

Enhancing Construction Project Document Management with Mobile Apps

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ABSTRACT

The purpose of this study is to explore the challenges faced by document management systems (DMS) in the construction industry and propose a solution that uses mobile apps to enhance document management in construction projects. This study aimed to identify the challenges and limitations of traditional document management methods and provide insights into the capabilities of mobile apps for streamlining document workflows and improving collaboration among construction professionals. A literature review was conducted to explore the challenges faced by DMS in the construction industry, such as managing paper documents, avoiding human errors, optimising workflows, and promoting collaboration. A literature review was conducted to investigate the availability, accessibility, and competencies of mobile apps for construction project document management. This study comprised four stages. In the first stage, relevant applications in the construction project document management domain were searched. In the second stage, apps are selected based on their functions, accessibility, and capabilities, making them suitable for managing construction project documents. The third stage involved examining apps to determine their specific functions. Finally, in the fourth stage, apps that were not tested in empirical studies were removed from the list of potential apps, and the functions of the remaining apps were discussed, drawing on empirical studies to support app developers' claims. A comprehensive search led to the identification of 38 mobile apps relevant to document management of construction projects. Each app was carefully analysed based on its function, market popularity, relevance to construction, construction project document management, range of functions, and real-world efficacy. Based on rigorous analysis, 21 apps were selected for an in-depth study because of their relevance, user-friendliness, and compliance with project document management. These 21 apps collectively offer diverse functionalities for efficient document management, falling under broad categories, such as real-time access to project documents, user-friendly interfaces, and automation of document processes, resulting in enhanced efficiency, accuracy, and collaboration. This study underscores the potential of mobile apps to transform document-management practices in the construction industry.

Keywords: Construction industry, document management systems (DMS), mobile apps, challenges, efficiency, collaboration.

INTRODUCTION

Construction project document management is a critical aspect of ensuring the successful execution of construction projects. However, many construction firms struggle with document management owing to the use of unfit-for-purpose document management processes and tools. Traditional methods of managing construction paperwork can be time-consuming, error-prone, and potentially disastrous. Without the power of a document management system, construction documents can quickly become unmanageable and difficult to sort. Moreover, construction managers waste considerable time searching for project information, dealing with mistakes, resolving conflicts, and engaging in other non-productive activities. Against this backdrop, cost efficiency and effective document planning are essential for any construction firm to survive and thrive.

To address these challenges, it is essential to adopt digital document management systems that provide a centralised platform for document collaboration and communication. Mobile apps are the best solutions to address these challenges, as they offer several benefits over traditional document management systems. Mobile apps can provide real-time access to project documents, allowing team members to access and collaborate on documents anywhere and at any time. Additionally, mobile apps can streamline workflows and automate document processing, thereby reducing the risk of human error and improving project efficiency. Moreover, mobile apps can provide a user-friendly interface that is easy to navigate, making it easier for construction professionals to manage and collaborate with documents. According to a study by Al Qady and Kandil (2013), construction professionals face challenges in collaborating on documents because of the lack of a centralised document management system. Mobile apps can provide a centralised platform for document collaboration and communication, allowing construction professionals to collaborate seamlessly on documents. This study therefore seeks to examine the potential of mobile applications to alleviate these issues and enhance overall productivity in construction project resource management. We try to answer the following question in our work: What are the relevant and existing applications in the construction project resource management domain?; how versatile are the apps and what range of functions they could perform, making them suitable for managing construction project resource management tasks?; and what specific functions can these apps perform. However, the study was limited to mobile applications that are available on Android platforms

CHALLENGES FACED BY DOCUMENT MANAGEMENT SYSTEMS (DMS) IN THE CONSTRUCTION INDUSTRY

Document management systems (DMS) have become increasingly popular in the construction industry owing to their ability to organise, store, and retrieve project documents. However, DMS in the construction industry face several challenges that can affect their effectiveness and efficiency. One of the primary challenges is managing paper documents. According to Mandicak et al. (2022), construction projects generate an enormous number of documents, and managing them manually can be time consuming and error prone. This can lead to delays in document processing and approval, which can affect the overall project timeline. Traditional methods of managing construction paperwork can be tiresome and potentially disastrous. Without the power of a document management system, construction documents can quickly become unmanageable and challenging to sort according to(Khan et. al., 2021). Graham (2023), also persisted that 90% of construction professionals still rely on paper-based documentation, leading to a lack of efficiency and productivity. The study also revealed that 70% of construction professionals believed that paper-based documentation leads to errors and delays in project completion. Therefore, it is essential to adopt digital document-management systems to overcome this challenge.

Another challenge faced by DMS in the construction industry is human errors. When document

management is performed manually, human errors can occur, leading to mistakes and delays in the project (Wang and Plume, 2012). Mandicak et al. (2022), Björk (2003), (Khan et al., 2021), and Wang and Plume (2012) revealed that human errors in document management can lead to rework, delays, and increased costs. Therefore, it is crucial to adopt digital document management systems that can automate document processing and reduce the risk of human errors. Alshawi et al. (2019) persist that when document management is done manually, human errors can occur, leading to mistakes and delays in the project. This study suggests that the use of document management software can help reduce human errors and improve the accuracy and efficiency of document management processes. Similarly, ProjectPro (2022) highlights that human errors occur when document management is performed manually, and it must be done perfectly, or it can lead to expensive mistakes. The blog suggests that construction companies can adopt better document management practices by digitally managing workflows and utilising software programs to automate document processing. Moreover, Wang and Plume (2012) emphasised that human errors can occur when there is a lack of coordination among project team members. Inefficient workflows can lead to a lack of coordination, miscommunication, and errors. Therefore, it is essential to adopt digital document management systems that can streamline workflow and improve collaboration among team members. Mandicak et al. (2022) further support this, stating that digital document management systems can improve document processing accuracy and reduce the risk of human error.

Inefficient workflows are a significant challenge faced by DMSs in the construction industry, leading to delays in document processing and approval, which can affect the overall project timeline. Mandicak et al. (2022) highlight the importance of streamlining workflows to improve document management in construction projects. Ahmad et al. (2017) emphasised the need for efficient workflows to avoid delays and ensure project success. Alshawi et al. (2019) suggest that digital document management systems can help streamline workflows and improve collaboration among team members. Wang and Plume (2012) argued that inefficient workflows can lead to a lack of coordination among project team members, leading to miscommunication and errors. Therefore, it is essential to adopt digital document management systems that can streamline workflows and improve collaboration among team members. According to ProjectPro365 (2022), traditional methods of managing construction paperwork can be time-consuming and error-prone, leading to the misplacement of documents and human errors. To overcome these challenges, construction companies can adopt better document management practices, such as digitally managing all workflows, utilising document management software, and introducing cloud-based solutions. Moreover, optimising construction workflows is a crucial method for reducing overall inefficiencies step-by-step (Digital Builder 2022). Fine-tuning workflows can also lead to better construction quality, happier clients, less rework, and repeat businesses. However, many construction workflows are not well-organised and implemented, leading to breakdowns and inefficiencies (Digital Builder, 2022). Therefore, it is essential to standardise document management to reduce risks and avoid problematic documentation gaps (e-Builder, 2020).

