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Support System to Determine The Priority of Bridge Improvement Using Topsis Method in Transmigration Department of Kapuas District, Indonesia

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Abstract: *Kapuas Regency Transmigration office is a government institution tasked with handling infrastructure infrastructures such as roads and bridges that are related to daily community activities. The Kapuas District Transmigration Office to determine priorities for bridge repair is still done manually, that is, field workers receive community opinions to do bridge repairs then the field workers notify the office to do bridge repairs, whereas up to now the priority bridges have been repaired are still in good category and there are still other bridges that need to be repaired. This causes the budget allocation for bridge repair in the Kapuas Regency Transmigration Office to be inaccurate and this also takes a long time and is considered to be less on target and is questionable for its accuracy because of the large amount of bridge data available. Given these problems, a Decision Support System is needed. Determining priorities for bridge repairs is done using the Topsis Method. There are several bridge criteria assessed in this study, namely the bridge floor, bridge holder, footstools, bridge wing walls, bridge back walls, connections, surface layers, sidewalks, backrests and the ranking of each criterion is performed. From the results of this Decision Support System, it can facilitate the Kapuas District Transmigration Office in determining which bridges will be repaired first.*

Keywords: *Bridge Repair Decision Support System, TOPSIS, Kapuas District Transmigration Office.*

I. INTRODUCTION

Website development is currently so fast, this is caused by several factors including the development of infrastructure that is quite rapid, such as the internet. Many industry players, educational institutions, health institutions, and others use websites and the internet in addition to their business and presentation of information, especially in modern urban communities..(Suhartanto, 2017). With the rapid development of information and communication technology, the internet has become a media that is needed by the community as a medium to obtain or exchange information, especially for information between parts of the world without the obstruction of distance, time, and place (Mertayasa, 2017). Advances in information technology are growing rapidly making it easy for people to be able to access information easily in a short time(Triyanto & Arifin, 2017). However, the information generated by an accounting information system will be useful in the process of making decisions, purchasing, installing, and using each system when the benefits outweigh the costs (Dwitrayani, Widanaputra, & Putri, 2017).

Information technology is given a limitation as to the technology of procurement, processing, storage, and dissemination of various types of information by utilizing computers and telecommunications that were born due to strong drives to create new technologies that can overcome human slowness in processing information(Triyono & Febriani, 2018). Strategic information system planning and appropriate information technology can support the company's business plan and development, to provide competitive business competition (Himawan & Astuti, 2017). Computerized development era continued and developed until the 1990s so that gave birth to internet technology (Setiawan, 2018).The work carried out is felt to be more efficient using information technology than to be done manually, so unknowingly within the user, there will be a desire or interest to want to re-use the information technology (Rahman & Dewantara, 2017).

Information technology can be used to automate the process of managing information from inputting information, storing, and updating it at any time so that everyone can get the latest information. The problem analyzed uses TOGAF (The Open Group Architecture Framework) to make strategic planning proposals to align the vision and mission and support the organization's strategic plan. (Helmiawan & Sofiyan, 2018). The development of technology

makes it easier for academics, especially students to access all forms of information without the limitations of distance, space, and time (Pratama, 2018). The combination of information technology and human management is the key to the successful implementation of information systems. Repetitive work can be replaced by a system to simplify work (Mayowan, 2019). Evaluation of information technology at this time is very necessary for agencies or agencies to do various things including choosing the type of information technology that is appropriate to be applied by agencies (Anas, Winarno, & Al Fatta, 2017).

Information security is also defined as the protection of information and information systems from unauthorized access, use, disclosure, disruption, modification, or destruction (Syafitri, 2016). The information presented here is intended to provide a concise description, and to provide insight into how the application of various applications where modeling and machine learning algorithms can provide better benefits to the security of information (Rachmat, 2019).

Kapuas Regency Transmigration Office is a government institution whose job is to handle infrastructure such as roads and bridges that are related to daily community activities.

Decision Support System Definition

The decision support system (DSS) was first introduced by Michael S. Scoot Morton in the 1970s with the term management Decision. DSS is designed to support all stages of decision making ranging from identifying problems, selecting relevant data, and determining the approach used in the decision-making process, to evaluating choices.(Arbian, 2017).

DSS is composed of several components, namely database, model base, and user interface(Satria, Atina, Simbolon, & Windarto, 2018).

