Journal of International Conference Proceedings (JICP) Vol. 4 No. 1 (2021)
Print ISSN: 2622-0989 / Online ISSN: 2621-993X
DOI: https://doi.org/10.32535/jicp.v4i1.1124

Conceptual Framework for Developing Web-based Maintenance Systems for Government's Simple-Buildings within the DKI Jakarta Provincial Government

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ABSTRACT

DKI Jakarta, as the capital of the Republic of Indonesia, has the highest population density in Indonesia, with a population of 16,334 people / km2. Therefore, community facilities and infrastructure within the DKI Jakarta Provincial Government play an important role so that community service can be carried out properly. As one of the main infrastructures, State Buildings must have building reliability as stated in the technical requirements stipulated in Presidential Regulation Number 73 of 2016. Building maintenance is an activity to maintain the building's reliability and infrastructure, and facilities so that the building always functions properly. Based on a survey conducted by the DKI Jakarta Provincial Office for The Creation of Works, Spatial Planning and Land Use in 2019, the number of building assets of Province DKI Jakarta are 9823 buildings. 60% of those buildings were classified as Simple-Building category. Due to the numerous building assets, maintenance activities need to be supported by an adequate maintenance system. This study aims to develop a building maintenance system based on web. The methodology used in this research are expert validation, interviews, field survey and literature studies. The results of the validation process will be developed into a simple-building's web-based maintenance system framework.

Keywords: Building Maintenance, Maintenance System, Preventive Maintenance

JEL Classification Codes: C83, C88, H11, H54, H82

INTRODUCTION

Based on a survey conducted by the DKI Jakarta Provincial Office for The Creation of Works, Spatial Planning and Land Use in 2019, the building assets of Province DKI Jakarta are 9823. 60% of those buildings were classified as Simple-Building category. The data also shows the condition of the building at the time of the survey, the condition of the building in the data collection is classified as "maintained", "heavily damaged" and "in need of repair". From the results of data processing, it was found that the condition of the "maintained" building assets was 5654 (five thousand six hundred and fifty-four) buildings (57.56%), the condition "needed to be repaired" was 2994 (two thousand nine hundred and ninety-four) buildings (30.48%), and 796 (seven hundred and ninety-six) buildings were "heavily damaged" (8.1%), and the condition was not yet known was 379 (three hundred and seventy-nine), (3.86%). With the assumption that a building in a condition that needs repair and is heavily damaged can be categorized as an inadequate or less reliable building, it can be temporarily concluded that 38.58% of the building assets in the DKI Jakarta Provincial Government are not in a proper condition. The figure below shows that the building assets of the DKI Jakarta Provincial Government with Simple-Building's classification are more numerous than buildings with non-Simple-Building classifications.

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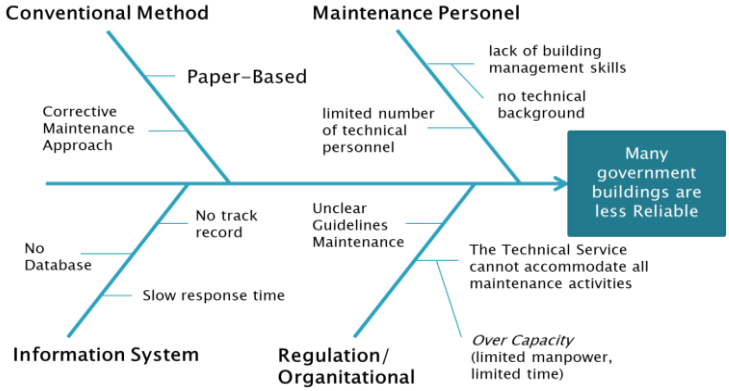
Figure 1. DKI Jakarta Provincial Office for The Creation of Works, Spatial Planning and Land Use building asset survey data 2019.

From interviews with the Head of DKI Jakarta Provincial Office for The Creation of Works, Spatial Planning and Land Use, there were several obstacles in maintaining state buildings DKI Jakarta Province. The technical incomprehension of those responsible for maintenance activities in planning building maintenance activities and other several factors that can be seen in Figure 2.

Figure 2. Fishbone Diagram about obstacles that occurs in building maintenance of State Building within DKI Jakarta Province.



Among the causes of building unreliability we can figure out that the absence of an efficient system for data recording, paper-based forms and a lack of technical personnel to monitor and communicate information is one of the obstacle that occurs in building maintenance (Ismail, 2014) .The influence of government policies, lack of clear job descriptions, and lack of technical experts are common problems in building maintenance (Alshehri et al., 2015). Also, the lack of maintenance personnel, the lack of preventive maintenance (Waziri & Vanduhe, 2013) and the lack of IT use, the lack of adequate maintenance procedures are some of the main issues in the management of government assets (Abdullah et al., 2011).

For this reason, it is necessary to have a maintenance system that is integrated with the web (Samudra, 2019) equipped with building maintenance guidelines to improve maintenance performance (Djonli, 2019; Fathoni, 2019; Handayaniputri, 2020; Inayah, 2020; Naufal, 2020; Wijaya, 2020; Yudha, 2019).

Based on the results of the literature review, the following gaps are obtained:

1. The maintenance system using the modeling developed in the previous research is on average used for single buildings, while for multiple buildings it has not been found.

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2. Multiple users in the communication system built on the maintenance system in the previous study were building users and maintenance actors where the building user as the party filing a complaint and the maintenance actor then plans and carries out corrective maintenance based on user complaints. There is no research that discusses building managers planning maintenance activities and proposing consultation / supervision with central technical officers.
3. In previous studies, the buildings that were often the object of research were single complex buildings or high-rise buildings, while low rise buildings or simple buildings were rarely the object of research, especially in IT-based research.