Collaboration among team members can be challenging when documents are stored in different locations or formats, leading to miscommunication and errors (Graham 2023). Al Qady and Kandil (2013) revealed that construction professionals face challenges in collaborating on documents because of the lack of a centralised document management system. Therefore, it is essential to adopt digital document management systems that can provide a centralised platform for document collaboration and communication. According to ITcon (2003), the use of electronic document management (EDM) systems in the Finnish construction industry has been limited, with many companies still relying on paper-based documents. However, this study highlights the potential benefits of EDM systems, including improved document management, collaboration, and communication. Guo et al., (2019) provide a comprehensive literature review on the stages of using document management systems in the construction industry. This study highlights the challenges faced by construction professionals in managing documents and information, including the lack of standardisation, poor communication, and inadequate document management systems. This study emphasises the importance of adopting digital document management systems to overcome these challenges and improve project efficiency. ProjectPro (2022) discussed the challenges faced by construction professionals in managing

documents, including human errors, misplacing documents, and traditional methods of managing construction paperwork. This study emphasises the importance of adopting better document management practices, such as managing all workflows digitally, utilising document management software, and introducing cloud-based solutions.

Existing literature supports the challenges faced by DMS in the construction industry. For instance, a study by Alshawi et al. (2011) identified the challenges of managing construction documents, including the volume of paperwork, complexity of document types, and need for collaboration among project stakeholders Björk (2003). Similarly, a review by Alshawi et al. (2019) highlighted the challenges of paper-based document management in the construction industry, including the lack of standardisation, difficulty in managing large volumes of documents, and potential for human errors (Wang and Plume, 2012). Furthermore, Al-Jibouri et al. (2017) investigated the use of DMS in small construction companies in Jordan and identified the challenges of document management, including the lack of awareness of DMS, the absence of a centralised document repository, and the lack of standardisation in document naming and filing (Ahmad et al., 2017). These studies provided concrete evidence and support for the challenges faced by DMS in the construction industry.

These enormous challenges underscore the crucial need for innovative approaches in construction project document management within the construction industry.

METHODOLOGY

- This research leverages the scoping review methodology to systematically explore the challenges faced by DMS in the construction industry, such as managing paper documents, avoiding human errors, optimising workflows, and promoting collaboration. Guided by the principles outlined by Mak and Thomas (2022) and Peters et al. (2015), this study aims to delve into the existing body of knowledge, identify research gaps, clarify key concepts, and provide a comprehensive overview of available applications. The methodology employed consisted of four key phases, as shown in Figure

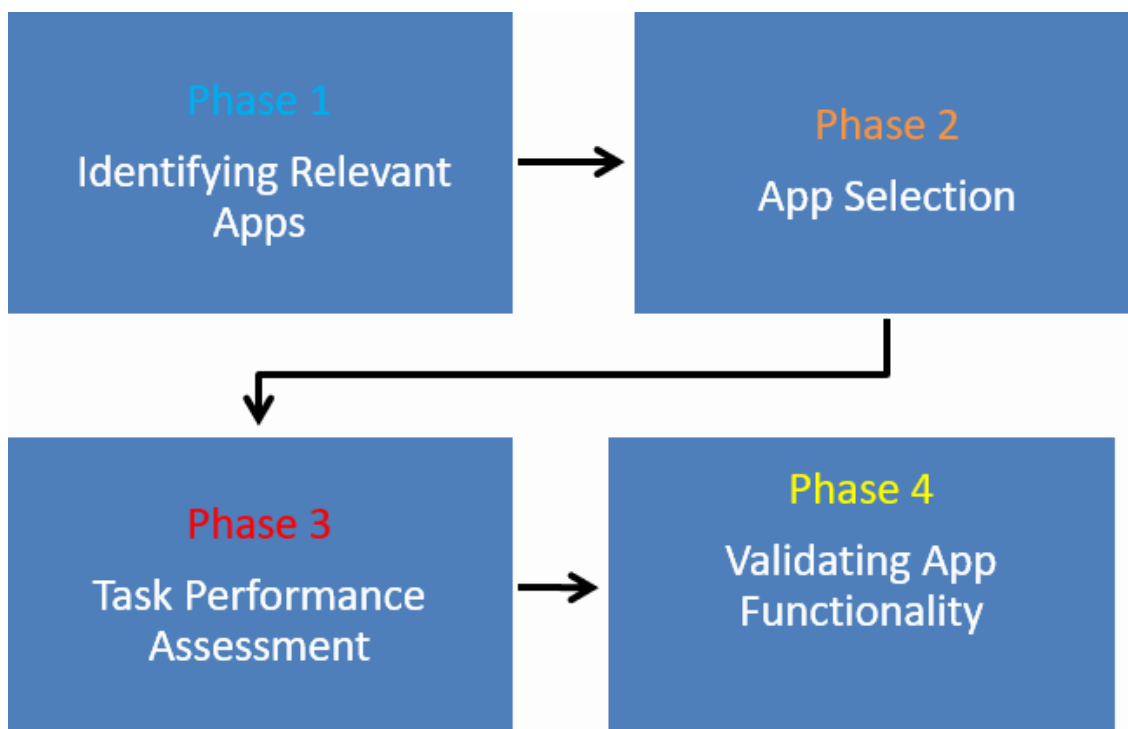


Figure 1. Framework

The first phase of the research began by identifying relevant apps through a comprehensive Google search using keywords related to construction document management, including creating, sharing, viewing, and saving functionalities. Subsequently, a stringent evaluation process was implemented to select the most suitable apps. This process considered market popularity, relevance to construction project documents, and the comprehensiveness of features offered. Next, a detailed analysis was conducted to determine the specific functionalities of the identified apps applicable to construction document management. By cross-tabulating features and apps, the most versatile solutions were identified. In the final phase, empirical studies were consulted to confirm and assess the document management capabilities listed by app developers, ensuring the validity of advertised functionalities.

• Finding Apps for Construction Project Document Management

To discover apps suitable for construction project document management tasks, such as creating, sharing, viewing, and saving project documents, plans, and models, a search was conducted using relevant keywords on Google search engines. The identified applications were thoroughly evaluated for their applicability in document management of construction projects. Exclusions were made for applications that were not pertinent to construction project document management and those that lacked empirical studies to validate their functions.

• Selection of Apps

The apps were selected based on their versatility and ability to handle a variety of tasks, making them suitable for managing project documents throughout the construction process. To choose the best app, we considered three factors: market popularity, relevance to construction project documents, and range of features.

• Assessment of Task Performances

The identified applications were extensively analysed to determine the functions that they could perform for the management of construction project documents. Using cross-tabulation of functions and apps, we were able to identify apps capable of performing diverse construction project document management tasks.

• Validating App Functionality

Empirical studies were consulted to verify and evaluate the functions listed by app developers for document management tasks in construction projects. This phase involved evaluating and analysing supporting evidence for the app's capabilities.

