



Development of agile-based website and field person application for construction project data management

Jontinus Manullang¹, Kamson Sirait², Sartika Dewi Purba³, Aditiarno Manik⁴, Harmoko Lubis⁵

^{1,3,5} *Komputerisasi Akuntansi, Akademi Informatika Dan Komputer Medicom, Medan, Indonesia*

^{2,4} *Manajemen Informatika, Akademi Informatika Dan Komputer Medicom, Medan, Indonesia*

Article Info

Article history:

Received Aug 1, 2024

Revised Aug 13, 2024

Accepted Aug 16, 2024

Keywords:

Agile Methodology;
Construction Project Management;
Field People Application;
Real-time Data Processing;
Software Development.

ABSTRACT

This research discusses the creation of a website and Field Person application designed to assist the management of construction project data processing. This system allows company leaders to monitor projects in real-time and assist field heads in compiling work reports. The main functions implemented include material management, shopping data, equipment data, work progress data, incoming funds, material usage, material requests, wage requests, and wage payments. This research uses an object-oriented software development methodology with an Agile approach to ensure flexibility and responsiveness to changing user needs, and offers innovative solutions in construction project management by utilizing technology to improve efficiency and accuracy in project data management.

This is an open access article under the [CC BY-NC](https://creativecommons.org/licenses/by-nc/4.0/) license.



Corresponding Author:

Jontinus Manullang,
Komputerisasi Akuntansi,
Akademi Informatika Dan Komputer Medicom,
Jl. Darat No.74, Petisah Hulu, Kec. Medan Baru, Kota Medan, Sumatera Utara 20152, Indonesia
Email: jhoe6590@gmail.com

Introduction

The construction industry is one of the most complex and challenging sectors in terms of project management (Ofori, 2000; Shehu & Akintoye, 2010). According to research by Gyampoh-Vidogah (2003), one of the main challenges in construction project management is effective and efficient information management. Many construction projects experience delays and overbudgets due to the inability to manage project data properly. The use of information technology can be a solution to overcome this problem by providing a platform capable of integrating all aspects of project management (Alzoubi, 2022; El Khatib et al., 2020). The use of web-based information systems and mobile applications has proven effective in improving the efficiency and accuracy of construction project management. According to research by Guo, Kai, and Limao Zhang (2022), the implementation of information technology in construction project management can increase transparency, reduce human error, and speed up the decision-making process. With a digital platform, all project data can be accessed in real-time by all parties involved, from company leaders to field heads.

An integrated information system enables the management of various aspects of a construction project, such as materials, equipment, finances, and work progress. According to a study by Adzmi, Rosazlina Mohd, and Zainuddin Hassan (2018), effective project management requires good coordination between all the resources involved. A system capable of integrating data from various sources will facilitate this coordination and enable better oversight of project implementation.

The development of a project management information system should consider the needs and preferences of end users. According to research by Turetken, Oktay, Jan Ondracek (2019), the successful implementation of an information system largely depends on the extent to which the system can meet the needs of its users. In this context, the Agile approach in software development is highly relevant as it allows the development team to adapt to changing needs during the development process.

The application of the Agile approach in the development of construction project management information systems has shown positive results. According to a report by Al-Saqqa, Samar, Samer Sawalha (2020), the Agile method enables more responsive and flexible software development, so it can more quickly adjust to the dynamics of project needs. With this approach, developers can iterate and get continuous feedback from end users, resulting in a product that is more in line with expectations.

One important component in construction project management information systems is reporting and monitoring work progress. According to research by Dallasega, Patrick (2018), an effective reporting system can help project leaders to monitor project progress in real-time and take necessary corrective actions. The "Field Person" application developed in this research is designed to facilitate accurate and timely reporting from field heads to company leaders.

In addition to progress reporting, project financial management is also a crucial aspect of construction project management. According to Pentoria, Rina, Mercya Vaguita (2023), good financial management can reduce the risk of overbudget and ensure that all financial resources are used efficiently. The "Orang Lapangan" system is equipped with features to record incoming funds, expenses, and material usage, making it easier to monitor and control project budgets.

