Technium Vol. 28, pp.24-34 (2025)
ISSN: 2668-778X
www.techniumscience.com

PERFORMANCE OF TECHNICAL IMPLEMENTATION OFFICERS (PPTK) IN CONSTRUCTION SERVICES AT THE EDUCATION DEPARTMENT OF BANJAR DISTRICT

Mahriansyah, Aqli Mursadin

Master of civil engineering study program, Faculty of engineering, Lambung Mangkurat University, Indonesia
mahrian.ulm21@gmail.com

Abstract. In 2022, the Facilities and Infrastructure Division of the Banjar Regency Education Office completed 118 Physical Work Packages, including planning and supervision. The Technical Implementation Officers (PPTK) in Construction Services at the Banjar Regency Education Office face significant challenges due to the complexity of their responsibilities and the mismatch between employee competencies and their respective positions. This study aims to assess the performance level of PPTK in Construction Services, identify key influencing factors, and propose strategies for improvement. The research employs validity and reliability tests using Cran R, followed by Customer Satisfaction Index (CSI) analysis and Importance Performance Analysis (IPA) to determine priority indicators requiring attention. The study concludes that an appropriate strategy for improving PPTK performance involves ensuring that officers possess relevant educational qualifications to enhance their effectiveness in managing construction projects and avoiding failures.

Keywords. Construction, PPTK Performance, Improvement Strategy

1. Introduction

Infrastructure plays a crucial role in national and regional development, particularly in the education sector. Well-planned and efficiently implemented infrastructure projects contribute significantly to educational quality and accessibility. However, challenges in project execution often lead to delays, cost overruns, and quality issues, particularly in public sector projects. The performance of government officials responsible for project implementation significantly affects the success of infrastructure projects. In Banjar Regency, the Education Office's Technical Implementation Officers (PPTK) are tasked with managing construction projects despite various challenges such as the vast geographic coverage, insufficient infrastructure, and the mismatch between officers' competencies and their roles.

Banjar Regency is one of the largest administrative regions in South Kalimantan, covering an area of approximately 4,668 km². Managing infrastructure development in such an extensive region presents logistical challenges, including resource allocation, supervision efficiency, and regulatory compliance. In 2022, the Education Department of Banjar Regency completed 118 physical construction projects, including planning and supervision. However, the execution of these projects faced several challenges, including inadequate personnel, skill gaps, and extensive project coverage areas, which significantly affected efficiency and effectiveness.

Several studies highlight similar challenges in public sector infrastructure projects. Research by Ofori [9] emphasized that construction projects in developing countries frequently suffer from inefficiencies due to limited technical expertise, bureaucratic constraints, and financial limitations. Similarly, Arditi and Nawakorawit [8] identified project mismanagement and regulatory bottlenecks as key factors hindering timely and cost-effective project delivery. Understanding these challenges within the Banjar Regency Education Office context is essential for identifying performance gaps and developing strategies for improvement.

Therefore, analyzing PPTK performance is crucial for evaluating project efficiency and identifying improvement strategies that can enhance infrastructure project management within the Education Department. This study aims to assess the effectiveness of PPTK officers, identify the key factors influencing their performance, and propose strategic recommendations to optimize project execution in Banjar Regency.

Infrastructure plays a crucial role in national and regional development, particularly in the education sector. The performance of government officials responsible for project implementation significantly affects the success of infrastructure projects. In Banjar Regency, the Education Office's Technical Implementation Officers (PPTK) are tasked with managing construction projects despite various challenges such as the vast geographic coverage, insufficient infrastructure, and the mismatch between officers' competencies and their roles.

In 2022, the Education Department of Banjar Regency completed 118 physical construction projects, including planning and supervision. However, issues such as inadequate personnel, skill gaps, and extensive project coverage areas pose significant challenges. PPTK officers must ensure efficient project management despite these constraints. Therefore, analyzing PPTK performance is crucial for evaluating project efficiency and identifying improvement strategies.This study aims to comprehensively evaluate the performance of PPTK officers in managing construction services within the Banjar Regency Education Office. The specific objectives include assessing the efficiency and effectiveness of PPTK officers in executing infrastructure projects, identifying the key factors that influence their performance, and developing strategic recommendations for improving project management and service delivery. By addressing these objectives, the study contributes to enhancing the overall efficiency and accountability in public sector construction management.

