The development of quality management systems in maintenance and monitoring the process of risk-based repair work in government buildings

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Abstract. Buildings exemplify the social and economic aspects of an environment and provide shelters, space and facilities for human activity. A decent maintenance system is a vital component of all buildings. However, a good maintenance system is not always present in the government buildings of Indonesia. Government buildings require maintenance to extend sustainability, indirectly accomplishing services to the community. Financial planning is issued annually by the government to maintain their buildings, but there is no underlined Quality Management System in this plan. This study aims to develop a Quality Management System in maintenance and monitor the process of repair work in Government Buildings. The methods used in this research are: The Delphi method and risk questionnaire surveys. The risks found in each activity have been analysed descriptively and qualitatively, resulting in responses reflecting the highest of risk. The result was that the risk-based quality management system in maintenance and monitoring process of repair work was successfully applied to improve the performance in the environment of governmental buildings.

1 Introduction

The current development of properties has prompted the rise of multi storey buildings such as office buildings, hotels, shopping centers and hospitals. These buildings are intended to implement the main functions of a building to its optimal use. The buildings that can be both maintained or not will be damaged and will cause failure of the buildings in their time. [1]. This damage is caused by human factors, such as: labours' lack of understanding and knowledge on maintenance and repair work techniques [2].

Governmental buildings are buildings that are responsible for the function of government activities, aimed at achieving national welfare. All activities carried out by using government funds. Therefore, government buildings are appropriate to represent the objectives of maintenance management. In several cases, government buildings that appear damaged are

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not maintained as perfected as the elevator, the fire, the faded paint, the use of personal stability and the way it is formed. This phenomenon may affect the general quality of the building as well as the application of its maintenance and repair procedures.

The process of maintenance and repair on buildings cannot be separated from the process of quality control. This supervision is necessary to ensure the success of the work. The maintenance and repair of the building is included in construction work, so when conducting supervisory work, the Regulation of the Public Works Minister No. 06 / PRT / M / 2008 concerning Guidelines on Supervision of Implementation and Construction Inspection in the Ministry of Public Works, can be used as a general guide. This Quality Management System (QMS) was developed with risk analysis. The risk management in QMS can be defined as: The manipulation of the production process to achieve the quality objectives by diverting the risk factors with the potential for failure of the quality objectives.

From the background information provided and the identification of problems that the author has described previously, the purposes of this study are to develop a risk-based QMS in maintenance and monitoring the process of repair work in government buildings.

2 Review of related literature

2.1 Building maintenance and repair management

Maintenance is defined as an activity to maintain buildings and services with the aim of ensuring the performance of functions throughout the life of the building according to the relevant standards [3]. To meet these standards good maintenance management is required and it must accomplish the users' satisfaction. Maintenance and renovation (with regards to buildings) are two terms that cannot be separated in facility management. They play an important role in terms of cost during the life cycle of a buildings [4] According to [5], building and maintenance management is an effectively organized system consisting of operations, repairs and maintenance to ensure the building is used according to its purpose and functions to its optimal ability.

According to [4], the proper application of maintenance management will extend the life span of the building and can also avoid unnecessary damage to elements of the building. Other causes of damage to buildings are from humans. From one journal I obtained 17 general operation and maintenance problems caused by less experienced workers and a lack of funding support [6]. Based on Regulation of the Public Works Minister Number 24 of 2008, the maintenance of buildings is an activity to repair/replace parts of buildings, components, building materials/infrastructure and facilities for buildings to remain functional (curative maintenance).

Sustainable development has become a central principle in today's modern industry; building maintenance has a vital role in making this happen [7]. Protecting buildings at an early stage and maintaining the investment value of the buildings, as well as maintaining the condition of buildings to meet the development objectives are the key objectives of maintenance [5].

2.2 Maintenance work and monitoring the process of repair work

Presidential Regulation No. 73/2011 stipulates that the meaning of a state-owned building is a building for the purpose of being a state-owned / regional property and held with financing sources derived from APBN/APBD funds, or other legitimate acquisitions. According to Government Regulation no. 45 2007, the Maintenance of buildings is: An attempt to maintain the condition of the building in order to continue meeting the requirements for functionality

or in an effort to improve the shape of the building, and guard against any damaging effects. Maintenance of buildings is also an attempt to avoid damage to components / building elements due to obsolescence's / riots before the age ends.

The maintenance of buildings is the activity of repairing/replacing parts of buildings, components, building materials, infrastructure and means for the buildings to remain functional [8] Supervision during maintenance and repair work is crucial in the process, where the organization is able to play a role in the fulfilment of job targets [9]. The functions of this supervision process throughout maintenance and repair work include improving performance, making suitable corrections and improving ongoing performance. This stage affects the overall success of the management system and the maintenance organization in maintaining quality objectives [10]

2.3 Quality management system

[11] can be defined as a management structure, responsibility, procedure, process, and resource management to implement the principles and activities needed to achieve the quality objectives. The QMS is a set of documented procedures and standard practices for system management aimed at ensuring conformity of a process and product (goods or services) to the needs of requirements determined by customers and organizations [12][13]. The quality management system documentation according to [14] can be defined by quality and objectives provisions, quality manuals, procedure documents, work instructions, forms, work plans, plans and quality specifications, external documents, and quality recorded documents.

