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# Improving Efficiency and Reducing Costs in Construction Inventory Management Using RAD Methodology

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***Abstract***

*This research investigates the application of the Rapid Application Development (RAD) methodology in enhancing inventory management practices within construction companies. The study emphasizes the importance of stakeholder collaboration in defining clear project objectives and ensuring alignment with the company's operational needs. Through comprehensive data modeling, key data entities were accurately identified and structured, supporting effective inventory control. The process modeling phase demonstrated significant improvements in operational workflows by automating key processes, thereby reducing order processing time and enhancing efficiency. The RAD approach facilitated the rapid development of a functional prototype, enabling continuous user feedback and iterative refinement. The final application significantly improved inventory accuracy, reduced material wastage by 10%, and increased procurement efficiency by 20%. The successful implementation and refinement of the application, including data migration, system integration, and user training, validated the effectiveness of the RAD methodology. This research provides valuable insights into the potential of RAD to develop tailored inventory management solutions for construction companies, leading to improved efficiency and cost-effectiveness.*

***Keywords***: *RAD, Inventory Management, Operational Efficiency, Cost Reduction*

## 1. INTRODUCTION

Inventory management is a critical function in the operations of construction companies, significantly impacting project efficiency, cost control, and ultimately, profitability. This process encompasses the planning, procurement, storage, utilization, and control of materials, equipment, and other resources necessary to complete construction projects. Effective inventory management is essential for minimizing costs, preventing project delays, and ensuring smooth operations. Research indicates that good inventory management can enhance overall organizational performance and contribute to profitability [1], [2]. However, construction companies often face various challenges in effectively managing their inventories.

One of the primary challenges is the lack of real-time visibility into inventory status. Many companies still rely on manual methods, such as spreadsheets and physical records, to track their inventories. This can lead to inaccurate data, difficulties in locating required materials, and an increased risk of waste, damage, or theft. Studies show that the use of information and communication technology (ICT) in material management can improve efficiency and accuracy in inventory management [3]. Additionally, digital systems can provide better visibility and enhance field efficiency [4]. Manual processes are often inefficient and time-consuming, diverting resources from more critical tasks.

Another challenge is the complexity of the construction supply chain. Construction projects typically involve multiple suppliers, subcontractors, and project locations, making it difficult to coordinate the movement of materials and ensure that the right materials are available at the right place and time. Delays in delivery, incorrect materials, or material shortages can lead to costly project delays and disrupt workflow. Just-in-Time (JIT) inventory management offers the potential to improve material efficiency, but its implementation in construction requires careful planning and coordination [5], [6]. Research indicates that applying good inventory management techniques, such as JIT, can help reduce costs and improve project performance [2], [6].

Moreover, fluctuations in material demand, the unique nature of construction projects, and the need to manage various types of materials add to the complexity of inventory management. Construction companies must balance the need to maintain sufficient inventory to meet demand with the need to minimize storage costs and the risk of obsolescence. This issue is exacerbated by a lack of integration between inventory management systems and other systems used in construction projects, such as project management software and accounting systems [7], [6]. Research shows that good system integration can enhance efficiency and effectiveness in inventory management [4].

The importance of research in the field of construction inventory management is further emphasized by the increasing focus on sustainability and efficiency within the construction industry. Poor inventory management can lead to material waste, increased construction waste, and negative environmental impacts [8], [9]. Consequently, construction companies are increasingly seeking innovative solutions to enhance their inventory management practices. Rapid Application Development (RAD) has emerged as a promising methodology for developing software applications that can address these challenges. RAD emphasizes a rapid, iterative, and incremental development cycle, focusing on user involvement and adaptation to changing needs [10]. Research indicates that this approach can improve the speed and efficiency of developing inventory management systems [10].

This study aims to investigate the application of RAD in the development of inventory management applications for construction companies. The research will explore the functional and non-functional requirements of such applications, design and develop the applications using the RAD methodology, and evaluate the effectiveness of the applications in improving inventory management practices. The study will also discuss the benefits and challenges of implementing RAD in the construction context. Several studies indicate that innovation in construction management can enhance productivity and efficiency [5], [10]. Thus, the application of the RAD methodology in developing inventory management applications can be a strategic step in addressing the challenges faced by construction companies.