Little (1970) defines DSS as a set of model-based procedures for data processing and valuation to help managers make decisions. He stated that to be successful, the system must be simple, fast, easy to control, adaptive, complete with important issues, and easy to communicate (Brata & Whidyanto, 2017). Decision Support System is a system of producing information aimed at a particular problem that must be solved (Firdaus, 2017). Sprague and Watson define the Decision Support System (DSS) as a system that has five main characteristics, which are:

1. Computer-based system
2. Used to help decision-makers
3. To solve complex problems that are impossible to do with manual calculations
4. Through interactive simulation methods
5. Where data and analysis models are as good as the main components (Fatmawati, Windarto, Solikhun, & Lubis, 2017).

Decision Support System Goals proposed by Keen and Scott in the Management Information System book have three objectives to be achieved are:

- Help managers to make decisions to solve semi-structured problems.
- Supports the manager's judgment rather than trying to replace it

Increase the effectiveness of manager decision making rather than efficiency (Wati & Rahayu, 2017)

II. RESEARCH METHODS

2.1 Topsis Method

The research method used in this study uses the TOPSIS (Technique for Order of Preference By Similarity To Ideal Solution) method, which will be used to find accurate data results (Candrasari, Wibowo, Jeriko, & Anggraini, 2019).

TOPSIS was one of the first multi-criteria decision-making methods, (Technique For Others Reference by Similarity to Ideal Solution) introduced by Kwangsun Yoon and Hwang Ching-Lai. TOPSIS aims to determine positive ideal solutions and negative ideal solutions. (Fatmawati & Sultoni, 2016).

The TOPSIS method is used as an effort to solve multiple criteria decision-making problems. This is because the concept is simple and easy to understand, its computation is efficient and can measure the relative performance of decision alternatives (Hasugian, 2018).

TOPSIS will rank alternatives based on the priority value of the relative proximity of an alternative to a positive ideal solution. The alternatives that have been ranked are then used as a reference for decision-makers to choose the best solution desired(Agustina, Andrianingsih, & Dzuhri, 2017).

2.2 Topsis procedure

1. Calculate the separation measure.
2. Determine the distance between the values of each alternative with a positive and negative ideal solution matrix.
3. Determine the preference value for each alternative.

4. Decision matrix D refers to alternative m that will be evaluated based on n criteria defined as follows:

$$D=\begin{matrix} x_{11} & x_{12} \ldots & x_{1n} \\ x_{21} & x_{22} \ldots & x_{2n} \\ x_{m1} & x_{m2} \ldots & x_{mn} \end{matrix}$$

With xij expressing the performance of the calculation for the i alternative to the j[th] attribute (Sofyan, Sutarman, & Amarullah, 2019).

2.3 WaterfallModel

The Waterfall Development Life Cycle (SDLC) Method, is a development model that is only suitable for software development that has fixed or unchanging specifications. SDLC Waterfall has a concept like a waterfall by providing sequential or sequential life paths. The sequence in the SDLC Waterfall method starts from the analysis, design, coding, testing, and support stages (Margono, Andreswari, & Fauzi, 2019).

This model consists of five stages.

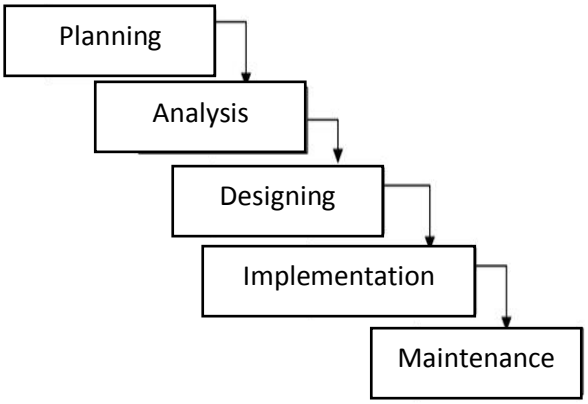

Figure 1. Waterfall System Development Model

This research method will explain the steps taken to design the system to be built.

2.4. Planning

A. Collecting Data Method

The data collection method used in this study is supporting data collection which is done by taking data in the form of basic information about bridge data from the Kapuas District Transmigration Office and conducting direct interviews.

B. Primary Data

Primary data is a source of data obtained directly from the source (not through intermediary media) (PM, Batubulan, & Fauziyyatul'Iffah, 2019). In this study, primary data were obtained at the Kapuas District Transmigration Office.

C. Secondary Data

Secondary data were obtained by finding references from literature studies (Suryani, 2018).

2.5 Analysis

A. System Analysis

At the stage of the system, analysis is analyzing the system that is running in this case study. At this stage, an analysis of software requirements will be carried out (Hermanto & Suyudi, 2018).

