



# Development of Operational Standards Procedures for Maintenance and Maintenance of Public Railway Infrastructure Infrastructure and Electrical Mechanical and Architectural Components in Wbs-Based Station Buildings to Improve Maintenance and Maintenance Performance



Hashfi Fahreza Anwar <sup>a</sup>  
Yusuf Latief <sup>b</sup>  
Nurul Inayah Wardahni <sup>c</sup>

## Article history:

Submitted: 27 April 2024

Revised: 09 May 2024

Accepted: 18 June 2024

## Keywords:

*electrical menikal;  
general railways architectural  
components;  
infrastructure maintenance;  
standard operational procedures  
for maintenance work;  
web-based station buildings;*

## Abstract

A railway station is a place of departure and stoppage for trains. Poor, inappropriate maintenance and upkeep of infrastructure without strict supervision can result in physical damage to the infrastructure itself, thus losing its initial value and reducing the service life of the infrastructure. If the maintenance and upkeep of infrastructure in the transportation sector is not done properly, it can cause delays or, in the worst case, accidents. To ensure a high level of reliability and availability, the implementation of an effective maintenance program is very important. This is then clarified if poor maintenance and upkeep practices, such as in the transportation sector, can also affect the reliability of the transportation system and even cause life-threatening accidents. Damage or accidents that occur can also lower the company's image and customer or consumer trust. This research aims to develop Standard Operating Procedures (SOP) for maintenance and upkeep work on station buildings, architectural components, and mechanical electrical. The method used is based on a Literature Study, survey, and case study. The result of this research is the development of SOP maintenance and upkeep work on architectural components and mechanical electrical to improve maintenance performance.

*International research journal of engineering, IT & scientific research © 2024.  
This is an open access article under the CC BY-NC-ND license  
(<https://creativecommons.org/licenses/by-nc-nd/4.0/>).*

## Corresponding author:

Hashfi Fahreza Anwar,  
Department of Civil Engineering, Faculty of Engineering, Universitas Indonesia, Depok, West Java 16424,  
Indonesia.

Email address: [fahreza.hashfi11@gmail.com](mailto:fahreza.hashfi11@gmail.com)

<sup>a</sup> Department of Civil Engineering, Faculty of Engineering, Universitas Indonesia, Depok, West Java 16424, Indonesia

<sup>b</sup> Department of Civil Engineering, Faculty of Engineering, Universitas Indonesia, Depok, West Java 16424, Indonesia

<sup>c</sup> Department of Civil Engineering, Faculty of Engineering, Universitas Indonesia, Depok, West Java 16424, Indonesia

## 1 Introduction

In densely populated urban areas, efficient public transportation is crucial for economic sustainability, population mobility, and long-term continuity (Berawi et al., 2015). Public transportation relies heavily on its functionality and maintenance (Berawi et al., 2015). One solution to address traffic congestion caused by an excessive number of private vehicles and rapid population growth is to introduce a rail-based transportation system. This system enables mass transit capable of accommodating a large number of passengers and operating at higher speeds compared to buses (Berawi et al., 2015).

Maintenance and care are crucial to ensure that assets such as infrastructure, buildings, and equipment remain functional (Akasah et al., 2009). Currently in Indonesia, routine maintenance and care of public railway infrastructure are also carried out. To ensure the safety and comfort of train travel, multiple stakeholders are involved, starting from the operational conditions of both facilities and infrastructure, which must always be maintained for train passage (Sanjaya, 2017). Most incidents related to infrastructure damage occur due to insufficient supervision of maintenance activities. According to the PT Kereta Api Indonesia (Persero) Directive No. PER.fU/KL.104/V/1/ regarding Inspection, Maintenance, and Control of Energy.

The public railway infrastructure buildings in Indonesia are divided into three categories: railway tracks, train stations, and train operation facilities. Train station buildings are essential components of public railway infrastructure because they serve as departure and arrival points for trains, as well as passenger boarding and alighting areas (Zhou et al., 2022; Durazo-Cardenas et al., 2018).

### *Literature Review*

#### *Standard Operational Procedure (SOP)*

Standard Operating Procedures (SOP) are a set of standardized written instructions regarding various organizational activity processes, detailing how and when they should be carried out, and where and by whom they are conducted (Regulation of the Minister of Home Affairs Number 52 of 2011).

#### *Public railway facility infrastructure maintenance performance and policy*

Performance refers to the comparison between the input and output (productivity) of each system (Liyanage & Villalba-Romero, 2015; Lidén, 2015). The National Research Council describes performance as the comparison between actual results and certain standards (Measuring Performance and Benchmarking Project Management, 2005). From these definitions, it is evident that performance is a measure of the value or results of a product, service, system, or organization based on established performance objectives (Ogochukwu et al., 2022; Gaudry et al., 2016).

