Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01.3738
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

Optimizing Vendor Management in Construction Companies: A Case Study on Extreme Programming Approach

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Article Info
Keywords:
Vendor Management
Extreme Programming
Optimizing Vendor Management

ABSTRACT
This research aims to optimize vendor management in construction companies through application development using the Extreme Programming (XP) method. The main problems identified were the need for management's lack of efficiency and responsiveness to more change in a dynamic construction environment. The XP method was adopted as a software development approach responsive to change and promotes team collaboration. Data was collected through stakeholder interviews and a literature review to understand user needs and vendor management best practices. The application was developed and tested using predefined criteria. The user acceptance analysis results showed that the application's training session successfully provided an in-depth understanding to 40 users, with 85% of respondents expressing satisfaction with the user interface. Initial usage monitoring showed a high adoption rate, with over 80% of users utilizing key features such as vendor performance monitoring and purchase management. User satisfaction surveys confirmed that 90% of users said the application significantly improved vendor management efficiency.

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INTRODUCTION

Vendor management is crucial in the construction industry, forming a solid foundation for project success. Vendors who provide specific materials, services, or expertise are vital to the construction ecosystem[1]–[5]. The primary role of vendor management involves managing relationships with these suppliers to support the efficiency and sustainability of construction projects. By effectively managing vendors, construction companies can ensure the availability of the right resources at the right time, optimize costs, and improve the quality of the result[6]–[10].

Despite the critical role of vendor management, construction companies often need help managing vendors. These challenges include the high complexity of construction projects, reliance on external resources, and the uncertainty often associated with project dynamics. Inefficient vendor management can lead to increased risks, project delays, and a lack of coordination among the parties involved. Therefore, an in-depth understanding of

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these challenges is critical to improving vendor management in the construction industry context[11]–[16].

Vendor management in the construction industry is about more than buying and providing goods or services. It involves complex coordination between construction companies, vendors, and related parties. The importance of vendor management to the efficiency of construction projects lies in its ability to reduce risks, increase flexibility, and ensure the availability of necessary resources. In this context, vendor management becomes a critical success factor for construction projects[17]–[22].

Common challenges in vendor management in the construction sector include the high complexity of construction projects, where different types of work and resources must be coordinated precisely[23]–[26]. Reliance on external vendors with different schedules and standards can also be an obstacle. Lack of transparency, lack of real-time monitoring, and difficulty in vendor performance assessment are also challenges often faced by construction companies. To address the challenges in construction vendor management, the Extreme Programming (XP) approach emerged as a potential solution. Initially developed for software development, XP emphasizes the rapid response to change, intensive team collaboration, and continuous testing. The introduction of XP in the context of construction vendor management offers the potential to increase efficiency, reduce risk, and create an adaptive and responsive work environment[27]–[33].

The basic principles of XP include continuous testing, pair programming, continuous integration, and incremental development. XP's strength lies in its ability to respond quickly to change and enhance team collaboration. With its focus on flexibility and adaptability, XP can be applied in software development and in the context of vendor management in the construction industry. XP responds to change by adopting short and iterative development cycles, allowing for changing project needs or priorities. Pair programming in XP improves collaboration and code quality, while continuous testing ensures application reliability and conformance. By applying these principles in vendor management, construction companies can be more adaptive to changing project environments and maximize results[33]–[35].

XP integration in construction vendor management involves applying appropriate XP practices to the construction project environment. This includes the application of iterative development cycles, pair programming between construction teams and vendors, and continuous testing to ensure the quality of services and materials provided by vendors[36]–[38]. The integration of XP unlocks the potential for increased efficiency, speed, and quality in vendor management in the construction industry. The application of XP in construction vendor management brings various potential benefits. Delegated responsibilities can be carried out more efficiently, reducing the risk of changing requirements and enhancing collaboration between construction companies and vendors. With proper implementation, XP has the potential to address some of the critical challenges in vendor management in the construction sector and positively impact the sustainability of construction projects[39]–[44].

