Developing Performance Measurement System of Management Maintenance in Government Building

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Abstract: Development of construction in Indonesia per annum to increase. However, not in line with the normative basis of maintenance, impact on the acceleration of damage to building construction. The purpose of this paper is to identify the key aspects of performance measurement for maintenance management building, objects within Parliament Building and Environment Indonesia, to improve the quality of performance.The study was conducted qualitatively, by analyzing data on the perception of the questionnaire to the respondents who had experience in the project, and then the data were processed by Structural Equation Modeling (SEM) to get priority indicator factors. The study results showed that there were 63 events of the indicators which were identified as potentially dangerous, and 29 dominant indicators that affected the measurement performance. Furthermore, The results of the study are expected to improve the performance management and maintenance more efficiently and improve the economic, techical, social and environmental value.

Keywords: developing, performance measurement KPIs, maintenance management, building management, SEM

1. Introduction

Today's asset managers and asset owners need to know the relationship between the outputs of the maintenance process for assessing their contribution to the business goal. Effectiveness of maintenance and its quality need to be measured for the justification of investment in maintenance [1]. According to Indonesia Central Statistics Agency Data in 2015, Construction buildings in Indonesia increased from the side of building work amounting to Rp 340.7 trillion, up 53.7%. It is increasingly recognized that maintenance has a huge impact on economic, technical, environmental and social performance. In Industrial Ecology, maintenance is considered from the perspective of the whole product life cycle. In a holistic or system thinking approach, it leads to the integration of system complexity and a multidisciplinary vision to manage assets as a whole [2]. Benchmarking of performance indicators were undertaken by the benchmarking committee (now known as European Maintenance assessment Committee) of the European Federation of National Maintenance Societies (EFNMS), from 1998 and the best practices committee of Society for Maintenance and Reliability Professionals, USA (SMRP) from 2004. Since 2006, these two organizations have been working on a harmonized process, comparing the existing indicators for formulas and term definitions. [1]. measurement maintenance can be defined as all required processes for ensuring the acceptable assets condition by eliminating negative environmental impact, prudent in using resources, concern for the safety of employees and stakeholders, while at the same time economically sound [3]. Therefore, maintenance people at functional level can perform their maintenance daily activities and improve their value created aligned to their company objectives in becoming a performance government.

2. Literature Review

Performance Maintenance

In determining the performance maintenance of the building required a measure of performance. According to Mahmood Shafiee (2015), maintenance performance is divided into four dimensions based on sources that have been collected, ie **economic, technical, social and environmental** aspects.

Management system maintenance is

Maintenance is defined by the European Standard as "a combination of all technical, administrative and managerial measures during the life cycle of an item intended to defend it, or return it, the circumstance in which it can perform the required function." (Eesti, 2010)

The criteria described reinforce the idea that measurements should incorporate **internal** maintenance functions with their interactions with **external** factor, especially clients. At the same time, the measurement should involve the objectives of management, since the management will propose improvements afterwards reading the indicator. (parida, 2013)

3. Methods

The research is decisions made and information considered must evolve, and decision support tools must be adapted to performance measurement new needs. As research managers, we propose to conduct research on decision support for measurement performance in maintenance using analyze these needs starting with the core principles of decision systems. We discuss their use in maintenance, and underline the weaknesses of current practice in this domain. In section 2 we review the research conducted on key performance indicators (KPIs) based on pilot survey, dashboards and prognosis approaches for decision support in maintenance. These studies are the starting point of some of the steps in the framework we propose in section 3. This framework is part of the set of founding elements we propose in order to conduct research on dashboards for measurement performance in maintenance based on Structural Equation Modeling (SEM). Section 4 concludes the paper and introduces prospects for the implementation of these elements for development measurement management maintenance. This research is conducted in Building Parliamentary RI and Universitas Indonesia during August to December 2017.

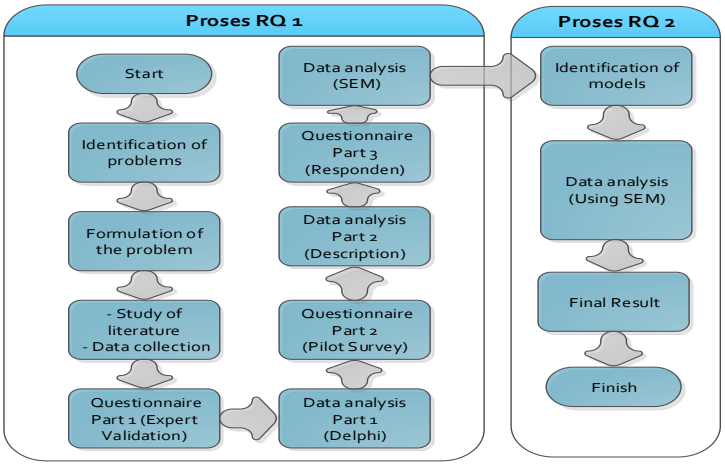


Table 1: The activity conducted in this research during August to April 2017.

