Evaluation of Quality Management Implementation using the Process Hierarchy Analysis Method

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ABSTRACT

The construction project of the Soekarno-Hatta Airport Police Headquarters represents a strategic step in enhancing security infrastructure and public services within the international airport area. This study aims to analyze the implementation of project quality management based on ISO 9001:2015 and the principles of Total Quality Management (TQM). The Analytical Hierarchy Process (AHP) method was employed to determine the priority of quality criteria in a structured manner through pairwise comparison questionnaires administered to project experts. the analysis results indicate that continuous improvement is the most dominant factor (13.16%), followed by occupational health and safety implementation (11.82%) and project management leadership (11.70%). other factors include personnel involvement (11.36%), evidence-based decision making (10.85%), customer focus (10.79%), product and service control (10.29%), risk and opportunity management (10.02%), and process approach (10.00%). these findings underscore that the success of construction projects is influenced by the synergy between leadership, quality culture, occupational safety, and risk management. the integration of iso 9001:2015 and tqm serves not only as a quality control mechanism but also as a strategy for enhancing project and sustainability

Keywords: Analytical Hierarchy Process, ISO 9001:2015, Total Quality Management, quality culture, risk management.

INTRODUCTION

Globalization and increasing competition require the construction industry to continuously improve project quality and efficiency. Quality management plays a crucial role not only in the final product but also encompasses the entire planning, implementation, and monitoring process. Implementation of standards such as ISO 9001:2015 and the Total Quality Management (TQM) approach have been proven to improve project performance in terms of cost, time, and quality, while supporting customer satisfaction [1]. The systems theory approach is an important foundation in quality management, where the organization is viewed as a single entity consisting of interconnected elements. The implementation of systems theory through TQM emphasizes the involvement of all organizational members in continuous improvement efforts. Several studies confirm that the success of TQM is influenced by critical factors such as management commitment, training, and effective communication [2]. According to [11], several obstacles in implementing a quality management system are identified, including a lack of support from top management and limited resources. Therefore, it is important for organizations to ensure a strong commitment from all levels of management to support the implementation of an effective quality management system. ISO 9001-certified construction companies have better project management performance compared to companies without such certification. Other research also shows that the implementation of TQM has a positive impact on improving organizational performance in the construction sector [3]. In the context of construction projects, ISO 9001:2015 plays a role in increasing service user satisfaction, risk management effectiveness, and quality cost efficiency [4]. However, its implementation still faces challenges, particularly in aspects of documentation, socialization, and limited resource support [5]. Therefore, regular monitoring and evaluation are necessary to ensure the effectiveness of quality system implementation [6]. In addition, the Analytical Hierarchy Process (AHP) method developed by Saaty 1993 is relevant for use in supporting decision-making in quality management

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[7]. By breaking down complex problems into a hierarchical structure, AHP helps evaluate the determinants of successful quality implementation in construction projects [8]. The Soekarno-Hatta Airport Police Building Construction Project was used as a case study for this research. This priority project faced technical challenges, such as the presence of underground communication cables and special needs in the detention area. These conditions require the implementation of optimal quality management and risk management to prevent delays and potential additional costs beyond the plan. Problem Formulation: 1) how does the implementation of the ISO 9001:2015 standard on a project influence project success? 2) identify the critical success factors (CSFs) in implementing quality management based on the ISO 9001:2015 standard and Total Quality Management (TQM) for sustainable project success?

RESEARCH METHODS

This research approach is quantitative, utilizing the Analytical Hierarchy Process (AHP) method as an analytical instrument to support the decision-making process in the implementation of construction project quality management. A questionnaire instrument with closed-ended questions served as the primary data source, compiled based on the theoretical foundation of ISO 9001:2015 and relevant research variables. Data collection was carried out from June 15 to July 5, 2025, after the completion of the project, so that respondents could provide assessments based on their experiences during implementation. Respondents were selected through purposive sampling, considering professional experience, strategic involvement, and in-depth knowledge of project quality management. The research sample included 40 experienced experts, including project managers, quality control engineers, construction managers, project owner representatives, and main contractor directors, all with a minimum of 10 years of experience in the field of high-rise building construction. The data obtained were then analyzed using the AHP method to generate priority weights for criteria objectively and systematically. The questionnaire was closed-ended with pre-defined answer choices. The instrument development refers to the Analytical Hierarchy Process (AHP) method with a pairwise comparison technique. Respondents were asked to rate the relative importance of each element using a scale of 1 to 9, according to the concept developed by Saaty (1980). The comparison data was processed to obtain the priority weights for each criterion studied. Through this mechanism, the research is expected to provide a more comprehensive picture of quality management implementation and support strategic decisions in the implementation of ISO 9001:2015. The comparison scale is shown in Table 1.

