

Analysis of DevOps Implementation on Project Audit System Development in a Construction Company

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Abstract. This research aims to develop a construction project audit system using DevOps methodology to improve efficiency and accuracy in construction project management. The research stages include Assessment, Plan, Develop, Deliver, Operate, and Evaluation. The results showed that the project audit system was successfully developed and operated for the past two years. System performance evaluation revealed that the average response time of the system was 120 m/s, with system availability reaching 99.8%. The project audit data has an accuracy rate of 99%, which confirms the reliability of the information generated by this system. The data analysis tool performed optimally and generated audit reports in an average of 20 seconds per report. The system contributes positively to addressing challenges in the construction industry by improving efficiency and accuracy in construction project management and audit supervision. Future research can explore the integration of the latest technologies, such as artificial intelligence and cloud computing, in project audit systems and measure their impact on actual construction projects.

1. INTRODUCTION

The construction industry plays a crucial role in developing infrastructure and the physical environment; however, managing construction projects in this industry often poses complex challenges. Environmental uncertainty, resource constraints, project complexity, stringent requirements regarding quality and safety, and time and budget constraints affect construction project management[1], [2]. Environmental uncertainty is a factor that is often difficult to predict. Regulatory changes, fluctuations in building material prices, and weather changes can impact construction projects, creating uncertainty in planning and execution. Limited resources such as labor, equipment, and materials are also challenges that must be faced. Coordinating and managing these resources requires careful planning and close supervision[3], [4].

Construction projects often have complex structures involving various subcontractors. Understanding and managing these dynamics requires careful planning, close supervision, and effective communication. Construction projects must adhere to strict quality and safety standards. Failing to meet these requirements can result in environmental damage and even workplace accidents. Construction projects often have tight time constraints and limited budgets. Planning and execution can result in project delays and going over budget[2], [5]–[7].

Construction project management is a complex and critical activity in the construction industry. Construction projects often involve significant investments, many parties, and a long implementation period. Therefore, ensuring that these projects are executed according to the set plans and objectives is of utmost importance. One essential tool used in this endeavor is a project audit system. Construction projects often require significant financial investments. In this case, the audit system helps ensure that the budget allocated to the project is used efficiently and by the plan. Audits carefully monitor expenditures, prevent waste, and identify savings opportunities[3], [8], [9].

Construction projects must meet strict quality and safety standards. Audits help ensure that all project phases, including planning, design, and execution, comply with established standards. This is important to prevent construction defects, quality degradation, and the risk of workplace accidents. Construction projects often involve multiple parties, including contractors, subcontractors, suppliers, and owners. Audits help identify and manage risks associated with the roles and responsibilities of each party so that appropriate actions can be taken to mitigate risks that may arise. Time constraints are often a challenge in construction projects. An audit system helps monitor project progress, identify potential delays, and ensure the project remains on schedule. This helps avoid delays that could negatively impact the project and budget. Audit systems create a high level of transparency in



construction projects. This is important in maintaining accountability among all parties involved in the project. Audits allow every action or decision to be accounted for, and ethical or legal violations can be identified and addressed[10]–[12].

With the above considerations, the project audit system in the construction industry is a crucial tool to ensure project success and risk avoidance. The audit helps control the budget and improves project quality, safety, and transparency. Therefore, within the scope of this research, we will explore how the application of DevOps methodology can strengthen the construction project audit system, improve efficiency, and provide more significant benefits to the construction industry[13]–[15]. A project audit system is designed to examine and evaluate a construction project in certain aspects to ensure that the project is running according to the plans, objectives, and standards set. Project audit systems are used to collect data, analyze performance, and provide recommendations for improvement. Project auditing involves monitoring project performance to ensure all project stages proceed according to plan. It involves assessing the expenditure, time, and quality of work done. Project audits help identify discrepancies with project plans and specifications. This includes looking for potential violations of applicable regulations, standards, or guidelines[16], [17].

A project audit creates a high level of transparency in the project. It ensures that actions and decisions taken in the project can be accounted for and traced back. Project audit results provide a basis for improvement recommendations. This can assist the project manager in taking the necessary actions to improve the project process or outcome. The importance of a project audit system in construction project management is significant. Without proper auditing, projects can be at risk of budget problems, delays, quality losses, or even failure. Auditing provides an essential tool for effective control and monitoring so that the project can proceed according to the established plan, budget, and objectives. It also helps ensure that projects meet applicable legal and regulatory requirements and the quality and safety standards required in the construction industry.

