Evaluation of Quality Management Implementation in the Construction of the Wai Pulu Bridge in Seram Island

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Abstract. This research aims to evaluate the level of quality implementation of sub-components and the achievement of quality management in the construction of the Wai Pulu Bridge, as well as provide solutions for construction work to meet the required quality standards in the Wai Pulu Bridge Construction Project. The research was conducted in Central Maluku Regency and Eastern Seram, Maluku Province, from March to May 2024. The research used a quantitative method, which was analyzed descriptively using statistics. The research methodology involved interviews and surveys with respondents from service providers, service users, and consultants, along with reviewing literature studies from similar research. The research results indicate that there are 7 variables for evaluating the achievement of quality management in the construction of the Wai Pulu Bridge, including: quality policy, quality manual, quality procedures, foundation work, substructure (abutment), and superstructure (floor plate). Strategies to improve the implementation of construction work include applying the quality policy sub-components, quality manual, quality procedures, and work instructions properly so that the quality of the work meets the required standards. Sub-components with lower importance should still be implemented in the field according to the technical specifications to ensure good quality work.

Keyword: quality management; quality policy; quality manual; quality procedures; construction work

1. Introduction

With the advancement of technology and the increasing complexity of human needs, the construction service industry must meet these diverse demands. One of the most crucial sectors is transportation. Transportation is a key factor in the national economy, as it indirectly supports the distribution sector. Bridges are an essential part of transportation infrastructure, enabling smoother traffic flow, efficient travel times, and contributing to the nation's economic improvement.

The road and bridge management program across Indonesia, whether for construction, improvement, or maintenance, requires high-quality results. This can only be achieved through measured implementation and supervision, adhering to standards and specifications. This ensures that the construction work is executed on time, within budget, and meets the quality standards to provide a safe and comfortable experience for road and bridge users.

Quality is one of the goals and indicators of success in construction work, particularly for project owners evaluating the quality of construction and consulting services. In this context, quality is considered a key element of construction project management methods and techniques. Quality is inherent in the product, implementation activities, work systems, workforce, and environment.

The Wai Pulu Bridge, located between Central Maluku Regency and Eastern Seram (SBT) Regency in Maluku Province, plays a critical role in connecting the two regions, ensuring that people can travel smoothly between different areas.

The purpose of constructing this bridge is to facilitate local residents' access to other areas and reduce travel time. However, quality issues in construction need serious attention from all parties involved. Reliable construction quality is defined by a structure that meets quality requirements and achieves its expected lifespan. If the construction quality does not meet the required standards, the structure will not last as long as planned.

This study evaluates the application of quality management in the construction of the Wai Pulu Bridge on Seram Island.

2. Methodology

Type of Research

This research is quantitative, analyzed descriptively using statistics. The study will be conducted on the Wai Pulu Bridge project in Central Maluku and Eastern Seram, Maluku Province, focusing on quality management in construction as per ISO 9001:2015.

Population and Sample

1. **Population**: The population for this study consists of the Wai Pulu Bridge project executed by the National Road Implementation Agency of Maluku Province.
2. **Sample**: The sample includes individuals involved in the project who have knowledge of quality management implementation, such as structural engineers, geotechnical experts, construction managers, project managers, construction safety experts, and quality management specialists. The sample size will consist of 26 questionnaires distributed to construction experts.

Research Analysis Techniques

The validity and reliability tests will be performed using SPSS software (version 26). Validity tests check whether the measurement tool is valid, while reliability tests use Cronbach's alpha to assess consistency, with a threshold of $\alpha = 0.05$. Further analysis uses Importance Performance Analysis (IPA) to evaluate the quality management achievement levels based on the importance and implementation of quality management components in the bridge construction work.

3. Result and Discussion

Respondent Characteristics

The characteristics of the respondents are described as follows:

a. Gender

The research results from the distribution of questionnaires in the field showed that there were 24 male respondents, accounting for 92%, while 2 female respondents made up 8%.

Gender	Number of Respondents	Percentage (%)
Male	24	92
Female	2	8
Total	**26**	**100**

b. Age

In this study, 6 respondents were under 30 years old, accounting for 23%, 16 respondents were between 30–40 years old, making up 62%, and 4 respondents were between 41–50 years old, making up 15%.

Age Range	Number of Respondents	Percentage (%)
Under 30	6	23
30–40	16	62

Age Range	Number of Respondents	Percentage (%)
41–50	4	15
Total	**26**	**100**

c. Institution

The results from the questionnaire distribution show the following distribution of respondents by institution: 5 respondents (19%) from the Owner's side, including 1 PPK (Project Manager) and 4 Field Supervisors; 9 respondents (35%) from the Contractor's side, including 1 Site Manager, 3 Structural Experts, 2 Geotechnical Experts, 2 Quality Control experts, and 1 K3 Expert; 5 respondents (19%) from the Consultant Supervisor's side, including 1 Supervisory Engineer, 2 Quality Engineers, and 2 Inspectors; and 7 respondents (27%) from the Construction Management Consultant's side, including 1 Team Leader, 2 Structural Experts, 3 Field Supervisors, and 1 K3 Expert.