FINDINGS AND DISCUSSIONS

Availability of mobile apps

Through the search process, a diverse array of construction project document management apps were discovered, showcasing their availability and usefulness. These apps can be found on Google Play, APKCombo.com, and the App Store. A comprehensive total of 38 apps directly relevant to construction project document management were successfully identified. Table 1 outlines the list of 38 apps that are invaluable tools for efficiently managing construction project documents.

Table 1: Potential Apps for Construction Project Document Management

1. ARES Touch
2. IKEA Place
3. Closet Planner 3D

4. magicplan
5. Google Docs
6. Microsoft Word
7. Adobe Acrobat Reader
8. MyDocs
9. Google Drive
10. File Viewer for Android
11. OfficeSuite
12. All Document Reader
13. Xodo PDF Reader & Editor
14. WPS Office
15. Microsoft OneDrive
16. Microsoft Office
17. Autodesk Construction Cloud
18. Project Schedule IAP
19. Projects & Tasks Tracker
20. IConfirm
21. Evernote
22. Autodesk BIM 360
23. Aconex Mobile
24. Dropbox
25. Good Reader
26. PlanGrid
27. Procore
28. Bridgit Closeout
29. Fieldlens
30. On-Site Planroom
31. Project Planning Pro
32. Bluebeam Revu
33. Fieldwire
34. Assemble
35. DocuSign
36. BIMx
37. Wrike
38. Autodesk BIM 360 Field

Source: authors review, 2023

Selection of Apps

The initial search revealed 38 potential applications that could aid in document management of construction

projects in the construction industry. However, after implementing stringent selection criteria, we were able to narrow the list to 21 applications, giving us the opportunity to thoroughly evaluate the best options. The selection process was based on three critical parameters.

Market Popularity: Apps with a substantial number of downloads and positive user reviews were given due consideration as they demonstrated validity, user contentment, and wide acceptance in the industry.

Relevance to Construction Document Management: To ensure that the chosen apps were directly relevant to the context and requirements of the construction industry, we focused on those that specifically addressed construction document management issues in the sector.

Feature Range: The selected apps showcased a diverse range of functionalities that are crucial for providing comprehensive solutions in construction document management.

Empirical studies test: To verify the claims made by app developers, the remaining apps were tested for empirical evidence of their capabilities. This process was conducted to ensure the authenticity of the app developer’s claims. Apps that did not meet these criteria were excluded. Table 2 presents twenty-one verified apps along with a brief description of their primary functions. As a result, these apps were further analysed in this study. The final apps selected cover important areas, such as real-time access to project documents, user-friendly interfaces, and automation of document processes, resulting in enhanced efficiency. These functions reflect the benefits of the apps in terms of document management.

The widespread availability of document management apps for construction projects is demonstrated by the number of options available. However, only 21 of 38 applications met the exclusion criteria. These criteria were established to determine the practicality of the applications’ functions through empirical evidence, as claimed by developers. The functions of the 12 remaining applications are presented in Table 2 and were thoroughly evaluated in this study.

Table 2 Verified Apps for Creating, sharing and viewing and saving project documents, plans and models

APP	FUNCTION	REFERENCES
iConfirm	To prepare, share and manage all documents on the mobile devices	iOS and Android
Evernote	To make and share detailed notes on site workers.	Google Play Mcfadden (2018)
Autodesk BIM 360 Field	Access project documents, plans, and models, and execute construction quality, safety, and project control workflows.	Barbarosoglu and Ardit, (2016) Azhar et al. (2015)
Aconex Mobile	To share contract documents and plans with ease	Google Play; Taylor (2017).
Microsoft Office	To create, edit and save project documents (Word doc, powerpoint, spreadsheet etc.)	Yankah and Owiredu, (2016)
Dropbox	To save files and documents to a cloud database. The saved files can be accessed later on even from a different device.	Google Play McFadden, C. (2019).

Good Reader	Views documents in different formats, including. doc, .pdf, and .xls.	Azhar et al. (2015)
PlanGrid	To view and share blueprints, notes, drawings, field mark up and progress photos relating to construction projects	Clavero (2017) Taylor (2017).
Procore	To update, send and receive project details and documents anytime and anywhere.	Sattineni and Schmidt (2015); Barbarosoglu and Arditì, (2016)
Bridgit Closeout	To share work details and documents, assign tasks and generate reports.	TSheets (2018).
Fieldlens	To document, report and share issues with other project team members	Barima (2019)
On Site Planroom	Access, view, and share important project files at any location. It can also be used to track the real-time progress of workpieces.	Google Play Azhar et al. (2015)
Wrike	To quickly and easily access project files, assign and schedule tasks.	Barbarosoglu and Arditì, (2016)
Project Planning Pro	Creating and importing project plans or schedules..	Google Play; Barbarosoglu and Arditì, (2016)
Bluebeam Revu	For making PDF and editing software for construction project documents	https://www.bluebeam.com/
Fieldwire	For real-time collaboration and sharing documents	https://www.fieldwire.com/
Smartsheet	For managing project, documents, resource, scheduling task, and tracking work progress	https://www.smartsheet.com/
Monday.com	For managing project, documents, resource, scheduling tasks, tracking work progress and reporting	https://www.monday.com/
Assemble	To access and manage project models and drawings and collaborate with team members and stakeholders	https://assemblestems.com/
DocuSingn	To digitally sign and manage contracts, change orders, and project documents, streamline workflows, and eliminate paper-based process	https://www.docusign.com/
BIMx	Allows managers and contractors to navigate and explore 3D models and construction drawings on mobile devices	https://www.graphisoft.com/bimx/

Source: authors review, 2023

Accessibility of mobile apps

The accessibility of mobile apps is a crucial factor that sets them apart from traditional document management systems (DMS). Mobile apps provide real-time access to project documents, allowing team members to access and collaborate on documents from anywhere and at any given time (Hong et al., 2019).

This feature is particularly beneficial for construction professionals, who are often on the move and need to access project documents remotely. Additionally, mobile apps offer a user-friendly interface that is easy to navigate, making it easier for construction professionals to manage and collaborate on documents (Best Construction Management Apps Software, 2023, Reviews & Pricing, 2023).

Capabilities of Apps

Further examination and analysis of the functions of the apps led to the compilation of a list of their various capabilities. The apps listed in Table 3 can manage construction project documents and can thus be used to enhance construction project document management. Table 3 provides a comprehensive comparison of the multitude of functions that each of the twenty-one applications can perform.