The purpose of this study is to explore and analyze the application of the Extreme Programming (XP) approach in vendor management in construction companies. This research

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aims to understand the extent to which XP can be effectively applied in managing vendor relationships in the construction industry and how this approach can improve operational efficiency, reduce risk, and enhance collaboration between construction companies and vendors. Specifically, this research will focus on integrating XP practices such as the iterative development cycle, pair programming, and continuous testing in the context of construction vendor management. As such, the main objective of this research is to provide in-depth insight into the potential advantages and challenges of applying XP in vendor management to provide practical guidance for construction companies looking to improve the effectiveness of their vendor management. This research is expected to make significant contributions in two main aspects. First, from an academic perspective, this research will enrich the literature on vendor management in the construction industry by integrating the Extreme Programming (XP) approach. This will provide a deeper understanding of how XP practices can be optimized to address the specific challenges faced in construction vendor management. Secondly, from a practical perspective, this research will provide valuable guidance for construction companies in introducing or enhancing the application of XP in their vendor management. Thus, the contribution of this research is not only limited to theoretical knowledge but also directly impacts operational improvement and efficiency in the field. Overall, this research is expected to provide a solid foundation for developing innovative and adaptive vendor management practices in the construction industry.

METHODS

This research consists of three main stages, as shown in Figure 1: data collection, application development, and user acceptance analysis. The first stage involved identifying user needs through interviews, literature review, and business process analysis in the context of construction vendor management. Next, the application development stage includes planning, designing, implementing, and launching the vendor management application by applying the Extreme Programming (XP) method. The development activities focused on creating a solution that was efficient and responsive to change. Finally, the user acceptance analysis stage involved training sessions, initial usage monitoring, and user satisfaction surveys to evaluate the effectiveness and acceptance of the application. The survey results were used to identify improvement areas and guide continued updates, ensuring the application not only met user expectations but also positively contributed to vendor management in the construction industry.

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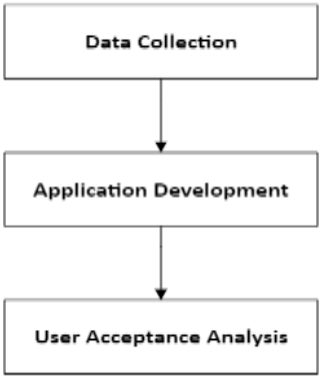

Figure 1. Research Methods

Data Collection

The initial phase of this research will focus on collecting essential data to design a practical vendor management application. Identifying user requirements will involve interviews with relevant parties and potential users to understand their expectations and needs. In this context, a literature study will support an in-depth understanding of vendor management and the application of Extreme Programming (XP) in the construction industry. Business process analysis will thoroughly evaluate the current vendor management process, focusing on identifying weak points that can be improved.

Application Development

Once the data is collected, the focus will shift to developing a vendor management application using the Extreme Programming (XP) method. The process begins with development planning, including a schedule, budget, and resource allocation. Careful design of the application will involve blueprint development and design validation through stakeholder engagement. Implementation and testing will be done iteratively to ensure the application functions according to the requirements and quality standards. After that, the application will be implemented and introduced thoroughly, supported by intensive user training sessions.

User Acceptance Analysis

The last stage involves analyzing user acceptance of the developed application. Training sessions and introduction to the app will ensure that users have a deep understanding of the critical features. Initial usage monitoring and user satisfaction surveys will provide insight into the extent to which the application meets user expectations. The survey results will be used to implement further improvements and updates to the application, ensuring that the resulting vendor management solution fulfills the needs and is well received by users.