Finally, the successful implementation of a construction project management information system is highly dependent on the support and active participation of all parties involved. According to Berdik, David (2021), user involvement in the development and implementation of information systems is essential to ensure that the system can be accepted and used effectively. Therefore, this study emphasizes the importance of collaboration between developers, company leaders, and field heads in every stage of the development of the "Orang Lapangan" system.

According to Rashid, Yasir (2019), the qualitative approach and case study technique are very appropriate methods to understand the complex context in construction project management involving the implementation of information technology. The qualitative approach was chosen to gain a deep understanding of user needs and field dynamics in construction project management. The case study technique was used to investigate the implementation of an information technology-based project management system in several different construction projects. By choosing this approach, this research aims to comprehensively explore how information technology can improve efficiency, accuracy and transparency in construction project management.

The Agile approach has proven effective in increasing flexibility and responsiveness in construction project management. According to Arefazar, Yasaman (2022) the Agile approach allows project teams to adapt to changing project needs and conditions more efficiently, rather than more rigid traditional approaches. This includes the use of short iterations (sprints) to develop products or services, as well as close collaboration between developers, project owners and end users. Information technology continues to grow as a key enabler for the implementation of Agile approaches in the construction industry. According to De Soto, Borja García (2018), digitalization in the construction industry can increase productivity by 15-25%. Information technology plays an important role in facilitating team collaboration, real-time project data collection and analysis, and faster decision-making. De Soto, Borja García (2018) also emphasized the importance of information system integration to support transparency and efficiency in construction project management. The implementation of technology-based project management systems supports Agile principles by enabling real-time monitoring of project progress, management of work backlogs, and iterative updates to project planning. According to Sofyani, Hafiez (2020), these systems not only increase transparency and accountability in projects but also facilitate more effective communication among project team members. PHP (Hypertext Preprocessor) is a popular server-side programming language for dynamic web application development. PHP has a syntax similar to C and Perl and supports strong integration with databases. According to a study by Laaziri, Majida (2019), PHP continues to evolve with improved security features, performance, and extensive community support.

CodeIgniter is a lightweight, fast, and easy-to-use PHP framework for web application development. CodeIgniter provides a structured work structure and has good documentation. According to Kayode, A. Aroyehun (2021), CodeIgniter allows developers to create applications quickly with features such as a flexible routing system and easy database integration. In designing and creating web structures, html is used as the basic language. HTML defines the content structure of a web page using label elements. HTML5, the latest version of HTML, provides further capabilities in terms of multimedia and interactivity. According to Kadhim, K. J (2018), HTML5 has become the main standard for better web development. Java is the programming language used for Android application development. Java is one of the most commonly used languages for Android because of its strong support from Google and the Android developer community. According to Putranto, Bambang Purnomosidi Dwi (2020), Android application development with Java provides flexibility and good performance. MySQL is a popular relational database management system (RDBMS), often used in web and mobile applications to store and manage data. MySQL is known for its good performance, strong security, and support for the SQL standard. According to Nichter, Daniel (2021), MySQL continues to evolve with improved security features, scalability, and availability. In integrated development (IDE), Android Studio can be used as a platform in Android application development. Android Studio provides a variety of tools and features that support the development, debugging, and profiling of Android applications. According to Sarkar, Anirban (2019), Android Studio continues to evolve with improved performance and new features to support more efficient Android application development.

Methods and Materials

This research uses an object-oriented software development methodology with an Agile approach. Agile was chosen because it allows the development team to adapt to changing needs during the development cycle.

Tools and Technology

1. Programming Language:
 - a. backend: php
 - b. Web Frontend: HTML+PHP
 - c. Frontend mobile: Android Java
2. Database: MySQL for data storage.
3. Framework: CodeIgniter (CI)
4. IDE/Application used: Android Studio

Stages of Development

1. Needs Analysis: Identification of user needs through interviews and surveys.
2. System Design: Designing the system architecture, data model, and user interface.
3. Implementation: Development of functional modules in accordance with the design that has been made.
4. Testing: Thorough testing of the system to ensure all functions are running properly.
5. Deploy: Implementation of the system to the server and distribution of mobile applications to users.