Identification of the research problems are:
1. There has been no research that has developed a maintenance system among building actors in supervision or consultation on building maintenance activities.
2. No papers have been found on the topic of improving maintenance performance in DKI Jakarta Province based on the development of a building maintenance system.

RESEARCH METHOD

Strategy and Process

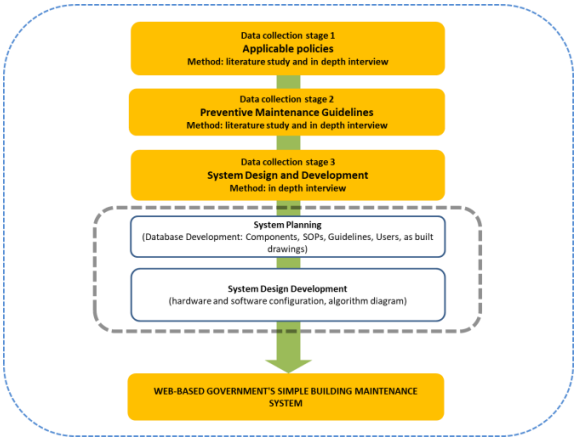
After the problems is identified, some formulations of the problem were obtained then determined by the research strategy. The research strategy used in this research is archive analysis (literature review) and surveys (deep interview).

Table 1. Problem Formulations and Research strategy

No	Problem Formulation	Question Used	Strategy
1	How the appropriate maintenance policies and guidelines in system development within the DKI Jakarta provincial government?	How	archive analysis, survey
2	How to develop a web-based maintenance system for multiple simple-buildings within the DKI Jakarta Provincial Government?	How	archive analysis, survey

The research process consists of three stages analysis. Firstly, collecting applicable policies and regulations data. Secondly, collecting preventive maintenance guidelines for simple building within DKI Jakarta Provincial Government data. The third analysis is carried out to design and developing a web-based maintenance system based on the result in previous stages. The research process flow is shown in Figure 3

Figure 3. Research Method flow



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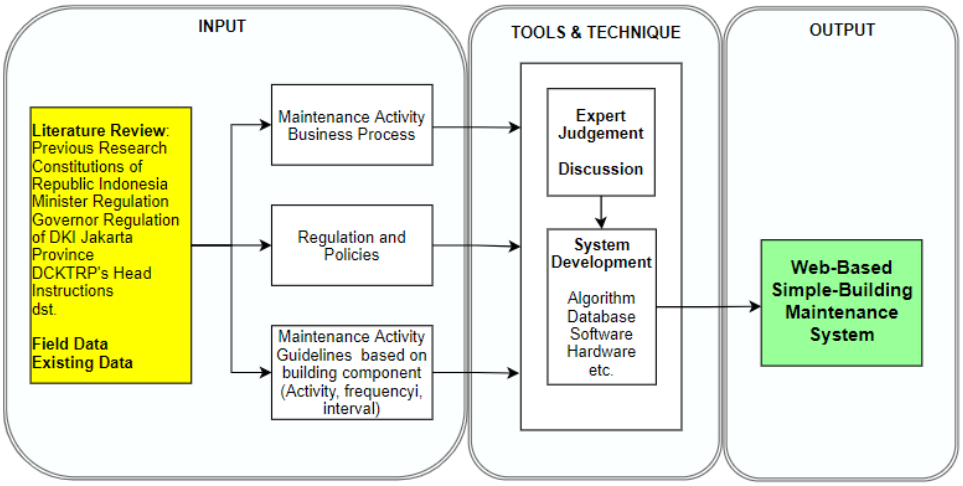
The data needed in this study were obtained from literature reviews of previous studies and existing data in the field as input of the process. The Inputs are but not limited to: the business process, regulation and policies, maintenance activity guidelines. As tools and techniques are but not limited to: expert judgments, discussion and system development. As the output is Web-based Simple-Building Maintenance System.

Figure 4. Research Input, Tools & Technique, and Output



Research Variables

Based on the results of interviews and literature studies, this study uses policy variables, preventive maintenance (Basri et al., 2017), and information systems

Table 2. Research's Independent variables (X)

No.	Sub Variable	No.	Sub sub variable	Reference
X.1	**Policies and Regulations for Maintenance Activities Policy**			
X.1.1	Planning and Development	X.1.1.1	Documenting the internal maintenance policy	(Adam, 2017)
		X.1.1.2	Determining the standard of building asset condition index	(Adam, 2017)
		X.1.1.3	Prepare a maintenance related strategy	(Adam, 2017)
		X1.1.4	Develop short- and long-term strategic plans	(Adam, 2017)
X.1.2	Implementation	X.1.2.1	Prepare an assessment of the condition of the assets to be maintained	(Adam, 2017)
		X.1.2.2	Carry out an assessment of the need for maintenance and care	(Adam, 2017)

No.	Sub Variable	No.	Sub sub variable	Reference
		X.1.2.3	Allocate sufficient budget for maintenance and maintenance work	(Adam, 2017)
		X.1.2.4	Develop a routine maintenance and maintenance program	(Adam, 2017)
		X.1.2.5	Develop a plan of supervision of maintenance and maintenance work	(Adam, 2017)
		X.1.2.6	Supervise and evaluate the performance of maintenance and maintenance work	(Adam, 2017)
X.1.3	Information and System	X.1.3.1	Gather information related to relevant assets	(Adam, 2017)
		X.1.3.2	Ensure proper collection of required data data	(Adam, 2017)
		X.1.3.3	Using a computer-based maintenance management system	(Adam, 2017)
		X.1.3.4	Established maintenance reporting capabilities	(Adam, 2017)
X.1.4	Improved Maintenance	X.1.4.1	Continuous improvement with use of updated maintenance techniques/resources	(Adam, 2017)
X2	Preventive Maintenance Guidelines			
X.2.1	Preventive Maintenance Activities	X.2.1.1	Structure Family Preventive Maintenance Activities	(Naufal, 2020)
		X.2.1.2	Architecture Family Preventive Maintenance Activities	(Wijaya, 2020)
		X.2.1.3	Mechanical Family Preventive Maintenance Activities	(Djonli, 2019)
		X.2.1.4	Electrical Family Preventive Maintenance Activities	(Yudha, 2019)
		X.2.1.5	Preventive Maintenance Activities of	(Fathoni, 2019)