Table 1. Basic paired comparison scale

Intensity of Interest	Description
1	Both elements are equally important
3	One element is slightly more important than the other element
5	One element is significantly more important than the other element
7	One element is clearly more important than the other
9	One element is absolutely more important than the other
2,4,6,8	Values between two adjacent considerations

(Source: Saaty, T. L. 1980)

This study used personally administered questionnaires as the primary method of data collection. This technique involved distributing questionnaires directly to respondents to obtain individual opinions regarding the implementation of quality management. The collected data was then analyzed using the Analytical Hierarchy Process (AHP) method. The data analysis process was divided into three main stages:

1. Comparing criteria,

2. Forming the AHP matrix, and

3. Determining priority weights.

The flow of these analysis stages is shown in Figure 1 as the basis for processing the research data.

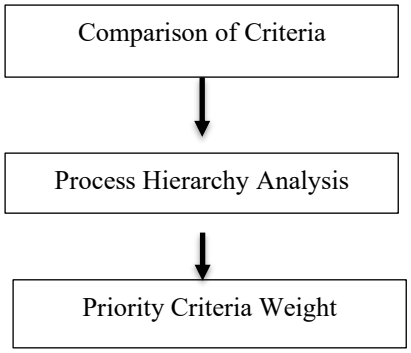

Figure 1. Analysis Stages

The Analytical Hierarchy Process (AHP) method, developed by Thomas L. Saaty in 1970, is a multi-criteria decision-making technique used to solve complex problems by decomposing them into a hierarchy. AHP allows subjective preferences to be converted into numerical values for quantitative analysis. The hierarchical structure in AHP consists of three levels: the main objective (goal), the criteria or sub-criteria that influence the decision, and the alternative solutions. The AHP hierarchy consists of:

a. Level 1: The main objective in decision-making.

b. Level 2 (Criteria/Sub-criteria): Factors that influence decision-making.

AHP provides a mechanism for measuring the level of assessment consistency using Equations 1 and 2.

CI (*Consistency Index*) = (λ_max – n)/(n –1) ..... (1)
CR (*Consistency Ratio*) = CI / RI..... (2)

Description:

λ_max: Maximum eigenvalue

n: Number of elements being compared

RI (Random Index): random index that depends on the value of n

The following is a table of random indices shown in Table 2.

Table 2. Random index

n	RI
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

(Source: Saaty, T. L. 1980)

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If CR ≤ 0.1 (10%), then the comparison results are considered consistent. If CR > 0.1, then a re-evaluation is necessary.

A flowchart is a step-by-step guide to ensure the research is directed and systematic. The research flowchart is shown in Figure 2.

