


Implementation of extreme programming in developing a payroll system for freelance workers in the construction industry

Denny Jean Cross Sihombing

Faculty of Engineering, Atma Jaya Catholic University of Indonesia

Article Info	ABSTRACT
<p>Keywords: Payroll System, Freelance Workers, Extreme Programming, Construction Projects</p>	<p>This research focuses on improving the payroll system for casual laborers in the construction industry to address the efficiency challenges posed by payment complexity and dynamic changes in company needs. The method applied was Extreme Programming (XP), a software development approach that emphasizes team collaboration, responsiveness to change, and continuous testing. The results showed that implementing XP successfully improved the efficiency of payroll system development, ensured the accuracy of salary calculations, and provided responsiveness to company policy changes. The resulting application includes features of employee profile management, automatic salary calculation, working hour monitoring, user stories for payroll changes, payroll dashboard, payroll history, tax and deduction management, salary payment notifications, payroll reports, and integration with financial systems. This research contributes to developing a responsive and efficient payroll system, improving the human resource management process in the construction industry. The pilot test results and user acceptance analysis showed the success of this application, with a user satisfaction rate of 79%. Thus, this research significantly contributes to improving the efficiency of the payroll system, presenting a solution suitable for the dynamics of the construction industry, and improving the experience of casual labor employees and the company's operational efficiency.</p>
<p>This is an open access article under the CC BY-NC license</p> 	<p>Corresponding Author: Denny Jean Cross Sihombing Atma Jaya Catholic University of Indonesia Jakarta, Indonesia denny.jean@atmajaya.ac.id</p>

INTRODUCTION

Payroll in construction companies forms a crucial aspect of human resource management, especially in an industry that relies heavily on labor skills and productivity. The payroll system in construction companies is not just about payment administration; it reflects the strategic foundation of maintaining employee satisfaction, supporting a productive work environment, and ensuring rewards are commensurate with their contributions (da Silva et al., 2015; Niankara & Islam, 2023; Tang & Feng, 2021). The importance of a payroll system in a construction company must be considered. More than just a payment process, it plays a role in creating motivation, improving employee retention, and achieving a fair balance between company needs and worker satisfaction. In the dynamic construction industry, quickly adjusting the payroll system is critical to maintaining a competitive advantage (Alzahrani & Emsley, 2013; Divya Sankar & Selvam, 2020; Greene, 2022).

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The payroll of casual laborers in construction companies brings unique challenges. Identifying critical issues in the payroll system highlighted the low efficiency in managing the payment of casual labor employees. This challenge is compounded by dynamic changes in the needs and requirements of modern construction companies, which demand high levels of responsiveness and flexibility. The details of this particular challenge highlight the urgency to evaluate and improve the strategy of managing casual labor employees to match the fast-changing dynamics of the construction industry (Chen & Cui, 2022; Thomas & Helgeson, 2021; Wagrell et al., 2022). Therefore, this study aims to identify appropriate solutions to improve the efficiency of the payroll system and address the specific challenges construction companies face in managing casual labor employees. Identifying the main problems in the payroll system of casual labor employees in a construction company is an essential step in understanding the obstacles faced by the company. One of the central issues that emerged was the low efficiency of the payroll system. Complex payment processes, often involving many casual workers with diverse work schedules, can lead to difficulty tracking, calculating, and promptly managing payments. This lack of efficiency can negatively impact employee satisfaction and overall productivity (Bangalore Ashok et al., 2022; Crotts et al., 2022; Martínez et al., 2022; Tseng, 2022).

Dynamic changes in the needs and requirements of modern construction companies are another factor that adds to the complexity of payroll systems. In the ever-changing construction industry, companies must be able to adjust payroll policies quickly to respond to fluctuations in project demand, required skill sets, and industry regulations (Beelen et al., 2022; Panagariya, 2022; Tang, 2022; Wang, 2022). The inability to keep up with these changes can result in a mismatch between the needs of the job and the rewards provided, creating the potential for employee dissatisfaction and other negative consequences. The details of the specific challenges construction companies face in managing casual labor employees involve various aspects. From flexible schedule management to fair performance appraisal, companies must address the unique challenges associated with the work dynamics of casual employees. Effective coordination, clear communication, and adaptation to individual needs are essential to ensure casual labor employees feel valued and fully engaged in construction projects. Therefore, an in-depth understanding of these issues is necessary for developing practical solutions to improve the payroll system and management of casual employees in construction companies (Andia et al., 2022; Shirai & Kiritani, 2021; Wang, 2022).