#### *Work Breakdown Structure (WBS)*

According to the PMBOK 6th edition, the Work Breakdown Structure (WBS) is a structured decomposition of the entire scope of work that must be performed by the project team to achieve the project objectives and produce the required deliverables. A complete and efficient WBS plays a key role in project management planning by breaking down the project into various phases, deliverables, and work packages (Siami-Irdemoosa et al., 2015). The process of creating a WBS provides a framework for what needs to be achieved or worked on (PMBOK 6th edition). This process involves breaking down the project outcomes and tasks into smaller, more manageable parts. At the lowest level of the WBS structure, there are work components known as work packages, which aid in project estimation, monitoring, and control (Jang et al., 2008; Li et al., 2019).

## 2 Materials and Methods

Based on the operational research model and methodology employed, there are 5 X variables (X1: Organizational Structure, X2: Organizational Tasks and Functions, X3: Work Breakdown Structure (WBS), X4: Business Processes and Activities, X5: Input, Output, Duration, X6: Communication Flow), all interconnected to influence the Y variable, which is maintenance performance. These X variables collectively contribute to achieving the Y variable which is the Railway Station Building Maintenance Performance.

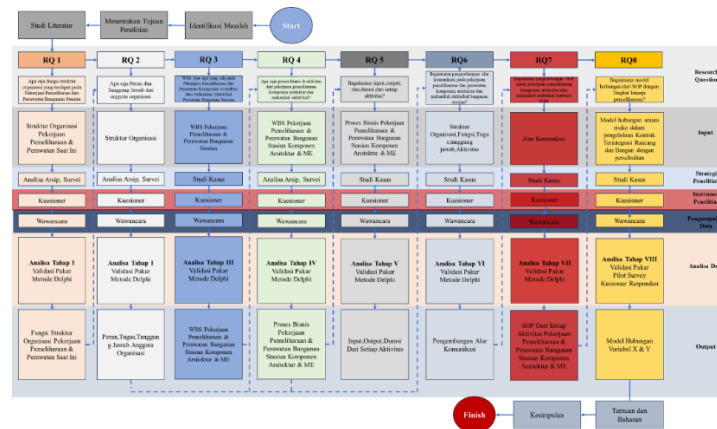


Figure 1. Operational model of research (Left) and research methodology (Right)

## 3 Results and Discussions

### Organization’s structure & function in railway station maintenance work

The result of RQ 1 is the validation by experts regarding the function of organizational structure in the maintenance and repair work of station buildings. The data collection in this initial phase aims to determine the Organizational Structure as an indicator in the development of SOPs. The input used is derived from archival documents of the organizational structure of PT KAI Regional Operations 1, which have been reprocessed according to the findings of the literature study conducted.

Each expert was asked to respond Yes or No to a provided questionnaire, and could also add notes or comments regarding the verified variables. This questionnaire was validated by experts to assess its suitability for the implementation of maintenance and repair activities for architectural and mechanical-electrical components of station buildings. The final results of this data collection are presented in the table below.

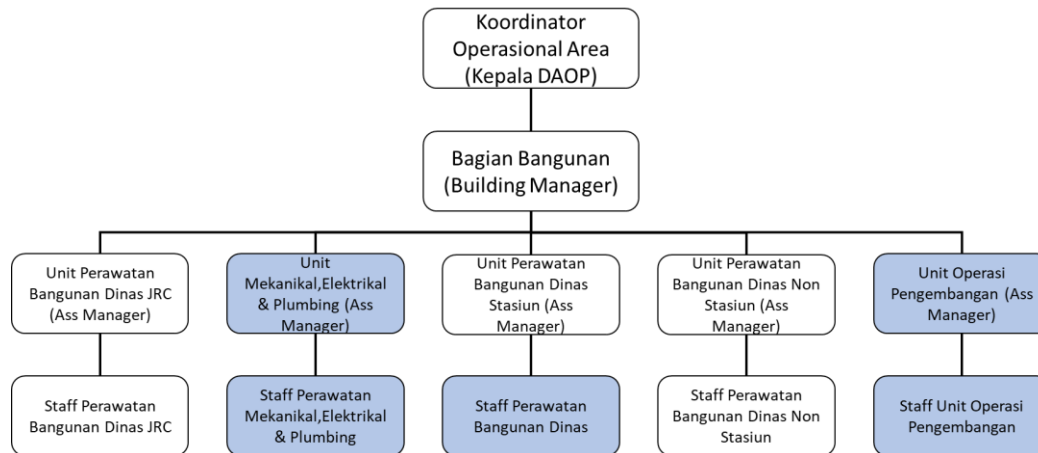


Figure 2. The final results of this data collection

### Organization's Responsibility & Role

Data collection for RQ 2 is conducted to verify whether the roles, tasks, and responsibilities of the organizational structure identified in RQ 1 are aligned with maintenance and repair activities. The approach used is similar to the data collection in RQ 1, which involves distributing questionnaires related to roles, tasks, and responsibilities. Experts are asked to respond Yes or No regarding the alignment of roles, tasks, and responsibilities obtained from literature studies and available documents. After experts verify, validate, and clarify the content, the data is collected and the results can be seen in the following table.

