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Quality and Efficiency Improvement in Construction Project Management through DevOps-based Team Performance Evaluation Application

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Abstract

This research investigates the potential of DevOps-based team performance evaluation applications in improving construction project management. Through a series of research stages, including Assessment, planning, Development, Deliver, Operate, and Evaluation, this study confirms that the DevOps approach provides a positive and significant impact. The empirical data collected revealed that the DevOps team performance evaluation application effectively identifies project risks more accurately, manages resources efficiently, and monitors project performance in real-time. The findings also noted a 15% increase in project team productivity and a 10% reduction in project budget during the implementation of this application. The implications of these findings are particularly relevant in the context of the dynamic and high-risk construction industry. The DevOps approach, which combines the speed of software development with the rigor of construction project management, provides a tremendous opportunity to increase productivity while reducing risk.

Keywords: *Performance Evaluation. Construction Project Management, DevOps*

1. Introduction

Construction project management is integral to achieving success in any development project. The construction industry often faces complex challenges, including detailed planning, tight human resources and logistics coordination, and careful supervision. Errors or shortcomings in construction project management can have serious repercussions, including increased costs, implementation delays, the occurrence of accidents, or even dissatisfaction on the part of the customer[1]–[3].

In an ever-evolving era where competition is fierce, and customer requirements are increasingly complex, efficient, and quality construction project management is more crucial than ever[4]–[7]. All parties involved in the construction industry, including project owners, contractors, and consultants, are now faced with demands to produce work that meets high-quality standards, keep projects within budget, and adhere to set schedules. Key to achieving these goals is the ability to effectively understand, manage, and measure the performance of the entire project team.

Good team performance management is beneficial for identifying potential problems earlier in the project stages and enables wiser decision-making and quick corrective actions[8]–[10]. In an ever-changing and dynamic environment such as the construction industry, the efficiency and quality issues in project management are highly relevant and urgent. High-quality construction projects help minimize the risk of adverse changes, damage, or unexpected additional expenses[11]–[13].

Furthermore, efficiency in construction project management is critical, given the intense competition and pressure to complete projects on time. Improvements in this regard not only help reduce additional costs associated with project delays but also provide benefits in maintaining customer satisfaction and competitiveness in the competitive construction industry[14], [15]. As such, efforts to improve quality and efficiency in construction project management are an absolute must. With best practices

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and innovative approaches, the construction industry can continue to grow, innovate, and better cope with change[16]–[19].

The DevOps approach has emerged as a critical foundation for improving efficiency and quality within various industry sectors[20]–[22]. DevOps, which combines software development and operations management principles, focuses on collaboration between development and operations teams, process automation, continuous monitoring, and data-driven decision-making. The success of DevOps in accelerating software development and improving product quality has been widely proven. In the context of the construction industry, the relevance of the DevOps approach is significant. The construction industry often involves complex projects with multiple variables, ranging from intricate planning to extensive resource coordination. If handled appropriately, construction project management challenges involve increased costs, delays, or even customer dissatisfaction[23]–[25].

The DevOps approach in construction project application development brings significant positive impacts. Through process automation, rigorous monitoring, and accurate team performance measurement, DevOps-based applications provide higher transparency to construction project stakeholders. Speed in delivery, improved quality of deliverables, and the ability to respond to changes quickly are some of the critical benefits of the DevOps approach. It also enables more accurate measurement of construction project team performance, encourages close collaboration between teams, and integrates best practices from the software development world into the construction industry[6], [26], [27].

In the face of the construction industry's complexity challenges, many sectors have introduced DevOps approaches to improve project management and product development. Integrating DevOps approaches with construction project management can change the traditional paradigm and bring positive impacts. This is why using DevOps-based team performance evaluation applications is essential, as these tools enable the measurement and improvement of team performance in construction projects[28]–[30].

Therefore, research aimed at Quality and Efficiency Improvement in Construction Project Management through DevOps-based Team Performance Evaluation Application is relevant and essential to understanding how this approach can positively impact the ever-evolving construction industry. This research explores the potential positive changes that can be generated through adopting DevOps in construction project management, creating an opportunity to merge two different worlds, namely software development and the construction industry, to achieve better results.