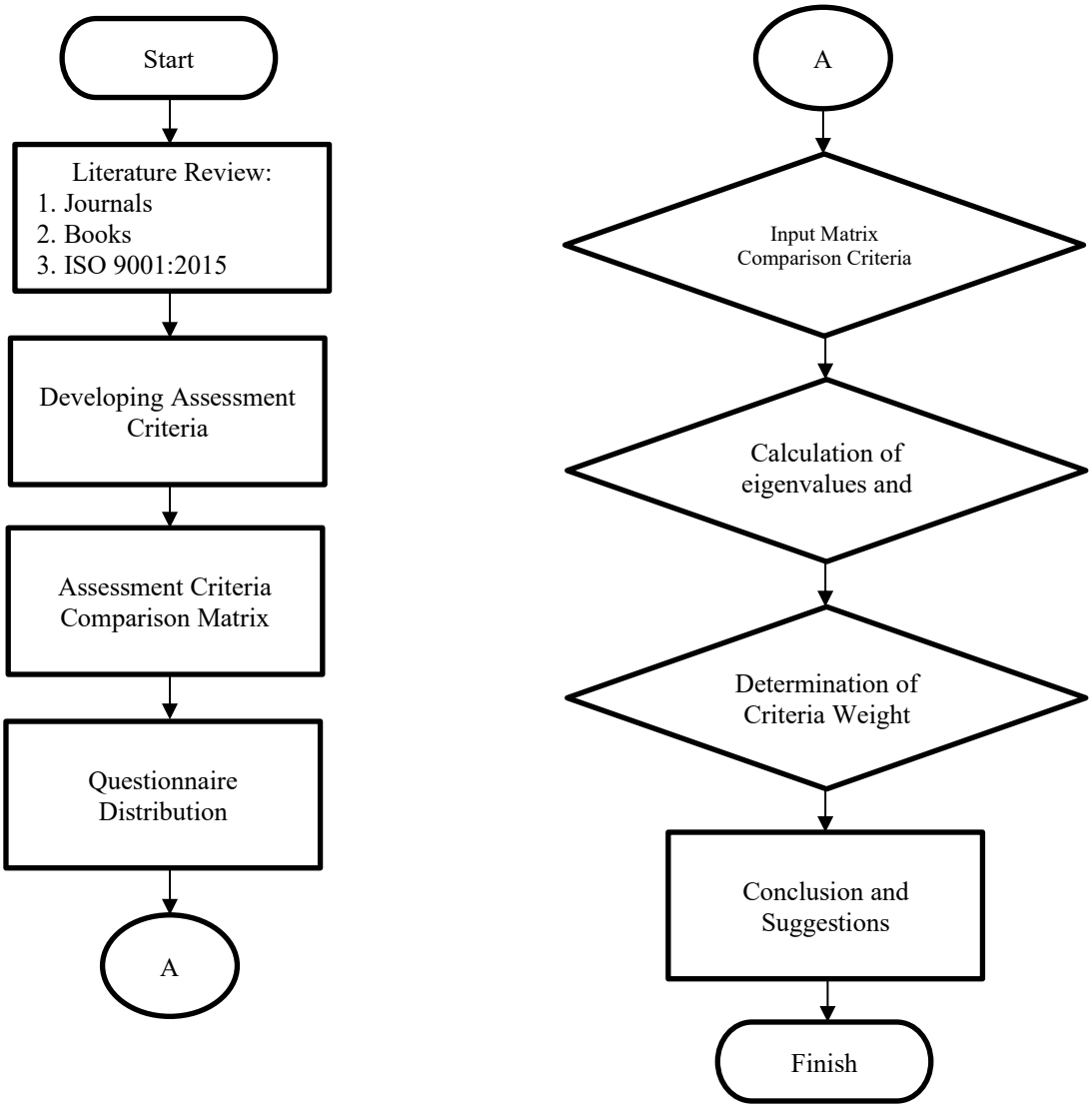

Figure 2. Research flowchart

RESULTS AND DISCUSSION

Respondents were selected purposively, taking into account academic qualifications and professional experience. The main criteria used were:

a. Minimum Bachelor's degree (S1) in Civil Engineering

b. Minimum 10 years of work experience in building or similar construction projects, to ensure adequate competency and practical insight in evaluating the implementation of ISO 9001:2015.

Data on respondent characteristics was collected to describe their background and role in the project, thus supporting the validity of the research results. A total of 40 expert respondents responded to the

questionnaire distributed between June 15 and July 5, 2025. The following are the results of the respondent characteristics:

a. Respondent Age

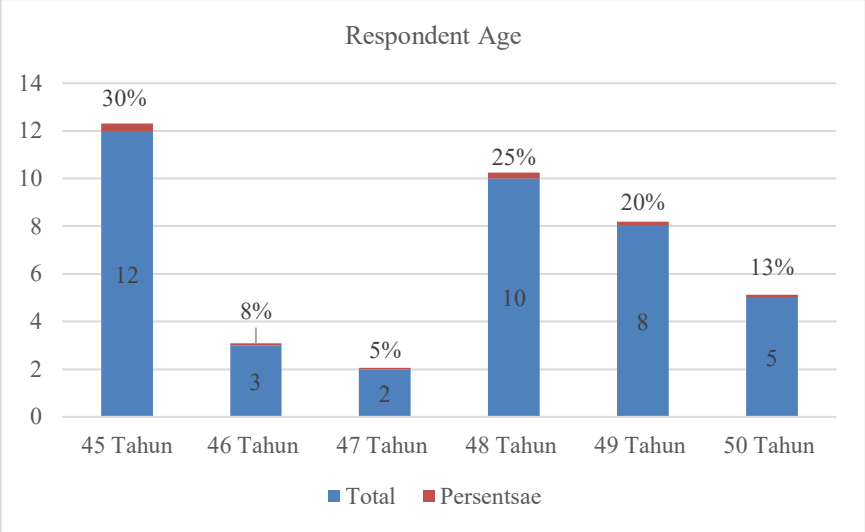

Figure 3. Respondent Age

Figure 3 shows that the respondents in this study, 40 construction experts, were between the ages of 45 and 50. The largest distribution was in the 45-year-old age group, with 12 respondents, or approximately 30% of the total respondents. Furthermore, the 48-year-old age group was represented by 10 respondents (25%), the 49-year-old age group by 8 respondents (20%), the 50-year-old age group by 5 respondents (13%), the 46-year-old age group by 3 respondents (8%), and the least frequent were the 47-year-old age group by 2 respondents (5%).

b. Gender

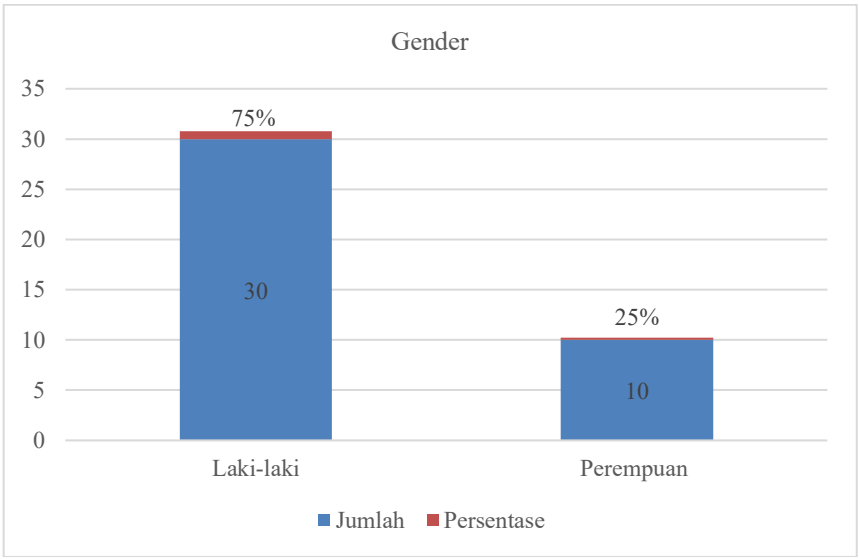

Figure 4. Gender

Figure 4 shows that this study involved 40 respondents, consisting of 30 males (75%) and 10 females (25%).

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b. Last education

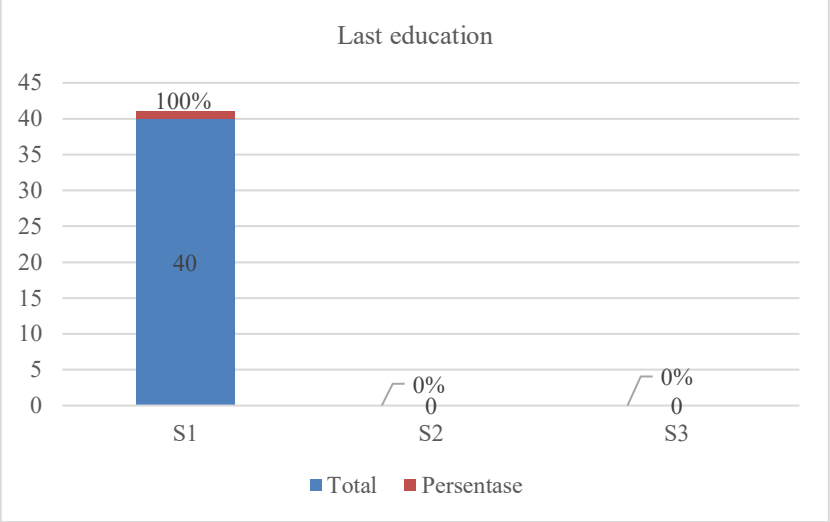

Figure 5. Last Education

Figure 5 shows that all respondents in this study had a Bachelor's degree (S1), a total of 40 people, or 100%. No respondents were found with a Master's or Doctoral degree (S2) or Doctoral degree (S3).