Table 1  
Functions, Roles, Duties and Responsibilities of the organizational structure identified in RQ 1 are aligned with maintenance and repair activities

Division	Units	Position	Functions, Roles, Duties and Responsibilities
Building		Building Manager	a. Coordinate and supervise the maintenance and upkeep of equipment/equipment98oring, installation and building utilities. b. Conduct regular direct inspections of all rooms/buildings to check the condition of machines, building equipment/equipment and building installations and utilities. c. Implement an orderly filing system for all documents, letters, operation manuals, maintenance and upkeep, as well as existing reports. d. Maintain and develop internal and external working relationships.
Building	JRC Service Building Maintenance Unit	Assistant Manager	a. Coordinating, directing and supervising the activities of staff and implementers who are under their authority. b. Prepare an operational budget plan. c. Coordinating, directing and supervising maintenance activities, maintenance and repair of building equipment/equipment and installation and building utilities. d. Evaluate and provide input on the use of materials and energy as well as operational costs. e. Prepare and present operational reports following standard operating procedures.
Building		JRC Department Building Maintenance Staff	a. Conduct inspections of all parts of the building to see the condition of building equipment/equipment, installations and building utilities. b. Regularly check and monitor the condition of structural components and building architecture. Monitor the results of the work of service providers (contractors) regularly. d. Carrying out certain special activities, for example, fire protection, etc. e. Prepare and submit reports