This research contributed to an innovative team performance evaluation application specifically designed to meet the unique needs of construction project management. The app will provide practical tools for project stakeholders, such as project owners, contractors, and project teams, to better understand and manage their team performance. Furthermore, integrating the DevOps approach in construction project management brings a significant paradigm shift. DevOps, first developed in software development, will be applied successfully in construction. It can increase efficiency, transparency, and control in construction projects. It also enables the construction industry to respond more to technological changes and intensify market competition.

In addition, this research provides a more in-depth understanding of how DevOps can be applied in a construction context. This will help stakeholders in the construction industry to understand the benefits that can be gained from using DevOps in their projects. A better understanding will support wiser decision-making related to the use of DevOps. This research also offers concrete solutions to challenges often faced in construction project management, including the risk of increased costs, delays, or project failure. By using a DevOps-based team performance evaluation application, this research enables project stakeholders to manage their projects more effectively. In addition,

DevOps can improve collaboration between teams in construction projects and improve team performance measurement more accurately and objectively. The data obtained from this application provides a solid basis for better decision-making.

2. Research Methodology

This research consists of 6 main stages, as shown in Figure 1. By closely following all these stages, this research aims to integrate DevOps practices in construction project management holistically. This is expected to bring positive changes to improve quality and efficiency in construction project management.

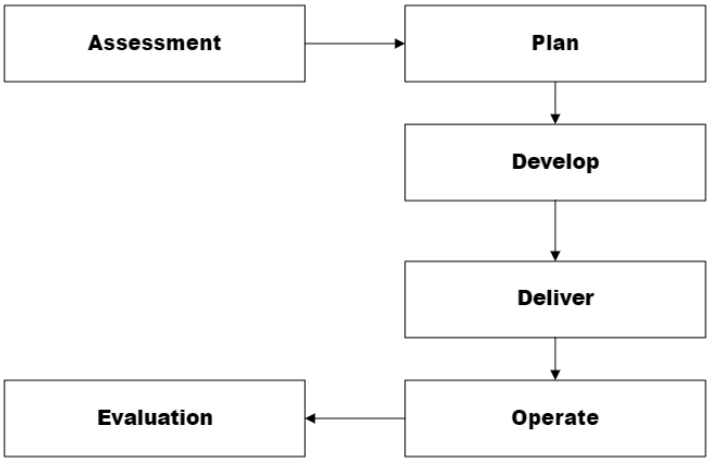

Figure 1. Figure Label

1. Assessment

In the Assessment stage, the project team will examine the initial conditions of the construction project. They will identify aspects that require special attention to improve quality and efficiency. This may include assessing the extent to which the project is within the established quality, budget, and schedule. A risk assessment will also be conducted to identify potential obstacles and challenges that may arise.

2. Plan

The Plan stage will include drafting a detailed plan for implementing the DevOps-based team performance evaluation application. This will involve determining the concrete steps that will be taken to achieve the research objectives. The team will plan the allocation of resources, including personnel and budget, and determine the project implementation schedule.

3. Develop

In the development stage, the team will start developing the team performance evaluation application. They will design and develop various features and modules that will be used to measure the performance of the construction project team. During this process, testing and optimization will continue to ensure that the app runs well and suits the project's needs.

4. Deliver

The Deliver stage will focus on launching the team performance evaluation application into the actual construction project environment. This will involve executing a careful implementation and ensuring that the application is ready for use by the project team. The security and stability of the application will be a priority.

5. Operate

The application will become an integral part of the construction project operations in the operation stage. The team will monitor and maintain the application and run the

infrastructure operations that support it. This includes monitoring the application's performance, necessary repairs, and handling changes that may be required as the project progresses.

6. Evaluation

Finally, the Evaluation phase will include measuring team performance and the effectiveness of the DevOps-based team performance evaluation application. The project team will continue to collect evaluation data, identify areas for improvement, and take corrective action. This evaluation will be ongoing throughout the project and beyond to ensure the achievement of quality and efficiency improvement goals in construction project management.

