Web Based Information System Development Of Maintenance Work To Improve Government Building Maintenance Performance

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Abstract. Building maintenance process especially for government building still mostly carried out conventionally and it doesn’t have decent information system. As a result, building maintenance process tend to be slow, complicated, unstructured and often create insignificant added cost. The purpose of this research is to develop web based information system of maintenance work in order to improve government building maintenance performance. The information system design method used is the SDLC waterfall Model method. To measure the performance of officers used Fuzzy method and DSS method Profile Matching is used to optimize the work according to available fund allocation. It is hoped that this information system can be useful for government agencies in carrying out maintenance and maintenance work their building.

1. Introduction

1.1 Background

Building maintenance work is an activity to maintain building reliability along with its infrastructure so that the building always functional (preventive maintenance). Maintenance of building is an activity to repair and / or replace part of a building, component, building material, and / or infrastructure and facilities so that the building remains functional (curative maintenance), (Permen PU No. 24, 2008). To ensure that the building and all its components are always in a safe condition, suitable for use, meet the applicable legal requirements, to maintain the value of the physical assets of the building, to maintain the quality of a building [1].

There is one important aspect, namely the need for a support system that allows all management functions to run well, meaning synchronization between one action and another [2]. The support system referred to here is a maintenance management information system [3]. Along with the increasing development of information technology in this era of rapid globalization, making data and information flows become faster [4]. Breakthroughs in the field of information technology have made information needed for all aspects of the decision-making process within the organization [5]. The information system provides added value to the process, production, quality, management, decision making and problem solving, as well as competitive advantage which of course is very useful for business activities [6]. The rapid progress of the World Wide Web has affected information systems and information technology in solving problems and creating opportunities for organizations to improve and improve their operations globally [7].

Web-based information systems can be a potential strategic weapon for a company / agency / organization. The key is to combine internet technology with traditional information strategies and use them to pursue company goals [8]. Various literatures related to the development of web-based
information systems have the same goal, namely to overcome obstacles related to cost, time, functionality, and quality [9].

1.2 Research Objectives
The objectives of this research are:
1. To identify factors or information requirements to develop web-based information system of maintenance work to improve Government building maintenance performance.
2. To develop and obtain a web-based information system of maintenance work to improve government building maintenance performance with Fuzzy Sugeno method.

2. Literature Review
2.1 Web Based Information System
Applications that appear on intranets and extranets using web technology can be referred to as web-based information systems [10]. There are several synonyms that refer to web-based information systems such as web applications, web-based applications, web-based systems, internet web applications, and rich internet applications. But there is a difference between web-based information systems and standard web applications or pages. The difference lies in the nature and type of information created for users. The application of web standards is uni-directional in terms of providing information to users. While web-based information systems can be interpreted as applications that not only disseminate information, but also proactively interact with users to be able to help their work) [11]. Therefore, the information presented to users is bi-directional.

2.2 Government Building
The definition of Government buildings is buildings for official purposes that become/will become state-owned assets and are held with sources of financing derived from APBN funds, and/or other legitimate gains, such as office buildings, school buildings, hospital buildings, warehouses, state houses and others.

2.3 Maintenance and Treatment of Building
Maintenance of buildings is an activity to maintain the reliability of buildings and their infrastructure and facilities so that buildings are always functional (preventive maintenance). Treatment of building is an activity to repair and/or replace parts of buildings, components, building materials, and/or infrastructure and facilities so that the building remains functional (curative maintenance) [12].

While the Building Maintenance Committee defines maintenance activities as an activity carried out to maintain, update, or improve every service facility and building environment that meets applicable standards and also to maintain the usefulness and value of the building.

2.4 Fuzzy Membership Function
Membership function (membership function) is a curve that shows the mapping of data input points into its membership value (often also referred to as membership degree) which has intervals between 0 to 1. One way that can be used to get membership values is through function approach. There are several functions that can be used [13]:

a. Linear Representation

\[ \mu[x] = \begin{cases} 
0; & x \leq a \\
(x - a)/(b - a); & a \leq x \leq b \\
1; & x \geq b 
\end{cases} \]

**Figure 1.** Linear representation
b. Triangle Curve Representation

\[
\mu(x) = \begin{cases} 
0; & x \leq a \text{ atau } x \geq c \\
\frac{(x - a)}{(b - a)}; & a \leq x \leq b \\
\frac{(b - x)}{(c - b)}; & b \leq x \leq c 
\end{cases}
\]