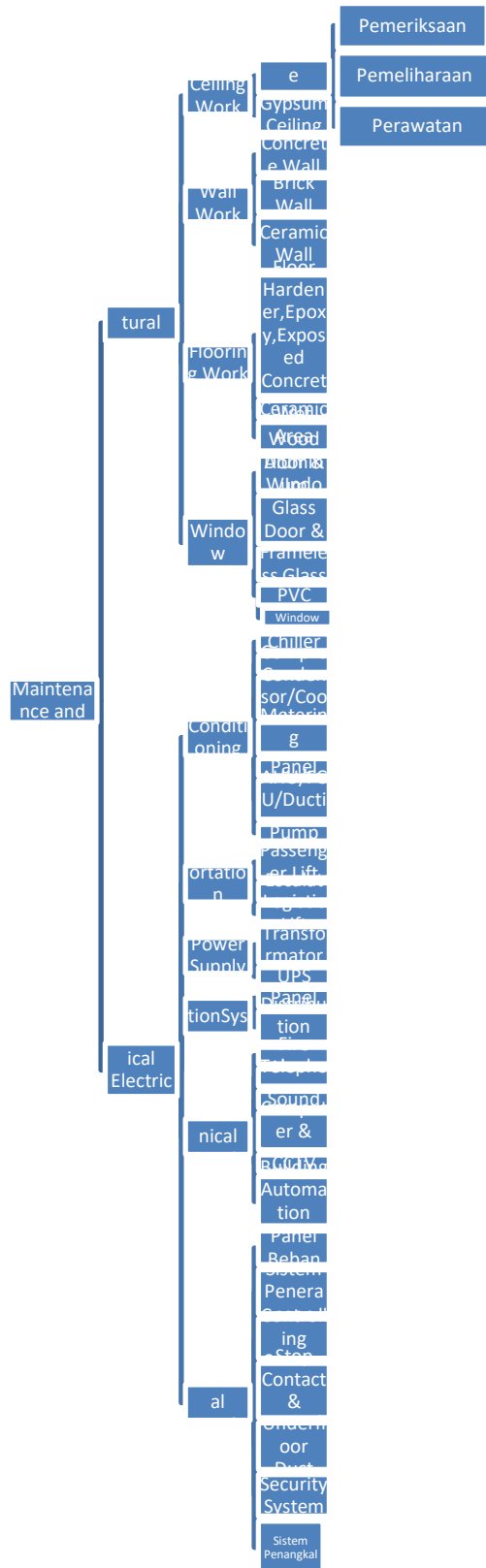
			according to their field.
Building	Mechanical & Electrical Units	Assistant Manager	a. Coordinating, directing and supervising the activities of staff and implementers who are under their authority. b. Prepare an operational budget plan. c. Coordinating, directing and supervising maintenance activities, maintenance and repair of building equipment/equipment and installation and building utilities. d. Evaluate and provide input on the use of materials and energy as well as operational costs. e. Prepare and present operational reports following standard operating procedures.
		Mechanical Electrical Plumbing Maintenance Staff	a. Conduct inspections of all parts of the building to see the condition of building equipment/equipment, installations and building utilities. b. Check and monitor the operation of mechanical and electrical equipment regularly. c. Regularly monitor the results of the work of mechanical and electrical service providers (contractors). D. Carrying out certain special activities, for example, electrical systems, fire protection, etc. e. Prepare and submit reports according to their field.
Building	Station Service Building Maintenance Unit	Assistant Manager	a. Coordinating, directing and supervising the activities of staff and implementers who are under their authority. b. Prepare an operational budget plan. c. Coordinating, directing and supervising maintenance activities, maintenance and repair of building equipment/equipment and installation and building utilities. d. Evaluate and provide input on the use of materials and energy as well as operational costs. e. Prepare and present operational reports following standard operating procedures.
		Station Service Building Maintenance Staff	a. Conduct inspections of all parts of the building to see the condition of building equipment/equipment, installations and building utilities. b. Regularly check and monitor the condition of structural components and building architecture. Monitor the results of the work of service providers (contractors) regularly. d. Carrying out certain special activities, for example, fire protection, etc. e. Prepare and submit reports according to their field.
Building	Non-Station Service Building Maintenance Unit	Assistant Manager	a. Coordinating, directing and supervising the activities of staff and implementers who are under their authority. b. Prepare an operational budget plan. c. Coordinating, directing and supervising maintenance activities, maintenance and repair of building equipment/equipment and installation and building utilities. d. Evaluate and provide input on the use of materials and energy as well as operational costs. e. Prepare and present operational reports following standard operating procedures.
		Non-Station Service Building Maintenance Staff	a. Conduct inspections of all parts of the building to see the condition of building equipment/equipment, installations and building utilities. b. Regularly check and monitor the condition of structural components and building architecture. Monitor the results of the work of service providers (contractors) regularly. d. Carrying out certain special activities, for example, fire protection, etc. e. Prepare and submit reports according to their field.
Building	Development Operations Unit	Assistant Manager	a. Coordinating, directing and supervising the activities of staff and implementers who are under their authority. b. Prepare an operational budget plan. c. Coordinating, directing and supervising maintenance and development activities of building equipment/equipment and installation and building utilities. d. Evaluate and provide input on the use of materials and energy as well as operational costs. e. Prepare and present operational reports in accordance with standard operating procedures.
		Floating Operations Staff	a. Conduct inspections of all parts of the building to see the condition of building equipment/equipment, installations and building utilities. b. Regularly check and monitor the condition of structural components and

---

			building architecture. Carrying out planning, and calculations, for maintenance work related to development (Renovation, Rehabilitation, Restoration). d. Monitor the results of the work of service providers (contractors) regularly. e. Prepare and submit reports according to their field.
--	--	--	---

*WBS to station building maintenance activities*

The findings of RQ3 consist of expert validation of the maintenance and care categories within the architectural and mechanical-electrical scopes of work packages. During the validation process, a maintenance category is deemed necessary if more than two experts agree that it is essential for the respective work package.



*Business process & activities*

The next step in data collection is to validate the business processes and activities related to the maintenance and care of architectural & ME components in station buildings. These business processes and activities are sourced from existing archives and documents and then validated by experts who are currently or have previously been involved in station building maintenance and care activities. After receiving input and suggestions from experts during the data collection for RQ4, the list of activities following the validation for architectural and ME components is as follows.

Table 2  
The list of activities following the validation for architectural and ME components

Work Packages	Business process	Activity List
Architectural Scope of Work	Daily Inspection	Provide Work Schedules & Instructions
		Preliminary Survey of Work Items
		Preparation of JSA & Permit To Work
		Preparation and checking of equipment and personnel
		Inspection and Insertion 102 of oring-list form (Check List) condition of Building Components.
		Checking Work Results
		Reporting
Work Packages	Business process	Activity List
ME Scope of Work	Daily Inspection	Provide Work Schedules & Instructions
		Preliminary Survey of Work Items
		Preparation of JSA & Permit To Work
		Preparation and checking of equipment and personnel
		Inspection and Insertion 102 oring-list form Check List of ME Component conditions.
		Checking Work Results
		Reporting

*Input, output, duration*

The next step in this process is to validate the input documents, output documents, and durations related to the maintenance and care activities of station buildings. Input documents include the information needed before performing the activities, output documents include the results obtained after the activities are completed, and duration refers to the time required to complete each activity (Noroozi et al., 2014). These documents are collected from available archives and then validated by experts who are experienced or currently active in building maintenance and care. Based on the comments and notes provided by the experts, it was found that some activities already have an appropriate duration and can be completed within the proposed time. However, there are several activities in the maintenance and care of architectural and mechanical-electrical (ME) components of station buildings that require additional time. Activities such as creating component condition analysis, recommendation reports, preparing the Work Plan and Requirements (RKS) and Own Estimate (HPS), as well as other analyses should be given more time and adjusted to ensure that the report results are optimal (Leony et al., 2024).