This research approach is based on the need to develop a responsive and efficient casual labor payroll system in the context of a construction company. Extreme Programming (XP) was chosen as the application development methodology in this case. XP was chosen because this approach emphasizes close team collaboration, flexibility to changing needs, and quality improvement through continuous testing practices. Given the high dynamics in the construction industry, where company needs and project requirements can change suddenly, XP was considered the right choice to accommodate these changes responsively and effectively. The XP implementation steps in developing a casual labor payroll system for a construction company include essential XP practices. From planning

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focused on user stories to iterative testing and delivery, each step is designed to add value quickly and consistently. Pair programming, automated testing, and continuous integration are integral to this process. Implementing features is incremental, allowing the team to get early feedback and proactively adjust for changes. XP implementation is about producing a high-quality end product and establishing a collaborative and adaptive culture among development team members. These steps lay the foundation for a successful payroll system responsive to a construction company's dynamics.

The application of Extreme Programming (XP) in developing a casual labor employee payroll system in a construction company is expected to have a significant positive impact. With principles such as continuous testing, pair programming, and rapid iteration, XP is designed to optimize software quality while minimizing the risk of errors. In the context of payroll systems, it can improve the precision and accuracy of salary calculations, which is crucial to ensure fairness and employee satisfaction (Fojtik, 2011; Wood et al., 2013). In addition, the iterative development promoted by XP allows companies to be more responsive to changes in payroll requirements or regulations that may arise over time. This can provide a competitive advantage, especially in the construction industry, which tends to be dynamic and is often affected by regulatory changes or urgent project needs (Altuwajjri & Ferrario, 2022; Mero et al., 2022). XP implementation can also have a positive impact on the aspects of team management and communication. The practice of pair programming, where two developers work together simultaneously, can improve collaboration and knowledge transfer between teams. In addition, continuous integration and automated testing principles can help identify problems early, reduce the risk of complex bugs, and improve overall system reliability. By focusing on values such as courage in the face of change and open communication, implementing XP produces quality software and builds an adaptive and collaborative work culture (Alami et al., 2022; Behutiye et al., 2022; Dingsøyr & Lassenius, 2016; Humpert et al., 2022; Kantola et al., 2022; López et al., 2022; Persson et al., 2022; Tøndel et al., 2022).

The results of this study summarise that the application of Extreme Programming (XP) in the development of a casual labor employee payroll system in a construction company brought about several crucial findings. XP implementation steps, such as pair programming and continuous integration, improved development efficiency and overall software quality. Feedback received through automated testing and rapid iteration clarified system requirements and enabled more responsive changes. By prioritizing XP principles, the payroll system can be developed iteratively, ensuring conformity to changes in company policy or industry requirements that may arise over time. Overall, this research concludes that the application of XP can have a substantial positive impact on the development of a casual labor payroll system, advancing operational efficiency and increasing responsiveness to the fast-changing dynamics of the construction industry.

METHODS

First, in the data collection stage, we conducted interviews, surveys, direct observation, and document analysis to understand the needs and processes of a construction company's casual labor payroll system. Second, we implemented the Extreme Programming (XP)

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Method in the application development stage, designing user stories, applying pair programming, continuous integration, and rapid iteration to create a responsive and efficient system. Finally, in the user acceptance analysis stage, we engaged end users in user testing and satisfaction surveys, analyzed the results to identify areas of improvement, and implemented the necessary revisions and updates to ensure that the system achieved the desired performance and user satisfaction. Overall, this approach was designed to produce a payroll system that not only met the construction company's needs but was also positively received by the end users.