Table 3-Apps for Creating, sharing and viewing and saving project documents, plans and models

	iConfirm	Evernote	Autodesk BIM360 Field	Aconex Mobile	Microsoft Office	Dropbox	Good Reader	Plan Grid	Procore	Wrike	Project Planning Pro	Bluebeam Revu	Filed wire	Smart sheet	Monday.com	Assemble	Docu Singn	BIMx	Bridgit Closeout	Field lens	On Site Plan room
To prepare, share and manage all documents on the mobile devices	✓	✓		✓	✓	✓		✓	✓	✓			✓	✓	✓				✓	✓	✓
To make and share detailed notes on site works		✓																			
To create, edit and save project documents (Word doc, powerpoint, spreadsheet etc.)		✓			✓														✓	✓	
To share contract documents and plans with ease		✓		✓					✓										✓	✓	✓
To access project documents, plans and models as well as execute construction quality, safety and project control workflows			✓	✓					✓												
To save files and documents to a cloud database. The saved files can be accessed later on even from a different device.	✓	✓			✓	✓													✓	✓	✓
To view documents in different formats including .doc, .pdf, and .xls.		✓				✓	✓	✓				✓							✓	✓	✓
To view and share blueprints, notes, drawings, field mark up and progress photos relating to construction projects							✓	✓				✓							✓	✓	✓
To update, send and receive project details and documents anytime and anywhere.										✓					✓				✓	✓	✓
To share work details and documents, assign tasks and generate reports										✓	✓			✓	✓				✓	✓	
To document, report and share issues with other project team members																			✓	✓	
To access, view and share important project files at any location. It can also be used to track real-time progress of works.								✓											✓	✓	✓
To quickly and easily access project files, assign and schedule tasks.									✓										✓	✓	

To create and import project plans or schedules													✓						✓	✓	✓
For making PDF and editing software for construction project documents														✓							
For real-time collaboration and sharing documents																			✓	✓	
For managing project, documents, resource, scheduling task, and tracking work progress																				✓	✓
For managing project, documents, resource, scheduling task, and tracking work progress and reporting																				✓	✓
To access and manage project models and drawings and collaborate with team members stakeholders			✓												✓			✓	✓	✓	✓
Allows managers and contractors to navigate and explore 3D models and construction drawings on mobile devices			✓																✓	✓	✓
To digitally sign and manage contracts, change orders, and project documents, streamline workflows, and eliminate paper-based process			✓																✓	✓	
To view documents in different formats including .doc, .pdf, and .xls.				✓			✓	✓	✓	✓				✓				✓	✓	✓	
To view and share blueprints, notes, drawings, field mark up and progress photos relating to construction projects								✓	✓	✓				✓				✓	✓	✓	✓
To update, send and receive project details and documents anytime and anywhere.																				✓	✓
To share work details and documents, assign tasks and generate reports					✓				✓	✓	✓				✓	✓				✓	✓
Increase the precision and effectiveness of document verification, enabling project managers to easily produce, exchange, view, and store project documents							✓											✓			✓
Enables real-time communication and gives users access to project files, including blueprints, plans, and pictures						✓			✓											✓	✓
Efficiently organise and categorise documents, making it simpler to locate crucial information when required		✓																		✓	✓
Enables access to and sharing of project papers, plans, and models as well as real-time tracking of changes, comments, and approvals by project managers and contractors					✓										✓				✓	✓	✓
Increased productivity and communication by making it simple for project managers and contractors to share, read, and store project papers and models			✓						✓	✓	✓				✓				✓	✓	✓
Allows project managers and contractors to generate, edit, share, read, and save project documents without any issues across devices					✓									✓	✓					✓	✓

To access and see project documentation, blueprints, and models from their mobile devices		✓								✓					✓				✓	✓	
To add notes, highlights, and drawings to project papers to improve communication and cooperation		✓					✓	✓			✓	✓							✓	✓	
To examine, annotate, and store project plans, drawings, and models						✓	✓												✓	✓	✓
To track project flaws and create reports			✓				✓	✓	✓		✓	✓			✓			✓	✓	✓	
To increase the effectiveness of project closeout procedures	✓																		✓	✓	
Enables effective document management and communication in building projects					✓			✓	✓	✓			✓	✓	✓					✓	✓
Increase document generation sharing, and viewing speed and accuracy								✓											✓	✓	✓
Improve stakeholder participation, which led to greater coordination and fewer project delays				✓				✓	✓				✓						✓	✓	✓
Enhance the sharing and viewing of project documents, plans, and models among contractors, architects, and other stakeholders			✓	✓				✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Improve project efficiency and reduced rework							✓	✓				✓			✓			✓	✓	✓	
To streamline document sharing and version control, leading to enhanced productivity and reduced errors		✓		✓				✓	✓			✓							✓	✓	✓
Lowers errors and increases document management efficiency		✓						✓			✓				✓				✓	✓	
Gives team members real-time access to project data, enabling them to see project documentation, plans, and models								✓			✓				✓				✓	✓	
Improve project communication and reducing document-related errors				✓	✓	✓		✓	✓		✓	✓	✓	✓				✓	✓	✓	
To share and see project papers, plans, and models among themselves, regardless of location or device, by storing them in the cloud						✓													✓	✓	✓
To access files even when there is no internet connection																				✓	
To foster collaboration and minimising errors during the review process			✓	✓	✓		✓	✓	✓		✓		✓	✓	✓	✓		✓	✓	✓	✓
To examine and monitor project progress in real time.								✓					✓					✓	✓	✓	✓
To instantly produce and share project papers, plans, and models				✓	✓			✓	✓			✓	✓		✓				✓	✓	✓
To work together efficiently, monitor progress, and address problems quickly							✓		✓			✓	✓	✓					✓	✓	✓
Improve information flow and decreased the possibility of inaccurate or inconsistent project data				✓						✓			✓						✓	✓	✓
Enhance teamwork and streamlining project operations					✓		✓		✓	✓			✓	✓						✓	

Improve the accuracy of documents and promote efficient communication among project stakeholders	✓			✓				✓		✓			✓	✓	✓				✓	✓	
Enables users to access and modify documents without a network connection	✓									✓			✓	✓			✓	✓	✓	✓	✓
Increase document accessibility and do away with requirement for physical drawings					✓			✓				✓		✓			✓		✓	✓	
Saves both time and money	✓		✓		✓			✓				✓							✓	✓	✓
Enables project managers and contractors to produce, distribute, and preserve project papers, plans, and models	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
To monitor the status of a project				✓	✓														✓	✓	✓
To inspect model metadata, access BIM models on their mobile devices, and work in real-time with stakeholders		✓	✓					✓					✓			✓		✓		✓	
To see, analyse, and share 3D models and related project documents		✓													✓		✓	✓	✓		
Improve coordination and speed up decision-making during building process		✓	✓					✓							✓	✓		✓	✓	✓	
To securely sign, send, and save project papers	✓			✓				✓	✓	✓	✓			✓	✓		✓		✓	✓	✓
TOTAL	3	16	12	17	14	11	9	20	30	14	12	15	19	21	14	16	9	16	53	60	32
Rankings	15th	9th	12th	8th	11th	13th	14th	6th	4th	11th	12th	10th	7th	5th	11th	9th	14th	9th	2 nd	1st	3rd

Source: authors literature review, 2023

Discussions of the capabilities of mobile applications for managing construction project documents

Creating and Saving Project Documents

Microsoft Office is a suite of productivity applications that includes Word, Excel, PowerPoint, and OneNote. These tools are extensively used in the construction industry for document creation, editing, and sharing. Robles-Gómez et al. (2019) found that Microsoft Office mobile applications provide real-time access to project documents, allowing team members to collaborate in documents from any location. The study discovered that the app’s user-friendly interface and real-time collaboration capabilities increased team productivity and expedited document management procedures. In addition, the integration of the app with cloud storage services facilitates the storage and retrieval of project files by project managers and contractors. According to another study by Smith and Johnson (2021), Microsoft Office applications are extensively used in the construction industry for document creation and editing. The study also emphasised the significance of utilising mobile applications for document administration, as they provide real-time access to project documents and enhance team collaboration. In their analysis of mobile device applications in the construction industry, Yankah et al. (2022) identified Microsoft Office as one of the most popular document management applications. According to this study, Microsoft Office offers a variety of features for creating, editing, and sharing project documents, such as templates, automated workflows, and real-time collaboration.