Activity	August-September				October-November				December			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
Composing research proposal and questioner	■											
Validation of questioner		■										
Collecting data related to main problem in internal and eksternal maintenance building			■	■								
Analyzing data and figuring out the main problem of internal maintenance management					■							
Designing of "Performance Measurement System of Management Maintenance "						■						
Collecting data related to the Developin							■					
Re-designing developing and re-collecting data								■	■			
Analyzing data										■		
Composing research publication											■	■

4. Findings and Argument

This research is conducted in four steps. The first step is as research managers, we propose to conduct research on decision support for measurement performance in maintenance using analyze these needs starting with the core principles of decision systems. We discuss their use in maintenance, and underline the weaknesses of current practice in this domain. The questionnaires given by the researcher to the experts who have expertise in the science of maintenance management analysis to be able to validate the dependent variable and research questions that have been prepared based on literature review.

The second step of this research is where the pilot survey was conducted. The aims of this pilot survey are to test survey administration procedures; to test procedures for handling non-respondents, missing data and data cleaning; assessing measurement quality. The measurement quality from EN15341 highlights that maintenance performance is the result of complex activities, which can be evaluated by appropriate indicators to measure actual and expected results, grouping them in economic, technical and organizational indicators. The Analysis use descriptive study to figure out and map the problem related to management maintenance building. The tool used in this study is validated questioner which is distributed to our chosen the management maintenance expert or professional.

These studies are the starting point of some of the steps in the framework we propose in the third step of this research, is where this framework is part of the set of founding elements we propose in order to conduct research on dashboards for measurement performance in maintenance based on Structural Equation Modeling (SEM).

The final step of this research is concludes the paper and introduces prospects for the implementation of these elements for development measurement management maintenance. Parida, an author who had previously developed maintenance performance measures in three hierarchies, suggested valuable comments especially in the naming of measures. Thus, the names of the measures were modified to be consistent with the industry terminology. This research is conducted in Building Parliamentary RI and Universitas Indonesia during August to December 2017.

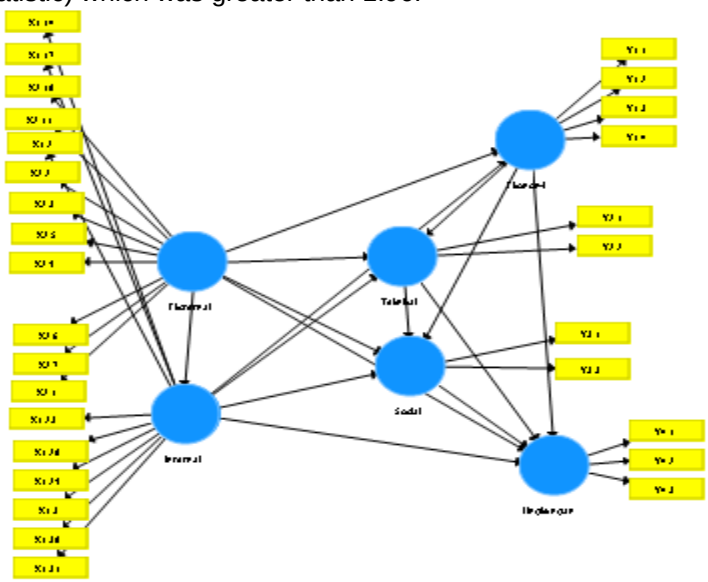
The dependent variable (Y) is the target as the focus of this study, namely in the form of maintenace performance of the project. While the independent variable (X) contains the problem to be observed or investigated, namely in the form system manajemen performance, that there 63 indictors factors as the independent variables and would be used in this study, as shown in table 1 below