c. Respondents' Positions

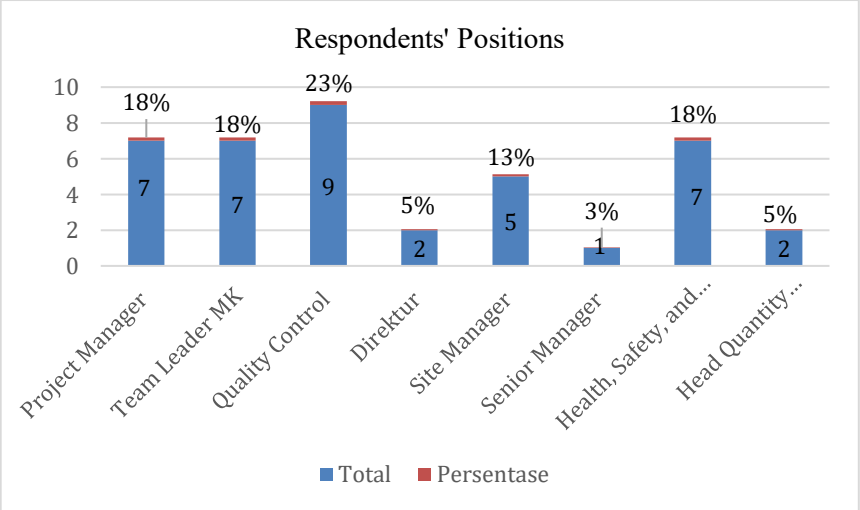

Figure 6. Respondent Positions

Figure 6 illustrates the variation in respondents' positions, reflecting the general organizational structure of construction projects. Of the 40 respondents, the position with the largest number of positions was Quality Control, with 9 people (23%), indicating the importance of quality control in supporting the implementation of a project's quality management system. Furthermore, three other positions had equal proportions: Project Manager, MK Team Leader, and Health, Safety, and Environment (HSE), each with 7 respondents (18%). This indicates significant participation from strategic and functional units in project implementation. Site Manager was represented by 5 respondents (13%), demonstrating the direct involvement of the field team in day-to-day managerial activities. The positions of Director and Head Quantity Surveyor were each held by 2 people (5%),

while only one Senior Manager (3%). This diversity indicates that the information collected encompasses perspectives from various levels of the organization, from both strategic and operational technical perspectives.

a. Length of Service on Construction Projects

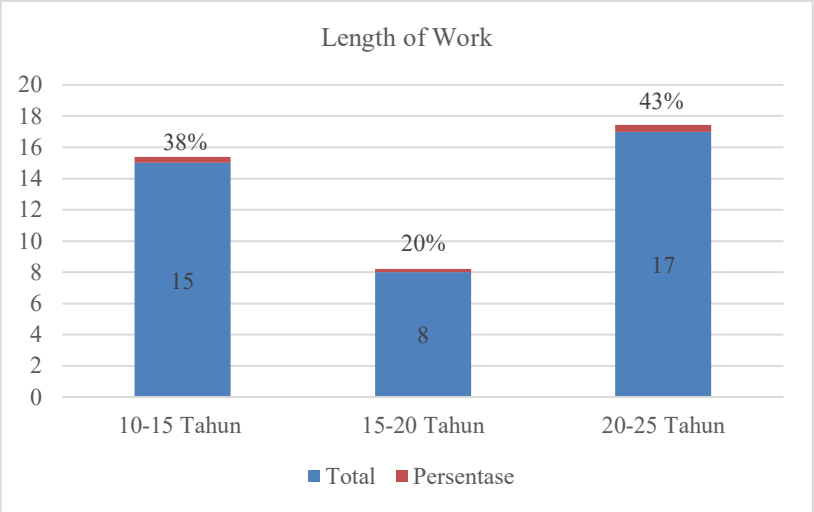

Figure 7. Length of Service in Construction Projects

Figure 7 shows that the majority of the 40 respondents in this study have extensive work experience in the construction sector. Those with 20–25 years of experience were the most dominant, representing 17 individuals (43%). This indicates that most respondents possess a solid understanding and extensive technical expertise in project management. Fifteen respondents (38%) had between 10 and 15 years of experience, and another eight respondents (20%) had between 15 and 20 years.