Table 3  
Process to validate the input documents, output documents, and durations related to the maintenance and care activities of station buildings

Scope of work	Business Process	Activity Description	Inputs	Outputs	Duration
Architectural Scope of Work	Monthly Checkup	Provide Work Schedules & Instructions	Inspection Work Schedule and Instructions	Minutes of Work Schedules & Instructions	1 day
		Preliminary Survey of Work Items	Work Item Survey Form	Minutes of Job Item Survey Results & Photos	1 day
		<b>Preparation of JSA &amp; Permit To Work*</b>	JSA Form	JSA Monthly Inspection Report Results	
		<b>Preparation and checking of equipment and 103oring103l*</b>	Personnel and Equipment Check Form	Monthly inspection report checking 103oring103l and tools	
		<b>Inspection and Insertion 103oring-list form (Check List) condition of Building Components.*</b>	List of Work Scope & Work Items	Component Check Results Report	1 day
		Determination of Analysis Results	Component Check Results Report	Component Condition Analysis Report	2 days
		Reporting	Reporting Form	Final Monthly Inspection Results Report	

Communication flow

The next data collection step is to identify the responsible parties for the maintenance and care of station buildings. These responsibilities are identified using the RAM RACI Method, which is tailored to the tasks, responsibilities, and activities involved in maintenance and care work. Subsequently, validation is conducted by experts who are currently or have previously been involved in bridge maintenance and care activities. At this stage, an approach is taken by distributing questionnaires to many experts in the related field (Lidén, 2015; Gaudry et al., 2016). The questionnaire then undergoes a process of verification, clarification, and content validation by these experts. Data collection for RQ6 aims to establish the responsible parties for each previously identified activity description. Each expert was asked to provide a Yes or No answer on the questionnaire and to provide notes or comments regarding the verified variables. The questionnaire for determining the responsible parties for activity descriptions is validated by the experts to evaluate who will be responsible for the maintenance and care of the architectural and mechanical-electrical components of the station buildings. The final results of the data collection at this stage are presented in the table below.

Table 4  
Data to identify the responsible parties for the maintenance and care of station buildings

Work Packages	Business process	Activity List	Person responsible			
			Responsible	Accountable	Consult	Inform
Architectural Scope of Work	Daily Inspection	Provide Work Schedules & Instructions	Station Service Building Unit Staff	Assistant Manager of the Station Service Building Unit	Assistant Manager of Station Service Building Unit & Building Manager	Third party
		Preliminary Survey of Work Items	Third Party & Station Service	Assistant Manager of	Assistant Manager of	Station service building unit staff,










Anwar, H. F., Latief, Y., & Wardahni, N. I. (2024). Development of operational standards procedures for maintenance and maintenance of public railway infrastructure infrastructure and electrical mechanical and architectural components in Wbs-based station buildings to improve maintenance and maintenance performance. *International Research Journal of Engineering, IT & Scientific Research*, 10(4), 95–108. <https://doi.org/10.21744/irjeis.v10n4.2446>






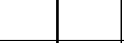




Work Packages	Business process	Activity List	Person responsible			
			Responsible	Accountable	Consult	Inform
			Building Unit Staff	Station Service Building Unit & Building Manager	Station Service Building Unit & Building Manager	Assistant Manager of the station service building unit, Building Manager
		<b>Preparation of JSA &amp; Permit To Work*</b>	Third party	Station Service Building Unit Staff & Assistant Manager of Service Building Unit	Assistant Manager of Station Service Building Unit & Building Manager	Station service building unit staff, Assistant Manager of the station service building unit, Building Manager
		<b>Preparation and checking of equipment and 104oring104l*</b>	Third party	Station Service Building Unit Staff & Assistant Manager of Service Building Unit	Assistant Manager of Station Service Building Unit & Building Manager	Station service building unit staff, Assistant Manager of the station service building unit, Building Manager
		<b>Inspection and Entering into the Check List forms of the condition of the Building Components.*</b>	Third party	Station Service Building Unit Staff & Assistant Manager of Service Building Unit	Assistant Manager of Station Service Building Unit & Building Manager	Station service building unit staff, Assistant Manager of the station service building unit, Building Manager
		Checking Work Results	Station Service Building Unit Staff	Assistant Manager of the Station Service Building Unit	Assistant Manager of Station Service Building Unit & Building Manager	Third party
		Reporting	Station Service Building Unit Staff	Assistant Manager of the Station Service Building Unit	Assistant Manager of Station Service Building Unit & Building Manager	Assistant Manager of Station Service Building Unit & Building Manager