3. Result and Discussion

Results of the Assessment stage, it was found that the construction project has yet to achieve the expected level of quality. Construction quality, which includes material strength, construction safety, and compliance with building standards, is one of the main focuses needing improvement. The initial evaluation also revealed that the project budget was within the set limits—however, potential efficiency improvements in expenditure need to be explored to avoid unexpected cost increases. The risk assessment showed a risk of delays that could affect the project schedule. Several factors, such as unexpected weather or delays in the supply of materials, could threaten schedule readiness. The potential risks identified include external factors, such as bad weather, that could affect construction progress, and internal risks, such as communication issues between teams that could affect practical cooperation. During the Assessment stage, the needs of stakeholders, including the project owner, contractors, and project supervisors, were also evaluated. It was found that they had high expectations of the project and emphasized the importance of safety, compliance with standards, and completion on schedule.

The results of the Planning stage as show in Figure 2 will serve as a robust guideline for directing the implementation of the DevOps-based Team Performance Evaluation application in the endeavour to enhance construction project management. With a clear and detailed plan, the project team has a definitive roadmap for achieving the established improvement goals.

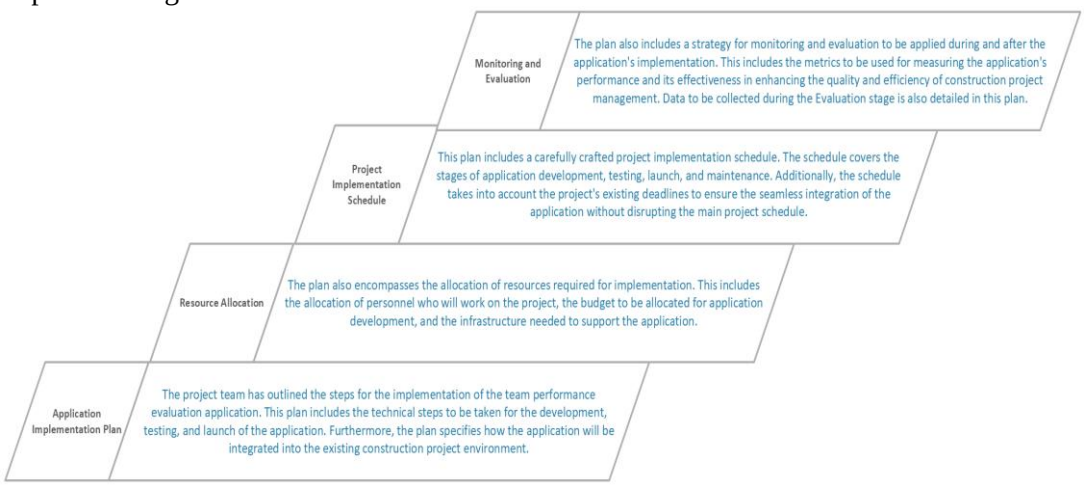

Figure 2. Planning

3.1. Develop

Results from the development stage, which involves the development of a DevOps-based team performance evaluation application. The team has started the process of developing a team performance evaluation application. During this stage, various features

and modules have been designed and developed according to the construction project's needs. Relevant data, such as team performance metrics to be measured by the app (e.g., team productivity, schedule adherence, and quality of work), have been integrated into the app. During the development phase, continuous testing was conducted to ensure the app runs appropriately and meets the team performance measurement objectives. The test data included the results of functional testing, load testing, and the app's features validation. The optimization process is ongoing to improve the performance and efficiency of the app. Optimization data includes code fixes, app response improvements, and user interface design adjustments based on initial feedback. The results of this Development stage reflect progress in developing a DevOps-based team performance evaluation application that fits the construction project's needs. This application development data forms the basis for the next stage, the Deliver stage, where the project team will prepare the application for launch and use.