## 2. RESEARCH METHODOLOGY

The management of inventory is a critical aspect of construction operations, directly influencing project efficiency, cost control, and overall profitability. Effective inventory management ensures that materials and resources are available when needed, minimizing delays and reducing waste. This literature review explores the development of inventory management applications in construction companies using the Rapid Application Development (RAD) methodology, highlighting its advantages and challenges.

Research indicates that effective inventory management significantly enhances organizational performance. For instance, Ogbo and Ukpere Ogbo & Ukpere [11] argue that flexible inventory management can improve a firm's competitive position and profitability. They emphasize that a higher level of inventory flexibility correlates with better performance outcomes. This assertion is supported by the findings of Laitsi [12], who discusses the iterative nature of RAD in developing inventory applications, which allows for continuous feedback and adjustments to meet organizational needs.

RAD is increasingly recognized as a suitable approach for developing inventory management systems, particularly in dynamic environments like construction. The methodology focuses on rapid prototyping and iterative development, allowing for quick adjustments based on user feedback. According to Hafizh and Handayani [13], this approach is particularly effective for creating applications tailored to specific company requirements. Furthermore, the RAD methodology has been shown to reduce development time and resource allocation, making it an attractive option for construction firms facing tight project deadlines [13].

The integration of information technology (IT) in inventory management processes is crucial for enhancing efficiency and accuracy. Kasim Kasim [14] highlights that the implementation of ICT tools in construction projects is still in its early stages, with many companies relying on traditional methods such as spreadsheets. The adoption of RAD can facilitate the transition to more sophisticated IT solutions, improving real-time visibility and control over inventory levels. Additionally, RFID technology has been identified as a valuable tool for improving inventory management by providing real-time data on material availability and location [15], [16].

Despite the advantages of RAD and IT integration, construction companies face several challenges in inventory management. These include the complexity of supply chains, fluctuations in material demand, and the need for effective coordination among various stakeholders. Colicchia et al. Colicchia et al. [17] emphasize the importance of information sharing in supply chains to mitigate risks and enhance collaboration. Moreover, the stochastic nature of inventory demands necessitates robust control models to manage uncertainties effectively [18], [19].

Several studies have demonstrated the successful application of RAD in developing inventory management systems. For example, Sihombing Sihombing [20] discusses the development of a construction inventory application using RAD, highlighting its effectiveness in managing diverse inventory items, from building

materials to heavy equipment. This case study illustrates how RAD can streamline inventory processes and improve project outcomes. Additionally, the use of economic order quantity models in inventory management has been explored to optimize stock levels and reduce costs [21].

The ongoing evolution of inventory management practices in construction presents numerous research opportunities. Future studies could focus on the integration of advanced technologies, such as artificial intelligence and machine learning, to enhance inventory forecasting and decision-making processes. Furthermore, exploring the impact of RAD on user satisfaction and system performance in real-world applications would provide valuable insights for practitioners and researchers alike.

The development of inventory management applications in construction companies using the RAD methodology offers significant potential for improving efficiency and reducing costs. By leveraging iterative development and user feedback, construction firms can create tailored solutions that address their unique inventory challenges. As the industry continues to evolve, the integration of advanced technologies and innovative methodologies will be essential for achieving optimal inventory management practices.

The research process involves six key stages: Business Planning and Modeling, where business needs and project scope are identified; Data Modeling, which designs the structure of required data; Process Modeling, defining workflows and business logic; Prototyping, creating a visual representation for user feedback; Testing and Feedback, thoroughly evaluating the prototype with user involvement; and Implementation and Refinement, deploying the application iteratively while integrating it with other systems and training users. Each stage ensures the application effectively meets business requirements and user expectations.

**1. Business Planning and Modeling**

This phase involves identifying business requirements and project scope. The development team and stakeholders collaborate to define project objectives, necessary features, and constraints. Business modeling is employed to understand the flow of information and business processes that the application will support.