Institution	Number of Respondents	Percentage (%)
Owner	5	19
Contractor	9	35
Consultant Supervisor	5	19
Construction Management Consultant	7	27
Total	**26**	**100**

d. Education Level

In this study, 11% of respondents had a diploma (D3/D4), 81% had an undergraduate degree (Strata 1), and 8% had a master's degree (Strata 2).

Education Level	Number of Respondents	Percentage (%)
Diploma (D3/D4)	3	11
Undergraduate (Strata 1)	21	81
Master's (Strata 2)	2	8
Total	**26**	**100**

e. Work Experience

From the questionnaire distribution, the results showed that 8% of respondents had less than 3 years of work experience, 31% had 3–5 years of experience, 54% had 6–10 years of experience, and 8% had more than 10 years of experience.

Work Experience	Number of Respondents	Percentage (%)
< 3 years	2	8
3–5 years	8	31
6–10 years	14	54
> 10 years	2	8
Total	**26**	**100**

Instrument Testing

a. **Validity Test**

The validity test in this study was conducted using Pearson's product-moment correlation with the assistance of SPSS 26 software. The validity test was performed to determine whether a questionnaire is valid or not.

b. **Reliability Test**

The reliability test of the questionnaire data was conducted using the Cronbach’s Alpha

method with a significance level of 0.05, assisted by SPSS 26 software. A variable is considered reliable if it has a Cronbach's alpha value greater than 0.60.

Mapping Analysis

a. Mapping of Quality Policy Components

Calculation of the values of quality policy components on the level of importance and the level of implementation of the quality management system in the execution of the Wai Pulu Bridge structure work.

Position of the mapping of quality policy components

Quality Policy	Importance	Application	Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4
X1	3.615	3.115		√		
X2	3.692	2.962		√		
X3	3.462	3.462				√
X4	3.500	3.423				√
X5	3.538	3.385				√
X7	3.615	3.269		√		
X8	3.577	3.385				√
X9	3.808	3.346	√			
X10	3.577	3.462				√
Average	**3.598**	**3.312**				

b. **Mapping of Quality Manual Components**

In the implementation of the Wai Pulu Bridge structure work, the calculation of the quality manual component values can be seen in relation to the level of importance and the level of application of the quality management system.

The position of the quality manual component mapping.

Quality Manual	Importance	Application	Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4
X11	3.615	3.115				√
X13	3.500	3.115				√
X14	3.769	3.538	√			
X15	3.615	3.423				√
X16	3.615	3.269				√
X18	3.654	3.500	√			
X19	3.692	3.577	√			
X20	3.538	3.385				√
X21	3.654	3.500	√			
X22	3.654	3.538	√			
X23	3.577	3.500				√
X24	3.654	3.423	√			
X25	3.654	3.385		√		
X26	3.500	3.423				√
X27	3.577	3.385				√
Average	**3.618**	**3.405**				

c. Mapping of Quality Procedure Components

Calculation of the values of quality procedure components on the level of importance and the level of implementation of the quality management system in the execution of the Wai Pulu Bridge structure work.

Position of Quality Procedure Components Mapping

Quality Procedure	Importance	Application	Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4
X28	3.577	3.385				√
X30	3.615	3.577				√
X31	3.615	3.308				√
X32	3.731	3.269		√		
X33	3.577	3.423				√
Average	**3.623**	**3.392**				

d. Mapping of Work Instruction Components

Calculation of the values of work instruction components on the level of importance and the level of implementation of the quality management system in the execution of the Wai Pulu Bridge structure work.

Position of Work Instruction Components Mapping

Work Instruction	Importance	Application	Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4
X34	3.615	3.538				√
X35	3.577	3.654				√
X36	3.731	3.615	√			
X38	3.731	3.500		√		
X39	3.731	3.654	√			
X40	3.654	3.500			√	
X42	3.615	3.423			√	
X43	3.692	3.615	√			
X44	3.654	3.423			√	
X45	3.769	3.577	√			
X46	3.615	3.615				√
Average	**3.671**	**3.556**				

Weighting Analysis (Scoring)

In this research, the Likert scale is used to determine the categories of questionnaire assessments utilized for further analysis using the scoring method.