**Figure 2.** Triangle curve Representation

3. Methodology

3.1 Research Flow Diagram

**Figure 3** Research Flow Diagram
4. Result & Discussion

4.1 Design of Fuzzy Sugeno

4.1.1 TIMING (K) Membership Function

\[ \mu \text{ Notification} (K) = \begin{cases} 0 & ; K \leq 0 \text{ or } K \geq 2 \\ \left( \frac{K}{2} \right) & ; 0 \leq K \leq 1 \\ \left( \frac{2-K}{1} \right) & ; 1 \leq K \leq 2 \end{cases} \]

\[ \mu \text{ ON PROCESS} (K) = \begin{cases} 0 & ; K \leq 1 \text{ or } K \geq 3 \\ \left( \frac{K-1}{1} \right) & ; 1 \leq K \leq 2 \\ \left( \frac{3-K}{1} \right) & ; 2 \leq K \leq 3 \end{cases} \]

Figure 4. TIMING Parameter

4.1.2 SOP (B) Membership Function

\[ \mu \text{ NON} (B) = \begin{cases} 0 & ; B \leq 0 \text{ or } B \geq 66,6 \\ \left( \frac{B}{33,3} \right) & ; 0 \leq B \leq 33,3 \\ \left( \frac{66,6-B}{33,3} \right) & ; 33,3 \leq B \leq 66,6 \end{cases} \]

\[ \mu \text{ SOP} (B) = \begin{cases} 0 & ; B \leq 66,6 \\ \left( \frac{B-66,6}{33,3} \right) & ; 66,6 \leq B \leq 100 \\ 1 & ; B \geq 100 \end{cases} \]

\[ \mu \text{ LACK} (B) = \begin{cases} 0 & ; B \leq 33,3 \text{ or } B \geq 100 \\ \left( \frac{B-33,3}{33,3} \right) & ; 33,3 \leq B \leq 66,6 \\ \left( \frac{100-B}{33,3} \right) & ; 66,6 \leq B \leq 100 \end{cases} \]

Figure 5. SOP Parameter

4.1.3 Rule Base System System

After the membership function creation process, the rule base system is made. Before creating a rule base system, first determine the value of the Fuzzy Sugeno output (Z) diagram. The Fuzzy Sugeno Diagram output is presented in Figure 3.5. According to Girona's research (2010), the output diagram of Fuzzy Sugeno Sugeno is determined manually with values ranging from 0 to 100.

Figure 6. Fuzzy Sugeno Output (Z) diagram

After the fuzzification process, the next step is the establishment of a rule base system. Two (2) TIMING parameters, SOP with 3 functions, so that there are \(3^2\) rules with a number of 9 fuzzy rule bases, each rule is always related to fuzzy relations.

\[ \Sigma \text{ rule base} = \text{num of function}^{\text{num of variable}} \]

\[ \Sigma \text{ rule base} = 3^2 = 9 \]

Rule is complete in Table 1, after that defuzzification is performed with a weighted average process.
Table 1. Rule Base System.

| IF         | TIMING   | SOP         | Fuzzy output |
|------------|----------|-------------|--------------|
| R1         | NOTIF    | NON         | POOR         |
| R2         | NOTIF    | DEFICIENT   | POOR         |
| R3         | NOTIF    | SOP         | EXCELLENT    |
| R4         | ON PROCESS | NON   | POOR         |
| R5         | ON PROCESS | DEFICIENT | POOR         |
| R6         | ON PROCESS | SOP     | EXCELLENT    |
| R7         | LATE     | NON         | POOR         |
| R8         | LATE     | DEFICIENT   | POOR         |
| R9         | LATE     | SOP         | POOR         |

4.2 DSS With Profile Matching
DSS with profile matching is used for the process of optimization of funds in the maintenance and maintenance work of government buildings in accordance with the specified criteria so that later will be automatically selected which jobs can be done according to the existing fund allocation.