In developing a project audit system for construction project management, various technologies and tools are utilized to ensure effectiveness and efficiency in the audit process. In addition, an audit system design and workflow are proposed to guide this process. Project management software such as Microsoft Project, Primavera, or Trello manages project schedules, resource allocation, and project progress reporting. With this software, project managers can monitor project progress in real-time, manage resources more efficiently, and deliver progress reports to relevant parties. Data analysis tools such as Microsoft Excel and Python or specialized data analysis tools such as Tableau are used to process audit data. This enables the audit team to analyze project data, identify trends, and compile informative audit reports. With these capabilities, the audit team can explore the data in greater depth, reveal discrepancies, and provide appropriate recommendations[18], [19].

The application of DevOps methodology in the construction industry provides significant benefits. By increasing collaboration between the various parties involved in a construction project, DevOps enables projects to run more smoothly and efficiently[20]. Through the automation of routine tasks and continuous integration, DevOps helps reduce the risk of human error and ensures that projects run according to plan. Real-time monitoring of project performance and in-depth data analysis help project teams identify issues early and take corrective action quickly. By breaking down projects into better manageable components, the construction industry can optimize resource usage and improve overall construction efficiency. Moreover, maintaining good code and documentation helps maintain project transparency and accountability. Thus, DevOps allows the construction industry to innovate, reduce project time, and improve the quality of deliverables, providing significant benefits in construction project management.

To address these challenges, the construction industry is increasingly looking for innovations and methods that can help improve efficiency, productivity, and quality in managing projects. One approach that is gaining popularity is the implementation of the DevOps methodology. DevOps is an approach that aims to improve cooperation between development and operational teams, automate processes, and integrate workflows to improve efficiency. In this research, we will explore how the implementation of DevOps can play a crucial role in addressing construction project management

challenges. We will investigate how DevOps can help improve efficiency, reduce uncertainty, and ensure construction projects run on schedule and within budget.

2. METHOD

In the assessment phase, identify construction project audit needs such as budget, schedule, and regulatory compliance. Determine the software or tools needed, including project management and data analysis tools. Next, in the planning stage, plan the project audit information system development by planning the hardware, software, and integration with existing project management systems. The development stage as show in Figure 1 involves software design, integration of data analysis tools, and ensuring system access to construction project data. In the delivery phase, launch the system into the production environment to collect and process project audit data. The operational stage involves system maintenance and ongoing management, ensuring the system runs appropriately. During evaluation, review system performance, audit data accuracy, and data analysis tool functionality, using the evaluation results to improve the efficiency and accuracy of construction project audits.

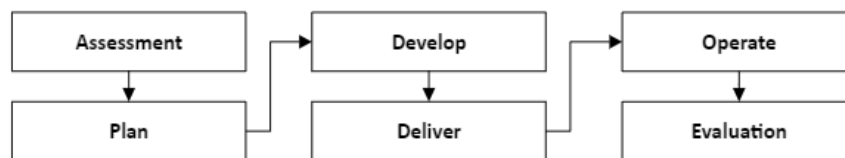


Figure 1 Research Stages

Assessment

During the assessment phase, identify the audit needs of the construction project. This includes understanding the information that should be audited, such as budget, schedule, and compliance with construction regulations. Identify software or tools required to support construction project audits, such as project management or data analysis tools.

Plan

In this stage, the development of the project audit information system is planned. This includes planning the hardware and software to be used and integration with existing project management systems and determining the testing strategy of the project audit information system to ensure that data audits can be performed accurately.

Develop

This stage includes software design and development, as well as the integration of data analysis tools to process and examine audit data. This stage also ensured that the system could access data from the project management system and project documents related to construction.

Deliver

The delivery stage of the project audit information system includes launching the system into the production environment. At this stage, the system is ready to use and can collect and process project audit data efficiently.

Operate

The operation phase of the project audit information system involves ongoing maintenance and management of the system. The system is running correctly, and project audit data is available for analysis by the audit team.