**2. Data Modeling**

The data required by the application is identified, and its structure is designed. Entities, attributes, and relationships between entities are defined to form the data model that will be used in the application's database.

**3. Process Modeling**

The business processes that the application will support are modeled. Workflows, business logic, and rules governing these processes are defined. This phase ensures that the application will effectively support business processes.

**4. Prototyping**

A prototype of the application is rapidly created based on the data and process models. This prototype serves as a visual representation of the user interface and application functionality. Users can interact with the prototype to provide feedback and ensure that the application meets their needs.

**5. Testing and Feedback**

The prototype is thoroughly tested to identify errors and deficiencies. Users are involved in the testing process to provide feedback and suggestions for improvement. User feedback is used to refine the prototype and ensure that the application meets their expectations.

**6. Implementation and Refinement**

Once the prototype is approved, the application is implemented in the production environment. This phase involves refining the application, integrating it with other systems, and training users. The implementation process is conducted iteratively and incrementally, with each iteration adding new functionality or improving existing features.

## 3. RESULTS AND DISCUSSION

The initial phase of this research underscores the importance of collaboration among various stakeholders to formulate clear project objectives. A comprehensive business needs analysis revealed that the construction company under study experienced significant material wastage, amounting to 15% per year, equivalent to a financial loss of approximately IDR 500 million. This finding highlights the urgency of developing an application that can reduce wastage and enhance procurement efficiency. The business modeling conducted ensures that the developed application will support real-time inventory updates, provide automated reorder alerts, and integrate with existing procurement systems, thereby effectively meeting the company's operational needs.

The data modeling conducted in this research successfully identified key data entities such as Inventory Items, Suppliers, Purchase Orders, and Stock Levels. The definition of attributes and relationships between entities ensures that the data used in the application will be accurate and well-structured. The average reorder time set at 7 days and the minimum stock level of 100 units per item indicate that the company has good control over its inventory. Accurate data modeling is crucial to support the application's functionality in efficiently managing inventory.

The business process modeling conducted ensures that the application will effectively support the company's operational workflows. By defining workflows, business logic, and rules governing these processes, the application can automate and optimize the processes of inventory receipt, stock issuance, reorder processing, and supplier management. The reduction in order processing time from 3 days to 1 day through automation demonstrates a significant increase in efficiency, which can positively impact the company's operational performance.

The development of the prototype using RAD principles allows for rapid iteration and continuous user feedback. The developed prototype features a user-friendly interface with dashboards for inventory tracking, data entry forms, and automated low stock alerts. Initial trials showed that users could access inventory information 50% faster compared to the previous system. This indicates that the RAD approach is effective in producing a prototype that can be quickly tested and refined based on user feedback.

Thorough testing of the prototype ensures that all features function as intended and that the application is easy for end-users to use. User feedback on improved search capabilities and more detailed reporting features was integrated into the final design, resulting in a more robust and user-friendly application. The 30% increase in user satisfaction indicates that the application successfully meets user expectations and enhances their experience in managing inventory.

The implementation of the application in the production environment involves data migration from legacy systems, integration with existing procurement software, and comprehensive user training. The iterative and incremental implementation process ensures that each iteration adds new functionality or improves existing features based on user feedback. Post-implementation reviews indicate significant improvements in inventory accuracy, a 10% reduction in material wastage, and a 20% increase in procurement efficiency. This demonstrates that the developed application successfully achieves the project objectives and provides tangible benefits to the construction company.

Overall, this research demonstrates that the RAD approach is effective in developing an inventory management application tailored to the specific needs of a construction company. The iterative process ensures continuous improvement and alignment with user needs, resulting in a successful project outcome and a positive impact on the company's operational performance. The results of the entire research stages are presented in Table 1.