No.	Sub Variable	No.	Sub sub variable	Reference
			Landscaping and Grha Tata Family	
X.2.2	Schedule / Frequency of Preventive Maintenance Activities	X.2.2.1	Structural Schedule / Frequency of Preventive Maintenance Activities	(Naufal, 2020)
		X.2.2.2	Architectural Schedule / Frequency of Preventive Maintenance Activities	(Wijaya, 2020)
		X.2.2.3	Mechanical Schedule / Frequency of Preventive Maintenance Activities	(Djonli, 2019)
		X.2.2.4	Electrical Schedule / Frequency of Preventive Maintenance Activities	(Yudha, 2019)
		X.2.2.5	Lanscape and Housekeeping Schedule / Frequency of Preventive Maintenance Activities	(Fathoni, 2019)
X.3	Information Systems			
X.3.1	Organization	X.3.1.1	S.O.P	(Inayah, 2020)
		X.3.1.2	Organizational structure	(Inayah, 2020)
X.3.2	Information Technology	X.3.3.1	Computer hardware	(Inayah, 2020)(Handayaniputri, 2020)
		X.3.3.2	computer software	(Inayah, 2020)
		X.3.3.3	Data management technology	(Inayah, 2020)
		X.3.3.4	Networking and telecommunication technology	(Inayah, 2020)
		X.3.3.5	World wide web	(Inayah, 2020)

As for the dependent variable is the building maintenance performance,

Table 3. Research's Dependent variables (Y)

No.	Variable	No.	Indicator	Reference
Y.1	Building Maintenance Performance	Y.1.1	Safety	Law of the Republic of Indonesia
		Y.1.2	Health	
		Y.1.3	Convenience	

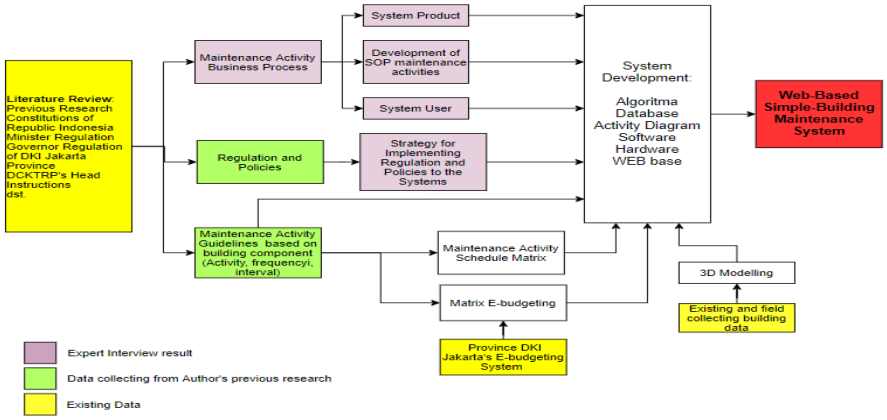
		Y.1.4	Easiness	Number 28 of 2002 (UU Republik Indonesia No. 28, 2002); Regulation of the Minister of Public Works and Public Housing Number 24 of 2010 (Permen PUPR No. 24, 2008)

RESULTS AND DISCUSSION

Based on the interview results, experts describe the maintenance system's needs in the DKI Jakarta provincial government. Author record these requirements as one of developing a maintenance system purpose based on the input data collected. Research flow has mentioned three types of input: regulation and preventive maintenance guidelines as the results of the previous author's research and business processes obtained through existing documents and interviews. These inputs are then reviewed, analyzed, and developed according to system requirements. The method of review, analysis and development cannot be separated from expert's advice and policies in the applicable maintenance system. The needs that meant by the experts was the easiness of building managers in carrying out maintenance activities, maintenance activity reports need, and building administrative requirements documents that were often neglected, such as certificates of serviceability.

These needs can be translated into several keywords: automation of maintenance activity scheduling, maintenance activity reports, and ease of budgeting using e-budgeting. Then, the input data is developed according to these keywords, such as the development of maintenance guidelines into a scheduling matrix and e-budgeting matrix and 3D-modeling to facilitate visualization. The following is the flow of data for the development of the maintenance system in this study.

Figure 5. Research Data Flow



Regulation and Policies

The regulations and policy from author's previous research results obtained 15 variables that affect maintenance activities within the DKI Jakarta Provincial

Print ISSN: 2622-0989 / Online ISSN: 2621-993X
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Government. From these results, an analysis of the existing conditions was carried out using deep interviews with experts, along with expectations related to the system. Gap analysis is obtained from the identification of existing conditions and the proposed development of the system.

