.095	0.022
9	Elshaday N.J. Chaay	0.252	0.214	0	0	0.026
10	Fina Logo	0.3	0	0.15	0.07	0.044

E. Utility Measures and Regrete Measurer

The values of S and R, are two calculated utility measures; the R value is derived from the highest value per subject after weight normalization (table 4);

Described by the following formula;

$R_j = \max (R_{ij}, ... Rin)$

The data is presented in the table as follows:

Table 6. R value

R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_{10}
0,187	0,24	0,216	0,15	0,283	0,25	0,15	0,132	0,252	0,3

The value S is taken from the sum of the values of each subject. Described by the following formula;

$$S_i = \sum_{j=1}^{n} W_j \left(\frac{x_{j^+} - xij}{x_{j^+} - x_{j^-}} \right)$$

$S_{i1} = 0.187 + 0.072 + 0.05 + 0.059 + 0.087 = 0.455$
$S_{i2} = 0.24 + 0 + 0.15 + 0.09 + 0.1 = 0.58$
$S_{i3} = 0.216 + 0.089 + 0.05 + 0.088 + 0 = 0.443$
$S_{i4} = 0.12 + 0.143 + 0.15 + 0.15 + 0.1 = 0.663$
$S_{i5} = 0.283 + 0.214 + 0.2 + 0.125 + 0.052 = 0.874$
$S_{i6} = 0.233 + 0.25 + 0.2 + 0.07 + 0.044 = 0.797$
$S_{i7} = 0 + 0.072 + 0.15 + 0.059 + 0.057 = 0.338$
$S_{i8} = 0.132 + 0 + 0.05 + 0.095 + 0.022 = 0.299$
$S_{i9} = 0.252 + 0.214 + 0 + 0 + 0.026 = 0.492$
$S_{i10} = 0.3 + 0 + 0.15 + 0.07 + 0.044 = 0.564$

Table 7. S value

S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}
0,455	0,58	0,443	0,663	0,874	0,797	0,338	0,299	0,492	0,564

And obtained the maximum and minimum results from S and R as follows:

Table 8. Max and Min Values of R and S

S^+	S^-	R^+	R^-
0,874	0299	0,3	0,132

F. QI VALUE

The value of Q is obtained using the formula;

$$Q_1 = V + (1 - V)\left[\frac{S_i - S^-}{S^+ - S^-}\right]\left[\frac{R_i - R^-}{R^+ - R^-}\right]$$

$Q_1 = \left[\frac{0.455 - 0.299}{0.874 - 0.299}\right] 0.5 + (1 - 0.5) = 0.2993 \left[\frac{0.187 - 0.132}{0.3 - 0.132}\right]$

$Q_2 = \left[\frac{0.58 - 0.299}{0.874 - 0.299}\right] 0.5 + (1 - 0.5) = 0.5658 \left[\frac{0.24 - 0.132}{0.3 - 0.132}\right]$

$Q_3 = \left[\frac{0.443 - 0.299}{0.874 - 0.299}\right] 0.5 + (1 - 0.5) = 0.3752 \left[\frac{0.216 - 0.132}{0.3 - 0.132}\right]$

$Q_4 = \left[\frac{0.663 - 0.299}{0.874 - 0.299}\right] 0.5 + (1 - 0.5) = 0.3702 \left[\frac{0.15 - 0.132}{0.3 - 0.132}\right]$

$Q_5 = \left[\frac{0.874 - 0.299}{0.874 - 0.299}\right] 0.5 + (1 - 0.5) = 0.9494 \left[\frac{0.283 - 0.132}{0.3 - 0.132}\right]$

$Q_6 = \left[\frac{0.797 - 0.299}{0.874 - 0.299}\right] 0.5 + (1 - 0.5) = 0.7842 \left[\frac{0.25 - 0.132}{0.3 - 0.132}\right]$

$Q_7 = \left[\frac{0.338 - 0.299}{0.874 - 0.299}\right] 0.5 + (1 - 0.5) = 0.0875 \left[\frac{0.15 - 0.132}{0.3 - 0.132}\right]$