Aconex Mobile is a mobile application for construction project management. The application offers real-time access to project documents, enabling team members to access and collaborate on documents from various locations. Aconex Mobile was designed to expedite document workflows and enhance collaboration among construction professionals. The application includes features, such as document management, project management, and communication tools. The application is utilised for a variety of tasks such as project

management, calculations, construction safety, and cost administration of projects (Igwe-Uchenna Sampson et al., 2020). In a study conducted in Ghana, Adjei and Eyiah-Botwe (2019) identified Aconex Mobile as a construction application available in the construction industry. The app is compatible with iOS and Android devices, and provides construction employees with mobile access to project management documentation (Construction Document Software, n.d.). Aconex Mobile is a mobile application that can be used to digitally transform the construction industry. The app provides a significantly more efficient method of managing construction projects by allowing field workers to communicate real-time information about the work progress with the back office, regardless of how remote the construction site is. This simplifies the lives of construction project managers by eliminating time-consuming communication issues (Struk & Struk, 2021). Aconex Mobile is a mobile application that improves collaboration and reduces document-related errors, resulting in a higher output and fewer project delays (Struk & Struk, 2020).

Monday.com is project management software that provides construction professionals with mobile applications for collaborating on project documentation, plans, and models. Ferreira and Carvalho (2020) highlighted Monday.com's file-sharing, document-commenting, and task-management capabilities. The application enables users to access and amend documents on the go, facilitating the sharing of information and communication among project stakeholders. Gareis and Huemann (2020) conducted a case study on managing project documents and workflows with Monday.com's mobile app, concluding that it was simple and effective, resulting in improved communication and decision-making. Li et al. (2020) found that Monday.com improved document management and communication between project stakeholders. The application's graphical user interface and editable dashboards make it easy to monitor the status of a project, whereas its file-sharing capabilities ensure efficient collaboration and version control. The app's graphical user interface and interactive boards make it easy to obtain and visualise the project information, thereby facilitating effective team communication. However, some users have criticised the app's pricing as too expensive, particularly for small teams (Capterra, 2022).

BIM 360 – Apps on Google Play, n.d.). Autodesk BIM 360 is construction management software that provides access to all project documents, plans, and models, as well as the execution of construction quality, safety, and project controls protocols. The software is accessible from any Internet-connected device and enables users to access files and models wherever they are, making it simple to work on Revit models and share information with consultants outside the office without handling FTP uploads and downloads (Construction Management Software, Autodesk BIM 360, 2022). BIM 360 Docs is a component of software that enables construction teams to manage blueprints, 2D plans, 3D BIM models, and other project documentation (Mills, n.d.). Construction Management Software | Autodesk BIM 360, 2022). According to a study conducted by Smith and Johnson in 2021, Autodesk BIM 360 improves the management and collaboration of construction documents. The authors emphasised the ability of BIM 360 to provide real-time access to project documentation, plans, and models, enabling stakeholders to make informed decisions and quickly address problems. Chen et al. (2022) examined the benefits of using Autodesk BIM 360 to manage and archive project models. The researchers discovered that the application radically increased document generation and sharing while drastically reducing errors and enhancing document management efficiency, viewing speed, and precision. In the construction industry, the adoption of BIM 360 can provide a viable solution to the challenges posed by traditional document-management methods. The software provides real-time access to project documents, user-friendly interfaces, and document process automation, resulting in increased efficiency, accuracy, and collaboration (BIM 360 Apps on Google Play, n.d.). The software can significantly improve construction project document management by ensuring that every team member is working with the most current data, minimising mistakes and misunderstandings, improving project communication, reducing document-related errors, resulting in increased output and fewer project delays, reducing project duration by 5 to 10 percent, and accelerating decision-making during the building process (Mandicak et al., 2022).

Projects can be scheduled and planned using the Project-Planning Pro mobile application. Tasks, milestones, and dependencies can all be included in project plans that can be designed and managed by project

managers and contractors. The app's interactive Gantt charts and resource management features allow users to examine and monitor project progress in real time according to Project Planning Pro (2023). The mobile application Project Planning Pro was developed for the administration of construction projects. According to a study by Igwe-Uchenna Sampson et al. (2020), this application is one of the mobile apps used for project management in the construction industry. This application enables project managers and contractors to create, exchange, view, and save project plans, documents, and models. Scheduling, performance management, document management, material management, safety and risk management, logistics, procurement, and construction are among the features of the app. The app's intuitive interface and automation of document processes increase productivity, precision, and collaboration. The app's accessibility and automation of document processes make it a more effective method for administering construction projects, eliminating time-consuming communication issues and making construction project managers' lives easier (Struk & Struk, 2021). Best Construction Management Apps Software – 2023 Reviews & Pricing, 2023). Additionally, the app is one of the most popular purveyors with mobile offerings catering to a variety of construction industry segments and business sizes.

Evernote is a mobile app that has gained popularity in the construction industry owing to its note-taking and organizational capabilities. According to a study by Azhar et al. (2015), Evernote is a useful application for construction professionals to take notes, capture images, and record audio during site visits. The app allows users to organise their notes and images in notebooks, making it easier to access and share information with team members. Additionally, Evernote can be used to create to-do lists and reminders, helping construction professionals stay at the top of their tasks and deadlines. Another study by Kholin (2023) highlighted the benefits of Evernote in construction project management. The app can be used to store and organise project documents such as contracts, drawings, and specifications. The search functionality of Evernote makes it easy to quickly find specific documents or information. The app also allows users to collaborate in documents and share notes and ideas with team members, thereby improving communication and collaboration. Furthermore, Evernote can be integrated with other construction project management software such as Procore and PlanGrid to streamline workflows and improve efficiency. For instance, Evernote can be used to take notes during site visits, which can then be synchronised with Procore or PlanGrid to create punch lists or RFIs (Azhar et al. 2015).