### *SOP Development*











The form of Standard Operating Procedures (SOP) for the maintenance and repair of architectural and mechanical-electrical components of station buildings is created based on the components resulting from data analysis stages 1 to 6, which include organizational structure, roles, tasks and responsibilities, activities, input, output, duration, and communication flow.

**Table 5**  
Standard Operating Procedures (SOP) include organizational structure, roles, tasks and responsibilities, activities, input, output, duration, and communication flow

No	Uraian Aktivitas	Pelaksana				Input	Output	Durasi
		Manager Bangunan	Asisten Manager Unit Bangunan Dinas Stasiun	Staff Unit Bangunan Dinas Stasiun	Pihak Ketiga			
1	Memberikan Jadwal & Instruksi Kerja					Jadwal dan Instruksi Kerja Pemeriksaan	Berita Acara Jadwal & Instruksi Kerja	1 Hari
2	Survey Pendahuluan Item Pekerjaan					Form Survey Item Pekerjaan	Berita Acara Hasil Survey Item Pekerjaan & Foto	1 Hari
3	Penyusunan JSA & Permit To Work*					Form JSA	Hasil Laporan Pemeriksaan Harian JSA	
4	Persiapan & Pengecekan Peralatan &					Form Pengecekan Personil dan Alat	Laporan inspeksi harian pengecekan personil dan alat	
5	Pemeriksaan dan Memasukan ke dalam borang-borang Daftar Simak (Check List) kondisi Komponen Bangunan.*					List Scope Pekerjaan & Item Pekerjaan	Laporan Hasil Pengecekan Komponen	
6	Pengecekan Hasil Pekerjaan					Form Checklist Item Pekerjaan	Laporan & Dokumentasi Pekerjaan	1 Hari
7	Pelaporan					Laporan & Dokumentasi Pekerjaan	Laporan Pengecekan Harian Pekerjaan	

No	Uraian Aktivitas	Pelaksana				Input	Output	Durasi
		Manager Bangunan	Asisten Manager Unit Bangunan Dinas Stasiun	Staff Unit Bangunan Dinas Stasiun	Pihak Ketiga			
1	Review Laporan Hasil Pemeriksaan					Laporan Hasil Pemeriksaan		1 Hari
2	Menyusun Program Pemeliharaan					Laporan Hasil Pemeriksaan	Laporan Rencana Program Pemeliharaan	1-2 Hari
3	Menentukan jadwal pelaksanaan pekerjaan pemeliharaan					Laporan Rencana Program Pemeliharaan	BA Jadwal dan Instruksi Kerja Pemeliharaan	1-2 Hari
4	Menginformasikan jadwal pelaksanaan pekerjaan kepada jajaran terkait					Disposisi		1 Hari
5	Pembuatan JSA & Permit To Work*					Form JSA & Form Permit To Work	Laporan JSA & Permit To Work	1-2 Hari
6	Persiapan dan pengecekan peralatan dan					Form Pengecekan Personil dan Alat	Laporan hasil pengecekan personil dan alat	1 Hari
7	Melaksanakan kegiatan pemeliharaan berkala, dan pengecekan serta penggantian komponen-komponen bangunan yang diperlukan peremajaan ringan *					Work Item	Laporan progress & dokumentasi pekerjaan	Sesuai Dengan bentuk pemeliharaan
8	Melakukan Pengawasan pada saat pelaksanaan pekerjaan					Form Checklist	Laporan Hasil Checklist Pekerjaan	Sesuai Dengan bentuk pemeliharaan
9	Pelaporan					Laporan Hasil Checklist Pekerjaan	BA Serah Terima	1 Hari

*Anwar, H. F., Latief, Y., & Wardahni, N. I. (2024). Development of operational standards procedures for maintenance and maintenance of public railway infrastructure infrastructure and electrical mechanical and architectural components in Wbs-based station buildings to improve maintenance and maintenance performance. International Research Journal of Engineering, IT & Scientific Research, 10(4), 95–108. <https://doi.org/10.21744/irjeis.v10n4.2446>*