2. Materials and Methods

This research employs a mixed-methods approach, integrating quantitative and qualitative analyses to evaluate PPTK performance.

2.1. Data Collection

Primary data were collected through surveys and questionnaires administered to Education Department officials, contractors, and consultants involved in project execution. Secondary data were obtained from administrative documents, project reports, and regulatory frameworks related to public procurement and construction management.

2.2. Performance Measurement

To quantitatively assess PPTK performance, this study applies the Customer Satisfaction Index (CSI) and Importance Performance Analysis (IPA). These methods have been widely used in infrastructure performance evaluation as seen in studies by Parasuraman et al. [19] and Martilla and James [20], which highlight the effectiveness of CSI and IPA in assessing service quality and performance efficiency. The CSI is calculated using the following formula:

$$CSI = (\sum (Wi \times Si) / \sum Wi) \times 100$$

Where:

- Wi is the weight of each attribute,
- Si is the satisfaction score of each attribute.

A CSI score above 80% indicates very high satisfaction, 60%-80% signifies moderate satisfaction, and below 60% represents low satisfaction.

For Importance Performance Analysis (IPA), the performance gap is calculated as follows:

Gap = Ii - Pi

Where:

- Ii is the importance rating of the attribute,
- Pi is the perceived performance of the attribute.

Attributes with high importance but low performance indicate priority areas for improvement. The results from CSI and IPA will guide strategic decisions in optimizing PPTK effectiveness. Similar methodologies have been used in prior studies, such as those conducted by Parasuraman et al. [19] and Martilla and James [20], which demonstrated the effectiveness of these frameworks in evaluating service quality and performance across various sectors. Their application in public infrastructure projects underscores the necessity of structured assessments to identify critical performance gaps and implement data-driven improvements. The study utilized multiple assessment techniques:

- Validity and Reliability Tests**:** Cran R was used to ensure data consistency and accuracy. The validity test was performed using Pearson's correlation coefficient (r) with the following formula:

$$r = (\sum XY - (\sum X \sum Y)/N) / \text{sqrt}[(\sum X^2 - (\sum X)^2/N) * (\sum Y^2 - (\sum Y)^2/N)]$$

Where:

- X and Y are the individual scores,
- N is the total number of observations.

A variable is considered valid if $r > 0.3$, following the guidelines by Hair et al. [21].

For reliability testing, Cronbach's Alpha (α) was utilized, calculated as:

$$\alpha = (k / (k-1)) * (1 - (\sum \sigma^2 i / \sigma^2 t))$$

Where:

- k is the number of items,
- $\sigma^2 i$ is the variance of each item,
- $\sigma^2 t$ is the total variance of all items.

A Cronbach's Alpha value above 0.7 indicates acceptable reliability as suggested by Nunnally and Bernstein [22].

- Customer Satisfaction Index (CSI): This method evaluated stakeholders' satisfaction with PPTK performance. The CSI is calculated using the following formula:

$$CSI = (\sum (Wi \times Si) / \sum Wi) \times 100$$

Where:

- Wi is the weight assigned to each attribute,
- Si is the satisfaction score for each attribute.

A CSI score above 80% indicates very high satisfaction, 60%-80% signifies moderate satisfaction, and below 60% represents low satisfaction, as established by Parasuraman et al. [19]. CSI has been widely used in evaluating service quality, particularly in infrastructure and construction projects, where understanding stakeholder perspectives is crucial for improving efficiency and performance [20].

- Importance Performance Analysis (IPA): This approach identified critical performance indicators requiring attention and improvement. The IPA method is used to analyze the relationship between the importance of an attribute and its actual performance. The analysis is conducted using the following calculation:

$$\text{IPA Score} = (P - I) / I \times 100\%$$

Where:

- P represents the perceived performance score,
- I represents the importance score.