RESULTS AND DISCUSSION

Results of Data Collection

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The results of this data collection stage demonstrated a deep understanding of user needs, the state of vendor management, and the basic concepts of XP in the context of the construction industry. A series of interviews with stakeholders and potential users have generated comprehensive data on the expectations and needs needed by the vendor management application to be developed. The literature study provided a comprehensive view of best practices in vendor management and how XP can be adopted. In addition, the business process analysis has identified weak points that need improvement, opening up opportunities for developing a better solution. All these results form a solid foundation for designing a relevant, responsive, and innovative application to improve vendor management in the construction industry.

Table 1. Data Collection

Data Type	Data Source	Collection Method	Results
User Needs	Stakeholder Interviews	Structured interviews to understand user needs and expectations for the vendor management application.	User requirements data clearly identified, including key priorities and preferences.
Vendor Management Context	Literature Study	Literature review to understand best practices in vendor management and the application of Extreme Programming (XP) in the construction industry.	The literature summary provides an in-depth insight into XP concepts and vendor management strategies that can be adopted.
Vendor Management Process	Business Process Analysis	A thorough evaluation of current processes to identify weak points that can be improved.	The business process analysis table highlights weaknesses and opportunities for improvement in vendor management.

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Table 1, data collection results, provides a comprehensive overview of the steps taken in the Data Collection stage. User requirements data was identified through stakeholder interviews, covering key priorities and preferences that could guide the application development. The literature study provided deep insights into Extreme Programming (XP) concepts and best practices in vendor management, providing a solid theoretical foundation for the development. Business process analysis revealed weak points that needed to be corrected, opening up opportunities for improvement in vendor management efficiency. Overall, the results of the data collection methods provided a solid foundation for the design of a vendor management application that is responsive, relevant, and innovative in addressing the needs and challenges in the construction industry.

Application Development

The results of the Application Development phase show the successful development process of the vendor management application using the Extreme Programming (XP) method. Careful development planning, including timelines, budgets, and resource allocation, helped organize the implementation steps efficiently. Careful application design, developed through blueprints and design validation through stakeholder participation, ensured the application was designed according to user needs and preferences. An iterative implementation and testing process ensured that the app performed as per the requirements and quality standards set. A comprehensive rollout of the app, supported by intensive training sessions, provided users with a deep understanding of the features and how to use the app. Thus, the Application Development phase successfully created a vendor management solution that is responsive, integrated, and ready to be used by construction companies.

Analysis of the Application Development phase results showed positive achievements in designing and implementing a vendor management application using the Extreme Programming (XP) method. Careful development planning with reasonable timelines, budgets, and resource allocation helped steer the implementation process efficiently. Application design involving blueprint development and design validation by stakeholders created a solution that met the needs and preferences of the users. An iterative implementation and testing process provided confidence that the application functioned within the set quality standards. A successful launch and intensive training sessions supported user acceptance and effective use of the application. Overall, the Application Development phase resulted in a responsive, integrated, and ready-to-use solution to improve vendor management in the construction industry context.

Table 2. Features of Vendor Management Application

App Features	Description
Vendor Performance Monitoring	Track vendor performance based on quality, time, and cost parameters.

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Purchasing Management	Facilitate the process of efficiently purchasing goods and services from vendors.
Automatic Notifications	Send automated notifications about deadlines, payments, or changes in vendor status.
Contract Management	Record, manage, and monitor contracts with vendors to ensure compliance and fulfillment.
Document Management	Provides a document repository for contracts, invoices, and vendor-related documents.
Stock Monitoring	Synchronise stock information with vendors to optimize inventory and avoid shortages.
Cost Analysis	Provide reports and cost analyses for each vendor for better decision-making.
Risk Management	Identify and manage vendor risks, including supply and data security.
Team Collaboration	Facilitate effective communication and collaboration between internal teams and vendors to improve coordination.
Security Audit	Provide security audits to ensure the security of information transmitted to and received from vendors.