Table 4. Gap Analysis according the policy factor result for maintenance building

No	Policy Factors	Gap Analysis	System Implementation
1	Documenting internal maintenance policies	The system is equipped with data on applicable maintenance guidelines	Master Database Guideline
2	Determine the standard index of building asset conditions	The system is expected to make it easier to determine the standard index of building asset conditions through track record data	Building Tracks
3	Prepare a maintenance related strategy	The information in this system can be used as a basis for developing a maintenance strategy	Building Data, Database, and Track Record
4	Develop short- and long-term strategic plans	The master database of maintenance activities on the system will be created for a period of 50 years or the entire life of the building in accordance with Article 64 of the Minister of Public Works and Public Housing Regulation Number 22 of 2018	Master Database Matrix Maintenance Schedule
5	Prepare an assessment of the condition of the assets to be maintained	Data on the condition of building assets for the DKI Jakarta provincial government can be found at tataruang.jakarta.go.id.	Data link with Tataruang.Jakarta.go.id
6	Conduct an assessment of maintenance and maintenance needs	As stated in the Circular paper of the Governor of DKI Jakarta Province Number 13 of 2017, physical activities above Rp. 200.000.000,00, - require Technical Recommendation from the related Technical Service.	Business Process Application for Technical Recommendations on System Algorithms
7	Allocating a sufficient budget for maintenance and maintenance work	Budget proposal options are required in the system so that budget allocations can be taken into account	Budget Proposal Menu added to Activity Planning Business Process
8	Develop a routine maintenance and maintenance program	The maintenance program is set out in the guidelines. The system must be able to be updated to update the guidelines	Admin users can update the guidelines on the system
9	Develop a plan of supervision of maintenance and maintenance work	The system is expected to facilitate monitoring activities for the implementation of maintenance	Checklist System and Upload Timestamp Photos on the e-form for implementation activities
10	Supervise and evaluate the performance of	An option for monitoring the activities of all building managers is required in a system that can be	Activity monitoring menu options for users of Head of

No	Policy Factors	Gap Analysis	System Implementation
	maintenance and maintenance work	accessed by the technical agency. Evaluation of the maintenance performance of each building manager can be seen through the report.	Sub-Department, Head of Section, and Technical Assessors
11	Gather information related to relevant assets	Information collection related to assets has been carried out by the Technical Service survey team and is available at tataruang.jakarta.go.id	Data link with Tataruang.Jakarta.go.id
12	Ensure proper data collection is required	Data that is input into the system must first be checked by a technical appraiser	Data on the system is inputted after being checked by a technical assessor
13	Use a computer-based maintenance management system	The maintenance system developed will be computer-based	The system uses a computer base
14	Established maintenance reporting capabilities	The system is expected to facilitate maintenance reporting activities	There is a Report Product on the Business Process for the Implementation of Activities
15	Continuous improvement with the use of updated maintenance techniques / resources	Updating the system must be carried out on an ongoing basis	Maintenance and updating of the system can be submitted to the Data Information Center Unit of the Office of Copyright, Spatial Planning and Land Affairs

Maintenance Guidelines

From the results of the previous author's research, expert's validation obtained simple-building's preventive maintenance which includes work family, types of work, work packages, preventive maintenance activities and periodic schedules of preventive maintenance activities (Rahmah, 2018; Suwandari & Sagita, 2019; Watchson, 2019). This guideline consists of 1045 activities divided by building.

Figure 6. WBS Structure elements of Simple-Building education functions

Description		
Structural elements contained in buildings or structures that use deep foundations or local shallow foundations. This tie beam is located above the ground and on shallow local foundations such as footplat foundations or deep foundations. This tie beam is the same as the beam except that it is located in the lower structure		
TIE BEAM		
DESCRIPTION		
WORK FAMILY	STRUCTURE	
WORK TYPE	TIE BEAM & SLOOF	
PACKAGE WORK	TIE BEAM	
ALTERNATIVE DESAIN	CONCRETE TIE BEAM	
Activity	**Preventive Maintenance Actions**	**Periodic Schedule**
Examination	Visual observation of cracks in concrete	Annual
Maintenance	Use a chisel to tap the concrete around the crack to make sure that none of the concrete has peeled off	2 years
	Clean the chiseled surface	2 years
	Grouting the crack	2 years
	Repaint with emulsion paint or paint that is waterproof and acidic on the surface	2 years

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After the preventive maintenance data for simple buildings is obtained, the development for the system is carried out by making a preventive maintenance schedule matrix with a span of 50 years according to the age of the building based on the Minister of Public Works and Public Housing No. 22 of 2018. This matrix will become the Master Database in the System.

This database is expected to make it easier for building managers to plan maintenance activities according to the age of the building. Simply by selecting the year of activity, a list of maintenance activities for that year will appear. Data on the year the building was founded is very necessary as a basis for determining the age of the building to display the maintenance activities required at the age of the building. For example, the year the building was built is 2000, maintenance activities will be carried out in 2022, then the maintenance activity that appears is the 22nd year maintenance activity.

Table 5. Example of a 50-year preventive maintenance activity scheduling matrix. "V" indicates that an activity was held that year, "I" is for incidental activities, and the black section indicates that the activity was not held that year.

