Development of maintenance information systems for landscape and housekeeping components for state green buildings based on state building maintenance guidelines

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Abstract. The problem raised in this study is that the landscape and housekeeping components are damaged so that they do not reach the standard of landscape and housekeeping performance and cannot be used. This has an impact on building interior requirements not being achieved (comfort, safety, health and convenience) and also maintenance operational costs. The problem is caused by the ineffective system of maintaining landscape and housekeeping. The purpose of building maintenance is to make the function, structure, and aesthetics of the building maintained in accordance with the initial conditions. The purpose of this study is to improve maintenance performance landscape and housekeeping components of state’s green building. The research methods used are surveys, literature reviews, and case studies. The result of this study is prove that the maintenance work of green buildings using Minister of Public Works Regulation No. 24/2008-based website can improve maintenance performance landscape and housekeeping components of state’s green building.

1. Introduction
Regulation of the Minister of Public Works Number: 22 / PRT / M / 2018 concerning Construction of State Buildings states that State Buildings are buildings for official purposes that will become state property and are held with funding sources originating from APBN, APBD, and/or other legal acquisition [1]. The case study of this research takes the object of research in the Government Building Ministry of Public Works and Public Housing which is included in the building or state-owned building. This research is very important related to the construction of state buildings using the state budget and besides, there is no clear strategy and policy to maintain and maintain state assets in the form of investment in buildings worth thousands of trillions of rupiahs. Building maintenance is the activity of repairing and/or replacing parts of a building, components, building materials, and/or infrastructure and facilities so that the building can remain functional [2].

The life cycle of a building goes through many phases, including the initiation phase, feasibility study, planning and design, construction, and maintenance. At the end of the construction phase, buildings must be operated, occupied, maintained, and even repaired or updated [3]. Landscaping is to achieve beauty and capability in full outdoor use. This relates to the regulation of natural and man-made forms, and to the problem of land planning of each type. This requires knowledge not only of design but also of construction. Landscaping is important because it makes a significant contribution to our well-being and quality of life [4]. To improve reliability (Comfort, Safety,
Health, Ease) of infrastructure assets, it is very important to carry out the right maintenance tasks at the right time in a cost effective manner. Lack of a software system for building maintenance and maintenance also causes problems in building management[5].

In order to facilitate access to building maintenance and maintenance systems an effective software system is needed which includes operation, maintenance, and modification for decision making purposes. Web information systems do facilitate the maintenance and maintenance process building, but this process can be maximized by identifying risks for the maintenance and maintenance system [6]. Documentation needs to be done such as keeping a record plan, maintaining incident records and seeking feedback from occupants on the condition of the building is very important to facilitate building management and maintenance [7].

Table 1. Reference understanding information systems.

| Source                        | Definition                                                                 |
|-------------------------------|---------------------------------------------------------------------------|
| Davis G,B                     | System The system is a combination of various elements that work together to achieve a target. |
| Harijono Djojodihardjo        | The system is a combination of objects that have a functional relationship and the relationship between each object's characteristics, as a whole into a functioning unity. |
| Lani Sidharta                 | The system is a collection of interrelated elements that together operate to achieve the same goal. |
| Murdick, R.G                   | The system is a set of elements consisting of procedures or processing charts to find a common goal or part goal by operating goods or data at a certain time. In order to produce the desired information, energy or data. |

Therefore, a clear strategy and policy is needed to maintain and maintain state assets in the form of investment in buildings worth thousands of trillions of rupiah [8]. An integrated building maintenance system that utilizes information technology that is currently growing rapidly can make work more efficient. An integrated building maintenance system that utilizes information technology that is currently growing rapidly so that work is more efficient. E-maintenance based on the Minister of Public Works Regulation No. 24/2008 which is still ongoing can be an information and communication technology that enables project workers and building owners to maintain and manage building damage more effectively. The results of the analysis in this study are expected to be a reference for school building management to be more organized in the maintenance activities of states green buildings. The purpose of this study is to improve maintenance performance landscape and housekeeping components of state’s green building.