QMS can help companies develop and maintain quality levels by controlling the business processes and supporters [15]. Stakeholders' satisfaction is fulfilled by companies that already implement QMS while it can be shown that companies who have not implemented QMS have lower customer satisfaction levels [16] After the implementation of QMS there is an obvious improvement of service quality. The application of this system needs support from managers, employees, and customers [17]. Combining a risk management-based quality management system can improve business efficiency as well as product quality, improve working procedures, and help organizations identify business goals and strategies [18].

From this literature study, it is expected that if the QMS is developed it can accommodate all maintenance and improve activities in government buildings so that the overall efficiency and quality of work increases. This can be seen in responses to the risks that may arise in every business process.

3 Methodology

To achieve the research objectives described previously, surveys and case studies were used. Archival data collection, interviews and questionnaires became the instruments of data collection in the study, which was divided into 8 stages. The data collected by using Delphi to related experts and respondents on the risk ranking questionnaire were used. After that, the QMS Development Action Analysis is done by making Work Instructions, Checklists and Quality Records to allow QMS to be used in planning repair and repair of government building based on risk factor.

Experts and respondents involved in this study consisted of 5 experts who had at least 5 years' experience in building maintenance. These people were asked to answer expert validation questionnaires. Two experts from the internal government building x institutions were involved in the section of the study related to the overall organization and the main person in charge of such work. This research also involved 44 risk respondents, spreading throughout several government and private agencies dealing with the implementation of building maintenance.

4 Result and discussion

To be capable of meeting the objectives required for quality standard, risk identification was needed to determine what factors will affect the incompleteness of the target. Then a quantitative analysis was conducted based on the following risk matrices:

Table 1. Risk matrix.

Threats Probability	0.05 Very Low	0.10 Low	0.20 Moderate	0.40 High	0.80 Very High
0.10	0.01	0.01	0.02	0.04	0.08
0.30	0.02	0.03	0.06	0.12	0.24
0.50	0.03	0.05	0.10	0.20	0.40
0.70	0.04	0.07	0.14	0.28	0.56
0.90	0.05	0.09	0.18	0.36	0.72

From the results of data collection, 124 risks were identified with a peak of 13 high categorical risks. Each business process had different activity risks with the following details:

Table 2. Risk identification & risk rating.

Var	Activities	Risk	Score
Maintenance			
X45	Creating a maintenance schedule	Cluttered schedule	High
X43	job monitoring	Lack of supervision detail	High
X12	Carrying out the work	less competent workers	High
X46	Submitting a schedule proposal to the assignor	Late submission of schedule proposal	High
X11	Carrying out the work	The number of workers is less	High
X42	Giving assignment letter to principal	Misrepresented work	High
Monitoring			
X122	Surveying location	Supporting data is incomplete	High
X60	Monitoring and supervising the implementation of activities	Implementation of work does not meet the technical specifications	High
X107	Receiving SPMK, Picture, BOQ, RKS and completeness of activity documents	There was a design change that changed BOQ	High
X105	Signing of Minutes of Weight, BAST of work submitted by Partner / Contractor	The proposed weight does not match the field conditions	High
X102	Reviewing the field, researching and initialling Minutes of Weight, and BAST Work submitted by Partner / Contractor.	Error calculation by the contractor	High
X121	Reviewing the field, researching and initialling Minutes of Weight, and BAST Work submitted by Partner / Contractor and supervisory consultant.	Error calculation by the contractor	High
X97	Carrying out supervision, monitoring / monitoring in the field in terms of quality, quantity and rate of volume.	Supervision of implementation not done properly	High

4.1 The development of quality management system

The development of QMS was in the form of 7 Standard Operating Procedures and 180 Work Instructions including related documents. From the data collection and validation from an expert applied to the risk response would be an example of additional activities and additional work instructions on planning the repair of a government building. Below is an example of

QMS development of Monitoring Process of Repair Work business processes, Monitoring Supervision Consultant:

No.	Activity	Executor								Instrument			Additional
		Committed Officer (Bureau Chief)	Head of Division	Head of Sub-division	Technical Working Group	Law Dept.	Finance Dept.	Budget User (KPA)	Monitoring Consultant	Input	Duration	Output	
1	Receiving Task Command Letter (SPT) with Work Order Letter (SPMK), Drawing, BoQ, Work Plans and Terms (RKS) and completeness of activity document from Partner who will carry out the activity / project, prepare the disposition sheet.									Task Command Letter (SPT) with Work Order Letter (SPMK), Drawing, BoQ, Work Plans and Terms (RKS), supporting documents	2 days	Project Document Completeness	
2	Receive and check the documents received.									Task Command Letter (SPT) with Work Order Letter (SPMK), Drawing, BoQ, Work Plans and Terms (RKS), supporting documents	1 days	Document Checking Report	
3	Dissociate for follow-up									Task Command Letter (SPT) with Work Order Letter (SPMK), Drawing, BoQ, Work Plans and Terms (RKS), supporting documents	1 days	Dispotition	
4	Studying the documents and preparing the draft of field supervisor's assignment letter									Task Command Letter (SPT) with Work Order Letter (SPMK), Drawing, BoQ, Work Plans and Terms (RKS), supporting documents	1 days	Project Documents	
5	Checking and initialing the Supervisory Task Command Letter									Draft of Supervisory Task Command Letter	1 days	Checked Supervisory Task Command Letter	
6	Signing of the Supervisory Task Command Letter.									Checked Supervisory Task Command Letter	1 days	Signed Supervisory Task Command Letter	
7	Carry out supervision, monitoring / monitoring in the field in terms of quality, quantity and rate of achievement									Project Documents	Everyday	Supervision Documents	
8	Filling in Daily Reports, proposing / evaluating and making technical recommendations on job changes in accordance with SPK / Contract.									The concept of daily reports and technical recommendations	1 days	Daily Report, Technical Recommendation	See Work Instruction for Change of Contract of any changes
9	Hold meetings on-site and / or elsewhere on a regular basis, making weekly and monthly									Minutes of Meeting	1 days	Minutes of Meetings, Weekly / Monthly Report	
10	Reviewing the field, checking the Progress and Handover Report submitted by Partner / Contractor.									Project Documents, Daily Report	2 days	Progress Report and Handover Report	See Work Instruction for Work Opname and Report Signing
11	Checking and signing Progress Report and Handover Report checked by Supervision Consultant									Progress Report & Handover report checked by Supervisor	1 days	Signed Progress Report and Handover Report	
	Total										14 days		

Fig. 1. Example of standard operating procedure of monitoring supervision consultant, risk based.

From the SOP above, we can note specific risks, such as: differences in field progress and proposed progress by the contractor. To avoid such risks, an additional work instruction was made for Work Opname and Report Signing, as follows.

NO	ACTIVITY	EXECUTION		ADD.	REF.
		NOT DONE	DONE		
Reviewing the field, researching and initialing Progress Report and Handover Report submitted by Partner / Contractor.					
	The official receiving the work (PPHP) periodically conducts field reviews together.				
	PPHP makes a checklist of supporting documents when conducting a field review				
	Prepare check list implementation in the field				
24	Examining the progress report on the field that has been submitted				
	Head of Technical Work Groups / PPHP create a Field Checking Report				

Fig. 2. Example of work istruction of job opname and report signing, risk based.

To ensure the implementation of each activity and the fulfilment of the anticipated output, a checklist of all relevant documents and jobs was made as follows:

NO.	DOCUMENT	REQUIREMENT FULFILLMENT		
		NOT DONE	DONE	REF.
1	Task Command Letter and Supporting Documents			
2	Document Checking Report			
3	Dispotition			
4	Project Documents and Draft of Task Command Letter			
5	Checked Supervisory Task Command Letter			
6	Signed Supervisory Task Command Letter			
7	Supervision Documents			
8	Daily Report, Technical Recommendation			
9	Minutes of Meetings, Weekly / Monthly Report			
10	Progress Report and Handover Report			
11	Signed Progress Report and Handover Report			
Made by:		**Notes :**		
Name / ID : ..... Position : ..... Date :				

Fig. 3. Example of work document checklist of monitoring supervision consultant.

5 Conclusion

Based on the data collection and analysis conducted, several conclusions were formed in the following table:

Table 3. Conclusion.

Conclusion		Existing	Result
1	Organization & Job description	Organizational structure in accordance with the rules applicable in Government Institutions	There are 3 organizational structure changes related to the equalization of workload
2	Business Processes and Activity	7 Business Processes with 63 Activities	7 Business Processes with 64 Activities (include instruments)
3	Risk	124 risks identified	13 highest risk of further response
4	Risk Based Quality Management System	Nothing yet risk-based	40 QMS development actions (7 SOP, 180 WI, 7 checklists, 63 quality record)

QMS Development in Government Building Maintenance and Monitoring the Repair stage generated SOP and WI based on risk by identifying possible risks for each activity that could degrade overall maintenance performance. From the identified risks, some responses were generated in to additional activities or additional Work Instructions. One of which can be seen in figure 1 - figure 3. The changes were also influenced by the recommendation of changes in the organizational structure of the maintenance division of government buildings. This was caused by uneven role allocation and responsibility in some labour functions. It is expected that QMS development on the maintenance and supervision of government buildings could vastly improve the maintenance and repair work of government buildings.

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