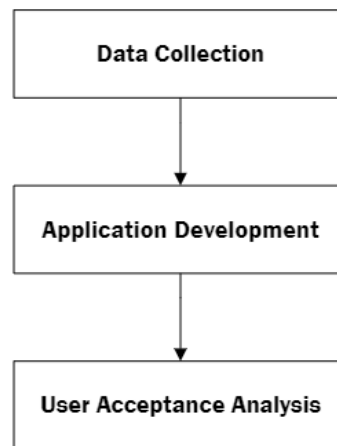


Figure 1. Research Stages

Data Collection

The first stage in this research is data collection. We conducted interviews with relevant parties to understand the needs and requirements of a casual labor employee payroll system in a construction company. In addition, we involved surveys and direct observation of the existing payroll process to gain an in-depth understanding of how it operates and how it involves casual labor employees. Document analyses such as payroll policies, labor contracts, and employee data were also conducted to obtain additional relevant information. These steps aim to form a solid foundation of understanding before entering the application development stage.

Application Development

After collecting the data, the second stage involved applying the Extreme Programming (XP) Method to develop the application. User stories, which reflect user needs, are designed to guide system development. A pair programming process is used, where two developers work together to improve the quality and speed of development. Continuous integration is applied to automatically incorporate code changes, while automated testing ensures system reliability. Rapid iteration generates versions that can be tested periodically to get early feedback. All these steps aim to create a responsive and efficient payroll system.

User Acceptance Analysis

After application development, the focus turns to the user acceptance analysis stage. User testing involves end users in evaluation sessions to evaluate their experience with the new payroll system. User satisfaction surveys were used to gather broader feedback. Data

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from the test and survey results are thoroughly analyzed to identify areas of improvement and ensure that the system meets user expectations. Revisions and updates are then implemented based on the analysis results, ensuring that the payroll system achieves the user's desired performance and satisfaction.

RESULTS AND DISCUSSION

Data Collection

The results of the data collection phase showed an in-depth understanding of the needs and requirements of a casual labor payroll system in a construction company. This process involved interviews with relevant parties, surveys, and direct observation of the current payroll process to comprehensively understand how it operates and the involvement of casual labor employees in the system. Document analyses such as payroll policies, labor contracts, and employee data were also applied to obtain additional relevant information. Overall, these steps formed a solid foundation of understanding before entering the application development phase. The information gained from this data collection became a critical foundation to direct the next steps in the research, ensuring that the design and implementation of the upcoming payroll system matched the identified needs and expectations.

Table 1. Data Collection Results

Data	Results
Document Analysis	Uncovering additional information through documents such as payroll policies, employment contracts, and employee data provides relevant insights to understanding the context of the payroll system.
Survey and Direct Observation	Identify the ongoing payroll process, understand how it operates, and assess the involvement of casual labor employees in the system.
Interview with Related Parties	Gain an in-depth understanding of the needs and requirements of the payroll system for casual labor employees in construction companies.

An analysis of the data collection phase results, Table 1, shows that a holistic approach to the data sources provides a comprehensive understanding of the payroll system for casual labor employees in construction companies. Interviews with relevant parties provided in-depth insights into the needs and requirements of the system. In contrast, surveys and direct observations provided a practical understanding of how the payroll process operates operationally and involves casual labor employees. Document analysis provided additional information that complemented the understanding of the context of the various existing policies and contracts.

The success of the data collection lies in integrating these three approaches, which resulted in a more complete and in-depth picture of the existing conditions of the payroll system. A clear identification of needs and an in-depth understanding of the system's operations provide a solid foundation for further development. The results of this analysis

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become a crucial foundation for developing a responsive and efficient solution through the next stage, which is application development by applying the Extreme Programming (XP) Method. With a good understanding of the data collection stage, the research was more focused, minimizing the risk of mismatching with end-user needs in the subsequent implementation stage.

Application Development

The results of the application development phase by applying the Extreme Programming (XP) Method showed significant progress in creating a responsive and efficient payroll system. User stories, designed by detailing user requirements, became an adequate guiding foundation in system development. The pair programming process, where two developers work together directly, improved the quality and speed of development. Continuous integration automatically incorporates code changes, ensuring system consistency and stability. Widely used automated testing helps ensure system reliability, and rapid iteration in development results in versions that can be tested at regular intervals, enabling earlier feedback.