**Table 1.** Finding

| Research Stage | Data and Finding |
|---|---|
| Business Planning and Modeling | a. Average material wastage: 15% per year.<br>b. Financial loss: IDR 500 million per year.<br>c. Application requirements: real-time inventory updates, automated reorder alerts, integration with procurement systems. |
| Data Modeling | a. Entities: Inventory Items, Suppliers, Purchase Orders, Stock Levels.<br>b. Attributes: item ID, description, quantity, supplier details, reorder thresholds.<br>c. Average reorder time: 7 days.<br>d. Minimum stock level: 100 units per item. |
| Process Modeling | a. Key processes: inventory receipt, stock issuance, reorder processing, supplier management.<br>b. Order processing time: reduced from 3 days to 1 day with automation. |
| Prototyping | a. Interface: inventory tracking dashboards, data entry forms, automated alerts. |

| Research Stage | Data and Finding |
|---|---|
| | b. Initial trial: 50% faster access to inventory information compared to the previous system. |
| Testing and Feedback | a. Functional and usability testing.<br>b. Improvement suggestions: better search capabilities, more detailed reporting features.<br>c. User satisfaction increase: 30% |
| Implementation and Refinement | a. Data migration from legacy systems.<br>b. Integration with procurement software.<br>c. User training sessions.<br>d. Material wastage reduction: 10%<br>e. Procurement efficiency increase: 20%. |

## 4. CONCLUSION

The findings of this research underscore the efficacy of the Rapid Application Development (RAD) methodology in overcoming the inventory management challenges prevalent in construction companies. The study emphasizes the critical role of stakeholder collaboration in establishing clear project objectives, which ensures that the developed application aligns with the specific operational needs of the company. Through meticulous data modeling, the research successfully identified and structured key data entities, thereby ensuring the accuracy and reliability of inventory data. This precision is essential for maintaining effective control over inventory levels and supporting efficient management practices. The process modeling phase demonstrated that the application could optimize operational workflows by automating key processes such as inventory receipt and reorder processing, significantly reducing order processing time and enhancing overall efficiency. The RAD approach facilitated the rapid development of a functional prototype, enabling continuous user feedback and iterative refinement. This iterative process resulted in a user-centric application that significantly improved inventory accuracy, reduced material wastage by 10%, and increased procurement efficiency by 20%. The successful implementation and refinement of the application, including data migration, system integration, and comprehensive user training, further validated the effectiveness of the RAD methodology. Post-implementation reviews highlighted substantial improvements in inventory management practices, contributing to enhanced operational performance and cost savings. Overall, this research provides valuable insights into the application of RAD in developing tailored inventory management solutions for construction companies, demonstrating its potential to drive significant improvements in efficiency and cost-effectiveness.

## REFERENCES

[1] A. Ogbo and W. Ukpere, "The impact of effective inventory control management on organisational performance: a study of 7up bottling company nile mile enugu, nigeria", Mediterranean Journal of Social Sciences, 2014. https://doi.org/10.5901/mjss.2014.v5n10p109

[2] O. Okeke, W. Okere, M. Abiahu, & C. Dafyak, "Inventory management and financial sustainability: insight from quoted manufacturing firms in nigeria.", International

Journal of Managerial and Financial Accounting, vol. 1, no. 1, p. 1, 2022. https://doi.org/10.1504/ijmfa.2022.10043940

[3] N. Kasim, "Ict implementation for materials management in construction projects: case studies", Journal of Construction Engineering and Project Management, vol. 1, no. 1, p. 31-36, 2011. https://doi.org/10.6106/jcepm.2011.1.1.031

[4] L. Judijanto, "Evaluation and development of building material sales information system to improve inventory management and customer service", WSIST, vol. 2, no. 01, p. 58-64, 2024. https://doi.org/10.58812/wsist.v2i01.830

[5] V. Rathinakumar, K. Priya, P. Kumar.I, & C. Ravekumar, "Construction material management through inventory control techniques", International Journal of Engineering & Technology, vol. 7, no. 3.12, p. 899, 2018. https://doi.org/10.14419/ijet.v7i3.12.16558

[6] Z. Dakhli and Z. Lafhaj, "Considering materials management in construction: an exploratory study", Logistics, vol. 2, no. 1, p. 7, 2018. https://doi.org/10.3390/logistics2010007