Findings: Implementation of the ISO 9001:2015 Standard in Projects is a Factor Influencing Project Success

The success of construction projects is greatly influenced by the effectiveness of the implementation of a quality management system. Two commonly used approaches are ISO 9001:2015 and Total Quality Management (TQM). To identify the most influential factors, this study used nine key quality indicators outlined in a questionnaire. The assessment was conducted using the Analytical Hierarchy Process (AHP) method, using a paired comparison scale (1, 3, 5, 7, and 9) to allow respondents to systematically assess the importance of each criterion. The questionnaire was completed by 40 expert respondents, purposively selected based on their experience and involvement in the project, specifically the construction of the Soekarno-Hatta Airport Police Station Building. The data obtained was then analyzed using AHP to determine the priority weight of each criterion, thus identifying the most influential factors in the implementation of ISO 9001:2015 on the project. The results of these calculations are shown in Table 3.

Table 3. Results of the Analysis Hierarchy Process (AHP) matrix from a total of 40 expert respondents

	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**Total**	**priority**	**Eigen Vector**	**percentage**
A	1,00	1,04	1,17	1,08	0,67	1,05	0,94	1,02	1,00	8,97	0,99	0,11	10,79
B	1,00	1,00	1,21	1,12	1,13	0,81	1,10	1,35	1,00	9,71	1,07	0,12	11,70
C	0,87	0,83	1,00	1,43	0,78	1,04	1,13	1,27	1,18	9,53	1,04	0,11	11,36
D	0,90	0,90	0,70	1,00	0,77	0,83	1,25	0,81	1,23	8,38	0,91	0,10	10,00
E	1,50	0,89	1,39	1,29	1,00	1,25	1,11	1,68	0,95	11,07	1,20	0,13	13,16

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	A	B	C	D	E	F	G	H	I	Total	priority	Eigen Vector	percentage
F	0,93	1,23	0,97	1,25	0,80	1,00	0,72	1,32	0,89	9,11	0,99	0,11	10,85
G	1,06	0,91	0,88	0,80	0,92	1,39	1,00	0,92	0,72	8,60	0,94	0,10	10,29
H	0,97	0,81	0,84	1,25	0,59	0,84	1,09	1,00	1,02	8,41	0,92	0,10	10,02
I	1,12	1,05	0,99	0,81	1,13	1,20	1,44	1,07	1,00	9,83	1,08	0,12	11,82
Total	9,36	8,65	9,16	10,04	7,80	9,42	9,78	10,44	8,98		9,15	1,00	

(Source: Primary data processing, 2025)

Description:

1. A: Customer Focus
2. B: Project Management Leadership
3. C: Personnel Involvement
4. D: Process Approach
5. E: Continuous Improvement
6. F: Evidence-Based Decision Making
7. G: Product and Service Control
8. H: Risk and Opportunity Management
9. I: OHS Implementation

Based on the results in Table 3, using the Analytical Hierarchy Process (AHP) method, project success is significantly influenced by the implementation of the ISO 9001:2015 standard and Total Quality Management (TQM) principles. The analysis shows that the continuous improvement aspect received the highest weighting of 13.16%, demonstrating its strategic role in building a sustainable quality system. Next, OHS and project management leadership received weightings of 11.82% and 11.70%, respectively, demonstrating the importance of safety aspects and the managerial role in project control. Other influential criteria included personnel participation (11.36%), data-driven decision-making (10.85%), customer orientation (10.79%), and product and service control (10.29%). Meanwhile, risk and opportunity management and the process approach contributed 10.02% and 10.00%, respectively. Based on these findings, it is clear that the synergy between ISO 9001:2015 and TQM has a positive impact on overall project performance and success.

Findings: Identification of Key Factors for Successful Quality Management Implementation for Sustainable Project Success

Through questionnaire data processing using the Analytical Hierarchy Process (AHP) method, several factors were identified that significantly influenced the successful implementation of ISO 9001:2015 and Total Quality Management (TQM) in the Soekarno-Hatta Airport Police Building construction project. The analysis resulted in nine key prioritized criteria: project management leadership, risk and opportunity management, personnel participation, a process-based approach, product and service control, commitment to continuous improvement, OHS implementation, customer orientation, and data-driven decision-making. Each criterion received a weighted score based on expert assessment. The ranking results for these nine criteria are presented in Table 4.

