Modernization of Construction Industry Management through Digitalization (Construction Management Software)

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Abstract

The paper highlights inefficiencies in Indian construction sites stemming from verbal communication and paper-based record-keeping, proposing a mobile application to address these issues. Targeting stakeholders such as builders, architects, engineers, contractors, and managers, the app aims to formalize task assignment, enhance material management, improve financial tracking, facilitate daily reporting, and streamline plan reviews. Additionally, it offers time and attendance tracking for site workers, serving as a central hub for communication, record-keeping, and task management. The research paper analyzes current shortcomings and introduces the app's functionalities, emphasizing potential benefits like enhanced project efficiency, cost control, adherence to schedules, and quality standards for local construction projects.

Key words. 1. Construction management, 2. Mobile application, 3. India, 4. Stakeholders, 5. Efficiency, 6. Task assignment, 7. Record-keeping, 8. Communication, 9. Project planning, 10. Cost control

1. INTRODUCTION

The construction industry plays a vital role in global infrastructure development. However, traditional construction site management practices often suffer from inefficiencies that lead to wasted resources, delayed project completion, and budget overruns. These inefficiencies stem from a reliance on verbal communication, manual record-keeping, and a lack of centralized data management. This research paper proposes a novel approach to construction site management through the development of a mobile application. This application addresses the shortcomings of current practices by promoting:

(i) Enhanced communication: The app facilitates formal task assignment and eliminates reliance on verbal communication, ensuring clarity and reducing misunderstandings.

(ii) Improved data management: The application provides a centralized platform for storing and accessing critical project information, including drawings, plans, material inventory, and daily reports.

(iii) Streamlined workflows: The app automates tasks such as material tracking, attendance monitoring, and progress reporting, leading to increased efficiency and reduced administrative burden. By implementing these features, the proposed mobile application has the potential to revolutionize construction site management, leading to significant improvements in project outcomes.

This paper will delve into the prevalent shortcomings of current construction site management practices, analyze existing solutions, and present the pro-

posed mobile application in detail. The paper will also explore the potential benefits of the application for various stakeholders involved in construction projects.

2. LITERATURE REVIEW

This literature review aims to examine various research papers focusing on different aspects of project management and construction industry practices to gain a comprehensive understanding of current trends, challenges, and opportunities in the field. 1)Project Management Tools in Software Development: The utilization of project management tools, such as Jira, in open-source software development is gaining prominence. Research analyzes developer communities within Jira projects to understand the impact of community size on issue resolution speed, indicating a growing interest in leveraging technology to enhance collaborative software development processes. 2)Materials Management in Construction: Efficient materials management is crucial for the smooth operation of construction projects. Research emphasizes the benefits of good materials management, including improved work planning, scheduling, labor output, and cost reduction. The development of comprehensive materials management schemes, coupled with the integration of software solutions, aims to optimize construction project processes.3)Project Planning and Contract Translation: The translation of contracts into detailed plans (DWPs) is essential for project success. Comprehensive plans encompassing specific tasks, required resources, and risk management strategies mitigate project risks and ensure adherence to timelines and budgets. Project scheduling software and recommended practices facilitate the creation of detailed plans, enhancing project management efficiency.4)Communication Strategies in Construction: Effective communication is pivotal for collaboration in the construction industry. Understanding social dynamics and employing effective communication strategies among project stakeholders fosters successful project outcomes. Interpersonal skills and communication proficiency play a critical role in mitigating conflicts and ensuring project alignment.4)Construction Project Life Cycle:A thorough understanding of the construction project life cycle is imperative for project stakeholders. Recognizing the various stages of the project life cycle enables effective project planning, execution, and monitoring, ultimately contributing to project success and stakeholder satisfaction.6)Adoption of Construction Management Software (CMS): Despite the benefits of construction management software (CMS), the industry has been slow to adopt it. Understanding the reasons behind this reluctance is crucial for bridging the gap between technological advancements and industry practices, thereby enhancing project management efficiency and effectiveness.7)Clarification of Construction Team Member Roles: Clarifying construction team member roles is essential for project delivery. By differentiating project supervision from management and highlighting the role of the project manager, research aims to improve understanding and collaboration among project stakeholders, ultimately enhancing project outcomes. This literature review provides valuable insights into various aspects of project management and construction industry practices. By synthesizing findings from different research papers, the review underscores the importance of effective project management methodologies, technologies, and communication strategies in ensuring successful project outcomes in the construction industry.

3. PROPOSED METHODOLOGY

3.1. Challenges in the prevailing circumstances

the industry faces persistent challenges related to communication and record-keeping methods, which hinder project management effectiveness and overall productivity. This paper aims to explore these challenges in detail and propose strategies for digital transformation to address them.

Inefficiencies Due to Communication and Record-Keeping Methods:

(i) Verbal Communication:

Verbal communication is a common practice on construction sites, yet it is inherently prone to misunderstandings and misinterpretations. Instructions conveyed orally may not be fully comprehended by all parties involved, leading to errors in execution and potential rework. Moreover, the transient nature of verbal communication makes it difficult to track and reference past conversations, hindering accountability and documentation of decisions.