B. Data Analysis

Selection of relevant data and can be analyzed from operational data. The selected data is stored in a separate database (Arta, Indrawan, & Dantes, 2017). The data needed for this research is code, name, and condition. These parameters can be seen in the following table:

Table 1. List of Alternative Bridge Data

Code	Name of the Technical Implementation Unit	Condition
A01	Palingkau SP.1	Damaged lightly
A02	Palingkau SP.2	Damaged lightly
A03	Palingkau SP.3	Severely damaged
A04	Dadahup A.2	Severely damaged
A05	Dadahup A.6	Damaged lightly
A06	Dadahup A.7	Severely damaged
A07	Dadahup A.8	Damaged lightly
A08	Dadahup A.9	Severely damaged
A09	Dadahup B.1	Damaged lightly
A010	Dadahup B.3	Severely damaged
A011	Dadahup B.4	Damaged lightly
A012	Dadahup C.1	Severely damaged
A013	Dadahup C.2	Damaged lightly
A014	Dadahup C.3	Severely damaged
A015	Dadahup C.4	Severely damaged
A016	Dadahup F.2	Damaged lightly
A017	Dadahup F.5	Severely damaged
A018	Dadahup G.1	Severely damaged
A019	Dadahup G.2	Rusak Ringan
A020	Dadahup G.3	Severely damaged

2.6 Designing

A. System Design

At this stage, the data analysis process is carried out using the TOPSIS method and the following is an information system framework that can be seen in the following figure (Chamid & Murti, 2017):

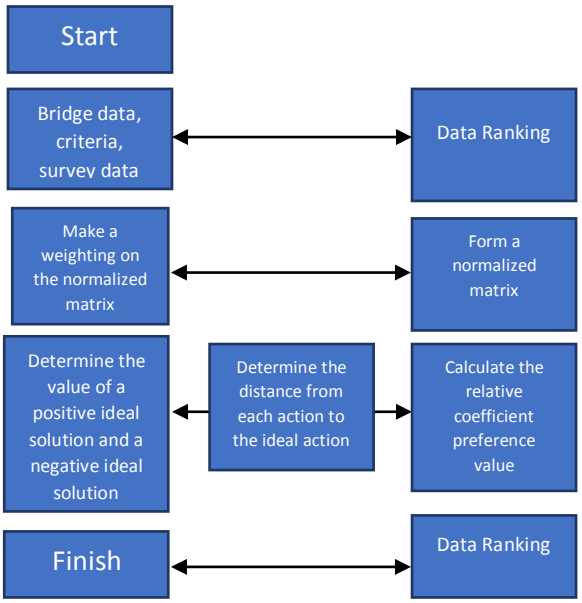

Figure 2. Information System Framework

B.Database Design

The database is the most important component in the development of information systems because it becomes a place to accommodate and organize all data in the system, so it can be explored to compile information in various forms (Ulandari, Yani, && Beny, 2019)The following is a database design on the decision support system to determine the priority of bridge repairs at the Kapuas District Transmigration Office in Central Kalimantan.

Table 2. Admin Table Design

Id	Full Name	Password	Nama_lengkap
Int(10)	Varchar(10)	Varchar(10)	Varchar(10)

2.7 Implementation

DSS System to Determine Bridge Repair Priorities at the Kapuas District Transmigration Office. There are 2 user interfaces, which are admin (staffing) and users. The making is using PHP programming language and in making a web-based display. Modules created in this application are:

a. Login module on admin and user pages.
b. Main system module page.
c. User data input modules, bridge data, criterion data.
d. Alternative value input modules, normalized values, normalized weighted ideal solution matrices, distance & on-page values (Yanuar & Aji, 2016).

2.8 Maintenance

Stages of system maintenance cover all processes needed to ensure the continuity, smoothness, and improvement of the system that has been operated (Tinaliah & Elizabeth, 2019).

III. RESULTS AND DISCUSSION

3.1 Research Result

A. Research Implementation Process

Based on research on decision support systems to determine priorities for bridge repair, the first process undertaken by researchers is to make some identification of the problem under study to determine the objectives to be achieved from the study. The research carried out aims to how to design and build a decision-making system using the TOPSIS method to help solve the Kapuas District Transmigration Office's bridge repair priorities right and fast (Nanda, Pitiasari, & Kusmawati, 2019).