Table 4. Ranking Table Results

No.	Ranking	Percentage
1	Continuous Improvement	13,16%
2	OH&S Implementation	11,82%
3	Project Management Leadership	11,70%
4	Personnel Involvement	11,36%
5	Evidence-Based Decision Making	10,85%
6	Customer Focus	10,79%
7	Product and Service Control	10,29%
8	Risk and Opportunity Management	10,02%
9	Process Approach	10,00%

(Source: Primary data processing results, 2025)

The following are the ranking results of the nine main criteria using the Analytical Hierarchy Process (AHP) method, represented as a percentage of alternative selections. Each criterion is presented according to its level of importance, calculated based on the weighting of expert respondents' evaluations. These results served as the basis for identifying the key factors that contributed most to the implementation of the quality management system in the Soekarno-Hatta Airport Police Building construction project, as shown in Figure 8.

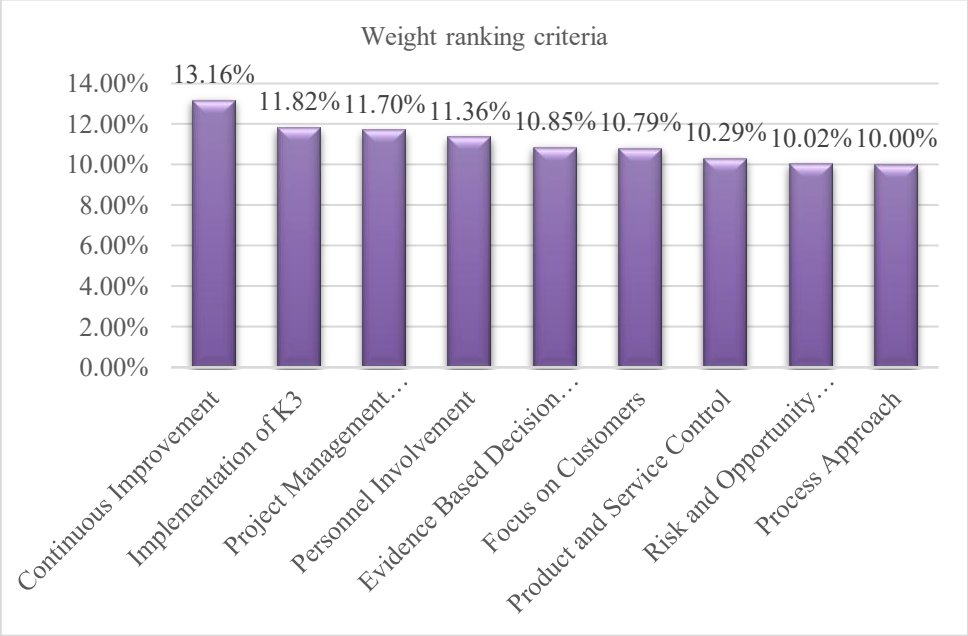

Figure 8. Ranking results of nine main criteria using the Analytical Hierarchy Process (AHP) method (Source: Primary data processing, 2025)

Based on the data analysis results in Table 4 and Figure 8 using the Analytical Hierarchy Process (AHP) method, a priority ranking of nine main criteria was obtained that contributed to the successful implementation of the ISO 9001:2015 quality management system in the Soekarno-Hatta Airport Police Station Building construction project. Assessments gathered from expert respondents indicate that several important elements significantly influence the implementation of the ISO 9001:2015-based quality system and Total Quality Management (TQM) principles in construction projects. The criterion with the highest weighting was continuous improvement at 13.16%, emphasizing the importance of a commitment to continuous improvement as the core of the quality system. Next came Occupational Safety and Health (OHS) with a weighting of 11.82% and project management leadership at 11.70%. This indicates that quality success is determined not only by systems and procedures, but also by a safety culture and effective leadership. Furthermore, personnel involvement (11.36%), evidence-based decision-making (10.85%), and customer focus (10.79%) also play a significant role in supporting quality consistency. Three other criteria—product and service control (10.29%), risk and opportunity management (10.02%), and the process approach (10.00%)—also contribute to maintaining the stability and sustainability of project operations. Overall, these findings confirm that the successful implementation of a quality management system is strongly influenced by the synergy between leadership, a quality culture, personnel participation, and the application of a systematic approach to project implementation. To clarify the priority weight of each criterion, the analysis results are visualized in the form of a spiderweb diagram in Figure 9,

Which shows the relative importance of each criterion. The further the red dot is from the center of the diagram, the greater the weight of that criterion.