No	Uraian Aktivitas	Pelaksana				Input	Output	Durasi
		Manager Banguna	Asisten Manager Unit Pengeembangan Operasi	Staff Unit Operasi	Pihak Ketiga			
1	Review Laporan Hasil Pemeriksaan					Laporan Hasil Pemeriksaan		1 Hari
2	Pembuatan rencana teknis perawatan bangunan gedung tertentu dan yang memiliki kompleksitas teknis tinggi dilakukan setelah mendapat pertimbangan tim ahli bangunan gedung.				Reject	Laporan Hasil Penilaian Tingkat Kerusakan Komponen	Rekomendasi Penanganan dari tim ahli	2 Hari
3	Persetujuan rencana teknis perawatan bangunan gedung tertentu dan yang memiliki kompleksitas teknis tinggi dilakukan setelah mendapat pertimbangan tim ahli bangunan gedung.		Approve			Rekomendasi Penanganan dari tim ahli	Approval Rekomendasi Teknis Penanganan	1 Hari
4	Pembuatan RKS & HPS				Reject	Rekomendasi Penanganan dari tim ahli	RKS & HPS	1-3 Hari
5	Persetujuan RKS & HPS					RKS & HPS	Approval RKS & HPS	1-3 Hari
			Approve					
6	<b>Pembuatan RAB &amp; Schedule Pelaksanaan Pekerjaan Pemeliharaan*</b>				Negosiasi Ulang	RKS	RAB Pekerjaan & Schedule Pekerjaan	1-3 Hari
7	Pengajuan RAB Pekerjaan Pemeliharaan				Reject	RAB Pekerjaan & Schedule Pekerjaan	RAB Final	1-3 Hari
8	Persetujuan RAB Pekerjaan Pemeliharaan					RAB Final	Surat Perintah Kerja	1-3 Hari
			Approve					
9	Menentukan jadwal pelaksanaan pekerjaan pemeliharaan					Surat Perintah Kerja	Jadwal Pelaksanaan Pekerjaan	1 Hari
10	Memberikan arahan pelaksanaan pemeliharaan					Disposisi		1 Hari
11	<b>Pembuatan JSA &amp; Permit To Work*</b>					Form JSA & Form Permit To Work	Laporan JSA & Permit To Work	1-2 Hari
12	<b>Persiapan dan pengecekan peralatan dan personil*</b>					Form Pengecekan Personil dan Alat	Laporan hasil pengecekan personil dan alat	1 Hari
13	<b>Membuat Batasan Area Kerja Agar Tidak Mengganggu Operasional Stasiun*</b>					Denah Lokasi perbaikan	Batas Area & Rencana pembuatan area kerja	1 Hari
14	<b>Melakukan Pekerjaan Renovasi *</b>					Work Item	Laporan progress & dokumentasi pekerjaan	Sesuai Dengan Bentuk Perbaikan
15	Pengecekan Hasil Pekerjaan					Form Checklist Item Pekerjaan	Laporan & dokumentasi hasil checklist pekerjaan	2 Hari
16	Pelaporan					Laporan & dokumentasi hasil checklist	BA Serah Terima	1 Hari

## 4 Conclusion

The organizational structure for the maintenance and repair of architectural and mechanical-electrical components of station buildings consists of the Building Division, which includes the Building Manager. Under this division, there are several units: the Building Maintenance Unit (JRC Service), led by an assistant manager; the Mechanical, Electrical, and Plumbing Unit, also led by an assistant manager; the Station Building Maintenance.

The organizational structure for the maintenance and repair of architectural and mechanical-electrical components of station buildings consists of the Building Division, which includes the Building Manager. Under this division, there are several units: the Building Maintenance Unit (JRC Service), led by an assistant manager; the Mechanical, Electrical, and Plumbing Unit, also led by an assistant manager; the Station Building Maintenance Unit, headed by an assistant manager; the Non-Station Building Maintenance Unit; and the Operations Development Unit, also led by an assistant manager.

The business processes for maintenance and repair are divided into three categories: Inspection, Maintenance, and Repair. According to the Work Breakdown Structure (WBS) for Station Building Maintenance and Repair, there are five inspection tasks, two maintenance tasks, and three repair tasks, totaling ten tasks across these three business processes. Ten types of tasks have been identified to create SOPs for the maintenance and repair of architectural and mechanical-electrical components of station buildings. The activity descriptions for each task vary according to the type and requirements of the job. The input and output documents are tailored to each activity description within the maintenance and repair tasks for the architectural and mechanical-electrical components of station buildings.

The duration of each activity in the maintenance and repair of architectural and mechanical-electrical components is adjusted according to the specific tasks. For maintenance tasks, the duration is tailored to the level of difficulty and the specific items involved. The communication flow is developed and structured according to the activity descriptions and the RAM/RACI method, aligned with each specific task. The development of SOPs is evaluated based on the SOP performance indicators listed in the Minister of Administrative and Bureaucratic Reform Regulation No. 35 of 2012.

