Landscape and housekeeping government building preventive maintenance guidebook based on work breakdown structure

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Abstract. Buildings suffer deterioration and function failures during its lifecycle even for landscape and housekeeping components in government buildings. Maintenance includes cleaning, inspecting, repairing, and replacing can provide buildings the ability to maximize the utilities of the building’s lifecycle. Corrective maintenance is the most used maintenance method in Indonesia although there are several alternatives, such as preventive maintenance that prevents any occurrences of building failures without neither repairing nor replacing any components throughout its lifecycle. Work breakdown structure (WBS) is an effective method to define preventive maintenance activities. However, in Indonesia there is still lack of preventive maintenance based on WBS activities guidebook and preventive maintenance policies. Therefore, the purpose of this study is to develop a guidebook of preventive maintenance landscape and housekeeping activities based on WBS to improve maintenance performance. The Research Method used is activities defined from policies, literature studies, and case studies drawn into WBS and validated by maintenance expertise. Experts validate the preventive maintenance activities using questionnaires and provide any maintenance activities to improve the guidebook. Result of the research showed that landscape and housekeeping preventive maintenance activities guidebook based on WBS government buildings maintenance. The guidebook is validated by experts and will be used building maintenance managers.

1. Introduction

Government around the world issue policies about maintenance. There are two regulations regarding maintenance issued by ministry of public works in Indonesia “Peraturan Menteri Pekerjaan Umum Nomor 24 Tahun 2008” and “Peraturan Menteri Pekerjaan Umum Nomor 16 Tahun 2010”. PerMenPU/No24/2008 regulation is about building maintenance guideline in Indonesia while PerMenPU/No16/2010 regulates scheduled inspection in building maintenance. According to PerMenPU/No24/2008 a building is a physical form of finished construction on land and/or water for activities conducted by human whether it is for a place to live, religion purpose, business, social, culture, or special occasion. Governmental building plays an important role for any activities regarding government and public issues [1]. To improve relation between public and government, building is required to provide information sharing and democracy [2]. Buildings start to deteriorate after completion and needed to be maintained to achieve its intended purpose and lifetime [3]. Therefore, governmental buildings needed to be maintained for public services and governmental utilities.
In some developed countries the government allocated 50% of operation and maintenance funding to be used by buildings [4]. Operation and maintenance represent more than 70% of costs during the life cycle cost of buildings [5]. Despite the high cost of O&M project stakeholders are often neglected the costs during design and construction phases throughout the projects [6]. There are four maintenance strategies in buildings, corrective, condition-based, predictive and preventive maintenance activities [7]. Preventive maintenance improves maintenance performance, reduces user cost, lifecycle cost, deterioration, extends service life, and improve safety [8].

Work breakdown structure is a useful project structuring tool by organizing a project hierarchically into smaller units and is commonly used in many researches [9]. Building maintenance cost and scheduling can be controlled using information organized provided by WBS [10]. Activities in projects can be easily defined and will be a guidance to control project activities and its uniqueness [11].

There are two components focused in this study, landscape and housekeeping. Landscaping is required for outdoor leisure activities, which is defined as the concepts of open space, trees, garden, and exterior environments [12]. Sidewalks as one of landscape components give a comfortable walking environment throughout buildings can be achieved by providing enough shading from trees [13]. To improve productivity, any indoor related activities should be provided comfort in work areas [14].

2. Theoretical Study

2.1. Landscape and Housekeeping
Landscape defined as outdoor building components such as benches, trees, waterways, sidewalk, etc. [12]. As for housekeeping components consist of any interior components [14]. According to PerMenPU/No24/2008, housekeeping components are general cleaning for furniture, artwork, lift, etc.

2.2. Preventive Maintenance
Maintenance is defined as an activity to maintain buildings optimal performance by repairing or replacing deteriorated components [15]. Preventive maintenance maintains buildings operation through regular inspection and repair to resolve any small problems before it become a bigger and expensive problem [3]. Different alternative design needs different maintenance activities to reduce any further deterioration [8]. Inspection, maintenance, and replacement or repair components part are 3 preventive maintenance steps for building’s landscape and housekeeping components according to PerMenPU/No24/2008. Preventive maintenance requires scheduling as a guidance for maintenance activities to control buildings function, inspection, and certification [16].

2.3. Work Breakdown Structure
According to PMBOK Work breakdown structure refers to deliverable oriented classified decomposition of the work to be accomplished by the project team. Decomposing a project’s components into manageable level by organizing and defining entire project’s structure [10]. Levels in work breakdown structure consist of 4 primary levels being project’s name as level 1, work section as level 2, sub-work section as level 3, and work package as level 4 also 2 secondary levels as seen in Table 1 [17]. The smallest definable and trackable unit or level is known as work packages or level 4 [11]. Next two level of WBS is includes activities and resources [19]. WBS levels in PMBOK can be seen in Table 1.

| Table 1. WBS Structure. |
|--------------------------|
| **Lv. 1** | **Lv. 2** | **Lv. 3** | **Lv. 4** | **Lv. 5** | **Lv. 6** |
| Project’s Name | Work | Sub-Work | Work | Activities | Resources |
| Work Section | Section | Package | | | |

3. Methodology
There are 3 stages in this research, defining WBS, defining preventive maintenance activities and schedules, and developing a preventive maintenance guidebook. Landscape and housekeeping work packages and alternative designs that need preventive maintenance are defined using WBS by literature study and are validated by experts. Preventive maintenance activities identified using literature studies integrated with alternative designs defined then validated by experts later on. Alternative designs and preventive maintenance that were validated were then written to guidebook as guidance for technician and facility managers. Flow diagram of the methodology can be seen in Figure 1.

Figure 1. Methodology Flow Diagram.

4. Result and Discussion
There are 29 work packages and 69 alternative designs validated by experts that require preventive maintenance activities. Work packages can be seen in Figure 2. Work packages validated by 5 experts in building maintenance with 8 years’ experience. Overall alternative design has inspection, maintain, replace or repair as the type of preventive maintenance activities. some alternative design only has 2 preventive maintenance exclude repair or replacing components.

Figure 2. Level 4 WBS.

Preventive maintenance guidebook content can be seen in Figure 3. Guidebook was developed after experts validate preventive maintenance activities. A total of 232 activities that should be done by technician to perform preventive maintenance activities in buildings.
Each preventive maintenance activities are scheduled as a part of maintenance. Schedule is given by every expert simultaneously with validation of preventive maintenance. The guidebook format is given by experts in civil council in Indonesia as a guidance this research.

| CODE | DESCRIPTION |
|------|-------------|
| WBS LEVEL 2 | WORK SECTION | LANDSCAPE |
| WBS LEVEL 3 | SUB-WORK SECTION | HARDSCAPE |
| WBS LEVEL 4 | WORK PACKAGE | WATERWAYS |
| ALTERNATIVE DESIGN | HORIZONTAL GUTTER |

**Figure 3.** Guidebook Content Example.

5. Conclusion

Work packages and alternative designs in building’s components defined using WBS requires preventive maintenance activities. Preventive maintenance activities in landscape and housekeeping components consist of inspection, maintain, and repairing or component replacement. Work packages and alternative designs validated by experts then written in preventive maintenance guidebook as a guidance for facility managers. In the guidebook not only consist of preventive maintenance activities but the activities also being scheduled to maintain the activities. Preventive maintenance guidebook is expected to improve maintenance performance in buildings especially government buildings.

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