Figure 7. DSS with Profile Matching Flow Diagram

Criteria

Table 2. DSS Profile Matching Criteria

| Quota Funds Weight | Frequency |
|--------------------|-----------|
| **Weight Value**   | **Cost**  | **Criteria** | **Weight Criteria** |
| 5                  | > 7 x 10 million | Very Expensive | Highest |
| 4                  | 5 – 6.9 x 10 million | Expensive |
| 3                  | 3 – 4.9 x 10 million | Quite |
| 2                  | 1.1 – 2.9 x 10 million | Less |
| 1                  | 0 – 1 x 10 million | Very Less | Lowest |

Urgency

| Weight Value | Urgency Level Each Maintenance Item | Weight Criteria |
|--------------|-------------------------------------|-----------------|
| 5            | Very Urgent | Highest |
| 4            | Urgent |
| 3            | Quite Urgent |
| 2            | Not Urgent |
| 1            | Very Not Urgent | Lowest |

Importance

| Weight Value | Importance Level Each Maintenance Item | Weight Criteria |
|--------------|----------------------------------------|-----------------|
| 5            | Very Important | Highest |
| 4            | Important |
| 3            | Quite Important |
| 2            | Not Important |
| 1            | Very Not Important | Lowest |

Figure 7. DSS with Profile Matching Flow Diagram
4.3 Use Case Diagram
4.3.1 Use Case Diagram Sistem informasi pemeliharaan gedung
In Figure 8 describes the web-based building maintenance system information system, there are four actors namely administrator, admin registration, admin and maintenance officer. Administrators have access rights to perform user logins, access the registration, appraisal, settings, fuzzy sugeno system base rules and report on performance results and points. Admin has access rights to the settings menu and reports on performance results and points. Registration admins have access rights to the registration menu and maintenance officers have access rights to the report on performance results and points.

![Main Use Case Diagram](image)

**Figure 8.** Main Use Case Diagram

4.3.2 Activity Diagram Sub Use Case Diagram login
In the system login activity diagram the administrator activity will be described to the system login, as shown in Figure 3.9.
At the first time the administrator accesses the web system information system building maintenance page, the administrator will be given the main application page. To enter the administrator page, you can press the login menu. On the login page, the administrator must enter a username and password. After the username and password are sent, the system will process and provide login results. If the login results fail, the administrator will be sent back to the login page, and if successful, the administrator will be sent to the main page.

### 4.3.3 Sequence Diagram Sub Use Case Diagram user login

Figure 9 Activity sub use case diagram Login Sistem

![Activity sub use case diagram Login Sistem](image)

Figure 10. Sequence sub Use Case Diagram Login

![Sequence sub Use Case Diagram Login](image)
4.4 Database Design

To see an overview of the relationship between databases, modeling techniques are used with ERD (Entity Relationship Diagram) as shown in the image below:

![ERD Diagram](image)

**Figure 11. ERD**

4.5 Interface Design

Main Menu Interface

![Main Menu Interface](image)

**Figure 12. Home Page**

User Login Menu Interface

![User Login Interface](image)

**Figure 13. User Login Page**
Dashboard Menu and Work Activities Graph Interface

Figure 14. Dashboard Menu Page & Work Activities Graph Page

5. Conclusion
From the research that has been done, it can be concluded that:

1. Functionally the information system of maintenance and treatment work of government buildings has been able to produce the expected output and user friendly and can facilitate the maintenance and treatment work of building. This information system is very helpful for the leader in carrying out quality improvements in building maintenance.

2. System development methods used in information system design are SDLC. The system development method was chosen because the information system design targets and limitations are quite clear, users can be involved intensively in the design of information systems so that the resulting information system is expected to suit the needs of users.

3. Fuzzy method is used to measure the performance of officers with a point system in the design of information systems. In this design consists of 2 variables, namely Timing and SOP variables and consists of 9 rule base systems as a basis for determining officer points.

4. DSS (Decision Support System) Profile Matching method is used to prioritize building maintenance and treatment work according to available fund allocation. There are 4 aspects that are measured in determining the priority of work, namely aspects of fund quota, frequency, urgency, and importance.

5. Management Information System for Government Building Maintenance is an Information System for building maintenance activities to determine the assessment of the quality of the components of the officers, resulting in an evaluation of the officers.

6. The results of this web based information system prototype can facilitate the leader and management in monitoring building maintenance work, making decisions, and evaluating the performance of officers so that they can determine planning and evaluation steps quickly.

7. Prototype produces indicators of building maintenance quickly because the analysis process has been carried out automatically.

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