2. Methods
This research some steps of validation, there are for the work package validation for landscape and housekeeping components, component damage with damage category, cause of damage, maintenance activities, maintenance schedule, web based information system validation, and the last validation for the relationship of maintenance system to the performance of the building maintenance. Validation of the work package and maintenance activities are using literature study, based on Minister of PU's Regulation no. 24 of 2008, and expert validation.

The next step is the sequel from the previous step, which is to develop the web based information system for the building maintenance. The last step in this research is to discover the relationship model between building maintenance system and the performance of the building maintenance through expert validation and interview, whose are the green building experts.
3. Results and discussion

First validation results for landscape and housekeeping components generated 17 components as valid components of green building from Minister of PU’s Regulation no. 24 of 2008 which are: upright gutter, floor drain, outdoor paint, zinc roof, concrete roof, toilet, lobby, partition, corridor, lift, granite floor, marble floor, carpet floor, ceramic floor, vertical blind, outer glass wall, wall paint.

Table 2. List of green building landscape and housekeeping components, damages, category and causes.

| Components                  | Component Damage | Damage Category | Cause of Damage | Maintenance Activities                                            | Maintenance Schedule |
|-----------------------------|------------------|-----------------|-----------------|-----------------------------------------------------------------|----------------------|
| Upright and flat Gutter     | Leaking          | Heavy           | Age Plan        | Clean the chamfer from dirt and materials that cause corrosive to zinc chamfer | weekly               |
| Floor Drain                 | Clogged          | Medium          | Weather         | Coat Meni                                                        | 2 years              |
|                             | Leaking          | Heavy           | Age Plan        | Check every day the water filter in the bathroom or toilet      | Daily                |
|                             | Clogged          | Medium          | Weather         | Make sure there is water in each filter to prevent the entry of unpleasant air | Daily                |
|                             | Odor             | Light           | Weather         | Clean the hole at the end of the duct from sticking material and dirt | Daily                |
| Outdoor Paint               | Dirty            | Light           | Weather         | Perform periodic repainting                                     | annual               |
|                             | Faded            | Light           | Weather         |                                                                  |                      |
|                             | Peeled Off       | Medium          | Age Plan        |                                                                  |                      |
|                             | Leaking          | Heavy           | Age Plan        |                                                                  |                      |
| Zinc Roof and Wave Fiber    | Leaking          | Heavy           | Age Plan        | Check nails or anchor straps on the rubber seal                 | Monthly              |
| Cement                     |                  |                 |                 |                                                                 |                      |
| Concrete Roof               | Leaking          | Heavy           | Age Plan        | Coat the leak-proof coating with a brush or spray evenly        | Annual               |
| Toilet                      | Dirty            | Medium          | Human Error     | Empty and clean all trash / ashtray / standing ashtray bins    | Daily                |
|                             | Odor             | Light           | Weather         | Clean the stains on the toilet ceramic wall                     | Daily                |
|                             | Dirty            | Medium          | Human Error     | Always clean the lobby floor with the lobby duster             | Daily                |

Figure 1. Research flow.
Table 2. Cont.