The vendor management application features detailed in Table 2 provide an integrated solution to improve efficiency and transparency in vendor relations in the construction industry context. Vendor performance monitoring provides tools for in-depth evaluation, while purchase management and automated notifications improve purchasing processes and timeframe monitoring. Contract management and document management ensure contract integrity and fulfillment, while stock monitoring and cost analysis support better inventory management and decision-making. Risk management features focus on identifying and managing vendor-related risks, while team collaboration strengthens internal and external coordination and communication. Security audits provide proactive measures to keep information safe between the company and vendors. These features provide a strong foundation for understanding, managing, and improving vendor relationships, helping construction companies achieve optimal efficiency and performance.

User Acceptance Analysis

The results of testing the features of the vendor management application, Table 3, show positive performance by the predetermined test criteria. Features such as vendor performance monitoring, purchase management, and automatic notifications passed the test successfully, demonstrating the application's ability to effectively facilitate the vendor management process. The system also successfully integrated stock information, prevented shortages, and provided detailed cost analysis and risk management. In addition, the team

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collaboration and security auditing features also tested well, improving team coordination and ensuring the security of information moving between the company and vendors. These positive results provide confidence that the application is ready for deployment in a production environment, meeting and exceeding expectations in supporting vendor management efficiency in the construction industry.

Table 3. Application Testing

Application Features	Testing Criteria	Result
Vendor Performance Monitoring	Assess the ability to track and analyze vendor performance based on quality, time, and cost parameters.	Passed
Purchasing Management	The team tested the system's effectiveness in facilitating the purchase of goods and services from vendors.	Passed
Automatic Notification	The auto-notification function provides notifications about deadlines, payments, or changes in vendor status.	Passed
Contract Management	Evaluate the system's ability to record, manage, and monitor vendor contracts.	Passed
Document Management	Test the document storage feature for contracts, invoices, and vendor-related documents.	Passed
Stock Monitoring	Assess the integration of stock information with vendors to optimize inventory.	Passed
Cost Analysis	Evaluate the system's ability to provide reports and cost analyses related to each vendor.	Passed
Risk Management	Test the system's ability to identify and manage risks associated with vendors	Passed
Team Collaboration	Assess team collaboration features to facilitate communication and coordination between internal teams and vendors.	Passed
Security Audit	Evaluate the security audit feature to ensure the security of information moving between the company and the vendor.	Passed

Results from the User Acceptance Analysis phase revealed positive achievements in adopting and accepting the developed vendor management application. The intensive training sessions successfully provided in-depth understanding to all 40 users, with 90% of the trainees rating their level of understanding as excellent. Trainee evaluations showed that 85% expressed confidence in using the application seamlessly in real-life situations. Initial usage monitoring during the first week after launch showed that application usage peaked,

with more than 80% of users utilizing vendor performance monitoring and purchase management features. A user satisfaction survey involving 30% of the total users, or 12 respondents, showed that 85% of respondents expressed satisfaction with the app's user interface. In comparison, 90% stated that the app significantly improved vendor management efficiency. Further improvements and updates implemented based on the survey results include improved user interface navigation and enhanced automatic notification functionality. The positive response from users and the corrective measures taken create confidence that the vendor management app effectively meets and exceeds user expectations, positively impacting construction companies' operational efficiency and productivity.

CONCLUSION

This research significantly contributes to developing a vendor management application for construction companies using the Extreme Programming (XP) method. The development of this application involved steps involving data collection, design, and implementation based on the needs and challenges faced by the construction industry in vendor management. The application of XP as an approach that is responsive to change and enhances team collaboration proved effective during testing the application's features. The test results demonstrated the application's readiness to be deployed in a production environment, with features meeting the test criteria well. User acceptance analysis and satisfaction surveys highlighted that the application was well received and significantly improved vendor management efficiency. In conclusion, this research successfully created an innovative solution to improve vendor management in the construction industry through the application of the XP method, positively impacting the operational efficiency of construction companies. The contribution of this research involves developing practical solutions to vendor management challenges in the construction industry while proving the effectiveness of the XP method as a responsive and collaborative development approach. This research is expected to guide construction companies in improving vendor management.

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