Job Package	Preventive Maintenance Activities	year									
		1	2	3	4	5	6	7	8	… .	50
Reinforced Concrete Structural Column	Visual observation of cracks in concrete	V	V	V	V	V	V	V	V	… .	V
	Clean the dirt on the concrete surface	V	V	V	V	V	V	V	V	… .	V
	Use a chisel to tap the concrete around the crack to make sure that none of the concrete has peeled off		V		V		V		V	… .	V
	Clean the chiseled surface		V		V		V		V	… .	V
	Grouting the crack	I	I	I	I	I	I	I	I	… .	I
	Repaint with emulsion paint or paint that is waterproof and acidic on the surface		V		V		V		V	… .	V
	Destructive Testing: Core Drill, and Compression Test						V	V	V	… .	V
	Non-Destructive Testing: UPV, Hammer Test, etc						V	V	V	… .	V

Besides the maintenance schedule matrix, an e-budgeting matrix was also developed. Maintenance activities that require budget are identified and analyzed using the DKI Jakarta Provincial e-budgeting system. E-Budgeting Supporting Data will be used as Master Database in the Planning Business Process with budget proposals. The steps for preparing E-Budgeting Supporting data are as follows:

1. Identify maintenance activities that require a budget for the results of maintenance guidelines by analyzing the material / material / work requirements for each maintenance activity.
2. Registering the availability of needs in the existing DKI Jakarta Provincial Government e-budgeting system.
3. Identify Account Codes, Budgeting Components, Units, and Unit Prices and their alternatives (if any) for each activity requirement.
4. Create an e-budgeting table/matrix.

Table 6. Example of e-budgeting matrix.

Housekeeping	Maintenance Activities	Material	Account Code	Budget	Unit	Unit Price

Component	Requiring Budget		In e-budgeting	Components		
Closet	Replacement of a damaged closet	Closet unit	9.1.2.18.03.02xxx	Unloading Toilet	Unit	35.414,08
			9.1.2.18.03.05xxx	Toilet installation	Piece	2.493.578,32
			9.1.2.18.03.05xxx	Installation of a squatting toilet	Piece	906.758,44
Water Tap	Replacement of a damaged tap	Water tap unit	9.1.2.18.03.05xxx	3/4 "Or 1/2" Water Faucet Mount	Piece	63.053,39
Sink	Replacement of a damaged sink	Sink unit	9.1.2.18.03.02xxx	Unloading Sink	Unit	26.560,56
			9.1.2.18.03.05xxx	Sink installation	Piece	978.550,80

Business Processes and Algorithm

A business process is a collection of all activities, including the roles, resources, and rules needed to produce and deliver a product or service for external or internal customers (Arisanti, 2020; Putri, 2018).

System user

System users can be identified from the analysis of maintenance activities in technical recommendations SOP. There are four activity actors:

1. **Building manager**, is the person in charge of maintenance activities in the building, both in the implementation, planning and budgeting of activities. The building manager can submit maintenance activities to Technical Services
2. **Administration**, is an officer who receives requests, requirements for document completeness and numbering.
3. **The Head Section**, is in charge of coordinating tasks with technical officers, checking and monitoring maintenance activities' progress.
4. **Technical Officers**, receive orders from the Head Section to follow up requests for surveys, field assistance, technical assessments or written responses to Building Manager.

Standard Operational Procedure

Standard Operational Procedures are analyzed and developed according to system requirements. Some of the activities in the SOP is revised include recording and bookkeeping, providing monitoring sheets, documentation and archiving, preparing receipts, field reviews of existing building documentation. The following is a technical recommendation SOP that has been developed.

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Figure 7. Developed Standard Operational Procedures for System

No.	Activities	Applicant	Executor					Standard Quality		
		SKPD/UKPD	TU	Head of Department	Regional Government Building Section: Administrative staff	Regional Government Building Section: Section Chief	Regional Government Building Section: Management Staff	Completeness	Time	Output
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	Submit a letter of application for the Technical Recommendation for Regional Government Building Planning							- Application letter - DPA - RAB - Planning drawings	5 minutes	Document
2	Record, send application letters and complete documents to Ka. Sub-Department							- Application letter - DPA - RAB - Planning drawings	15 minutes	Document
3	Studying, disposing of application letters and completeness of documents to the Regional Government Building Section							- Application letter - DPA - RAB - Planning drawings	1 day	- Disposition
4	Checking the completeness of documents, sending letters and documents to Ka. Regional Government Building Section (if complete), If incomplete the letter is returned to SKPD to be completed		coordination with SKPD regarding completeness of			Yes		- Application letter - DPA - RAB - Planning drawings	30 menits	- Draft Letter to SKPD if there are incomplete documents
5	Studying, disposing of application letters and completeness of documents to the Management Staff (if complete). If it is not complete, it will be returned to the administrative staff to be returned to the SKPD				No			- Application letter - DPA - RAB - Planning drawings	1 day	- Disposition
6	Conduct planning technical assessments of drawing documents, RAB calculations		coordination with SKPD if necessary					- Application letter - DPA - RAB - Planning drawings and existing conditions uploaded	360 minutes, (freeze if required for field activities)	-the result of the survey if the survey was carried out -or other documents resulting from field
7	Making Technical Assessment Results and drafting a cover letter for technical recommendations					No		- DPA - RAB - Planning drawings	360 minutes	-Technical Assessment Results -Draft cover letter of recommendation
8	Checking the results of technical assessments, verifying the cover letter for technical recommendations, along with the attached documents (if yes). If not, return to the Management Staff for revisions.						Yes	- DPA - RAB - Planning drawings - Result of technical assessment, Concept of Recommendation Letter	60 minutes	- Approval of Draft Technical Recommendation Letter - Approval of the RAB and Planning Drawings
9	Check the results of technical assessments and sign a technical recommendation cover letter along with its attached documents							- RAB - Planning drawings - Letter of recommendation	1 day	- Technical Recommendations - Validated RAB technical documents and planning drawings
10	Give number and date, then send a letter of technical recommendation along with the attached documents to SKPD / UKPD.							- Technical Recommendations - Validated RAB technical documents and planning drawings	30 minutes	date and number of the letter
11	Receive the results of the technical assessment and a letter of recommendation for the planning of the Regional Government Building along with the attached documents							- Technical Recommendations - Validated RAB technical documents and planning drawings	30 minutes	

Algorithm

After the system user and SOP can be defined, the next step is compiled into an algorithm. Algorithm is a systematic sequential step to solve a job or problem (Iskandar et al., 2018). Every time you solve a problem, the system is designed in a logical sequence in a systematic manner. Algorithm arrangement starts with the initial process as a condition, followed by the instruction process and the limits that have been set so that it can end with output. The system algorithm is structured based on the activities of each user in the system by considering business processes and SOP.