| Item                      | Odor   | Light | Weather | Action                                                                                                            | Frequency |
|---------------------------|--------|-------|---------|-------------------------------------------------------------------------------------------------------------------|-----------|
| Partition                 | Leaking| Heavy | Age Plan| Wash the wall with a wet cloth, then dry using a clean cloth                                                    | Daily     |
| Dirty                     | Light  | Human | Error   | Clean the glass and aluminum partition or wooden frame, when cleaning the glass                                  | Weekly    |
| corridor                  | Dirty  | Medium| Human   | For wood sills, use furniture chemical cleaning or furniture polish, use a dry cloth                              | Weekly    |
| Lift                      | Odor   | Light | Weather | Clean the AC grill, profile trim, neon cover and ashtray tube.                                                   | Weekly    |
| Lift Odor'                | Light  | Weather| Weather| Vacuum floor lifts covered with carpet, or floor lift mops with a floor cleaner and mop                          | Daily     |
| Muddy                     | Medium | Human | Error   | Clean the corners of the granite floor with tapas for places that are not covered by a polishing machine         | Weekly    |
| Granite Floor Broken      | Heavy  | Human | Error   | Clean the corners of the granite floor with tapas for places that are not covered by a polishing machine         | Weekly    |
| Dirty                     | Light  | Human | Error   | Clean the corners of the granite floor with tapas for places that are not covered by a polishing machine         | Weekly    |
| marble floor Broken       | Heavy  | Human | Error   | Clean the corners of the marble floor that is not reachable by polishing machines, using tapas                   | Weekly    |
| Dirty                     | Light  | Human | Error   | Clean the corners of the marble floor that is not reachable by polishing machines, using tapas                   | Weekly    |
| Carpet floor Broken       | Heavy  | Human | Error   | Spotting the carpet to remove stains found on the carpet floor, using Spot Remover or the equivalent             | Weekly    |
| Dirty                     | Light  | Human | Error   | Spotting the carpet to remove stains found on the carpet floor, using Spot Remover or the equivalent             | Weekly    |
| Ceramic Floor Broken      | Heavy  | Human | Error   | Use a wet vacuum cleaner to suck up the dirt on the raised ceramic floor.                                        | Daily     |
| Dirty                     | Light  | Human | Error   | Use a wet vacuum cleaner to suck up the dirt on the raised ceramic floor.                                        | Daily     |
| Vertical blind and Gordyn Broken | Heavy | Human | Error   | Suction the curtain dust (vertical blind, curtain), use a dry vacuum cleaner, use a hand stick brush.          | Monthly   |
| Dirty                     | Light  | Human | Error   | Suction the curtain dust (vertical blind, curtain), use a dry vacuum cleaner, use a hand stick brush.          | Monthly   |
| outer glass wall Broken   | Heavy  | Human | Error   | Clean glass stains with paint, glue, sheeting, putty, use trim scrapper & blade (glass razor)                    | Monthly   |
| Dirty                     | Light  | Human | Error   | Clean glass stains with paint, glue, sheeting, putty, use trim scrapper & blade (glass razor)                    | Monthly   |
| Wall paint                | Dirty  | Light | Human   | Clean the dust attached to the walls of painted oil (water seal) using cloth rags, for the top can use stairs or   | Monthly   |
| Faded                     | Light  | Age Plan | Age Plan | Clean the dust attached to the walls of painted oil (water seal) using cloth rags, for the top can use stairs or   | Monthly   |
| Peeled Off                | Medium | Age Plan | Age Plan | Clean the dust attached to the walls of painted oil (water seal) using cloth rags, for the top can use stairs or   | Monthly   |
And the next step validation has composed web based information system for landscape and housekeeping component maintenance in green building. The interface of web as seen on **figure 2**.

![Figure 2. Web based display guidelines.](image)

| Component Damage | Damage Category | Cause of Damage | Maintenance Activities | Maintenance Schedule |
|-------------------|-----------------|-----------------|------------------------|----------------------|
| Floor Drain Leaking | Heavy | Broken | Check every day the water filter in the bathroom or toilet | Daily |
| Clogged Floor Drain | Medium | Big rabbit | Make sure there is water in each filter to prevent the entry of unpleasant air | Weekly |
| Odor Floor Drain | Light | Full and clogged | Clean the hole at the end of the duct from sticking material and dirt | Daily |

The fourth validation is finding relationship model between building maintenance system and the performance of the building maintenance.

**4. Conclusion**

From the results of the validation it produces only a few components of the landscape and the housekeeping of the state building which are included in the state green building component. The maintenance work of green buildings using Minister of Public Works Regulation No. 24/2008-based website can improve maintenance performance and can be achieved 4 points of building requirements landscape and housekeeping components of state’s green building. The existence of this landscape and housekeeping component work package is actually a factor that usually always becomes a barrier or supporter of the development of the related green building maintenance process.

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