Results and Discussions

The requirements analysis for the construction project management application had to meet the various needs of the leaders and field heads. Leaders need comprehensive access to project data, including project information, equipment data, user data, budget data, and overall visibility into project progress to support strategic decision-making. Can be seen from the following picture:

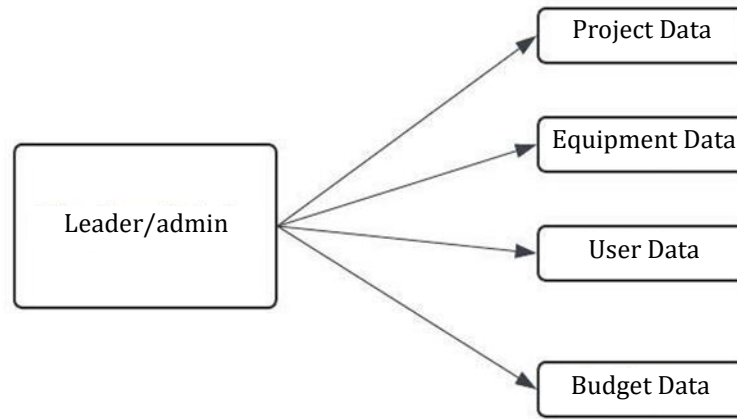


Figure 1: Master data process

For leadership needs in construction project management applications, it is important to ensure that the system is able to provide comprehensive access to strategic data. Leaders need the ability to access and analyze detailed project budget data, including cost estimates, actual expenditures, and financial planning to ensure the project runs according to the approved financial plan. In addition, leaders also need to manage information related to equipment used in the project, including equipment inventory, usage status, and maintenance, to ensure that all physical assets support project operations efficiently. The ability to view and evaluate overall project data, such as overall progress, milestone achievement, and risk evaluation, is also an important need to support timely and data-driven strategic decision-making, more details can be seen in the following figure :

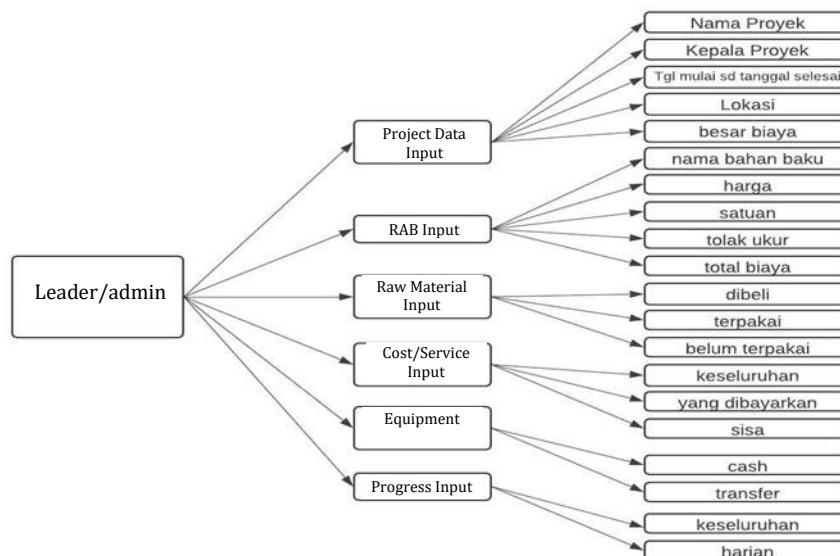


Figure 2. Project process

The following is the job list of the field head that will help organize job reporting.

