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Analysis of ISO 9001:2015 Quality Management System Implementation on Project Quality in Building Construction

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ABSTRACT: During construction, many failures and reworks still occurred, indicating a low awareness of the importance of adhering to quality standards in construction implementation. These shortcomings can negatively impact construction work. A quality management system is essential for managing the construction industry to enhance work quality effectively and efficiently. By implementing the ISO 9001:2015 quality management system, companies can properly control all activities and minimize repetitive work. This study aimed to identify the dominant factors influencing the ISO 9001:2015 quality management system and evaluate its application to the quality of work in building construction projects. Data collection was conducted through surveys using questionnaires, with respondents consisting of stakeholders directly involved in project implementation in Malang. The data were analyzed using multiple regression analysis to identify the dominant factors among the ISO 9001:2015 quality management system clauses and the Importance-Performance Analysis (IPA) method to assess the impact of the system's implementation on project quality. The study identified four quality management system factors that significantly affect project quality, with "Relationship Management" being the most dominant factor. Furthermore, the implementation results of the quality management system demonstrated exemplary achievements in "Customer Scope" and "Relationship Management.

KEYWORDS: ISO 9001:2015, Quality Management System, Building Construction, Multiple Regression Analysis, IPA Method Analysis.

I. INTRODUCTION

In the era of globalization, the development of physical infrastructure in Indonesia is increasing rapidly, driven by modernization and the need to accommodate the global generation. Considering the critical role of the construction industry in advancing the economy, construction companies must identify key factors to execute projects with efficiency and effectiveness [14]. However, construction failures and repetitive work remain prevalent in many projects. This highlights a persistent lack of attention to achieving the expected quality of work, which can lead to adverse outcomes such as delays, wasted resources, and cost overruns [15] [3].

To address these challenges, a quality management system is essential to manage the construction industry effectively and improve work quality [8]. ISO 9001:2015 is one of the quality management standards designed to enhance the quality of products and services [7]. By implementing an ISO 9001:2015-based quality management system, companies can control all activities—whether production or services—more efficiently, achieving the desired outcomes while minimizing repetitive work.

Research on factors influencing the ISO 9001:2015 quality management system has been conducted by Yurazak et al. (2022), Jaya et al. (2018), and Budihardja & Indriyani (2019). Additionally, Hartanto (2018) explored the implementation of the ISO 9001:2015 quality management system, specifically in road pavement projects.

Building on these previous studies, this research seeks to analyze the dominant factors influencing the ISO 9001:2015 quality management system and assess its application to project quality in building construction work. The objective of this study is to identify the dominant factors affecting the ISO 9001:2015 quality management system and evaluate the outcomes of its implementation on the quality of building construction projects.

II. RESEARCH METHOD

The research process begins with a literature review of the problem chosen by the researcher, followed by the preparation of a set of questions to be used in a questionnaire. The questionnaire is then tested by a small group of participants to identify any flaws before being distributed to respondents. The focus of the questionnaire is on the relevance and application of the ISO 9001:2015 quality management system in ensuring the quality of building construction projects.

This research was conducted on a multi-story building project with more than four floors, located in Malang City, East Java. Data collection involved field observations, interviews, and distributing questionnaires to stakeholders directly involved

in the project. The questionnaire distributed to respondents consisted of three parts:

1) General information about the respondents involved in the project implementation.
2) The level of importance and application of ISO 9001:2015 clauses in building construction projects.
3) Factors influencing the quality of work in building construction implementation

Data testing was the first step in data processing. Validity and reliability tests were conducted to determine whether the questionnaire data were suitable for further analysis. Partial correlation analysis was then used to identify the relationships between variables and indicators, helping to pinpoint the key influencing factors in this study.

To develop an equation and estimate outcomes, multiple regression analysis was applied to understand the form and magnitude of the variables. Finally, the Importance-Performance Analysis (IPA) method was used to evaluate the performance level of the application, identifying areas of good or poor performance.