(ii) Paper-Based Record-Keeping:

Traditional paper-based record-keeping systems present numerous challenges in the construction industry. Important documents such as blueprints, permits, contracts, and change orders are often managed manually, increasing the risk of loss, damage, or misplacement. Retrieving specific information from stacks of paper documents can be time-consuming, resulting in delays in decision-making and project progress. Furthermore, paper-based systems lack real-time accessibility, impeding stakeholders' ability to access crucial information when needed, particularly in dynamic construction environments.

(iii) Impact on Project Efficiency:

Inefficient communication and record-keeping methods directly impact project efficiency and productivity. Miscommunications can lead to rework, delays, and cost overruns, ultimately affecting project timelines and budgets. Moreover, the lack of clear documentation and tracking mechanisms can result in disputes among project stakeholders, further exacerbating project delays and hindering collaboration.

(iv) Quality Control and Compliance:

Inadequate communication and record-keeping practices pose risks to quality control and compliance with regulatory standards in the construction industry. Without proper documentation of construction activities, it becomes challenging to verify adherence to building codes, safety regulations, and quality standards. Poor communication can also compromise the implementation of quality control measures, leading to defects, safety hazards, and potential legal liabilities for construction companies.

(v) Need for Digital Transformation:

Recognizing the limitations of traditional methods, there is a growing need for digital transformation within the construction industry. Implementing modern communication and project management technologies can help streamline processes, enhance collaboration, and improve overall project outcomes. By leveraging digital solutions, construction companies can overcome communication barriers, improve record-keeping accuracy, and achieve greater efficiency in project delivery.

Therefore inefficiencies in communication and record-keeping methods significantly impact the construction industry's ability to deliver projects on time, within budget, and to quality standards. By embracing technology-driven solutions, construction companies can enhance collaboration, streamline processes, and achieve better project outcomes in an increasingly competitive

3.2. Key Stakeholders in Construction Projects

The main people involved in the process of construction of Building are as follows

(i) Builder (Investor): The individual who finances the project, owns the land, and has a vision for the development.

(ii) Architect: Analyzes the land layout and permissions to create possible layouts based on the builder's vision. They are also responsible for acquiring necessary permits from local authorities.

(iii) RCC Consultant (Structural Engineer): Ensures the structural integrity and safety of the building using reinforced concrete. Their expertise includes design, material selection, and complex calculations to withstand anticipated loads.

(iv) Contractor: Builds the structure using their workforce based on the structural drawings.

(v) Project Manager: Plans project tasks (daily, monthly, yearly), recruits contractors, and manages external work not related to the site's execution.

(vi) Site Engineer: Inspects materials, ensures planned tasks are executed, and monitors the work.

3.3. Detailed Software Functionalities Explanation

The application offers seven modules to improve communication, planning, and record-keeping throughout the construction process:

(i) Repository: Accessibility to construction-related drawings is crucial for all parties involved in a project. Therefore, we have implemented a module called "Repository" that stores all drawings, plans, and layouts. This module is accessible to everyone involved in the project (all actors). Architects and RCC consultants can add and modify existing drawings within the repository, while other users have view-only access.

(ii) Transactions: This module gives the builder a detailed report on how and where he has spent money, how much he has earned, the total amount spent, total income gained, and profit/loss. The project manager manages customer and material-related transactions. Therefore, whenever there is a purchase of a flat or new material, the project manager needs to update it here. Only the builder has access to the entire transaction module and all its functionalities, while the project manager can only update the expenses. This module will help the builder track his expenses. The project manager also needs to update all construction site-related expenses such as wages, steel, cement, sand/gravel, and miscellaneous costs.

(iii) Material Management: Tracks material to avoid loss and ensure proper utilization. The site engineer is responsible for updating the app whenever new construction materials are stocked or consumed. The builder and project manager can view material utilization.

(iv) Plan of Action: Ensures tasks are properly planned to avoid wasting time and money. The project manager devises monthly, weekly, and daily plans, creates task tickets (described further), and tracks activities. All users can view the plan of action.

(v) Daily Reports: The project manager creates daily reports on completed tasks. These reports are used to inform the plan of action for the next day. Only the site engineer can generate these reports, while others can view them.

(vi) Attendance: Tracks employee attendance. The site manager updates the software with each worker's in-time and out-time for the day. Other users can only view this information.

(vii) Task Tickets: Addresses the issue of verbal communication on local sites by introducing a formal task assignment system. When assigning a task, a user creates a task ticket specifying the assignee, work description, and required completion time. This system allows for easier task tracking, identification of overdue tasks, and addition of comments by both parties. Once a task

is completed, the assigned person can close the ticket. The system also allows for assigning task priority levels.

Figure2 of the document explains about the same modules through flowchart. This mobile application functions as a central hub for communication, record-keeping, and task management on local construction sites. By fostering collaboration and streamlining project execution, the application has the potential to significantly improve efficiency, cost control, adherence to schedules, and quality standards.