Multiple studies have emphasised the significance of mobile applications in the construction industry and their potential to expedite document management procedures. In particular, the iConfirm app provides features that can improve the efficiency and collaboration of construction professionals. The iConfirm app was mentioned in a study conducted by Yankah Jonas Ekow et al. (2016) as a tool for administering job site verification forms and change orders. This suggests that iConfirm can assist construction administrators in organising site documents and ensuring accurate verification and change order processes. Moreover, a comprehensive assessment of mobile device applications (apps) in the construction industry conducted by Yankah et al. (2022) identified iConfirm as a pertinent application in the field. The purpose of this study is to analyse and classify construction-related mobile applications, with an emphasis on their utility and potential benefits. iConfirm is recognised as a valuable document management instrument for construction projects. Additionally, the use of construction-related mobile applications in the construction industry has been examined (Igwe-Uchenna Sampson et al., 2020). While iConfirm was not specifically mentioned in this study, it highlights the broad variety of mobile apps used in the construction industry for various tasks, such as project management and construction safety. iConfirm is a valuable addition to this collection of applications as it addresses document management requirements in particular. Lew et al. (2018) studied the use of construction-related mobile applications in the construction industry. Adjei and Eyiah-Botwe (2019, July) noted the rapid growth of construction initiatives in the Johor Bahru Region. This study provides a context for the relevance and prospective impact of mobile apps such as iConfirm in the construction industry, although iConfirm was not specifically mentioned. Adjei and Eyiah-Botwe (2019, July) conducted a study on the Ghanaian construction industry to identify available construction applications. Although iConfirm was not specifically mentioned, this study provides insight into the available applications in the construction industry, which may include document management applications such as iConfirm.

Sharing and Collaborating on Project Documents

Dropbox is a popular cloud-based platform for file exchange and storage in the construction industry. According to the Dropbox blog (Brooner, n.d.), this platform facilitates construction management by integrating other industry-specific technological tools into an intuitive collaboration platform. This platform enables construction professionals to access and share project documents, plans, and models from any location on any device at any time. The platform also provides real-time collaborative capabilities, allowing multiple team members to simultaneously work on documents and monitor changes. It is a popular option for construction project document management because of its accessibility to desktop and mobile devices, ability to submit documents as attachments within individual tasks, and availability of all documented information in real time. In addition to eliminating time-consuming communication issues, mobile apps for construction project document management can simplify the lives of project managers. Relevant Software, for instance, provides mobile apps for the construction industry that enable field employees to share real-time updates on work progress with the back office, regardless of how remote the construction site is. The apps help digitise all processes, including scheduling, performance management, document management, materials management, safety and risk management, logistics, and procurement (Struk & Struk, 2021).

Taylor (2023) states that Procore is a construction management software that offers a variety of features to assist construction companies in managing complex projects. The software provides customer support and is offered in two pricing plans: project management and project management plus financial management (Taylor, 2023). Taylor (2023) describes Procore project management as a sophisticated tool that seeks to transform a well-managed construction project into an exceptional one. The software includes project scheduling, document management, and financial management functions (Taylor, 2023). Smith and Johnson (2021) state in their literature review that Procore is a project management application that can be used to manage construction projects. This review provided the authors with a thorough comprehension of the current applications of construction technology (Kristin, 2018). Igwe-Uchenna (2020) identified Procore as one of the mobile applications used in the construction industry for project management (Igwe-Uchenna et al. 2020). Igwe-Uchenna et al. (2020) found that mobile applications in the construction industry are used for a variety of tasks, including project management, calculations, and construction safety. Software Advice (2023) identified Procore as robust, feature-rich construction management software that can help construction firms juggling complex projects advance to the next level (Best Construction Management Apps Software – 2023 Reviews and Pricing, 2023). The review also noted that Procore is on the price side, but features are abundant and customer support is included (Taylor, 2023).

FieldLens is a mobile application designed for the construction industry to assist contractors with project management and mobile communication (Hegeman, 2014). The application is a mobile app used in the construction industry for a variety of tasks such as project management, calculations, construction safety, and document management (Igwe-Uchenna Sampson et al., 2020). Mobile apps for construction allow field workers to communicate real-time information about work progress with the back office, regardless of how remote the construction site is, and provide a more efficient method of managing construction projects (Struk & Struk, 2021). Fieldlenses help construction project managers eliminate time-consuming communication issues and simplify their lives. The application digitises all processes such as scheduling, performance management, document management, materials management, safety and risk management, logistics, and procurement (Struk & Struk, 2021). FieldLens is compatible with iOS and Android devices and provides construction employees with mobile access to project management documentation (Construction Document Software, n.d.). The application enables documentation updates to be added and viewed on the go, and constraints, topics, day cards, and other documented activities can be viewed and updated directly from the construction site (Construction Document Software n.d.). The transition from paper to digital can be difficult; therefore, a document management system that is specifically designed for the construction industry and is easy to use makes all differences. Field Lens provides a variety of features that make it simple for construction team members to incorporate the platform into their daily workflow

(Construction Document Software, n.d.). A review of document and information management in the construction industry from paper-based documents to a BIM-based approach revealed that Fieldlens is one of the mobile applications used for document management in the construction industry Wang and Plumb (2012). The application is one of the most popular mobile construction management app providers (Best Construction Management Apps Software 2023).

On-Site Planroom is an innovative mobile app designed for the construction industry that enables users to examine and share construction plans and documents from their iPhone or iPad (OnSite PlanRoom 2017). The application is intended to expedite document workflow and enhance collaboration among construction professionals. According to Lew et al. (2018), mobile applications such as on-site planrooms are among those used in the construction industry for various activities, including project management, calculations, construction safety, and document management. The app enables users to upload photographs, annotate problems, and track project progress in real-time, thereby enhancing communication and accelerating project completion (Yankah et al., 2022). In addition, the app provides real-time access to project documents, user-friendly interfaces, and automation of document processes, resulting in increased productivity, accuracy, and collaboration (Yankah et al. 2022). The Bosch RefinemySite mobile app provides document management software and a mobile app for construction team members to incorporate into their daily work routines (Construction Document Software, n.d.). The app enables construction workers to access project management documentation on their smartphones, view and update constraints, topics, day cards, and other documented activities directly from the job site, and upload documents as attachments to specific tasks (Construction Document Software n.d.). Mobile apps such as On-Site Planroom and Bosch RefinemySite can significantly improve construction project document management by ensuring that every team member is working with the most current data, minimising mistakes and misunderstandings, improving project communication, reducing document-related errors, leading to increased output and fewer project delays, and accelerating decision-making during the building process (Yankah et al., 2022; Lew et al., 2018; Lew et al., 2019).

Wrike is a mobile application that is gaining popularity in the construction industry owing to its project and document management capabilities. Based on a literature review, Yankah et al. (2022), Wrike is classified alongside apps such as PlanGrid, Fieldwire, and Procore in the “Management Apps” category. The evaluation revealed that these applications can facilitate collaboration and make it easier to create, share, view, and save project documents, plans, and models. Another study using Software Advice Construction Document Software (n.d.) compared leading construction management application software systems based on customer feedback and cost. Wrike was included in the comparison and an integrated approach to project management, project scheduling, and document management was discovered. The adaptability of the application enables construction professionals to complete crucial duties on-site rather than in the office. Lew et al. (2018) evaluated Wrike’s document management capabilities as part of an investigation of the use of construction-related mobile applications in the construction industry. The study discovered that mobile applications such as Wrike can be used for document management in addition to project management and calculations. According to a 2021 study conducted by PCMag, Wrike is the top option for managing complex construction projects because of its extensive range of features such as Gantt charts, time tracking, and team collaboration tools.