1. Research Indicators Clause ISO 9001:2015

The research indicators for the ISO 9001:2015 clauses [14], [5], [12] in the implementation of building construction, based on the results of part 2 of the questionnaire, are presented in Table 1:

Table 1. Research Indicators Clause ISO 9001:2015

No.	ISO 9001:2015 Quality Management System Clause
A	**Customer Scope**
A1.	The company receives input and suggestions from project owners
A2.	The company with project owner related to project sustainability
A3.	The company involves project owners in decision making
A4.	The company increases project owner satisfaction
A5.	The company carries out the suitability of the quality of work
A6.	The company increases the loyalty of project owners
A7.	The company anticipates the future needs of project owners
B.	**Leadership**
B1.	Company leaders make decisions involving staff and employees
B2.	Company leaders give rewards and punishments to team and employees
B3.	Company leaders improve the quality management system for each work division
B4.	Company leaders establish a more systematic work system
B5.	Company leaders determines the duties and responsibilities according to the division
B6.	Company leaders increase discipline within the organization
B7.	Company leaders set quality targets
B8.	Company leaders always check the quality of work
B9.	Coordination between company leaders and employees is going well
B10.	Company leaders try to fix and deal with problems
C.	**Human Resources Engagement**
C1.	Staff and employees receive training to have skills and competencies
C2.	Staff and employees receive competency certification according to their expertise
C3.	Staff and employees have awareness and commitment to quality
C4.	Staff and employees have defined quality objectives
C5.	Staff and employees have active participation in the work
C6.	Staff and employees have a job desk according to their expertise in the field of work
C7.	Staff and employees always communicate with company leaders
C8.	Staff and employees have loyalty to work according to their fields
D.	**Planning**
D1.	Project planning carried out is following the quality of work
D2.	Project planning carried out has minimized the impact of risk
D3.	There are difficulties in project planning
E.	**Support**
E1.	The company has a good relationship with suppliers
E2.	The company has good relations with subcontractors
E3.	The company gets a smooth distribution of materials from suppliers
E4.	The company gets material quality assurance from suppliers
E5.	The company has a work method that fits the needs
E6.	The company has a work method that fits the needs
E7.	The company has adequate supervisory personnel in the implementation
F.	**Company Operations**
F1.	Improving the implementation of the quality of work has been implemented
F2.	Improved job monitoring controls have been implemented

No.	ISO 9001:2015 Quality Management System Clause
F3.	Enhanced communication between work divisions went well
F4.	The company has increased the effectiveness and efficiency of work
F5.	The use of resources has been fulfilled in the implementation of the work
G.	**Continual Improvement**
G1.	The company has increased awareness and knowledge about quality among all staff
G2.	The company is improving the quality of its resources
G3.	The company increases the application of HSE to all staff
G4.	The company enhances the quality of the company against construction competition
H.	**Performance Evaluation**
H1.	The company evaluates the work methods carried out
H2.	The company considers the work of the project owner
H3.	The company assumes the distribution of resources
H4.	The company evaluates work supervision controls on the project
H5.	The company believes the completeness of the documentation in the work
H6.	The company carries the project owner's expectations regarding results of the work
I.	**Relationship Management**
I1.	The relationship between company leaders and employees is going well
I2.	The relationship between the company's stakeholders is excellent and professional

2. Research Indicators of Factors Affecting Quality of Work

The factors affecting the quality of work [2], [13] in the implementation of building construction, based on the results of part 3 of the questionnaire, are shown in Table 2:

Table 2. Research Indicators of Factors Affecting Quality of Work

No.	Factors Affecting the Quality of Work Implementation
1.	Supervision in each work item
2.	Availability of work support tools
3.	Competent experts
4.	Material specification quality
5.	Weather conditions
6.	Total human resources
7.	Number of labour skills
8.	There is a change in job design
9.	Equipment quality specifications
10.	Communication and coordination between work divisions
11.	Planning and implementation following procedures
12.	Supervision and control in the implementation of work

III.RESULT AND DISCUSSION

1. Data Respondent

The respondents for this study were selected based on their direct involvement in project implementation. The respondents comprised three groups: contractors, supervisory consultants, and project owners, with a total of 38 respondents.

Figure 1. Percentage of Respondent's Agency

Contractors accounted for the largest proportion of respondents, comprising 63% (24 out of 38 respondents). This higher representation of contractors is due to their significant involvement in the active implementation of building construction projects.