### *Conflict of interest statement*

The authors declared that they have no competing interests.

### *Statement of authorship*

The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

### *Acknowledgements*

We are grateful to two anonymous reviewers for their valuable comments on the earlier version of this paper.

## References

- Akasah, Z. A., Shamsuddin, S. H., Rahman, I. A., & Alias, M. (2009). School Building Maintenance Strategy: a new management approach. In *Malaysian Technical Universities Conference on Engineering and Technology (MUCET 2009), Pahang, Universiti Malaysia Pahang* (pp. 1-5).
- Berawi, M. A., Berawi, A. R. B., Prajitno, I. S., Nahry, N., Miraj, P., Abdurachman, Y., Tobing, E., & Ivan, A. (2015). Developing Conceptual Design of High Speed Railways using Value Engineering Method: Creating Optimum Project Benefits. *International Journal of Technology*, 6(4), 670.
- Durazo-Cardenas, I., Starr, A., Turner, C. J., Tiwari, A., Kirkwood, L., Bevilacqua, M., ... & Emmanouilidis, C. (2018). An autonomous system for maintenance scheduling data-rich complex infrastructure: Fusing the railways' condition, planning and cost. *Transportation Research Part C: Emerging Technologies*, 89, 234-253. <https://doi.org/10.1016/j.trc.2018.02.010>
- Gaudry, M., Lapeyre, B., & Quinet, É. (2016). Infrastructure maintenance, regeneration and service quality economics: A rail example. *Transportation Research Part B: Methodological*, 86, 181-210. <https://doi.org/10.1016/j.trb.2016.01.015>
- Jang, W. S., Healy, W. M., & Skibniewski, M. J. (2008). Wireless sensor networks as part of a web-based building environmental monitoring system. *Automation in Construction*, 17(6), 729-736. <https://doi.org/10.1016/j.autcon.2008.02.001>
- Leony, A., Latief, Y., & Wardahni, N. I. (2024). The development of maintenance and care system for public railway facility infrastructure integrated with building information modeling (BIM) software based on work breakdown structure (WBS). *International Research Journal of Engineering, IT & Scientific Research*, 10(3), 49-57. <https://doi.org/10.21744/irjeis.v10n3.2436>
- Li, J., Li, N., Afsari, K., Peng, J., Wu, Z., & Cui, H. (2019). Integration of Building Information Modeling and Web Service Application Programming Interface for assessing building surroundings in early design stages. *Building and Environment*, 153, 91-100. <https://doi.org/10.1016/j.buildenv.2019.02.024>
- Lidén, T. (2015). Railway infrastructure maintenance-a survey of planning problems and conducted research. *Transportation Research Procedia*, 10, 574-583. <https://doi.org/10.1016/j.trpro.2015.09.011>
- Liyanage, C., & Villalba-Romero, F. (2015). Measuring success of PPP transport projects: a cross-case analysis of toll roads. *Transport reviews*, 35(2), 140-161.
- Noroozi, A., Khan, F., MacKinnon, S., Amyotte, P., & Deacon, T. (2014). Determination of human error probabilities in maintenance procedures of a pump. *Process Safety and Environmental Protection*, 92(2), 131-141. <https://doi.org/10.1016/j.psep.2012.11.003>
- Ogochukwu, C. G., Ogochukwu, O. F., Ogorchukwu, I. M., & Ebuka, I. A. (2022). Assessment of the performance of railway transportation in Nigeria from 1970 to 2010. *Scientific African*, 15, e01120. <https://doi.org/10.1016/j.sciaf.2022.e01120>
- Sanjaya, A. (2017). Kajian Perbandingan Biaya Dan Waktu Pekerjaan Perawatan Jalan Rel Menggunakan Mekanisasi Dan Non Mekanisasi (Studi Kasus: Petak Jalan Rel Antara Bojonggede-Bogor). *ASTONJADRO*, 6(1), 28-35.
- Siami-Irdemoosa, E., Dindarloo, S. R., & Sharifzadeh, M. (2015). Work breakdown structure (WBS) development for underground construction. *Automation in construction*, 58, 85-94. <https://doi.org/10.1016/j.autcon.2015.07.016>
- Zhou, S., Dumss, S., Nowak, R., Riegler, R., Kugu, O., Krammer, M., & Grafinger, M. (2022). A conceptual model-based digital twin platform for holistic large-scale railway infrastructure systems. *Procedia CIRP*, 109, 362-367. <https://doi.org/10.1016/j.procir.2022.05.263>