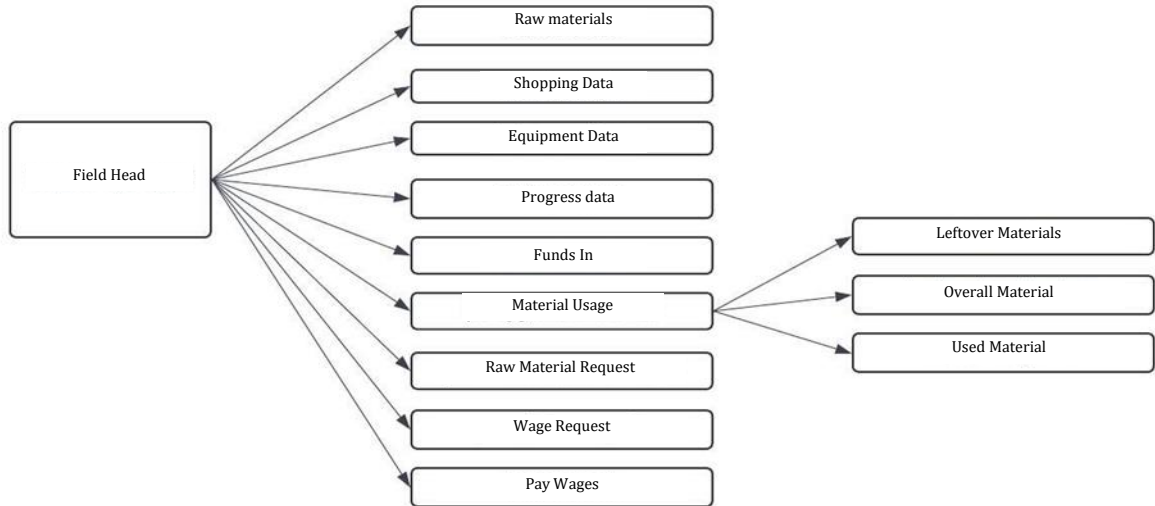


Figure 3. Field head reporting process

Design and Implementation

The Field section of the website was designed with a focus on ease of use, professional aesthetics, and optimal functionality. The main pages such as Home, About Us, Features, and Contact Us are designed to provide complete information and easy access for users. With responsive features, easy navigation, and strong data security, this website is expected to meet user needs and support the management of construction projects effectively.

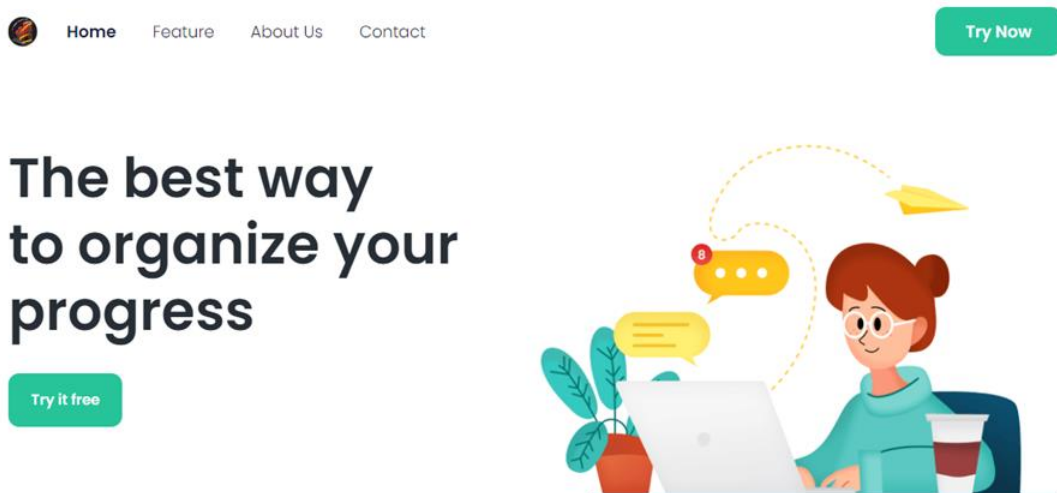


Figure 4. Web page display of field people

Application Simulation

In the field person application there are 2 main entities, namely admin / leader and user / field head as follows:

Leader

Admin / leadership is one of the users of this application who has the authority to manage users of this application, the company leader opens the "Field Person" application on a mobile device and enters login credentials (username and password), After logging in, the leader is directed to the main dashboard which displays a summary of ongoing projects, including progress status, incoming funds, and other brief reports can be seen from the image below:

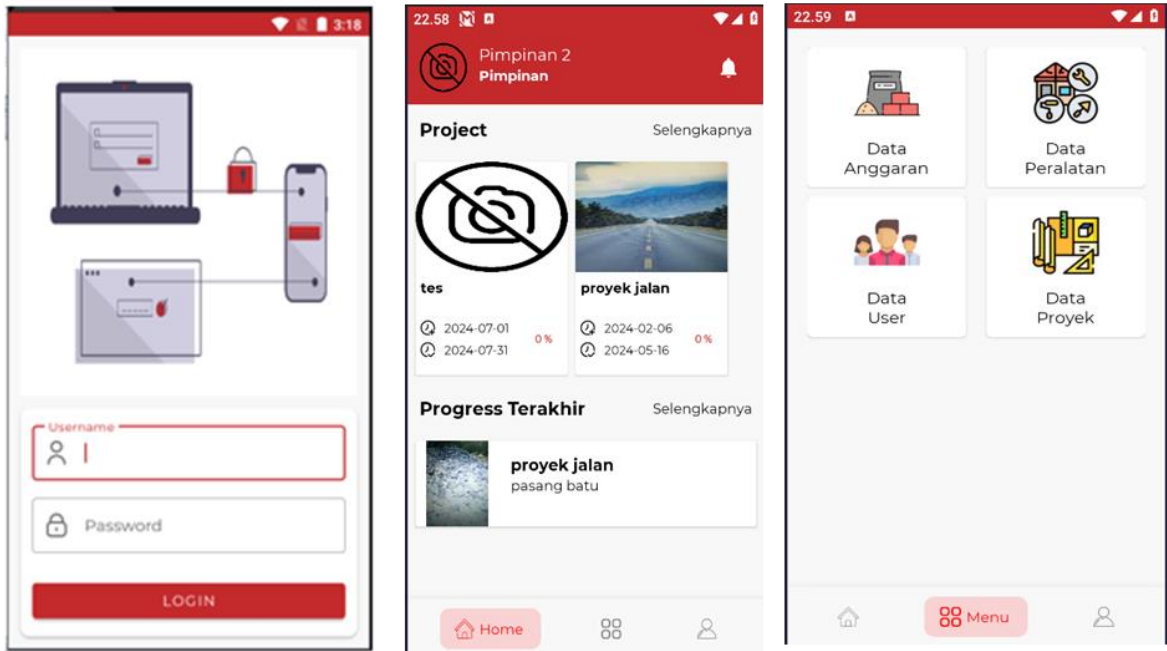


Figure 5. Display of the login page, dashboard and main menu of the Leader

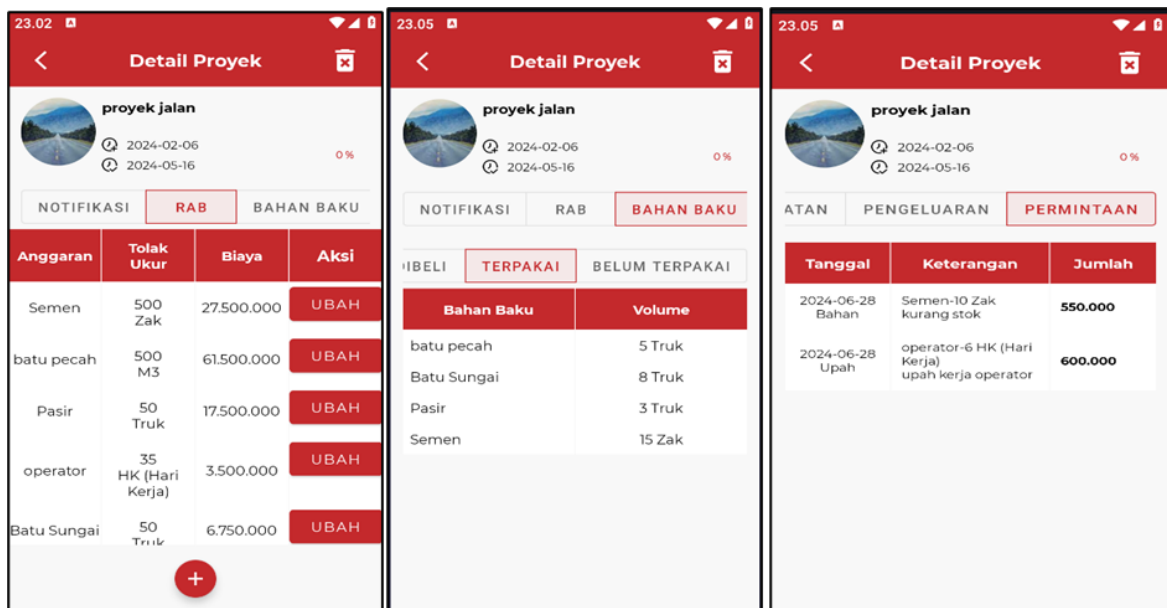


Figure 6. Leader project details view

Field head,

The field head is a user who will use the application with the approval of the leader, in this case, the field head can access the application if the leader has registered the field head, as well as giving the responsibility of the work to be supervised, the following is a view of the field head page:

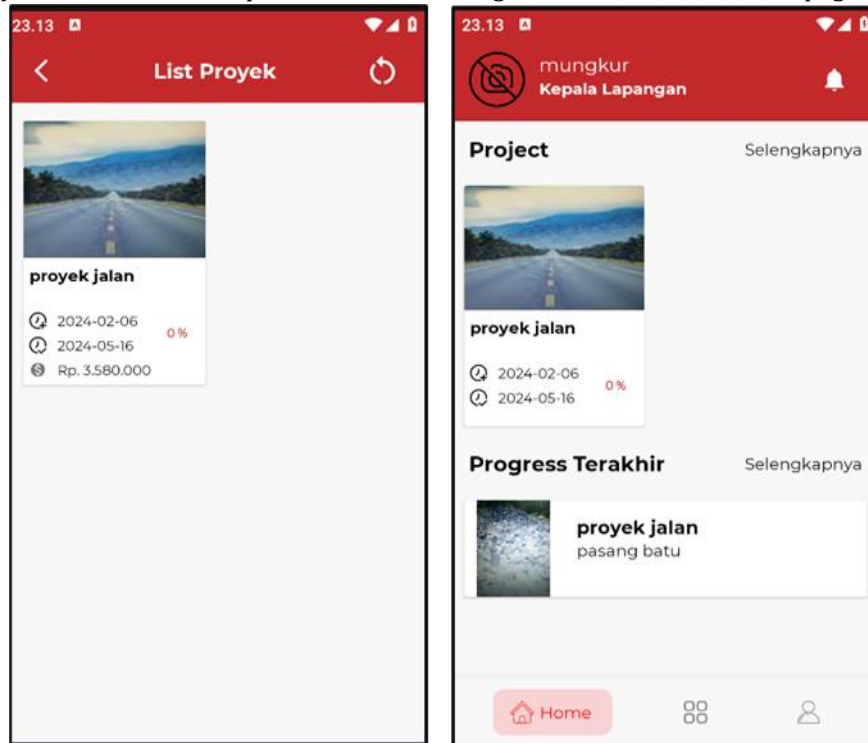


Figure 7. Dashboard and field head project view

In the use of the field head is responsible for sending reports, every day, and can be seen in the picture below

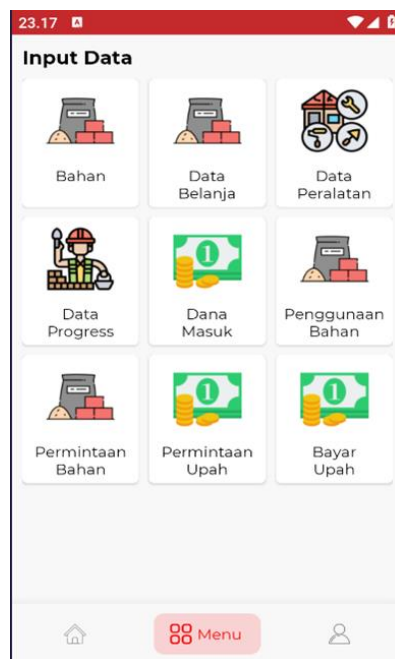


Figure 8. Menu list of field head application

Testing

Testing the "Orang Lapangan" application is a critical step to ensure that the application functions according to the needs and expectations of the users. This testing covers various aspects, including functionality, performance, usability, and security. According to Bhanushali, A. (2023), comprehensive software testing is essential to detect errors and ensure the quality of the software before it is released to end users. In the context of the "Field People" application, functional testing is conducted to ensure features such as materials management, project progress reporting, and request approval are working properly. Performance testing ensures the application remains responsive under various load conditions, while usability testing assesses the user interface to ensure ease of use for company leaders and field heads. By conducting thorough testing, the "Field People" application can provide a reliable and efficient experience for its users.