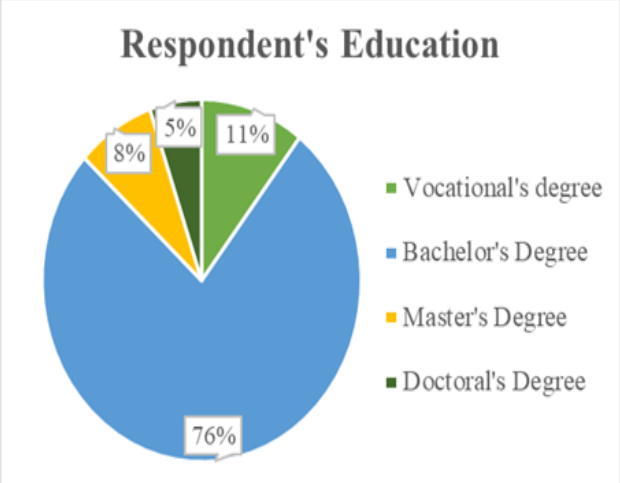

Figure 2. Percentage of Respondent's Education

Regarding educational background, the majority of respondents were undergraduate degree holders, making up 76% (29 respondents). This was followed by diploma holders

at 11% (4 respondents), master's degree holders at 8% (3 respondents), and doctoral degree holders at 5% (2 respondents).

2. Validity Test

This test was conducted to measure the accuracy of the research instrument by comparing data using the Pearson Correlation Index with a significance level of 5% (or 0.05). If $r_{table} < r_{count}$, the data is declared valid; otherwise, if $r_{table} > r_{count}$, the data is declared invalid [10]. In this study, the r_{table} value for N = 38 is 0.329 (as referenced from the validation table). Based on the validity test results, the research instrument was declared valid because the $r_{table} < r_{count}$ (0.329 < r_{count}) for the research instrument.

3. Reliability Test

The reliability test was used to assess the consistency of the research instrument when measurements were conducted multiple times. A research variable is considered reliable if the Cronbach's alpha value exceeds 0.600 [10].

Table 3. Reliability Test Result

No.	Variable	Cronbach's Alpha	Conclusion
X.A.	Customer Scope	0,917	Reliable
X.B.	Leadership	0,915	Reliable
X.C.	Human Resources Engagement	0,912	Reliable
X.D.	Planning	0,925	Reliable
X.E.	Support	0,916	Reliable
X.F.	Company Operation	0,918	Reliable
X.G.	Continual Improvement	0,923	Reliable
X.H.	Performance Evaluation	0,916	Reliable
X.I.	Relationship Management	0,931	Reliable
Y	Factors that affect the Quality of Work	0,949	Reliable

4. Pearson Correlation Test

The correlation test aims to determine the level of connection between variables, specifically whether variable X impacts variable Y and the degree of association between the variables, as reflected by the correlation coefficient (r) [11]. For the correlation test, a significance value less than or equal to 0.05 indicates a correlation is present. If the significance value is greater than 0.05, no correlation exists. The strength of the association is determined based on the correlation coefficient, following the established guidelines.

Table 4. Pearson Correlation Test Result

No.	Variable	Pearson Correlation Score	Level of Correlation with Variable Y
X.A.	Customer Scope	0,641	*High*
X.B.	Leadership	0,611	*High*
X.C.	Human Resources Engagement	0,650	*High*
X.D.	Planning	0,537	*Enough*
X.E.	Support	0,660	*High*
X.F.	Company Operation	0,659	*High*
X.G.	Continual Improvement	0,670	*High*
X.H.	Performance Evaluation	0,723	*High*
X.I.	Relationship Management	0,676	*High*

5. Coefficient of Determination Test Analysis

The coefficient of determination test (R Square) is used to measure the percentage contribution of variable X to variable Y [11].

Table 5. Coefficient of Determination Test Result

Model	R	R Square	Adjusted R Square	Std. Error Estimate	R Square Change	F Change
1	.789[a]	.623	.502	6.012	.623	5.140

6. Multiple Linear Regression Test Analysis

The purpose of this study is to identify the variables that significantly influence the quality of building construction work, as defined by the ISO 9001:2015 quality management system. Multiple regression analysis is employed to determine whether two or more independent variables (X) significantly influence the dependent variable (Y). The decision-making criteria are based on a significance value (sig) of less than 0.05 or $t_{count} > t_{table}$ [9].