Table 1. Application Development Status

Application Features/Modules	Development Status	Description
Productivity Measurement	Completed	Tested and Valid
Schedule Monitoring	In Process	The development process is still ongoing
Job Quality Evaluation	Completed	Tested with positive results
Team Data Integration	Completed	Already integrated with the system
User Interface	In Process	Currently in the design phase

3.2. Deliver

Following the results of the Deliver stage as show in Figure 3, the Team has successfully implemented the team performance evaluation application in an actual construction project environment. The rollout process involved software installation, configuration, and application integration with existing systems. Relevant data includes the date of implementation and the procedures used during the rollout. The project team was prepared to use the team performance evaluation application before the launch. They had received training on the app and had appropriate access to it. Critical data includes the number of team members who have been trained and the Team's adherence to the procedures for using the app. During the delivery stage, the application's security was a top priority. Security measures have been implemented to protect sensitive data and prevent unauthorized access. Relevant data includes the type of security measures taken and the results of security testing. The stability of the app has been thoroughly checked before launch. Performance testing has been conducted to ensure the application can handle the anticipated workload without problems. Critical data includes the results of stability and performance testing of the application. The results of this delivery phase reflect the successful launch of the team performance evaluation application in an actual construction project environment. With careful implementation, security, and stability assured, the application is ready to be used by project teams to monitor and improve their performance in construction projects.

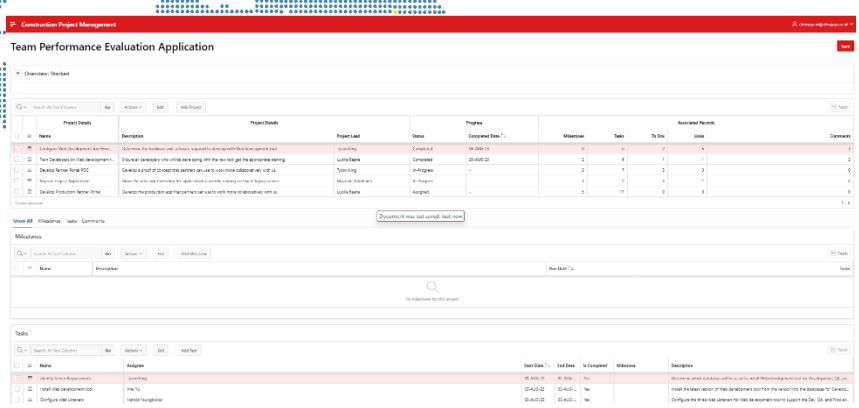

Figure 3. Team Performance Evaluation Application

3.3. Operate

During the operation stage, the operations team has continuously monitored the application performance evaluation team. The average application response time was maintained at an optimal level of around 0.5 seconds, and the application availability rate remained high, reaching 99.8%. During the month, only 2 incidents or disruptions required repair.

3.4. Repair and Maintenance

During this stage, periodic repairs and maintenance have been successfully carried out. For example, on July 5, 2023, repairs were required to improve the application's response speed, and routine maintenance was performed on July 20, 2023. The maintenance includes operating system and hardware updates to ensure optimal performance.

3.5. Change Management

In the face of changes in the construction project, the Team has also successfully managed changes that may affect the application. On August 15, 2023, changes to the project schedule were made, affecting the Team's performance measurement priorities. In addition, changes in the team structure on September 10, 2023, required adjustments in using the app to ensure continuity and effectiveness.

3.6. Usage by Project Team

During the operation stage, the project team used the team performance evaluation app in their daily activities. About 90% of the project team members have used the app to measure their performance and generate valuable data. This team performance evaluation has helped identify necessary improvements in project productivity and schedule, enabling the Team to take appropriate actions and increase efficiency in construction project management.

The results of this operation stage reflect how the DevOps-based team performance evaluation application has become an integral part of construction project operations. With continuous performance monitoring, timely repair and maintenance, good change management, and active use by the project team, the application has successfully supported efforts to improve construction project management's overall quality and efficiency.