Evaluation

During the evaluation phase, review the performance of the project audit information system. This evaluation includes checking whether the system has fulfilled its purpose, whether the audit data is accurate, and whether the data analysis tools are functioning correctly. Use the evaluation results to improve the project audit information system and ensure construction project audits run more efficiently and accurately.

3. RESULTS AND DISCUSSION

Assessment

The result of the Assessment stage in developing the construction project audit information system is that the types of information to be audited in construction projects have been identified as show in Table 1. This includes budget, schedule, construction quality, compliance with regulations and standards, and human resources and machinery performance. A list of specific audit requirements has been compiled, including the data to be evaluated and integrated into the audit information system as shown in Table 2.

Table 1 Results of Identification of Construction Project Audit Needs

No	Identification of Construction Project Audit Needs
1	Construction project budget.
2	Project implementation schedule.
3	Quality of construction work.
4	Compliance with regulations and industry standards.
5	Performance of project human resources (HR).
6	Performance of construction equipment and machinery.

Table 2 List of System Requirements

No	Needs List
1	The budget should be audited monthly to ensure consistency with the original plan.
2	The project implementation schedule should be audited periodically to avoid delays.
3	Audits relating to the quality of work should include material testing and measurement of deliverables.
4	Compliance with safety and environmental regulations should be regularly audited.
5	Evaluation of human resource performance should include training levels and productivity.
6	Machinery and equipment performance should be monitored to avoid breakdowns or disruptions that affect the schedule.

Plan

The outcome of this planning stage is a detailed plan for developing the construction project audit information system. This includes hardware and software details, integration with other systems, and testing strategies to ensure the project audit information system can operate properly and provide accurate audit data as show in Figure 1. This data guides the next stage of development.

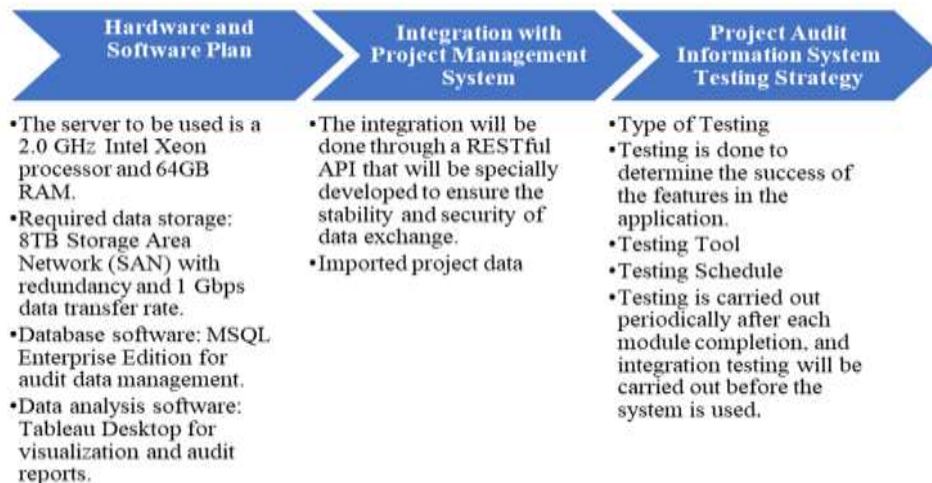


Figure 2 Result of Plan Phase

These data provide a deeper understanding of the development plan for the construction project audit information system. This information will guide the development team in implementing an efficient and reliable project audit system.

Deliver

The data provided reflects the roll-out stage of the project audit information system in a production environment as show in Figure 3. The system has been rigorously tested and is ready to accurately collect and process construction project audit data, enabling the audit team to perform their duties efficiently and effectively.