$Q_8 = \left[\frac{0.299 - 0.299}{0.874 - 0.299}\right] 0.5 + (1 - 0.5) = 0 \left[\frac{0.132 - 0.132}{0.3 - 0.132}\right]$

$Q_9 = \left[\frac{0.492 - 0.299}{0.874 - 0.299}\right] 0.5 + (1 - 0.5) = 0.525 \left[\frac{0.252 - 0.132}{0.3 - 0.132}\right]$

$Q_{10} = \left[\frac{0.564 - 0.299}{0.874 - 0.299}\right] 0.5 + (1 - 0.5) = 0.7304 \left[\frac{0.3 - 0.132}{0.3 - 0.132}\right]$

Table 9. Qi Calculation Results

No	Alternative	Qi Value
1	Alesandro F.R umbekwan	0.2993
2	Alfinski G.P. Bantong	0.5658
3	Anac T.X. Offal	0.3752
4	Arnaldo F.V. Medellu	0.3702
5	Ayunda P. Rumadual	0.9494
6	Boas K.A.M. Yufuwai	0.7842
7	Chelsea C. Santoso	0.0875
8	Damian C. Bitbir	0
9	Elshaday N.J. Chaay	0.525
10	Fina Logo	0.7304

G. RANKING

The VIKOR index value is used in the VIKOR method to rank different options. The alternative with the lowest VIKOR index value is considered the most effective and ranked first. The following image shows the data:

Table 10. Ranking

Alternative	Q_1	Rating
Damian C. Bitbir	0	1
Chelsea C. Santoso	0.0875	2
Alesandro F.R umbekwan	0.2993	3
Arnaldo F.V. Medellu	0.3702	4
Anac T.X. Offal	0.3752	5
Elshaday N.J. Chaay	0.525	6
Alfinski G.P. Bantong	0.5658	7
Fina Logo	0.7304	8
Boas K.A.M Yufuwai	0.7842	9
Ayunda P. Rumadual	0.9494	10

H. IMPLEMENTATION

After collecting the results of the above calculations, the author began to build the rating system in question. This system can be used to improve the quality of service and make assessment easier and more efficient for students.
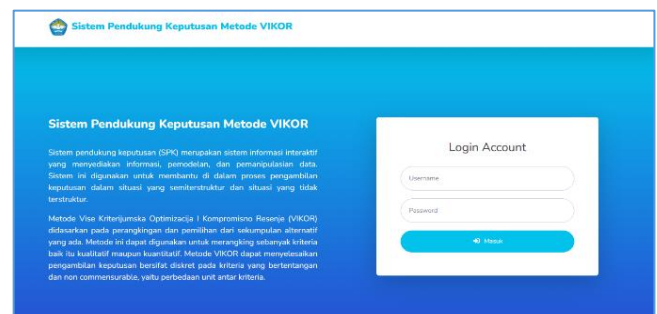

Figure 5. Login

When a user accesses the decision support system application for admission of new students, the login page will appear as the first page. There, users must enter their username and password for validity before being able to access all menus within the app. The display of the ranking page of the new student selection results can be seen in figure 6.

Figure 6. New Student Rankings

The new student ranking page displays the results of the new student ranking selection resulting from the calculation of the VIKOR method. The existence of this

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application makes it easier for the company to determine the ranking of new students.

Table 11. Blackbox

Test Field	Expected Results	Conformity
Intercase	On request of USer	Appropriate
Data input	In accordance with the current facts	appropriate
Report	According to the calculation results	appropriate

To ensure that the results are in accordance with the procedures applicable at YPPK Christ the King Junior High School, the authors and school respondents used the blackbox method.

VI. CONCLUSION

The results of research using the vikor method found that it was ranked 1 with a value of 0, while ayunda got the last rank with a value of 0.9494, from the results of manual testing with excel or with the system showed the same result, namely rank 1, namely demian. This system can assist the committee in recommending students who pass the selection for new student admissions. The suggestion for system development is to try to use other methods for calculations so that the results are more accurate.

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