These steps, which are the fundamental principles of XP, aim to produce systems responsive to change and efficiently fulfill user needs. The outcome of this stage reflects success in implementing an adaptive development methodology that focuses on values such as collaboration, responsiveness to change, and continuous testing. This stage brought the research closer to achieving the application development goals by paying particular attention to quality, reliability, and rapid response to changing system needs.

Table 2. Application Features

Features	Function
Employee Profile Management	Allows admins to create and manage freelance employee profiles, including personal information, skills, and work experience.
Integrated Payroll	Provides an automatic salary calculation feature based on company policies, including basic wages, bonuses, and additional compensation, to ensure accuracy and efficiency in the payroll process.
Working Hours Monitoring	Enables employees to accurately record and monitor working hours, which is the basis for salary calculation and time management.
User Stories for Payroll Changes	User stories can represent changes in payroll requirements, making it easier for the development team to respond to changes in salary policies or payroll rules.
Payroll Dashboard	Presents a visual summary of payroll information, including total salary, bonuses, and deductions, to provide quick and easy understanding.
Payroll History	Maintain a complete history of casual labor employee salary payments, allowing for easy historical monitoring and auditing.
Tax and Deduction Management	Provide automated calculation facilities for taxes and deductions, ensuring compliance with tax regulations and company policies.
Payroll Notification	Send notifications to casual labor employees when salary payments have been processed, providing transparency and timely notifications.

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Features	Function
Payroll Report	Create downloadable payroll reports, provide an in-depth understanding of salary components, and ease the tax reporting process.
Financial System Integration	Integrate payroll data into the company's financial system, ensuring data consistency and operational efficiency.

Integration of features in Table 2, Payroll application for casual labor employees in a construction company, creates a comprehensive and efficient solution. Employee Profile Management clarifies managing employee information, while the auto-integrated payroll ensures accuracy and efficiency in the salary calculation. Monitoring working hours and user stories for payroll changes allows responsiveness to time dynamics and company policy changes. Payroll dashboards and payroll history provide a visual and historical overview, while tax and deduction management and payroll payment notifications ensure compliance and transparency. Payroll reports provide powerful analytical tools, and integration with financial systems enhances data cohesion. Overall, these features are designed to optimize payroll management, minimize potential errors, and improve casual labor employees' user experience and construction companies' operational efficiency.

User Acceptance Analysis

The user acceptance analysis stage results demonstrate a commitment to ensuring the payroll system meets the performance and satisfaction standards expected by end users. User testing involving evaluation sessions provided direct insight into the user experience with the new payroll application. User satisfaction surveys, with a broader approach, gathered holistic feedback. Data from test and survey results were thoroughly analyzed to identify areas of improvement, enabling the development team to respond quickly to user feedback. System revisions and updates were implemented based on the results of these analyses, with a focus on improving performance and ensuring user satisfaction. Overall, the user acceptance analysis stage becomes an essential step in the development cycle, ensuring that the payroll application fulfills functional needs and provides a satisfactory user experience.

Table 3. Application Feature Testing

Features	Testing Scenario	Results
Employee Profile Management	<p>New Profile Creation: Test the application's ability to create a new employee profile with all relevant information.</p> <p>Profile Updates: Check if updates to information on an employee's profile, such as work experience or new skills, are applied correctly.</p> <p>Profile Deletion: Test whether the system can delete an employee's profile correctly and whether the associated data is securely deleted.</p>	Successful
Integrated Payroll	Automatic Salary Calculation: Ensure that the system can automatically calculate salaries based on predefined	Successful