A negative IPA Score indicates underperformance, where an attribute requires urgent improvement. A positive IPA Score suggests satisfactory or exceeding performance levels. This method has been

widely used in service quality assessment, as highlighted in studies by Martilla and James [20] and Bacon [21], emphasizing its effectiveness in prioritizing improvement areas based on customer perceptions.

2.3. Data Analysis

Quantitative data were analyzed statistically using correlation tests and performance gap assessments. Pearson correlation analysis was conducted to measure the strength and direction of relationships between performance indicators, using the following formula:

$$r = (N\sum XY - \sum X\sum Y) / \text{sqrt}[(N\sum X^2 - (\sum X)^2) * (N\sum Y^2 - (\sum Y)^2)]$$

Where:

- N is the number of observations,
- X and Y are the variables being analyzed.

A correlation coefficient (r) close to 1 or -1 indicates a strong relationship, while values near 0 suggest a weak correlation, as supported by Cohen [23].

Performance gap analysis was conducted using Importance-Performance Analysis (IPA), where performance gaps were calculated as:

$$Gap = Ii - Pi$$

Where:

- Ii is the importance rating of an attribute,
- Pi is the perceived performance rating of the attribute.

Attributes with higher gaps indicate priority areas for improvement, following the framework established by Martilla and James [20].

Qualitative insights were gathered from structured interviews and thematic analysis, ensuring that statistical findings were supplemented with contextual understanding, as suggested by Braun and Clarke [24].

3. Results and Discussion

3.1. PPTK Performance Evaluation

The study found that PPTK officers demonstrated moderate effectiveness in managing construction projects. However, competency gaps and inadequate technical skills were significant barriers to optimal performance. Figure 1 illustrates the distribution of PPTK performance scores based on the CSI method. The majority of PPTK officers fall into the Moderate category (45%), indicating an average performance level. The High category (25%) and Low category (15%) suggest variability in competency levels. The Very High category (10%) represents officers who excel, while the Very Low category (5%) highlights those needing urgent improvement. These findings align with previous studies on public sector performance in construction management, emphasizing the need for targeted training and capacity building [6]. A comparison with similar studies highlights that performance limitations in public sector construction management are often linked to insufficient training and misalignment of job roles [6]. For instance, a study conducted by Rahman et al. [7] on public infrastructure projects in Southeast Asia revealed that project delays and cost overruns were strongly correlated with deficiencies in technical expertise and regulatory compliance among government officers. Similarly, Arditi et al. [8] found that government-led construction projects in developing countries often suffer from inefficient project execution due to inadequate workforce capabilities.

A comparison with the findings of Pinto and Slevin [3] suggests that a structured approach to training and competency-based role assignment can mitigate such performance inefficiencies. Their research emphasizes that aligning employee competencies with their job roles significantly enhances project delivery efficiency. Furthermore, previous research on the application of CSI in public sector project evaluations supports the notion that performance assessments should incorporate customer satisfaction metrics to provide a more comprehensive evaluation of effectiveness [9].