4. Results and Discussion

The research paper addresses the pervasive challenges faced by construction sites, including inefficiencies stemming from improper verbal communication, manual record-keeping, and the absence of centralized data management. Through the proposed mobile application, these issues are targeted for resolution, promising substantial benefits to builders in terms of reduced wastage, enhanced management capabilities, and increased profitability. Upon consultation with builders in and around Pune regarding the software proposed in the research paper, the response was overwhelmingly positive. Builders expressed enthusiasm for implementing the techniques outlined in the application, foreseeing significant improvements in construction site management. The constructive feedback received from industry stakeholders highlights the potential of the proposed solution to revolutionize construction site operations and enhance overall efficiency. Furthermore, data obtained from reputable sources, such as Oro from https://oroinc.com/b2b-ecommerce/blog/digital-transformation-in-construction/, underscores the transformative impact of technology on construction projects. The digital transformation in the construction industry, facilitated by Management Software adoption, has revolutionized project planning and visualization. Technologies including workflow automation, cloud computing, artificial intelligence (AI), Internet of Things (IoT), and digital twinning have become integral components of modern construction practices, empowering builders to streamline processes and optimize project outcomes. In summary, the research findings highlight the critical role of technology, particularly Management Software, in driving efficiency and innovation within the construction industry. Fig 2 of the paper shows statistical data as a result of digitisation

5. Project Advancements: Building on Builder Needs

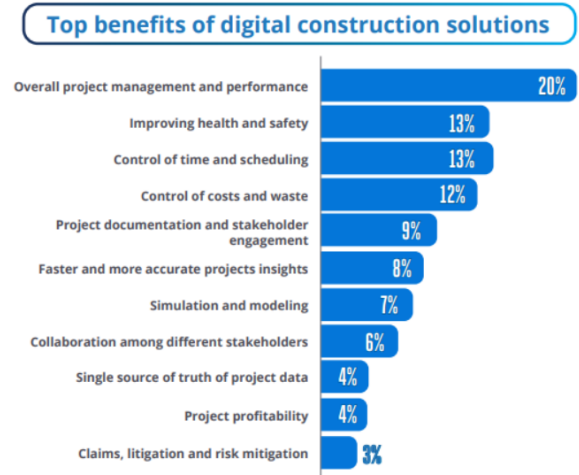This project was developed with a deep understanding of the challenges faced by builders in Pune. While

Fig. 1: Benefits of digitisation

it addresses a wide range of construction management needs, here are some exciting advancements we can incorporate to further enhance its value proposition:

(i) Customization for Specific Builder Needs: The app can be made highly customizable to cater to the unique requirements of each builder. This means builders can choose to activate specific features and functionalities that are most relevant to their projects. Imagine this: a small builder can focus on task management and communication tools, while a larger firm can integrate features for advanced scheduling, material procurement, and even drone integration for site monitoring. This flexibility ensures the app seamlessly integrates into existing workflows and maximizes its impact for each user.

(ii) Monetization Strategies for a Growing User Base: As the user base expands, we can explore various monetization options to ensure the app's long-term sustainability. A subscription-based model could be implemented, with different tiers offering access to a wider range of features. For instance, a basic tier might provide core functionalities like task management and communication, while a premium tier could offer advanced analytics, reporting tools, and integrations with other construction software.

(iii) Performance Tracking and Employee Management: The app can be a powerful tool for employee performance management. By integrating task completion tracking and daily work summaries, builders can gain valuable insights into individual employee performance. This data can be used to identify areas for improvement, provide targeted training, and promote a culture of accountability on the construction site. Imagine supervisors being able to track worker progress in real-time, ensuring deadlines are met and

projects stay on schedule.

(iv) Enhanced Security with Integrated Camera Monitoring: Integration with Accounting Software: Integrate the Transactions module with popular accounting software used by builders. This allows for automatic data transfer between platforms, reducing manual data entry and errors.

(v) Inventory Management Automation: Explore potential integrations with barcode scanners or RFID tags for material management. This would streamline material tracking, reducing manual updates and improving accuracy.

Construction sites can be vulnerable to theft and vandalism. To address this concern, the app can be integrated with security camera systems. This would allow builders to remotely view live and recorded footage directly within the app, providing an extra layer of security and peace of mind. Imagine builders being able to check on their sites remotely, deterring potential security breaches and allowing for quicker response times in case of incidents. By incorporating these advancements, your project will be even more comprehensive and responsive to the needs of builders.

6. Citations and references

The reference section includes a diverse array of research papers addressing various facets of project management and construction industry practices. The research paper with the respective author names are given below.

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7. Conclusion :

In conclusion, the proposed construction management app has the potential to revolutionize how local construction sites operate. By addressing the pervasive issues of disorganized workflows and verbal communication, the app offers a user-friendly solution that streamlines daily tasks and fosters transparency. Further advancements in automation, like automatic data transfer between accounting software and the app, can significantly reduce manual work and errors. Real-time collaboration features, such as built-in chat or video conferencing, can bridge communication gaps and expedite problem-solving. Additionally, robust reporting with data analysis capabilities can empower builders to identify areas for improvement and optimize project workflows. By incorporating these advancements, the app can evolve from a valuable tool for local builders in Pune to an indispensable resource for construction companies of all sizes across the industry.