Table 6. Multiple Linear Regression Test Analysis

Variable	Notation	Coefficient Beta	t_{count}	Sig
Constant		**10,714**		
Customer Scope	**X.A**	0,907	-0,373	0,712
Leadership	**X.B**	0,665	-0,584	0,564

Human Resources	**X.C**	2,819	2,274	0,003
Engagement Planning	**X.D**	3,937	2,149	0,003
Support	**X.E**	3,470	2,598	0,004
Company Operation	**X.F**	1,178	0,341	0,735
Continual Improvement	**X.G**	1,154	0,151	0,881
Performance Evaluation	**X.H**	0,818	0,165	0,870
Relationship Management	**X.I**	4,642	2,875	0,001

Decision making with ttable = 2.048, In the output, the regression model is obtained as follows:

Y = 10,714 + 0,907X.A + 0,665X.B + 2,819X.C + 3,937X.D + 3,470X.E + 1,178X.F + 1,154X.G + 0,818X.H + 4,642X.I

And based on the partial t-test that has been analyzed, it shows that four variables significantly influence the quality of building construction project implementation with a $t_{count} > t_{table}$, including:

1. Variable HR involvement, the t_{count} value is 2.274 > 2.048 t_{table}, this variable has a significant effect.
2. Variable Planning, the t_{count} value is 2.149 > 2.048 t_{table}, this variable has a significant effect.
3. Variable Support, the t_{count} value is 2.598 > 2.048 t_{table}, this variable has a significant effect.
4. Variable Relationship Management, t_{count} value is 2.875 > 2.048 t_{table}, this variable has a significant effect

7. Analysis Implementation of ISO 9001:2015 Quality Managements System

This analysis is conducted to map the importance and implementation of the ISO 9001:2015 quality management system, as well as the factors influencing the quality of work in building construction, using the IPA analysis method. The importance and implementation values are calculated from the respondents' average scores based on the questionnaire results, then plotted on a Cartesian diagram [1].