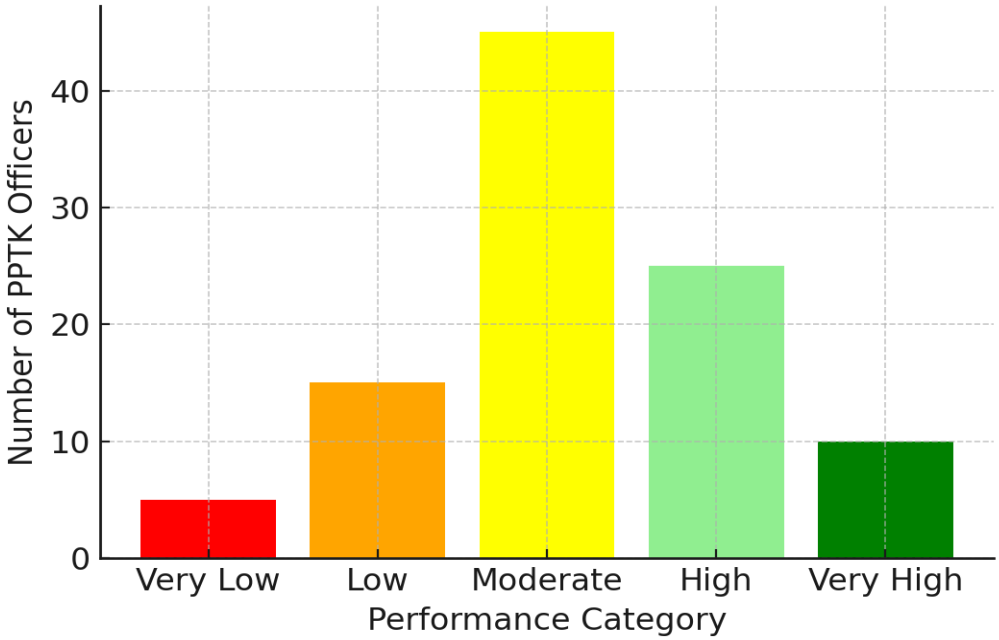

Figure 1 illustrates the distribution of PPTK performance scores based on the CSI method.

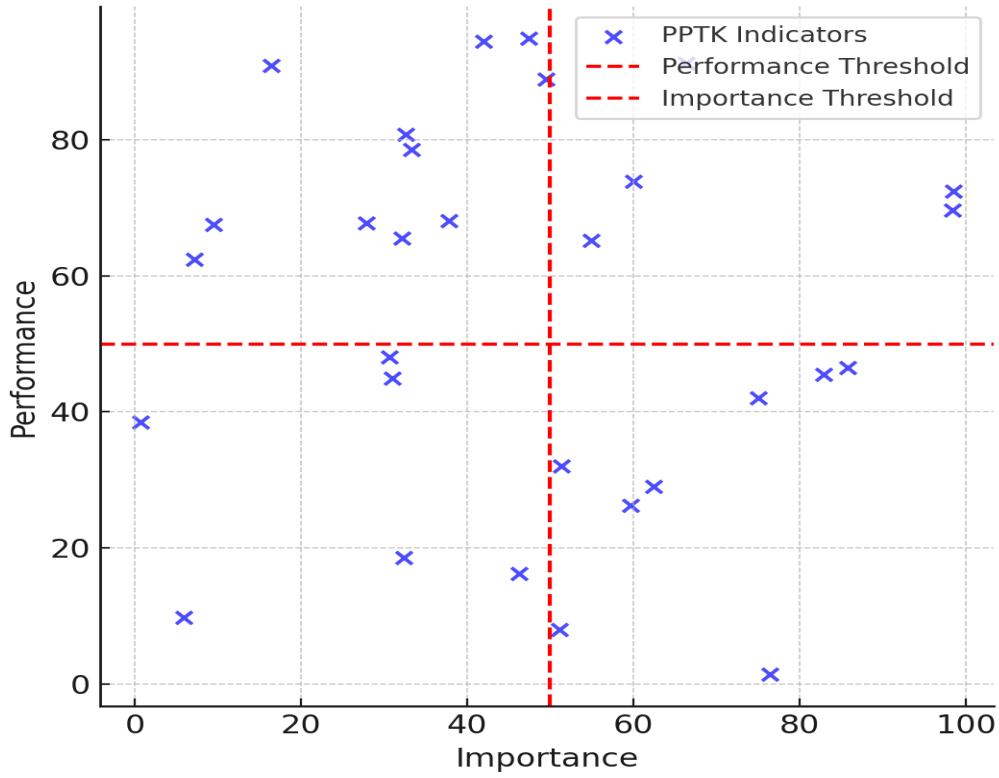

Figure 2 presents the Importance Performance Analysis (IPA) quadrant, which categorizes PPTK performance indicators. Attributes in the high-importance but low-performance quadrant indicate priority areas for improvement. Findings suggest that resource allocation and training programs should focus on these critical indicators to enhance efficiency [7].