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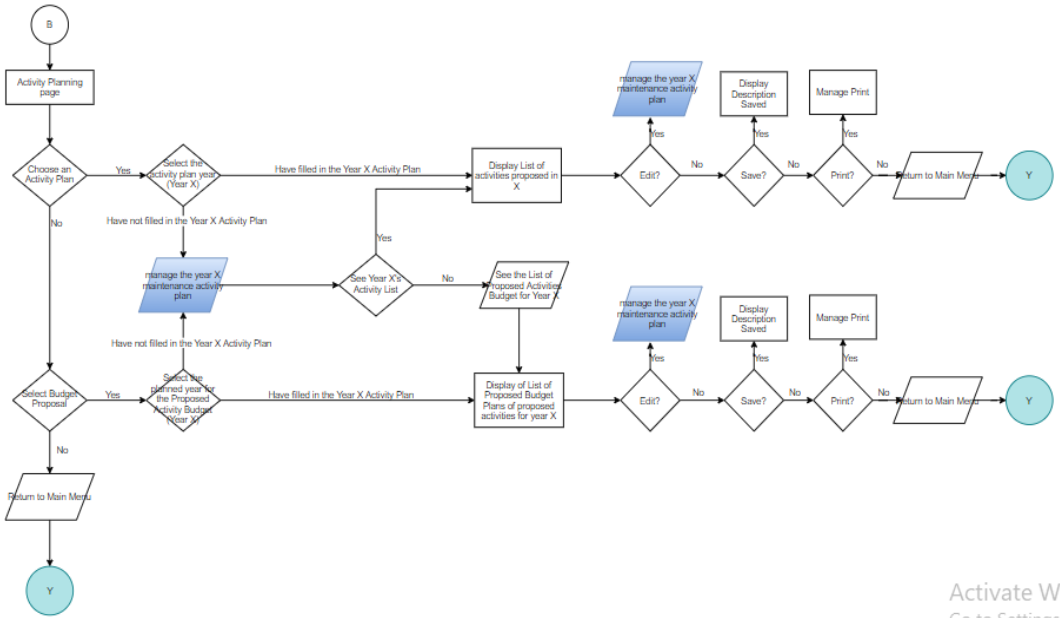
Figure 8. Example of an Algorithm for Building manager users



Product System

Apart from algorithm, the system product that will be produced can also be identified from the business process. System products are the outputs issued by the system as the end result of an activity process. This system product is taken or developed from existing products used in the DKI Jakarta Provincial Government.

1. **Product Technical Recommendations**. Is the final result of the Rekomtek application process.
2. **Product Response Letter**. Is the final result of the consultation request process
3. **Product Follow Up Reports**. Is the final result of the consultation request process which does not require a response letter.
4. **Budget Proposal Products**. Is the final result of the planning process in activities that require a budget.
5. **Product Activity Report**. Is the end result of the process of implementing activities on the system.

3D Modelling

3D modelling is using the Revit 2020 application. TKN 03 Pasar Rebo, is used as case study for the modeling. Because of no building document was found, field data collecting was done to get the building data (Volk et al., 2014).

Things that need to be considered in making models in Revit are the naming or coding of building component specifications. (Suryani & Riantini, 2019). It also determines the volume of components in maintenance activities. 3D modelling is based on documents as-built drawings or surveys and measurements in the field.

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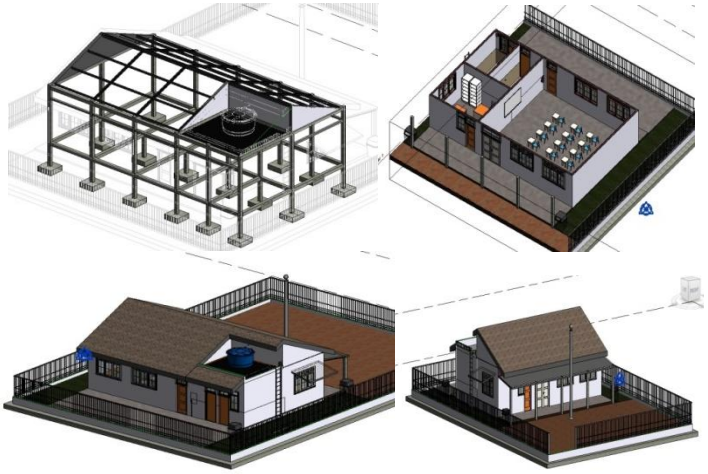
Figure 9. TKN 03 Pasar Rebo 3D modeling images



These 3D modelling will be attached to the system. Technical administration officer will install manually each building component that will activate the particular preventive maintenance activity. Then for selected components will connected automatically to the maintenance schedule matrix and e-budgeting matrix.