Figure 1: Application system architecture

X1	Aspek Internal	X1.14	*(Proactive Work)* Sumber : SMRP-EN 15341
X1.1	*(Stocked Maintenance, Repair, and Operating (MRO) Inventory Value as a Percent of Replacement Value)* Sumber : SMRP-EN 15341	X1.15	*Preventive Maintenance (Pm) & Predictive Maintenacne (Pdm) Work Order Compliance)* Sumber : SMRP
X1.2	*(Overall Equipment Effectiveness (OEE))* Sumber : SMRP-EN 15341	X1.16	*(Preventive Maintenance (PM) & Predictive Maintenance (PdM) Work Orders Overdue)* Sumber : SMRP
X1.3	*(Total Effective Equipment Performance (TEEP))* Sumber : SMRP-EN 15341	X1.17	*(Preventive Maintenance (PM) & Predictive Maintenance (PdM) Yield)* Sumber : SMRP
X1.4	*(Uptime)* Sumber : SMRP	X1.18	*(Preventive Maintenance (PM) & Predictive Maintenance (PdM) Effectiveness)* Sumber : SMRP
X1.5	*(Idle Time)* Sumber : SMRP	X1.19	*(Preventive Maintenance (PM) & Predictive Maintenance (PdM) Compliance)* Sumber : SMRP
X1.6	*(Utilization Time)* Sumber : SMRP-EN 15341	X1.20	*(Storeroom Records)* Sumber : SMRP
X1.7	*(Systems Covered by Criticality Analysis)* Sumber : SMRP-EN 15341	X1.21	*(Contractor Hours)* Sumber : SMRP
X1.8	*(Total Downtime)* Sumber : SMRP	X1.22	*(Wrench Time)* Sumber : SMRP
X1.9	*(Unscheduled Downtime)* Sumber : SMRP	X1.23	*(Continuous Improvement Hours)* Sumber : EN 15341
X1.10	*(Preventive Maintenance Hours)* Sumber : SMRP-EN 15341	X1.24	*(Total Energy Used in maintenance)* Sumber : SMRP-EN 15341

X1.11	*(Condition Based Maintenance Hours)* Sumber : SMRP-EN 15341	X1.25	*(Number of failures due to maintenance creating environmental damage)* Sumber : EN 15341
X1.26	*(Number of injuries for people due to maintenance)* Sumber : EN 15341	X1.33	*(Total time to restore)* Sumber : EN 15341
X1.27	*(Number of failures causing potential injuries for people)* Sumber : EN 15341	X1.34	*(Total man-hours worked by maintenance personnel)* Sumber : EN 15341
X1.28	*(Number of failures causing damages for environment)* Sumber : EN 15341	X1.35	*(Immediate corrective maintenance time)* Sumber : EN 15341
X1.29	*(Number of maintenance work- orders causing down time)* Sumber : EN 15341	X1.36	*(Internal direct mechanical man hours* Sumber : EN 15341
X1.30	*(Total operating time)* Sumber : EN 15341	X1.37	*(Internal direct electrical man hours)* Sumber : EN 15341
X1.31	*(Assets Replacement Value)* Sumber : EN 15341	X1.38	*(Internal direct instrumentation man hours)* Sumber : EN 15341
X1.32	*(Planned and scheduled maintenance time causing production down time)* Sumber : SMRP	X1.39	*(Number of internal direct maintenance personnel using software)* Sumber : SMRP

The analysis of literature review and expert validation obtained 6 (six) dimension of performance measurement system of management maintenance, as shown in Table 2. This evaluation used bootstrapping procedure whose aim was to predict the relationship between the latent variables. Subsequently, it was used to evaluate the structural model in order to assess the magnitude of the percentage of the explained variance to obtain the value of R^2, to construct latent endogenous, Stone-Geisser's = Q^2 to test the predictive relevance and average variance extracted (AVE) to predict the re-sampling procedure. This procedure used the entire original sample to perform re-sampling where the record number should be higher than the original sample as demonstrated in Fig. 4. Figure 4 demonstrated the significance of relation among the variables could be identified by examining the value of *t*-value (T Statistic) which was greater than 1.96.



IGURE 4. performance measurement system of management maintenance Model

According to Table 3, the values of R-Square (R^2) were obtained from eksternal indicators of 0.77887 thatmeans the variability construct of Safety performance can be explained by economic, technically by 77.887%.

TABLE 3. Result of R Square (R2)

Indicators	Original Sample (O)	T Statistics (|O/STDEV|)
Eksternal -> Internal	0.77887	9.69126
Economic -> Technically	0.53766	3.3918
Eksternal -> Economic	0.51022	2.43463

5. Conclusion

Indonesia has high number of poor maintenance management building. Some aspects should be considered when selecting the maintenance management system strategy. First, it is stated that the system developed and presented here is shaped and influenced by the author's opinion and level of knowledge. In order to provide a comprehensive system to the fullest extent possible, steps are taken to consider as many systems as possible. Next Step maintenance managers are the people who use the most systems and they also know the maintenance operations as well as possible. Therefore they are in a good position to determine which indicators will be useful in maintenance management. They are accustomed to such systems today and therefore it is difficult for them to see other possibilities than they are already used. To obtain an overview of broader maintenance performance indicators in the MPM system formulation process, EN 15341 (CEN, 2007) or SMRP Good Practices (SMRP, 2011) main indicators of maintenance performance are considered key sources for formulating performance indicators. Based on these findings, we hope the theoretical basis that has been exposed and conducted further analysis, then obtained the initial hypothesis of research that is by conducting the development of maintenance and maintenance management system will improve the performance of maintenance and maintenance of government buildings in the parliamentary environment of Indonesia.

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