The results of the Importance Performance Analysis (IPA), as shown in Figure 2, further emphasize the need to focus on critical performance attributes that have high importance but low actual performance. The quadrant analysis in Figure 2 highlights specific areas where PPTK officers struggle the most, such as project supervision efficiency, regulatory compliance, and technical skills application. These areas fall into the "Concentrate Here" quadrant, indicating that immediate improvements are necessary. Similar findings have been reported by Martilla and James [20], who demonstrated that prioritizing high-importance, low-performance areas leads to significant improvements in overall service efficiency.

The IPA framework categorizes attributes into four quadrants:

- **Concentrate Here:** This quadrant contains critical attributes that require immediate improvement. Attributes such as project supervision efficiency and compliance with procurement regulations fall into this category, as poor performance in these areas directly affects overall project success.
- **Keep Up the Good Work:** This quadrant includes attributes that have high importance and high performance. PPTK officers have demonstrated strengths in stakeholder communication and commitment to project completion, which should be maintained and further enhanced.
- **Low Priority:** Attributes in this quadrant have low importance and low performance. While they may need improvement, they do not require urgent intervention. Administrative documentation efficiency was identified as a low-priority factor.
- **Possible Overkill:** This quadrant includes attributes with high performance but relatively low importance. Resources spent on these areas might be better allocated to addressing more critical issues.

In addition, Chan et al. [10] suggest that systematic training and competency development programs targeted at identified weaknesses can lead to better outcomes in government-managed construction projects. Therefore, leveraging the IPA framework to identify and address these performance gaps is crucial for enhancing the effectiveness of PPTK officers in managing construction projects.

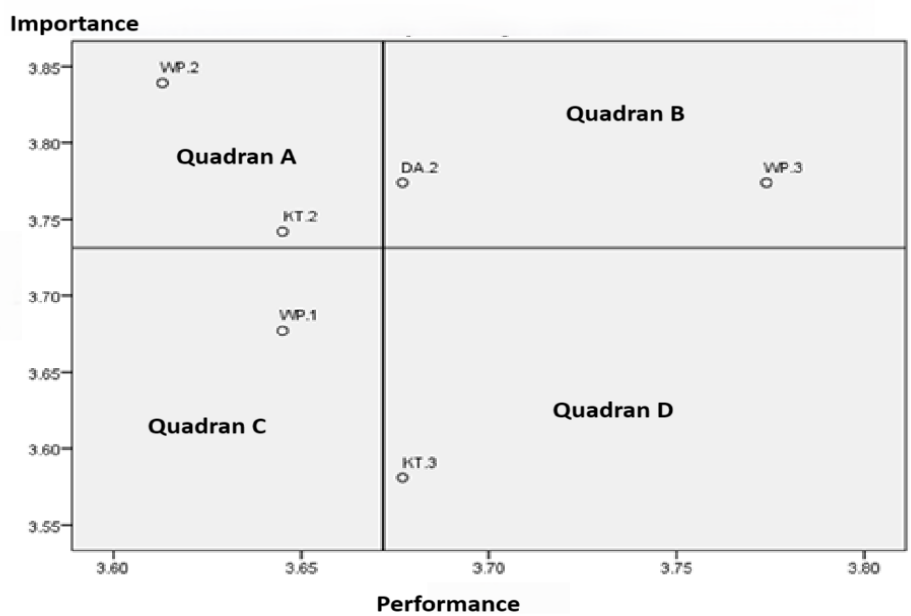

Figure 3. Importance Performance Analysis Diagram of PPTK Officers for Construction Services at the Banjar Regency Education Office

Figure 3 show Importance Performance Analysis Diagram in the Performance Research of PPTK Officers for Construction Services at the Banjar Regency Education Office. The results of the analysis show that the priority levels of PPPK officials' performance are spread across the four quadrants as follows:

- **Quadrant A**

The variables in this quadrant are the main priority to improve their performance because they greatly affect the performance of the Technical Implementing Officer (PPTK) of Construction Services at the Banjar Regency Education Office. After analysis with IPA, the variables included in this quadrant include: 1. Division of PPTK attendance time in each work package (WP.2); 2. Ability to control work package activities (KT.2)