System Technology

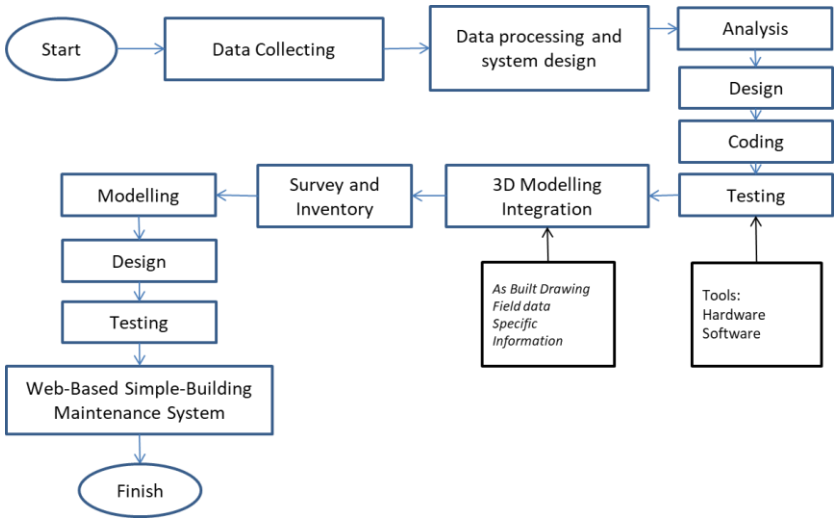
Technology used for the system are:

1. Backend Programming Languages using PHP. Backend is the server-side of the website. It stores and arranges data, and also makes sure everything on the client-side of the website works fine. It is the part of the website that you cannot see and interact with.
2. Front End Programming Languages using JavaScript. The part of a website that the user interacts with directly is termed the front end. It is also referred to as the 'client side' of the application. It includes everything that users experience directly: text colors and styles, images, graphs and tables, buttons, colors, and navigation menu. HTML, CSS, and JavaScript are the languages used for Front End development.
3. UI Frameworks using Bootstrap. The UI Framework is the set of classes and interfaces that define the elements and behavior of a window-based UI Subsystem. It defines a structure for defining user interfaces. Bootstrap is a free and open-source CSS framework directed at responsive, mobile-first front-end web development. It contains CSS and (optionally) JavaScript-based design templates for typography, forms, buttons, navigation, and other interface components. (Goodman, 2015)
4. Web Servers using Apache. A web server is computer software and underlying hardware that accepts requests via HTTP, the network protocol created to distribute web pages or its secure variant HTTPS. A user agent, commonly a web browser or web crawler, initiates communication by making a request for a specific resource using HTTP, and the server responds with the content of that resource or an error message. The server can also accept and store resources sent from the user agent if configured to do so.
5. Php framework using Laravel. A PHP framework is a platform to create PHP web applications. PHP frameworks provide code libraries for commonly used functions, cutting down on the amount of original code you need to write. Some of the features of Laravel are a modular packaging system with a dedicated dependency manager, different ways for accessing relational databases, utilities that aid in application deployment and maintenance, and its orientation toward syntactic sugar

Journal of International Conference Proceedings (JICP) Vol. 4 No. 1 (2021)
Print ISSN: 2622-0989 / Online ISSN: 2621-993X
DOI: https://doi.org/10.32535/jicp.v4i1.1124

6. Database using MariaDB / MySQL. MariaDB is a community-developed, commercially supported fork of the MySQL relational database management system (RDBMS). MariaDB intended to maintain high compatibility with MySQL, ensuring a drop-in replacement capability with library binary parity and exact matching with MySQL APIs and commands.
7. The system development process can be seen in the following figure

Figure 10. System development process



CONCLUSIONS

Development of the SOP technical recommendations for the system according to the business process of maintenance activities and referring to the results of policy analysis obtained 11 activities from the previous 17 activities and reduced time processing to 62 hours from the last time processing 124 hours (except in cases requiring field action). By reducing the number of activities in the SOP and time processing, the maintenance performance is considered more effective.

The use of computer-based in maintenance activities reduces the use of paper in the maintenance process. Where monitoring sheets, receipt sheets, assistance sheets, letter files, drawing paper are no longer needed, the reduction in paper use is at least 50%. It is possible to increase the reduction percentage if any regulatory update supports the acceleration of the bureaucratic process.

A systematic list of maintenance activity schedules and e-budgeting lists minimize the building manager's mistakes in planning maintenance activities or determining budget account codes due to the technical understanding. By selecting the year to do the maintenance work, the system will show the maintenance activities that need to be carried out in that year and the budget components required. With this system, maintenance activity planning can be managed by people who do not have a technical background.

The use of 3D modeling makes it easier to visualize building components for building managers. It also facilitates the identification of both real and virtual components in the planning process. It's just that it is necessary to disseminate the use of the system with 3D modeling for building managers, especially those who do not have a technical background

Making 3D modelling using Revit is constrained in the component family. Not all building components are available in the Revit component family. Some must be

created manually, or you have to search and install the appropriate family from other sources that provide. Considering that BIM is not yet widely used in Indonesia, the search for appropriate family components requires quite effort.

System development using interactive 3D modelling has not been widely found in Indonesia. There are limited IT experts who can do this. So, this system is considered relatively expensive to implement. IT development is needed, and experts who, in addition to mastering IT, also master building engineering to facilitate the development of 3D interactive building modelling systems in the future.

REFERENCES

Abdullah, S., Razak, A. A., Hanafi, M. H., & Salleh, M. N. (2011). Managing government property assets: The Main issues from the Malaysian perspective. *Journal of Techno-Social*, *3*(1), 35–52.

Adam, F. (2017). *Pengembangan pedoman pekerjaan preventive maintenance komponen bangunan mekanikal pada bangunan gedung pemerintah berbasis work breakdown structure untuk meningkatkan kinerja pemeliharaan dan perawatan (Unpublished Master Thesis)*. Universitas Indonesia.

Alshehri, A., Motawa, I., & Ogunlana, S. (2015). The common problems facing the building maintenance departments. *International Journal of Innovation, Management and Technology*, *6*(3), 234–237. https://doi.org/10.7763/ijimt.2015.v6.608

Arisanti, K. (2020). Pengembangan sistem informasi untuk pekerjaan pemeliharaan dan perawatan komponen struktur bangunan hijau gedung pemerintahan dengan menggunakan building information modelling (BIM) (Unpublish Master Thesis). Universitas Indonesia.