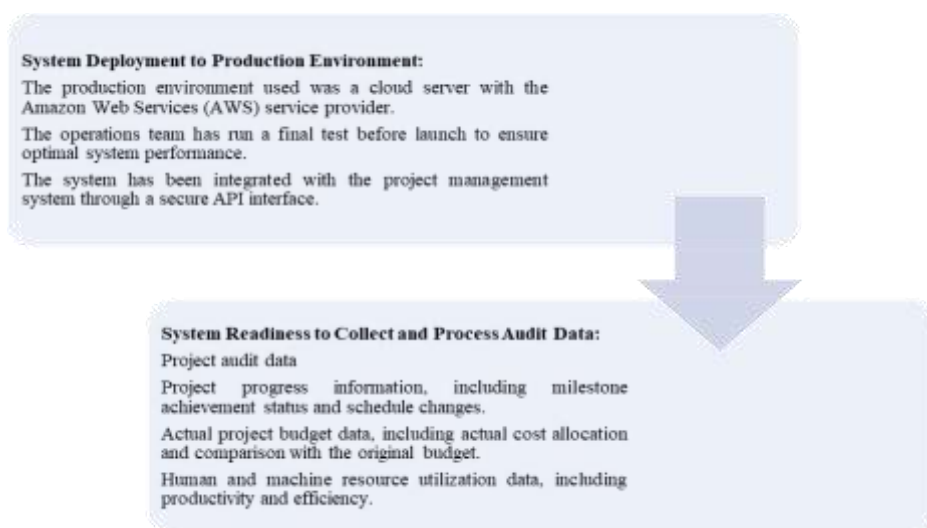


Figure 3 Result of Deliver Phase

Operate

Project audit data is available in real-time in the system database and can be accessed by the audit team at any time. Data analysis tools have been regularly updated to ensure compliance with changes in analysis needs. Monthly audit reports are generated automatically on the 1st of each month. The project audit information system has been operational for one year since launch. The operations team regularly performs maintenance, including software updates and system security upgrades. The system has undergone 6 updates in the past year to maintain stability and security. There were no significant system incidents that affected operations during the period. The results of the Operate stage show that the construction project audit information system has been operating well over the past year. Project audit data is available regularly, and the system performs optimally. These



data provide an overview of system maintenance and audit data availability that is important for the sustainability of the construction project audit process.

Evaluation

System performance evaluation checks how much the system has fulfilled its purpose. The evaluation includes checking the accuracy of the audit data collected by the system. The audit data was compared with the physical construction project documents to ensure consistency and accuracy. The results of the audit data accuracy evaluation show that the level of conformity of audit data with physical project documents is 99%. The audit data includes accurate information on project progress, budget, schedule, and project changes. Audit data errors found have been resolved and corrected. The performance of the data analysis tools used in the system was evaluated to ensure that they function correctly and provide relevant audit reports. Evaluation of the data analysis tool showed that it successfully generated audit reports in an average of 20 seconds per report. The data analysis tool has been used to generate audit reports that support project decision-making. Some minor improvements have been implemented to enhance the efficiency of the data analysis tool. The results of the Evaluation phase show that the project audit information system has been operational for two years and has thoroughly evaluated its performance, audit data accuracy, and data analysis tool functionality. The rich data provided a more in-depth picture of the system's achievements and helped identify areas for improvement to enhance the efficiency and accuracy of construction project audits.

Discussion

This research develops a construction project audit system by applying DevOps methodology through structured stages. At the Assessment stage, the identification of construction project audit needs, the type of information to be audited, and a list of required software were detailed. The Plan stage includes planning the project audit system's hardware, software, and testing strategy. Then, the development stage describes the design and development of the software, as well as the integration of data analysis tools. The Deliver stage marks the launch of the system into the production environment. In the Operate Stage, data shows that the system has been running well for the past year, with regular maintenance and continuous availability of audit data. The Evaluation results confirm the system's success with high data accuracy levels and optimized performance of the data analysis tools. In the context of the complex construction industry, the system helps address challenges in project management more efficiently.

4. CONCLUSION

This research has successfully developed a construction project audit system by applying DevOps methodology through a series of structured stages. The evaluation confirmed the system's success with high data accuracy and optimized performance of data analysis tools. In the complex construction industry context, the system contributes positively by improving efficiency and accuracy in construction project management and audit oversight. For future research, it may be relevant to explore further developments in integrating the latest technologies, such as artificial intelligence and cloud computing, in project audit systems. These technologies can assist in more sophisticated data analysis and more informed decision-making. In addition, future research can focus on implementing these systems in actual construction projects and measure their impact in more depth on efficiency, cost savings, and risk management.

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