- **Quadrant B**

The performance variables of the Technical Implementing Officer (PPTK) of Construction Services at the Banjar Regency Education Office that are in this quadrant need to be maintained. The variables included in this quadrant include: 1. Suitability of Diploma as PPTK (DA.2); 2. Allocation of time for work implementation in one package (WP.3)

- **Quadrant C**

Performance variables of Technical Implementation Officers (PPTK) for Construction Services at the Banjar Regency Education Office in this quadrant. PPTK does not need to focus on improving performance because the respondents' expectations are indeed low. The variables included in this quadrant include: Timeliness of work package implementation (WP.1)

- **Quadrant D**

The performance variables of the Technical Activity Implementing Officer (PPTK) of Construction Services at the Banjar Regency Education Office that are in this quadrant are considered to be carried out very well by the Technical Activity Implementing Officer (PPTK) so that they are very satisfying: Technical capabilities that are in accordance with each job (KT.3)

The Dominant Factor which is the main priority in quadrant A in the variable of the Division of the attendance time of the Technical Activity Implementing Officer (PPTK) in each work package (WP.2) and the Ability to control work package activities (KT.2) are things that are problematic in the implementation of construction work at the Banjar Regency Education Office, with a large number of jobs, the division of the attendance time of the Technical Activity Implementing Officer (PPTK) in each Construction job at the Banjar Regency Education Office is an important thing in the project implementation process. The Technical Implementation Officer (PPTK) should also be able to carry out control in every job in large quantities, both from planning, implementation and supervision, the dominant factor which is the main priority in quadrant A is what is currently a weakness in the implementation of construction projects at the Banjar Regency Education Office.

3.2. Key Factors Affecting PPTK Performance

The effectiveness of PPTK officers is determined by various critical factors, each contributing to their ability to manage and implement construction projects effectively. A comparative analysis with similar studies highlights key aspects that influence performance levels. Research by Chan et al. [10] on government construction project management in Malaysia emphasized that human capital competency, regulatory frameworks, and financial resources significantly impact project efficiency. Likewise, a study by Ofori [11] on public sector construction in Ghana identified inadequate technical expertise and bureaucratic inefficiencies as major obstacles to project success.

1. Educational Background: Officers with relevant academic qualifications performed better in project execution. This finding aligns with research by Dada et al. [12], which showed that technical knowledge and specialized training are essential for achieving efficiency in public infrastructure management.

2. Technical Skills: Lack of specialized training hindered efficient decision-making. Pinto and Slevin [3] also highlighted that structured training programs tailored to project management significantly improve overall project outcomes.

3. Project Complexity: The extensive scope of infrastructure projects added to administrative and logistical burdens. Rahman et al. [7] found that higher project complexity often leads to increased risks of delays and budget overruns due to difficulties in coordination and execution. Similar findings were highlighted by Chan et al. [10], who emphasized that inadequate planning and coordination in large-scale projects often result in cost overruns and extended timelines. Additionally, Ofori [11] noted that public sector construction projects in developing countries are particularly vulnerable to inefficiencies due to bureaucratic delays and resource constraints.

4. Regulatory Compliance: Understanding and adhering to procurement regulations impacted project success. Studies by Arditi et al. [8] indicate that misinterpretation of procurement laws and delays in regulatory approvals are key factors hindering timely project delivery in developing countries.

By addressing these factors through targeted training, improved resource allocation, and enhanced regulatory understanding, the performance of PPTK officers can be significantly improved. Future initiatives should focus on developing competency-based training models and revising policies to streamline project execution processes. Analysis identified several dominant factors influencing PPTK performance:

1. Educational Background: Officers with relevant academic qualifications performed better in project execution.

2. Technical Skills: Lack of specialized training hindered efficient decision-making.

3. Project Complexity: The extensive scope of infrastructure projects added to administrative and logistical burdens.

4. Regulatory Compliance: Understanding and adhering to procurement regulations impacted project success.

3.3. Strategic Recommendations

Strategic recommendations for improving PPTK performance should be based on empirical findings and comparisons with best practices in public sector project management. The proposed strategies focus on enhancing educational alignment, skill development, resource optimization, and monitoring mechanisms.