a. Variable X ISO 9001:2015 Clauses Quality Management System

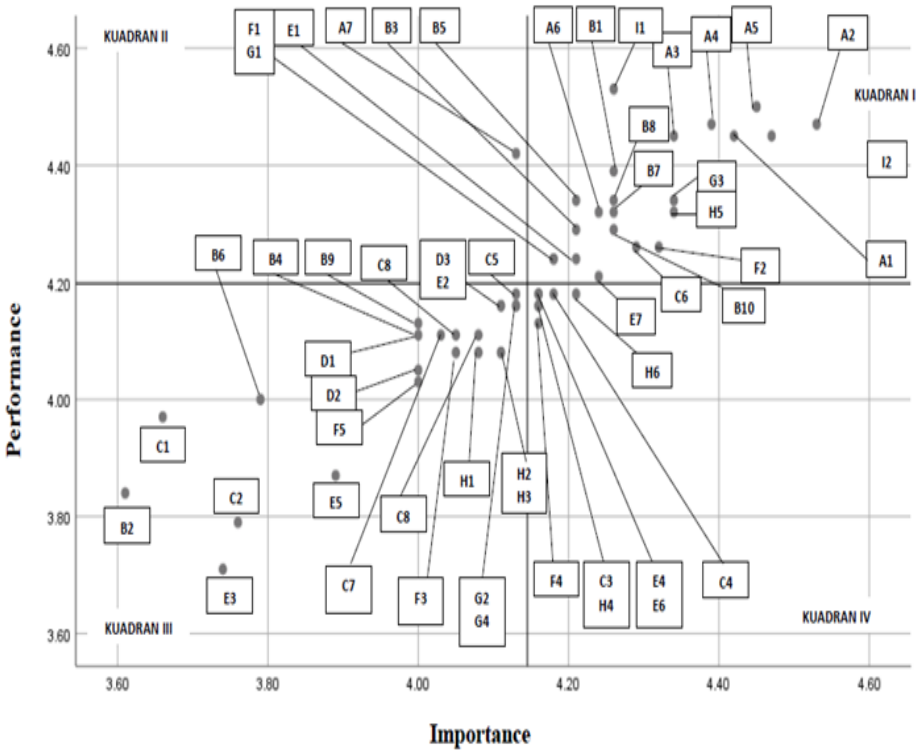

Figure 3. Cartesian Diagram ISO 9001:2015 Quality Management System

Based on the results, the indicators of the ISO 9001:2015 quality management system variables with strong performance (Quadrant I) are the "Customer Scope" and "Relationship Management" variables. Conversely, the variables identified as having weaknesses (Quadrant IV) are "HR Involvement" and "Support."

b. Variable Y Factors Affecting the Quality of Work Implementation

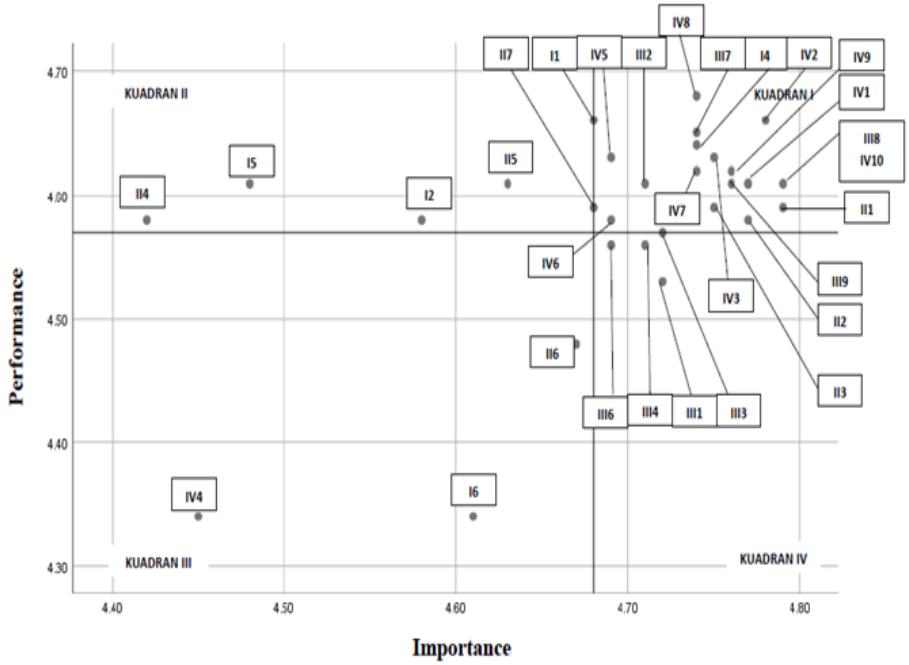

Figure 4. Cartesian Diagram Factors Affecting the Quality of Work Implementation

Based on these results, the indicators of the variable factors influencing the quality of work with good performance (Quadrant I) are: (1) supervision at work, (3) competent experts, (4) quality of material specifications, (9) quality of tool specifications, (10) coordination between work divisions, (11) planning and implementation according to procedures, and (12) supervision and control of work implementation. Meanwhile, the indicator of factors affecting the quality of work with weaknesses (Quadrant IV) is: (8) design changes.

IV. CONCLUSIONS

1. The factors influencing the ISO 9001:2015 quality management system on the quality of work in building construction are the "Human Resources Involvement" variable, the "Planning" variable, the "Support" variable, and the "Relationship Management" variable.
2. The implementation of the ISO 9001:2015 quality management system and the factors that affect the quality of work implementation in building construction are as follows:
   a. ISO 9001:2015 Quality Management System variables that have exemplary achievements are the "Customer Scope" variable and the "Relationship Management" variable. While the variables that have weaknesses are "HR Involvement" and "Support."
   b. The factors that influence the Quality of Building Construction Implementation with good

performance are (1) supervision in work, (3) competent experts, (4) quality of material specifications, (9) quality of equipment specifications, (10) coordination between the division of work, (11) planning and implementation according to procedures, and (12) supervision and control of work implementation. While the factor that has weaknesses is a factor (8). There is a design change.

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