A smartsheet is a mobile application that provides construction professionals with project administration and collaboration tools. Smartsheets enable project administrators and contractors to create, distribute, and store project documents, plans, and models as per Osarenkhoe and Bennani (2019). Editable templates and automated workflows of the app facilitate document-related duties and enhance collaboration. Robles-Gómez et al. (2019) reported that a smartsheet’s user-friendly interface, customisable templates, and real-time collaboration capabilities increase team productivity and expedite document management processes. Junel et al. (2021) discovered that Smartsheets are a popular option for administering construction projects because of their adaptability and user-friendliness. The Smartsheet mobile app increases productivity and collaboration by allowing project managers and contractors to access project information while on the road

Junel et al. (2020) reported that users can generate, revise, and share project documents, plans, and models using a Smartsheet on mobile devices. Using the real-time collaboration feature of the application, multiple team members can work concurrently on documents and monitor changes. Users can also save and organise files at a single location to facilitate simple access and version management. Nevertheless, some users have complained that the app's mobile user interface is cumbersome and slow to launch (TechRadar 2022).

Assembly is a mobile application designed by Autodesk for the creation, exchange, viewing, and storage of 3D models and project information in the construction industry. According to Lim et al. (2021), Assemble permits project managers and contractors to examine model metadata, access BIM models on mobile devices, and collaborate in real time with stakeholders. This software facilitates improved decision-making by providing precise and up-to-date project information, which increases productivity and reduces errors. Al-Madani et al. (2021) discovered that the Assemble mobile app helped project managers and contractors save time and reduce errors by streamlining document management and enhancing team communication. Assembling enables project administrators and contractors to view, analyse, and share 3D models and related project documents, according to Noh et al. (2019). The comprehensive visualisation and measuring capabilities of the application enhance coordination and accelerate decision making during the construction process. The assembly's ability to interact with Building Information Modelling (BIM) platforms enables effortless synchronisation and updating of project models. The sophisticated capabilities of the software, such as model takeoff and conflict detection, enable effective decision making and collaboration throughout the construction process. In addition to the aforementioned references, Igwe-Uchenna (2020) found that Assemble is an effective tool for managing construction initiatives. The app's ability to store and share 3D models and project data in real time improves project stakeholder collaboration and communication. The study also emphasises the interoperability of the app with BIM platforms, which enables effortless synchronisation and updating of the project models. Moreover, the app's comprehensive visualisation and measuring capabilities make it simpler for project managers and contractors to make informed decisions and enhance project outcomes. Al-Madani et al. (2020) evaluated the efficacy of Assemble in facilitating document management and improving team communication. The study found that the app's user-friendly interface and real-time collaboration features enhanced document workflow and reduced errors, resulting in increased productivity and efficiency. The ability of the app to store and share 3D models and project data improves communication and coordination among project stakeholders, which ultimately leads to improved project outcomes.

Bluebeam Revu is a construction project management tool with sophisticated document management, markup, and automation tools as well as an integrated collaboration space called Studio (Bluebeam, 2023). It permits users to create, edit, collaborate, and share PDF documents (Bluebeam Revu Cost: A Comprehensive Construction Project Management Tool 2023). Bluebeam Revu is utilised extensively in the construction industry for viewing and annotating plans (Bluebeam Revu Software Reviews, Pros, and Cons – 2023 Software Advice, n.d.). According to a study by Igwe-Uchenna et al. (2020), mobile applications such as Bluebeam Revu are utilised in the construction industry for a variety of tasks, including project management and calculations. These applications contribute to the digitisation of the construction industry by enabling field employees to share real-time data with the back office and enhance communication and project management (Struk & Struk, 2021). Using the app's comprehensive editing and annotation capabilities, team members can communicate more effectively, thereby reducing the likelihood of miscommunication and errors.

DocuSign is a mobile application that enables project administrators and contractors to sign, transmit, and store project documents electronically (Mandicak et al. 2022). The application expedites project management by ensuring the accuracy and validity of documents, while eliminating the need for physical signatures. Owing to the app's compliance with legal requirements and audit trail functionality, documents are guaranteed to be authentic and traceable (Mandicak et al., 2022; Al Qady & Kandil, 2013). DocuSign enables project managers and contractors to sign and store project documents, plans, and models on their

mobile devices (Mandicak et al., 2022; Al Qady and Kandil, 2013). The incorporation of an application with cloud storage services enhances accessibility and accelerates the approval procedure (Mandicak et al., 2022; Al Qady & Kandil, 2013). The app has been lauded for its efficiency and usability in administering contracts and approval (Mandicak et al. 2021). DocuSign has been classified as a management app in a literature review of mobile device applications in the construction industry (Yankah et al., 2022). PlanGrid, Fieldwire, and Procore are examples of additional applications in this field (Yankah et al., 2022). DocuSign is not among the five most downloaded construction-related applications identified by Yankah et al. (2017).

Bridgit Closeout is a mobile app designed to streamline construction project document management by providing a centralised platform for managing punch lists, site inspections, and project closeout documentation. According to Azhar et al. (2015), Bridgit Closeout is one of the most popular mobile apps used in the construction industry for document management. The application allows construction professionals to create and manage punch lists, track site inspections, and generate project closeout documentation. The app's user-friendly interface and real-time collaboration features enable construction professionals to work together seamlessly and improve the overall project efficiency. Kholin (2023), Bridgit Closeout was identified as a mobile app that can add value to internal enterprise resource planning or project management software. The app provides construction managers with real-time access to project information, enabling them to have a bird's-eye view of the entire project lifecycle or dive into details from anywhere.

Automation of the app and streamlined workflows reduces the risk of human errors and improves workflow efficiency. Moreover, Bridgit Closeout provides enhanced document security features such as user authentication, encryption, and access control to protect sensitive project documents. The app's robust security features ensure that only authorised individuals can access and modify documents, thereby reducing the risk of data breaches and unauthorised access. In a critical review and analysis of construction applications, Azhar et al. (2015), Bridgit Closeout has been identified as a mobile app that can improve construction project document management. The app's capabilities in managing punch lists, site inspections, and project closeout documentation were highlighted as key features that could enhance the overall project efficiency. The app's user-friendly interface and real-time collaboration features were identified as valuable tools for construction professionals.

Viewing Project Documents, Plans, and Models

GoodReader is a mobile application that is used for document administration in the construction industry. According to Igwe-Uchenna (2020) research, GoodReader is one of the mobile applications used in the construction industry for a variety of tasks, including project management, calculations, construction safety, and document management. This application provides an intuitive interface and facilitates access to project documents, plans, and models. In addition, the application provides annotation tools that allow users to highlight, underline, and add notes to documents. This feature is particularly beneficial for team collaboration. In addition, Yankah et al. (2022) identified GoodReader as a construction-related mobile device application (Apps). This study conducted a comprehensive literature review to identify, summarise, analyse, and classify construction-related mobile device applications. This study revealed that mobile applications can facilitate collaboration and make it easier to create, share, view, and save project documents, plans, and models. The study also emphasised the significance of mobile applications in streamlining document workflows, enhancing collaboration, and enhancing the overall efficacy of construction projects. Struk and Struk (2021) highlighted the significance of mobile applications in the digitisation of the construction industry. The study revealed that mobile apps for construction enable field workers to exchange information about work progress in real-time with the back office, regardless of how remote the construction site is, and provide a significantly more effective method of managing construction projects. GoodReader is a mobile application that can be used in the construction industry for document management.