Questionnaire Tabulation using the Scoring Method

No.	Variable	Answer Score Respondents
I. Quality Policy		
X1	Availability of quality policy statement	81
X2	Quality policy is clearly stated and easy to understand	

No.	Variable	Answer Score Respondents
		77
X3	The existing quality policy includes continuous quality improvement	90
X4	A framework is available to establish and review quality objectives	89
X5	Quality policy socialization is well implemented and stated by top management	88
X7	Quality objectives acceptance criteria are clear	85
X8	Quality objectives are measurable	88
X9	Quality objectives are consistent with the quality policy	87
X10	There is periodic monitoring of the fulfillment of quality objectives	90
II. Quality Manual		
X11	Availability of quality manual	81
X13	The content of the quality manual is clearly stated and easy to understand	81
X14	Has a Work Plan and Specifications (RKS)	92
X15	There is monitoring, evaluation, and review of the quality manual	89
X16	There is guidance in implementing the quality manual	85
X18	Contains explanations of the interaction of processes within the SMM ISO 9001:2015	91
X19	Contains control sheets (approval sheets, history of changes, table of contents)	93
X20	Contains the objectives of the quality manual, scope of SMM, control, and distribution of the quality manual	88
X21	Contains company profile, vision, mission, quality policy, quality objectives, production process map	91
X22	Contains general requirements, document control, and record control	92
X23	Contains management commitment, customer focus, responsibilities and authorities, internal communication, management review	91
X24	Contains resource provision, human resources, competence, awareness, and training, as well as working environment	89
X25	Contains product planning, customer requirements definition, product development planning, production implementation, product protection	88
X26	Contains internal audits, process monitoring, monitoring and	

No.	Variable	Answer Score Respondents
	measurement, corrective actions, preventive actions	89
X27	Contains organizational structure, job descriptions and authorities, standard references	88
III. Quality Procedures		
X28	Availability of quality procedures	88
X30	The content of the quality procedures is clearly stated and easy to understand	93
X31	There is monitoring, evaluation, and review of the quality procedures	86
X32	There is a history of documents and records of changes	85
X33	There is a distribution list and notation	89
IV. Work Instructions		
a. Foundation Work		
X34	Foundation determination	92
X35	Foundation reinforcement bar installation	95
X36	Foundation formwork installation	94
X38	Formwork removal	91
b. Abutment Work		
X39	Abutment reinforcement bar installation	95
X40	Abutment formwork installation	91
X42	Abutment formwork removal	89
c. Slab Work		
X43	Slab reinforcement bar installation	94
X44	Slab formwork installation	89
X45	Slab casting	93
X46	Slab formwork removal	94

5. Scoring Analysis

The achievement level of quality management in the implementation of the Wai Pulu Bridge structure work for the Quality Policy Component is 82.80%, categorized as very good. The Quality Manual Component has an achievement level of 85.13%, categorized as very good. The Quality Procedure Component has an achievement level of 84.81%, categorized as very good. The Work Instruction Component for Foundation Work has an achievement level of 89.82%, categorized as very good. The Work Instruction Component for Beam Work has an achievement level of 88.14%, categorized as very good. The Work Instruction Component for Slab Work has an achievement level of 88.94%, categorized as very good.

Quality Management Achievement Level

No.	Component	Achievement Level (%)	Category
I	Quality Policy Component	82.80%	Very Good

No.	Component	Achievement Level (%)	Category
II	Quality Manual Component	85.13%	Very Good
III	Quality Procedure Component	84.81%	Very Good
IV	Work Instruction for Foundation Work	89.82%	Very Good
V	Work Instruction for Beam Work	88.14%	Very Good
VI	Work Instruction for Slab Work	88.94%	Very Good

6. Recommendations

The strategy that can be recommended to improve the implementation of the construction work for the Wai Pulu Bridge is to properly implement the subcomponents of the quality policy, quality manual, quality procedures, and work instructions in order to achieve good work quality. Subcomponents that have a low level of importance should still be applied in the field according to the applicable technical specifications to ensure good work quality.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Based on the research results related to the implementation of quality management in the Wai Pulu Bridge structure work, it can be concluded that: Several work components with a high level of importance for implementation have been successfully carried out, including the Quality Policy, Quality Manual, Quality Procedures, and Work Instructions, particularly in foundation work, abutment, and slab. The quality management achievement level for the implementation of the Wai Pulu Bridge structure work in the Quality Policy, Quality Manual, Quality Procedures, and Work Instructions components is categorized as very good.

The recommended strategy to improve the construction work for the Wai Pulu Bridge is to properly implement the subcomponents of the Quality Policy, Quality Manual, Quality Procedures, and Work Instructions to achieve good work quality according to the standards. Subcomponents with a low level of importance should still be applied in the field according to the applicable technical specifications to achieve good work quality.

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