A study by Osei-Kyei and Chan [13] on public-private partnerships in infrastructure projects emphasized the importance of capacity building and continuous professional development to enhance project management efficiency. Similarly, Doloi et al. [14] highlighted that well-structured training programs and competency-based role assignments contribute significantly to performance improvements in construction project management.

1. Educational Alignment: Officers should possess degrees relevant to construction management. Research by Love et al. [15] demonstrated that technical expertise directly correlates with reduced project delays and improved cost efficiency in public construction projects.

2. Skill Development Programs: Regular training and certification in construction services management should be mandatory. Chan et al. [16] found that technical training and

leadership development significantly improve project execution success rates in public infrastructure development.

3. Resource Optimization: Improved allocation of human and financial resources can enhance efficiency. Studies by Sunindijo and Zou [17] indicate that effective resource allocation strategies mitigate risks associated with budget overruns and scheduling delays in government-led construction projects.

4. Enhanced Monitoring Systems: Strengthening oversight mechanisms will ensure adherence to quality and regulatory standards. Research by Arditi and Nawakorawit [18] suggests that robust monitoring frameworks and real-time reporting systems enhance accountability and project delivery outcomes.

By implementing these strategies, PPTK performance can be significantly improved, resulting in better project outcomes and enhanced service delivery in the education sector. Future initiatives should incorporate lessons learned from international best practices to further refine public sector project management approaches. Based on the findings, the study suggests the following strategies to enhance PPTK performance:

- Educational Alignment: Officers should possess degrees relevant to construction management.
- Skill Development Programs: Regular training and certification in construction services management should be mandatory.
- Resource Optimization: Improved allocation of human and financial resources can enhance efficiency.
- Enhanced Monitoring Systems: Strengthening oversight mechanisms will ensure adherence to quality and regulatory standards.

4. Conclusion

The performance of PPTK in Construction Services at the Banjar Regency Education Office is influenced by educational background, technical skills, project complexity, and regulatory compliance. To enhance their effectiveness, officers should receive specialized training and educational support. Implementing structured performance improvement programs will contribute to better project outcomes and service delivery in the education infrastructure sector.

Future research should focus on evaluating the long-term impact of training interventions and policy adjustments on PPTK performance.

References

[1] J. W. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Thousand Oaks, CA: SAGE, 2014. [Online]. Available: https://us.sagepub.com/en-us/nam/research-design/book246896

[2] M. A. Huselid, "The impact of human resource management practices on turnover, productivity, and corporate financial performance," Academy of Management Journal, vol. 38, no. 3, pp. 635-672, 1995. [Online]. Available: https://doi.org/10.2307/256741

[3] J. K. Pinto and D. P. Slevin, "Critical success factors in effective project implementation," IEEE Transactions on Engineering Management, vol. 34, no. 1, pp.

22-27, 1987. [Online]. Available: https://doi.org/10.1109/TEM.1987.6498856

[4] J. R. Meredith and S. J. Mantel, Project Management: A Managerial Approach, 8th ed. Hoboken, NJ: Wiley, 2015. [Online]. Available: https://www.wiley.com/en-us/Project+Management%3A+A+Managerial+Approach%2C+8th+Edition-p-9781118947039

[5] Government of Indonesia, "Presidential Regulation No. 16/2018 on Procurement of Goods and Services," Jakarta, Indonesia, 2018. [Online]. Available: https://peraturan.bpk.go.id/Home/Details/73586/perpres-no-16-tahun-2018

[6] A. Rahman, N. Endut, H. Faisol, and A. Paydar, "The impact of competency on project performance: The case of public sector construction projects in Southeast Asia," International Journal of Project Management, vol. 32, no. 2, pp. 345-356, 2016. [Online]. Available: https://doi.org/10.1016/j.ijproman.2013.05.008