Table 1. Testing table of Leader Page

No	Type of Testing	Test Scenario	Testing Steps	Result
1	Functional Testing	User login	1. Open the app 2. Enter username and password 3. Click the login button	Leaders are successfully logged in and directed to the main dashboard
2	Functional Testing	View project details	1. Select project from dashboard 2. View project details	Project information is displayed completely
3	Functional Testing	Approve material request	1. Go to the material request tab 2. Select the request that has not been approved 3. Click approve	Material request approved and status updated
4	Functional Testing	Approve wage requests	1. Open the wage request tab 2. Select the request that has not been approved 3. Click approve	Wage request approved and status updated
5	Performance Testing	View financial report	1. Open the financial report tab 2. View graphs and transactions	Financial reports are displayed accurately
6	Usability Testing	Navigation interface	1. Try accessing various features without guidance	Leaders can easily navigate the interface
7	Security Testing	User data security	1. Test data encryption during login and data transactions	User data is safe and secure

Table 2. Field Head Page test table

No	Type of Testing	Test Scenario	Testing Steps	Result
1	Functional Testing	User login	1. Open the app 2. Enter username and password 3. Click the login button	The field head successfully logs in and is redirected to the main dashboard
2	Functional Testing	Entering project progress data	1. Select project 2. Enter daily progress data 3. Upload photos (optional) 4. Save data	Progress data is saved and displayed on the dashboard
3	Functional Testing	Create a material request	1. Open the material request menu 2. Click create new requisition 3. Enter request details 4. Send request	Material request sent for approval
4	Functional Testing	Creating a wage request	1. Open the wage request menu 2. Click create new requisition 3. Enter wage request details 4. Send request	Wage request sent for approval

5	Performance Testing	Application response under high load	Run a script that simulates multiple active users simultaneously	The application remains responsive and does not crash
6	Usability Testing	Navigation interface	Try accessing features without guidance	Field heads can easily navigate the interface
7	Compatibility Testing	Compatibility on various devices and OS	1. Install the app on Android and iOS devices 2. Test key functions on both platforms	App works well on all devices

Conclusions

The Field Person application offers an innovative solution in construction project management by utilizing technology to improve efficiency and accuracy in project data management. Through features such as materials management, progress reporting, and real-time project data integration, the app facilitates better collaboration between company leaders and field heads. On the project management side, the app enables company leaders to oversee and manage projects effectively through detailed data analysis and real-time project progress monitoring. This enables more timely and evidence-based decision-making, which is key in improving productivity and reducing risks in construction projects. In terms of the application, Field People has successfully passed functional, performance, usability, and security testing with positive results. Comprehensive testing shows that the app can not only operate well under various conditions, but is also safe to use by users from different backgrounds. The main advantage of the app lies in its strong integration between project and field management, enabling field heads to manage daily tasks more efficiently and ensuring that up-to-date information can be accessed and managed easily. As such, Field People is not only an administrative tool, but also a strategic tool that supports the achievement of overall project goals. Overall, the Field Person app represents a step forward in the digital transformation of the construction industry, providing the tools needed to face the challenges of modern project complexity in a more structured and effective way. The limitations of this research include the limited scale of implementation of the Field Person app, where piloting and testing focused more on medium-scale construction projects, so the results may not be fully representative of the app's performance on large or small-scale projects. In addition, this research has not fully explored the long-term impact of implementing this application on overall project productivity and efficiency. Suggestions for future research development include expanding the scope of trials to different types of projects with different scales and complexities, as well as conducting longitudinal analysis to assess the long-term impact of the app. In addition, the development of additional features that can be tailored to the specific needs of certain construction industries, such as infrastructure or residential projects, can further increase the relevance and effectiveness of this application.

References

- Adzmi, R. M., & Hassan, Z. (2018). A theoretical framework of critical success factors on information technology project management during project planning. *International Journal of Engineering and Technology (UAE)*, 7(4), 650–655.
- Al-Saqqa, S., Sawalha, S., & AbdelNabi, H. (2020). Agile software development: Methodologies and trends. *International Journal of Interactive Mobile Technologies*, 14(11).
- Alzoubi, H. M. (2022). BIM as a tool to optimize and manage project risk management. *International Journal of Mechanical Engineering*, 7(1).
- Arefazar, Y., Nazari, A., Hafezi, M. R., & Maghool, S. A. H. (2022). Prioritizing agile project management strategies as a change management tool in construction projects. *International Journal of Construction Management*, 22(4), 678–689.
- Berdik, D., Otoum, S., Schmidt, N., Porter, D., & Jararweh, Y. (2021). A survey on blockchain for information systems management and security. *Information Processing & Management*, 58(1), 102397.