B. Data Processing and Data Retrieval

The bridge data was obtained from the Kapuas District Transmigration Office, where the bridge data came from several locations, which included 37 data and information technical implementation units. Interviews and questionnaires were conducted to obtain information on data needed in making this research. So that information will be obtained in the form of data which will later be the basis for the design and processing of supplier selection with the topsis method (Yusnaeni, Ningsih, & Misriati, 2017).

3.2 Discussion

A. Data Bases

At this stage, the researcher analyzes the data needed in this case study. The data needed for this research are code, name, and bridge condition.

3.2 DSS Calculation Process with the Topsis Method

1. The first step is to create alternative data

Table 2. Alternative Data

Code	Name of Bridge Technical Implementation Unit
A01	Palingkau SP1
A02	Palingkau SP2
A03	Palingkau SP3

2. Criteria Data

Table 3. Criteria Data

Code	Criteria Name	Attribute	Value
C01	Bridge Floor	Cost	5
C02	Bridge holder	Benefit	3
C03	Pedestal	Cost	4
C04	Bridge Wing Wall	Benefit	2
C05	Bridge Rear Wall	Benefit	5
C06	Connection	Cost	4
C07	Surface Coating	Cost	5
C08	Sidewalk	Benefit	3
C09	Horseblock	Cost	2

In determining the priority of bridge repair requires a value, the value is derived from the indicators below:

1 = Very Bad

2 = Bad

3 = Enough

4 = Good

5 = Very Good

3. Alternative Values

Table 4. Alternative Values

	C01	C02	C03	C04	C05	C06	C07	C08	C09
A01	4	1	2	2	2	2	3	3	2
A02	5	1	4	2	3	3	4	3	2
A03	4	3	4	1	3	3	2	2	2

TOPSIS method procedure process in solving problems consists of the following steps:

1. Normalization

Table 5. Squares

	C01	C02	C03	C04	C05	C06	C07	C08	C09
A01	16	1	4	4	4	4	9	9	4
A02	25	1	16	4	9	9	16	9	4
A03	16	9	16	1	9	9	4	4	4
Total	**57**	**11**	**36**	**9**	**22**	**22**	**29**	**22**	**12**

To normalize we have to square each matrix element in table 4.3, for example, cell A01-C04 is 2 squared 2 * 2 = 4. The results are as above.

The total row is obtained by adding up each row in each criterion. After getting the total, all you need to do is normalize by dividing each element of the table 4.3 matrix with the root (sqrt) of the total corresponding rows, the results are as follows:

Table 6. Normalization

	C01	C02	C03	C04	C05	C06	C07	C08	C09
A01	0,5298	0,3015	0,3333	0,6667	0,4264	0,4264	0,5571	0,6396	0,5774
A02	0,6623	0,3015	0,6667	0,6667	0,6396	0,6396	0,7428	0,6396	0,5774
A03	0,5298	0,9045	0,6667	0,3333	0,6396	0,6396	0,3714	0,4264	0,5774

For example for the first line (A01) obtained from:

A01-C01 = 4 / sqrt (57) = 4 / 7,549 = 0,5298

A01-C02 = 1 / sqrt (11) = 1 / 3,316 = 0,3015

A01-C03 = 2 / sqrt (36) = 2 / 6 = 0,3333

A01-C04 = 2 / sqrt (9) = 2 / 3 = 0,6667

A01-C05 = 2 / sqrt (22) = 2 / 4,690 = 0,4264

A01-C06 = 2 / sqrt (22) = 2 / 4,690 = 0,4264

A01-C07 = 3 / sqrt (29) = 3 / 5,385 = 0,5571

A01-C08 = 3 / sqrt (22) = 3 / 4,690 = 0,6396

A01-C09 = 2 / sqrt (12) = 2 / 3,464 = 0,5774

2. Valued Normalization

Valued normalization is obtained from the multiplication of table 4.5 with table 4.3, i.e.:

Table 7. Valued Normalization

	C01	C02	C03	C04	C05	C06	C07	C08	C09
A01	2,6491	0,9045	1,3333	1,3333	2,1320	1,7056	2,7854	1,9188	1,1547
A02	3,3113	0,9045	2,6667	1,3333	3,1980	2,5584	3,7139	1,9188	1,1547
A03	2,6491	2,7136	2,6667	0,6667	3,1980	2,5584	1,8570	1,2792	1,1547

For example Line A01 is obtained by:

(0,5298*5) = 2,6491

(0,3015*3) = 0,9045

(0,3333*4) = 1,3333

(0,6667*2) = 1,3333

(0,4264*5) = 2,1320

(0,4264*4) = 1,7056

(0,5571*5) = 2,7854

(0,6396*3) = 1,9188

(0,5774*2) = 1,1547

3. Ideal Solution Matrix

Positive = (Maximum: Benefit), (Minimum: Cost)
Negative = (Minimum: Benefit), (Maximum: Cost)
The results can be seen in the following table:

Table 8. Matrix of Ideal Solutions

	C01 (cost)	C02 (benefit)	C03 (cost)	C04 (benefit)	C05 (benefit)	C06 (Cost)	C07 (Cost)	C08 (Benefit)	C09 (Cost)
Positive	2,6491	2,7136	1,3333	1,3333	3,1980	1,7056	1,8570	1,9188	1,1547
Negative	3,3113	0,9045	2,6667	0,6667	2,1320	2,1320	3,7139	1,2792	1,1547

4. Determine the Distance and Preference Value

To find the total and ranking, we must find the distance of positive and negative ideal solutions obtained from processing table 4.6 (weighted normalization) and table 4.7 (ideal solution matrix). The trick is to squeeze the difference between each element of the weighted normalization matrix with the ideal solution matrix, then add up each alternative, after that it is rooted. Look for the positive ideal distance A01 as follows:

A01 positive = SQRT ([(2,6491 – 2,6491)^2] + [(0,9045 – 2,7136)^2] + [(1,3333 –1,3333)^2] + [(1,3333 – 1,3333)^2] + [(2,1320 –3,1980)^2] + [(1,7056 – 1,7056)^2] + [(2,7854 – 1,8570)^2] + [(1,9188 – 1,9188)^2] + [(1,1547 – 1,1547)^2]) = **2,2959**. Likewise the others are as follows:

Code	Positive	Negative	Preference
A01	2,2959	2,1585	0,4846
A02	3,1088	1,4106	0,3121
A03	1,8326	2,8803	0,6111

Preference can be obtained from the division of negative ideal divided by the sum of a positive and negative ideal as follows:

A01 = 2,1585 / (2,2959 + 2,1585) = **0,4846**
A02 = 1,4106 / (3,1088 + 1,4106) = **0,3121**
A03 = 2,8803 / (1,8326 + 2,8803) =**0,6111**

The best alternative there that has the biggest preference is A03 with a preference value of 0.611.

From the results of the above research, it can be seen that the development of the Bridge Repair Decision Support System has been successfully developed. This system can assist the Transmigration Agency in determining bridge repair decisions. The use of technology in decision making has proven effective from the results of research conducted by other researchers. Like the research conducted by Akhundzadeh & Shirazi(2017) which develops decision making systems using fuzzy logic. The system they developed is intended to determine decisions in the paper industry in selecting and evaluating technology that will be implemented in the industry.

The development of decision-making technology using fuzzy logic was also carried out by Ren & Lützen (2015), but in the system they developed, they also used a multi-criteria decision-making (MCDM) approach. The system they developed is intended to evaluate and determine technology in mitigating ship emissions. Similarly, the decision-making system developed by An, et al(2017) also uses the MCDM method to evaluate groundwater remediation technology. Furthermore, in evaluating the criteria for the sustainability of renewable energy technologies, Sitorus and Brito-Parada(2020) also using the MCDM model method and fuzzy logic.

The systems developed help decision-makers to collect, evaluate, and assess the information collected and then weight and rank incoming data. That means, information plays a very important role in making decisions, the more and detailed information that comes in and the faster the evaluation and weighting process is carried out, the faster and more accurate decisions that can be taken (Zhong & Xu, 2020). The process can be done quickly with the help of information technology so that the use of the latest information technology in the digital age is a must in creating effectiveness and efficiency (Baharuddin & Dalle, 2017).

IV. CONCLUSIONS AND RECOMMENDATIONS

Based on research that has been done through the stages of testing a decision support system, the following conclusions can be drawn.

1. Conclusion

   This Decision Support System will also increase efficiency both in terms of implementation time and costs and can make it easier for the Transmigration Office of Kapuas Regency, Central Kalimantan to prioritize bridge repairs that will be repaired first.

2. Recommendations
   It can be developed to classify other case studies and Can be developed with other methods to produce a greater and better level of conformity.

REFERENCES

This heading is not assigned a number.

A reference list **MUST** be included using the following information as a guide. Only *cited* text references are included. Each reference is referred to in the text by a number enclosed in a square bracket (i.e., [3]). References **must be numbered and ordered according to where they are first mentioned in the paper,** NOT alphabetically.

Examples follow:

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