[7] C. Gatari, N. Shale, & A. Osoro, "Inventory management and sustainable performance of state corporations in kenya", International Journal of Supply Chain Management, vol. 7, no. 1, p. 56-68, 2022. https://doi.org/10.47604/ijscm.1667

[8] S. Holloway, "The role of inventory management in achieving sustainability in supply chains",, 2024. https://doi.org/10.20944/preprints202407.1016.v1

[9] A. Bathool, "Sustainability initiative towards supply chain inventory management", Recent Research Reviews Journal, vol. 1, no. 1, p. 132-143, 2022. https://doi.org/10.36548/rrrj.2022.1.012

[10] D. Sihombing, "Development of construction inventory application with rapid application development method", Jurnal Informatika Universitas Pamulang, vol. 8, no. 3, p. 444-450, 2023. https://doi.org/10.32493/informatika.v8i3.34375

[11] A. Ogbo and W. Ukpere, "The impact of effective inventory control management on organisational performance: a study of 7up bottling company nile mile enugu, nigeria", Mediterranean Journal of Social Sciences, 2014. https://doi.org/10.5901/mjss.2014.v5n10p109

[12] R. Laitsi, "Making web-based product and inventory applications using the laravel framework (case study : cv. global best ls)", Jurnal Sains Dan Informatika, vol. 8, no. 2, p. 144-150, 2022. https://doi.org/10.22216/jsi.v8i2.1451

[13] R. Hafizh and I. Handayani, "Controlling stock data collection and pricing in the inventory system", Jurnal Infotel, vol. 15, no. 4, p. 335-344, 2023. https://doi.org/10.20895/infotel.v15i4.1055

[14] N. Kasim, "Ict implementation for materials management in construction projects: case studies", Journal of Construction Engineering and Project Management, vol. 1, no. 1, p. 31-36, 2011. https://doi.org/10.6106/jcepm.2011.1.1.031.

[15] M. Liukkonen, "Rfid technology in manufacturing and supply chain", International Journal of Computer Integrated Manufacturing, vol. 28, no. 8, p. 861-880, 2014. https://doi.org/10.1080/0951192x.2014.941406.

[16] Z. Wang, H. Hu, & W. Zhou, "Rfid enabled knowledge-based precast construction supply chain", Computer-Aided Civil and Infrastructure Engineering, vol. 32, no. 6, p. 499-514, 2017. https://doi.org/10.1111/mice.12254.

[17] C. Colicchia, A. Creazza, C. Noè, & F. Strozzi, "Information sharing in supply chains: a review of risks and opportunities using the systematic literature network analysis (slna)", Supply Chain Management an International Journal, vol. 24, no. 1, p. 5-21, 2019. https://doi.org/10.1108/scm-01-2018-0003.

[18] H. KANEKIYO and S. AGATA, "Optimal control in an inventory management problem considering replenishment lead time based upon a non-diffusive stochastic differential equation", Journal of Advanced Mechanical Design Systems and Manufacturing, vol. 13, no. 1, p. JAMDSM0008-JAMDSM0008, 2019. https://doi.org/10.1299/jamdsm.2019jamdsm0008.

[19] F. Naseri, M. Esmaeili, M. Seifbarghy, & T. Heydari, "Pricing and inventory control decisions in the stochastic hybrid production systems with multiple recovery options", Rairo - Operations Research, vol. 55, no. 5, p. 2685-2709, 2021. https://doi.org/10.1051/ro/2021115.

[20] D. Sihombing, "Development of construction inventory application with rapid application development method", Jurnal Informatika Universitas Pamulang, vol. 8, no. 3, p. 444-450, 2023. https://doi.org/10.32493/informatika.v8i3.34375.

[21] E. Dewi, M. Dahlui, D. Chalidyanto, & T. Rochmah, "Achieving cost-efficient management of drug supply via economic order quantity and minimum-maximum stock level", Expert Review of Pharmacoeconomics & Outcomes Research, vol. 20, no. 3, p. 289-294, 2019. https://doi.org/10.1080/14737167.2019.1633308.