- Dallasega, P., Rauch, E., & Frosolini, M. (2018). A lean approach for real-time planning and monitoring in engineer-to-order construction projects. *Buildings*, 8(3), 38.
- De Soto, B. G., Agustí-Juan, I., Hunheviz, J., Joss, S., Graser, K., Habert, G., & Adey, B. T. (2018). Productivity of digital fabrication in construction: Cost and time analysis of a robotically built wall. *Automation in Construction*, 92, 297–311.
- El Khatib, M., Nakand, L., Almarzooqi, S., & Almarzooqi, A. (2020). *E-Governance in Project Management: Impact and Risks of Implementation*.
- Guo, K., & Zhang, L. (2022). Multi-objective optimization for improved project management: Current status and future directions. *Automation in Construction*, 139, 104256.
- Gyampoh-Vidogah, R., Moreton, R., & Proverbs, D. (2003). Implementing information management in construction: establishing problems, concepts and practice. *Construction Innovation*, 3(3), 157–173.
- Kadhim, K. J., Odhaib, M. F., Hadi, Y. H., Ameen, H. M., Muhdi, A. A., Abdlsahib, A. A., Osman, W. R., & Bt, S. (2018). Developing a Multi Platforms Web Applications for Mobile Device Using HTML5. *J Inform Tech Softw Eng*, 8(225), 2.
- Kayode, A. A., & Alabi, A. O. (2021). Design and Implementation of a Simplified CodeIgniter Framework for Commercial Vehicles Ticket Reservation System. *Asian Journal of Research in Computer Science*, 7(2), 1–12.
- Laaziri, M., Benmoussa, K., Khouliji, S., Larbi, K. M., & El Yamami, A. (2019). A comparative study of laravel and symfony PHP frameworks. *International Journal of Electrical and Computer Engineering*, 9(1), 704–712.
- Nichter, D. (2021). *Efficient MySQL Performance*. “ O’Reilly Media, Inc.”
- Ofori, G. (2000). Challenges of construction industries in developing countries: Lessons from various countries. *2nd International Conference on Construction in Developing Countries: Challenges Facing the Construction Industry in Developing Countries, Gaborone, November*, 5(24), 15–17.
- Pentoria, R., Vagueta, M., & Meilina, S. (2023). Management of Regional Revenue and Expenditure Budgets at the Regional Financial Management Agency. *Adabi: Journal of Public Administration and Business*, 10(1), 33–48.
- Putranto, B. P. D., Saptoto, R., Jakaria, O. C., & Andriyani, W. (2020). A Comparative Study of Java and Kotlin for Android Mobile Application Development. *2020 3rd International Seminar on Research of Information Technology and Intelligent Systems (ISRITI)*, 383–388.
- Rashid, Y., Rashid, A., Warraich, M. A., Sabir, S. S., & Waseem, A. (2019). Case study method: A step-by-step guide for business researchers. *International Journal of Qualitative Methods*, 18, 1609406919862424.
- Sarkar, A., Goyal, A., Hicks, D., Sarkar, D., & Hazra, S. (2019). Android application development: a brief overview of android platforms and evolution of security systems. *2019 Third International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud)(I-SMAC)*, 73–79.
- Shehu, Z., & Akintoye, A. (2010). Major challenges to the successful implementation and practice of programme management in the construction environment: A critical analysis. *International Journal of Project Management*, 28(1), 26–39.
- Sofyani, H., Riyadh, H. A., & Fahlevi, H. (2020). Improving service quality, accountability and transparency of local government: The intervening role of information technology governance. *Cogent Business & Management*, 7(1), 1735690.
- Turetken, O., Ondracek, J., & IJsselsteijn, W. (2019). Influential characteristics of enterprise information system user interfaces. *Journal of Computer Information Systems*, 59(3), 243–255.