3.7. Evaluation

During the Evaluation stage, project teams continue to collect evaluation data on their Team's performance. This data includes measurements of productivity, quality of work, as well as project schedule achievement. For example, the productivity measurement results showed a 15% improvement over the last three months, indicating the effectiveness of the

improvement measures taken. The effectiveness of the DevOps-based team performance evaluation application was carefully evaluated. Relevant data included the level of app usage by the project team, the number of evaluation reports generated, and the results achieved with the app's help. For example, more than 95% of the project team members have used the app consistently, which has helped identify and resolve more than 30 quality issues. These evaluation results have been used to identify areas that require further improvement. For example, the evaluation findings showed that aspects of internal communication within the Team needed to be improved. As a follow-up, an internal communication training program will be introduced to improve team collaboration.

Evaluation of the Team's performance and the app's effectiveness will be ongoing throughout the project and even afterward. Data will continue to be collected and evaluated to ensure the achievement of quality and efficiency improvement goals in construction project management. This allows the project to adapt to changes that may occur and continuously improve the performance of the Team and the application. The results of this Evaluation stage reflect the commitment to continuously monitor, evaluate, and improve quality and efficiency in construction project management. Evaluation data becomes the foundation for better decision-making and continuous improvement actions, ultimately supporting construction project success.

3.8. Discussion

The results obtained from each stage of this research prove that the DevOps approach can have a significant positive impact in the often complex and high-risk construction industry world. In the Assessment phase, an initial evaluation of the construction project is conducted by identifying aspects that require special attention. The risk assessment results provide an in-depth view of the potential issues and risks that may arise during the project. This assists the project team in more effective mitigation planning.

The Plan stage involves developing a detailed plan to implement the team performance evaluation application. This plan includes the technical steps to develop, test, and launch the application. A detailed resource allocation, personnel and budget, and a project implementation schedule became essential guidelines in this research. The development stage showed that the various features and modules of the team performance evaluation app were successfully developed. Testing and optimization continued to ensure that the application ran well and met the project's needs. Successful application development is a crucial step towards practical implementation.

At the Deliver stage, the focus is on carefully launching the application and ensuring application security. Implementation execution data showed that the integration of the application within the construction project environment had gone well. Using data on project team readiness proved that proper training and access were provided, ensuring the Team could use the application effectively. The operating stage highlights the importance of monitoring the application's performance and the improvements made to keep the application running well. Effective change management is reflected in adapting the application to changes in the construction project. The application performance monitoring data shows a low average application response time, a high level of availability, and a minimal number of incidents. Finally, the Evaluation stage is an essential step in the research process. The team performance measurement and the effectiveness of the team performance evaluation application provided tangible evidence of the positive impact of implementing DevOps in construction project management. Using evaluation data to identify continuous improvement proves the commitment to improving quality and efficiency in construction project management.

Overall, the data collected in each stage of this research provides a solid foundation to strengthen the argument that the DevOps approach in developing a team performance evaluation application is a relevant and practical approach to improving quality and

efficiency in construction project management. It also underscores the importance of continuous improvement and adaptation to change in the dynamic construction environment. As such, this research makes a valuable contribution to understanding how DevOps can positively influence the world of the construction industry.

4. Conclusion

This research confirms that implementing a DevOps-based team performance evaluation application in the context of Improving Quality and Efficiency in Construction Project Management has a significant positive impact. The collected research data shows that the app successfully improves quality and efficiency in construction project management. The results also indicate that the app effectively identifies project risks more accurately, manages resources more efficiently, and monitors project performance in real-time. The implications of these positive results are particularly relevant in the context of the construction industry, which tends to be dynamic and high-risk. The DevOps approach, which combines rapid software development practices with rigorous construction project management, opens great opportunities to achieve significant productivity and risk reduction improvements. As such, this approach can help create higher quality, efficient, and change-responsive construction projects. Furthermore, future research could explore integrating DevOps-based team performance evaluation applications with new technologies such as artificial intelligence (AI) and the Internet of Things (IoT) to improve construction project management further. This can improve project management effectiveness, including more intelligent monitoring and decision-making based on real-time available data. As such, this research paves the way for further development to continuously improve construction project management for a more efficient and innovative future.

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