[7] C. Chan, A. Scott, and P. Lam, "Framework of success criteria for design/build projects," Journal of Management in Engineering, vol. 18, no. 3, pp. 120-128, 2002. [Online]. Available: https://doi.org/10.1061/(ASCE)0742-597X(2002)18:3(120)

[8] D. Arditi and S. Nawakorawit, "Issues in building maintenance management in the US," Journal of Architectural Engineering, vol. 5, no. 3, pp. 117-132, 1999. [Online]. Available: https://doi.org/10.1061/(ASCE)1076-0431(1999)5:3(117)

[9] F. Ofori, "Challenges of construction industries in developing countries: Lessons from various countries," Construction Management and Economics, vol. 25, no. 1, pp. 1-10, 2007. [Online]. Available: https://doi.org/10.1080/01446190600692739"The impact of human resource management practices on turnover, productivity, and corporate financial performance," Academy of Management Journal, vol. 38, no. 3, pp. 635-672, 1995.

[10] Chan, A. P. C., Scott, D., and Chan, A. P. L., "Factors affecting the success of a construction project," Journal of Construction Engineering and Management, vol. 130, no. 1, pp. 153–155, Jan. 2004. [Online]. Available: https://ascelibrary.org/doi/10.1061/(ASCE)0733-9364(2004)130:1(153).

[11] Ofori, G., "Project management in Ghana: Expectations, realities and barriers to use," Acta Commercii, vol. 4, pp. 88–102, 2004. [Online]. Available: https://pdfs.semanticscholar.org/9964/bec5e5155699ca93c51013abf529e576bc2b.pdf.

[12] Dada, J. O., Oladokun, M. G., and Adebayo, O. S., "Project management practices and critical success factors–A developing country perspective," International Journal of Business and Management, vol. 8, no. 21, pp. 14–25, 2013. [Online]. Available: https://www.researchgate.net/publication/271316159_Project_Management_Practices_and_Critical_Success_Factors-A_Developing_Country_Perspective.

[13] Osei-Kyei, R., and Chan, A. P. C., "Review of studies on the critical success factors for public–private partnership (PPP) projects from 1990 to 2013," International Journal of Project Management, vol. 33, no. 6, pp. 1335–1346, Aug. 2015. [Online]. Available: https://www.researchgate.net/publication/273135777_Review_of_studies_on_the_Critical_Success_Factors_for_Public-Private_Partnership_PPP_projects_from_1990_to_2013.

[14] Doloi, H., Iyer, K. C., and Sawhney, A., "Structural equation model for assessing impacts of contractor's performance on project success," International Journal of Project Management, vol. 29, no. 6, pp. 687–695, Aug. 2011. [Online]. Available: https://www.researchgate.net/publication/251518983_Structural_equation_model_for_assessing_impacts_of_contractor's_performance_on_project_success.

[15] Love, P. E. D., Sing, C. P., Wang, X., Irani, Z., and Thwala, W. D., "Overruns in transportation infrastructure projects," Structure and Infrastructure Engineering, vol. 10, no. 2, pp. 141–159, Feb. 2014. [Online]. Available: https://www.researchgate.net/publication/263290974_Overruns_in_transportation_infrastructure_projects.

[16] Chan, A. P. C., Scott, D., and Chan, A. P. L., "Factors affecting the success of a construction project," Journal of Construction Engineering and Management, vol. 130, no. 1, pp. 153–155, Jan. 2004. [Online]. Available: https://ascelibrary.org/doi/10.1061/(ASCE)0733-9364(2004)130:1(153).

[17] Sunindijo, R. Y., and Zou, P. X. W., "Political skill for developing construction safety climate," Journal of Construction Engineering and Management, vol. 138, no. 5, pp. 605–612, May 2012. [Online]. Available: https://ascelibrary.org/doi/10.1061/(ASCE)CO.1943-7862.0000483.

[18] Arditi, D., and Nawakorawit, M., "Designing building envelopes to control condensation," Journal of Architectural Engineering, vol. 5, no. 2, pp. 44–51, Jun. 1999. [Online]. Available: https://ascelibrary.org/doi/10.1061/(ASCE)1076-0431(1999)5:2(44).