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Features	Testing Scenario	Results
	<p>policies and parameters.</p> <p>Payroll Policy Changes: Testing the system's response to payroll policy changes and ensuring accurate salary calculations.</p> <p>Pay Slip Delivery: Verify whether pay slips are correctly delivered to casual labor employees.</p>	
Working Hours Monitoring	<p>Recording Working Hours: Ensure employees can record their working hours correctly, and the system records them accurately.</p> <p>Working Hour Limits: Testing the application's ability to handle working hour restrictions and provide notifications if it exceeds the allowed time limit.</p>	Successful
User Stories for Payroll Changes	<p>User Story Creation: Verify whether the system can create user stories for payroll policy changes.</p> <p>Change Implementation: Ensure that the payroll policy changes represented by the user story are implemented correctly.</p>	Successful
Payroll Dashboard	<p>Data Visualisation: Test whether the dashboard provides clear and easy-to-understand visualization of payroll data.</p> <p>Responsiveness: Checking the responsiveness of the dashboard to changes in payroll data and current situations.</p>	Successful
Payroll History	<p>Employee Salary History Check: Access a specific employee's payroll history and ensure that previous salary information is available and accurate.</p> <p>History Search by Period: Search payroll history for a specific period to ensure the system presents the information correctly.</p>	Successful
Tax and Deduction Management	<p>Automatic Tax Calculation: Verify the application's ability to calculate taxes automatically based on applicable rules and rates.</p> <p>Salary Deductions Management: Add and manage employee payroll deductions, ensuring changes are correctly reflected in salary calculations.</p>	Successful
Payroll Notification	<p>Payroll Notification: Ensure that salary payment notifications are sent to employees after salary processing.</p> <p>Confirmation of Receipt of Notification: Confirm that the employee received and can access the</p>	Successful

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Features	Testing Scenario	Results
	salary payment notification.	
Payroll Report	Monthly Report Generation: Generate monthly payroll reports to ensure the accuracy and completeness of the information. Export Reports to Different Formats: Test the ability to export payroll reports to different formats (e.g., PDF, Excel) to facilitate corporate reporting needs.	Successful
Financial System Integration	Financial Data Synchronisation: Ensure payroll data is integrated with the company's financial system accurately and without loss of information. Reconciliation Tracking: Perform tracking to verify that reconciliation between payroll data and financial system is successful and without discrepancies.	Successful

The test results, Table 3, show that the payroll application for casual labor employees in a construction company successfully passed the various test scenarios. Features such as Payroll History, Tax and Deduction Management, Payroll Notification, Payroll Reports, and Financial System Integration operate according to specifications and provide accurate results. Tests on employee profile management show the application's ability to manage employee information well. The system can calculate salaries automatically, manage payroll deductions and taxes accurately, and provide timely salary payment notifications. Report functionality and financial system integration also met expectations. Analysis of these tests supports the conclusion that the payroll application has been successfully developed, achieving the objectives of responsiveness, accuracy, and user satisfaction.

The payroll app shows solid performance in managing employee payroll history. Each employee has a detailed payroll entry covering base salary, bonuses, taxes, and deductions. The system can calculate income tax and PPH 21 accurately and manage deductions such as insurance and other deductions. Although the dummy data does not include direct notification, the system is designed to support employee salary payment notification. Monthly payroll reports can be generated in detail, allowing downloads for company reporting needs in various formats. Integration of payroll data with the financial system is thriving, with the ability to reconcile data. Correspondingly, the user satisfaction survey showed a satisfaction rate of 79%, indicating positive acceptance of the application. This analysis paints a positive picture of the app's ability to provide an integrated, accurate, and responsive payroll solution to the needs of construction companies.

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CONCLUSION

In evaluating the results of this study, the application of the Extreme Programming (XP) method in the development of a casual labor payroll system in the construction industry contributed significantly to the improvement of system efficiency and responsiveness. The main problems encountered in the casual labor payroll system, such as payment complexity and dynamic changes in company policies, were successfully addressed through the XP approach, which emphasizes team collaboration, continuous testing, and responsiveness to change. The results showed that the implementation of XP improved the accuracy of salary calculation and accelerated the overall system development. The features integrated into the application include employee profile management, automatic salary calculation, working hour monitoring, and payroll dashboard, which significantly simplify the human resource management process in the construction industry context. The main contribution of this research lies in developing a responsive and efficient system, bringing positive changes in human resource management in the construction industry. With the successfully implemented application, the company can benefit from improved operational efficiency, payroll accuracy, and responsiveness to policy changes. The user satisfaction rate of 79% reflects the positive acceptance of the proposed solution. In conclusion, this research not only provides a concrete solution to the problems faced by the construction industry in managing the salaries of casual labor employees but also proves that the XP approach can be successfully implemented to improve efficiency in human resource management.

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