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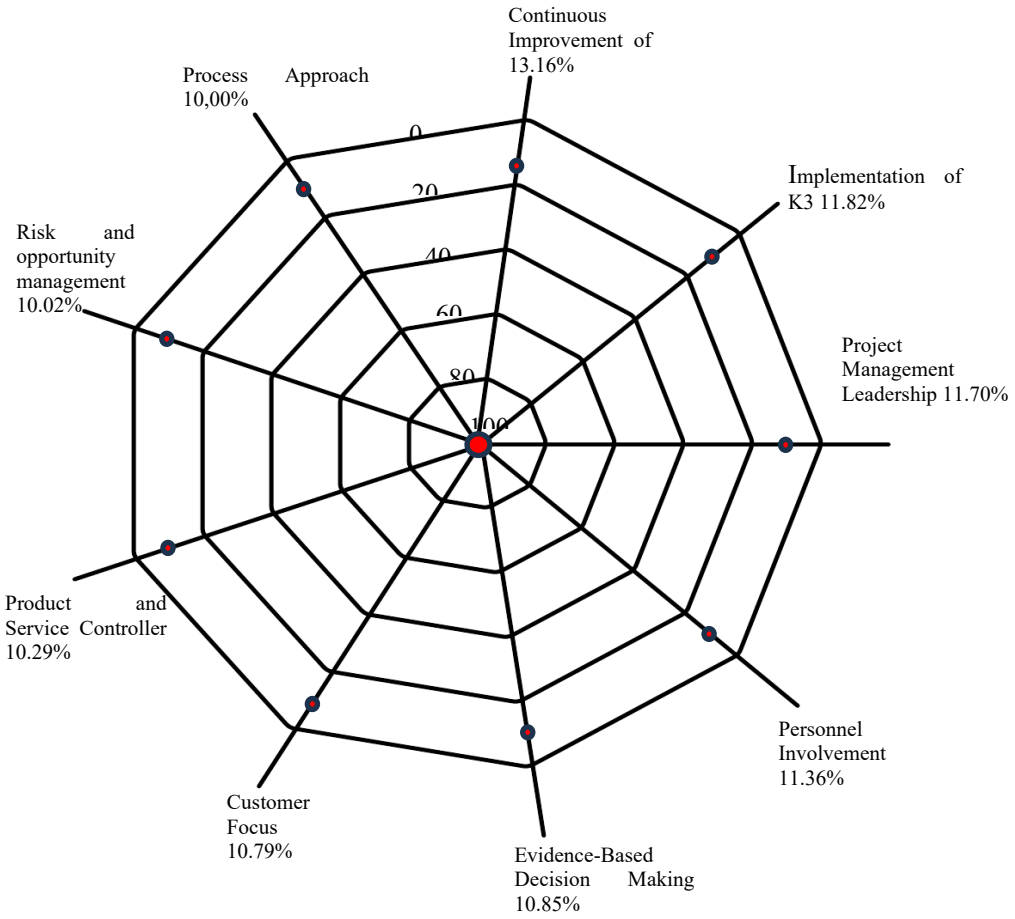

Figure 9. Priority ranking graph of quality management criteria using a spider webv(Source: Desiran Sembiring's Thesis, 2021)

CONCLUSION

The results of this study indicate that the success of the construction of the Soekarno-Hatta Airport Police Station Building was significantly influenced by the implementation of ISO 9001:2015 and Total Quality Management (TQM). Through AHP analysis, nine main factors were obtained as determinants of success, with the highest weighting on the aspect of continuous improvement 13.16%, then Occupational Safety and Health 11.82%, and leadership in project management 11.70%. Other contributing factors include workforce involvement, evidence-based decision making, customer focus, product and service control, risk and opportunity management, and the application of a process approach. These findings show that project success is not only determined by technical aspects, but is also influenced by the quality of leadership, quality culture, and the participation of all personnel. In this case, the implementation of ISO 9001:2015 and TQM serves a dual function, namely as a quality control instrument and a performance improvement strategy that supports the sustainability of the construction project.

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