Basri, E. I., Razak, I. H. A., Ab-Samat, H., & Kamaruddin, S. (2017). Preventive maintenance (PM) planning: A review. *Journal of Quality in Maintenance Engineering, 23*(2), 114–143. https://doi.org/10.1108/JQME-04-2016-0014

Djonli, Y. (2019). *Pengembangan pedoman pekerjaan preventive maintenance komponen mekanikal pada bangunan gedung pemerintah berbasis work breakdown structure (WBS) untuk meningkatkan kinerja pemeliharaan dan perawatan*. https://doi.org/10.1088/1751-8113/44/8/085201

Fathoni, R. (2019). *Pengembangan pedoman pekerjaan preventive maintenance komponen lansekap dan tata grha pada bangunan pemerintah berbasis WBS untuk meningkatkan kinerja pemeliharaan dan perawatan (*Unpublished Master Thesis). Universitas Indonesia.

Goodman, B. (2015). *User interface framework*. https://docs.oracle.com/cd/E12517_01/back_office/pdf/141/html/pos_impg2/uiframework.htm

Handayaniputri, A. (2020). *Pengembangan e-maintenance pada pekerjaan pemeliharaan dan perawatan bangunan hijau gedung pemerintah berbasis Work Breakdown Structure (WBS) dengan menggunakan Building Information Modelling (BIM) untuk Meningkatkan kinerja pemeliharaan dan perawatan gedung* (Unpublish Doctoral Dissertation). Universitas Indonesia.

Inayah, N. (2020). *Structural Equation Model hubungan antara kebijakan, Work Breakdown Structure (WBS), pedoman, sistem informasi, dan Building Information Modeling (BIM) terhadap kinerja pemeliharaan pada bangunan gedung tinggi* (Unpublished Master Thesis). Universitas Indonesia.

UU Republik Indonesia No. 28, Pub. L. No. 28, 21 Bangunan Gedung 147 (2002). https://doi.org/10.1007/978-1-4614-7990-1

Iskandar, E., Prayitno, E., Kurniawati, D., Sari, D. F., Amin, A., & Imron, A. (2018). Development of the nearest tourism determination application using Dijkstra algorithm. *Proceedings of the 3rd International Conference of Project Management (ICPM) Bali 2019*.

Ismail, Z. A. (2014). Improving maintenance management practices for building facility. *Journal of Construction Engineering and Project Management*, *4*(3), 21–32. https://doi.org/10.6106/jcepm.2014.4.3.021

Naufal, M. (2020). *Pengembangan pedoman pekerjaan preventive maintenance komponen struktur pada bangunan gedung pemerintah berbasis WBS untuk meningkatkan kinerja pemeliharaan dan perawatan* (Unpublished Master Thesis). Universitas Indonesia.

Permen PUPR No. 24, Pedoman Pemeliharaan dan Perawatan Bangunan Gedung 16 (2008).

Putri, P. A. (2018). Improving business processes to develop standard operation procedures on government building maintenance work in Indonesia. *MATEC Web of Conferences*, *195*. https://doi.org/10.1051/matecconf/201819506006

Rahmah, A. W. (2018). Development of execution guidelines for maintenance , reparation , and material specification determination of green building landscape component work in government building based on Work Breakdown Structure (WBS). *Proceedings of the 1st International Conference of Project Management (ICPM) Malang 2018*.

Samudra, R. (2019). Web based information system development of maintenance work to improve government building maintenance performance. *IOP Conference Series: Earth and Environmental Science*, *258*(1). https://doi.org/10.1088/1755-1315/258/1/012034

Suryani, R., & Riantini, L. S. (2019). The development of green BIM based standard operating procedure on schematic design phase of building projects to improve duration performance from The perspective of architecture consultant. *Journal of International Conference, 2*(1), 1–10.

Suwandari, Y., & Sagita, L. (2019). Development of operational standards for risk-based cultural heritage office building maintenance procedures that the building safe and comfortable to use (Study Case Heritage Office Building PT . Asuransi Jiwasraya). *Proceedings of the 3rd International Conference of Project Management (ICPM) Bali 2019).*

Volk, R., Stengel, J., & Schultmann, F. (2014). Building Information Modeling (BIM) for existing buildings - Literature review and future needs. *Automation in Construction*, *38*(March), 109–127. https://doi.org/10.1016/j.autcon.2013.10.023

Watchson, D. (2019). *Pengembangan sistem informasi pemeliharaan dan perawatan bangunan gedung rusunawa berbasis Work Breakdown Structure (WBS) Dengan menggunakan Building Information Modeling (BIM)* [Master Thesis, Universitas Indonesia].

Waziri, B. S., & Vanduhe, B. A. (2013). Evaluation of factors affecting residential building maintenance in Nigeria : Users' perspective. *Civil and Environmental Research*, *3*(8), 19–25.

Wijaya, L. (2020). *Pengembangan pedoman pekerjaan preventive maintenance komponen arsitektur pada bangunan gedung pemerintah berbasis Work Breakdown Structure (WBS) untuk meningkatkan kinerja pemeliharaan dan perawatan* (Unpublished Master Thesis). Universitas Indonesia.

Yudha, A. (2019). *Pengembangan pedoman pekerjaan preventive maintenance komponen elektrikal pada bangunan gedung pemerintah berbasis WBS untuk meningkatkan kinerja pemeliharaan dan perawatan* (Unpublished Master Thesis). Universitas Indonesia.