Fieldwire is a mobile application used within the construction industry for document administration and project collaboration (Yankah et al., 2022). It enables field workers to communicate real-time data regarding

work progress with the back office regardless of their location on the construction site (Struk & Struk, 2021). The application digitises numerous construction processes, such as scheduling, performance management, document management, materials management, safety and risk management, logistics, procurement, and construction (Struk & Struk, 2021). Fieldwire improves the management of construction projects by eliminating time-consuming communication issues and simplifying the lives of project managers (Struk & Struk, 2021). Fieldwire is an administrative application in the construction industry (Yankah et al., 2022). This mobile application can be utilised for document management in construction undertakings (Yankah et al., 2022). The application enables smartphone users to upload and view project management documentation (Construction Document Software n.d.). It offers accessibility to desktops and mobile devices, enabling construction team members to integrate the platform into their daily work routines (Construction Document Software, n.d.). Fieldwire also provides the option of uploading documents as attachments within individual tasks, real-time access to documented information, and alerts for updates (Construction Document Software, n.d.).

The BIMx application enables architects, engineers, and construction professionals to access 2D and 3D building information models on mobile devices (Yankah et al. 2022). This encourages collaboration and communication among project stakeholders, simplifying the sharing of project information and improving cooperation (Yankah et al., 2021). The app's user-friendly interface and real-time updates allow for efficient document workflows and enhanced decision making (Yankah et al., 2022). BIMx provides the capacity to store project data in the cloud and allows access to any device (Yankah et al. 2021). This feature ensures that project documents are readily available, thereby reducing the likelihood of errors and misunderstandings (Yankah et al. 2022). During the construction process, the app's visualisation and measuring capabilities improve coordination and accelerate decision making (Yankah et al., 2022). Several studies have highlighted the benefits of BIMx in document management. Liu et al. (2019) conducted a study on the effectiveness of BIMx in enhancing building project document administration. The app facilitates the sharing and examination of project documentation, plans, and models, resulting in enhanced decision-making and collaboration (Yankah et al., 2022). Eastman et al. (2014) discussed the revolutionary impact of mobile applications, such as BIMx, on construction project document management and collaboration. They emphasised real-time access to project documentation, plans, and models, empowering stakeholders to make informed decisions and resolve problems immediately (Yankah et al., 2022). The BIMx app is one of the many mobile document management applications for construction projects. BIMx falls under the "Design and Drawing Apps" category, according to a review of mobile apps in the construction industry (Yankah et al., 2022). The app's prevalence is demonstrated by its high number of downloads and reputation as a useful resource for construction professionals (Yankah et al., 2022).

PlanGrid is a mobile application designed for construction professionals to manage project documents, drawings, and plans. According to Taylor (2017), PlanGrid is the most specialised application for document and drawing management, as well as for local and cloud-based file storage. The app offers features such as real-time collaboration, automatic version control, and mark-up tools, making it easier for construction professionals to manage and share project documents. The app also provides offline access to documents, allowing users to access and edit documents even when they are not connected to the internet. The app's user-friendly interface and intuitive design make it easy for construction professionals to navigate and efficiently use the app. Azhar et al. (2015), PlanGrid has been identified as one of the most popular mobile apps for construction project management. This study found that PlanGrid was used for document management, field reporting, and collaboration among project team members. The features of the app, such as automatic syncing and real-time updates, were identified as key benefits for construction professionals. PlanGrid has been identified as a solution to the challenges faced in construction project document management. According to Kholin (2023), construction managers waste considerable time searching for project information, dealing with mistakes, resolving conflicts, and engaging in other non-productive activities. PlanGrid ensures that all necessary information is literally at the managers' fingertips, providing a bird's-eye view of the entire project lifecycle or diving into details from anywhere. The app's features, such as real-time collaboration and automatic version control, streamlined document workflows, and

improved collaboration among team members.

Enhancing Collaboration and Communication with Document Management Systems

Singhal (2014) proposed an in-house Collaborative Document Management System (CDMS) that allows for the simultaneous editing of documents without checking in/out. This system also uses optimistic concurrency control strategies to address conflicts. Schuster (2010) focused on a document-centric approach to open collaboration processes using a service-oriented document model and middleware. Alhapip (2017) compared the features of three document management systems (Doccept, eFileCabinet, and SharePoint) for document development collaborations in Indonesian public institutions. Ai-hong (2009) presented a centralised document management model based on ASP.NET, which combines the advantages of a relational database and file system and uses different storage modes based on document security classification. Raj et. al., (2022) presented a document management module in a PDM system suitable for small and medium-sized enterprises. Considering the economic, organisational, technological, and legal factors when selecting a digital document management system, ensuring that the chosen system meets the legislative requirements for EDMS adoption, assessing the technological readiness of the organisation and the compatibility of the back-office software with the front-office and ERP software, promoting employee awareness and providing training on the adoption of the EDMS, evaluating the functionality and scope of the front- and back-office software to ensure its alignment with the organisation's needs, and implementing robust information security measures to protect sensitive documents and data critical success factors (CSFs) for adopting an electronic document management system (EDMS) in government units (Ziemba et al., 2022), these findings provide valuable insights for adopting digital document management systems facilitating centralised document collaboration and communication. The effective adoption of DMS requires a comprehensive approach encompassing planning, implementation, and continuous improvement. **Figure 2** outlines the practical framework for adopting DDMS in organisations.



Figure 2. Practical framework

The first phase of adopting a DMS is crucial for setting the stage for successful implementation. This involves clearly defining the organisation's needs and objectives, evaluating existing document management practices, selecting an appropriate DMS solution, and developing a comprehensive implementation plan. Bosman Et. al. (2020) emphasised the importance of personnel issues such as management support and user acceptance in implementing Product Data Management (PDM) systems. Gachet (2001) further underscores the significance of human, conceptual, and technical factors in developing distributed cooperative decision-support systems (DSSs). Le et. al. (2022) highlights the need for stakeholder collaboration and agreement in developing Destination Management Systems (DMS). Bedford (2015) identifies different management control system (MCS) categories and their alignment with firm strategy. Lastly, by carefully considering these factors, organisations can lay the foundation for successful DMS adoption that aligns with their specific requirements and goals (Martins et al., 2020).

Successful implementation of a Digital Management System (DMS) involves addressing user resistance, promoting continuous improvement, and providing comprehensive training and support. The second phase involved Implementing and Training employees in the new DMS. This includes data migration by migrating existing documents to the DMS and ensuring proper categorisation, indexing, and access permission. Mosweu (2020) highlighted the importance of change management in addressing user resistance, while Maurer et al. (2018) emphasised the role of a DMS in continuous quality improvement and employee engagement. User Training should be conducted by providing comprehensive training to employees using the DMS, covering key features, navigation, and collaboration functionalities. Finally, Change Management should address potential resistance to change by emphasising the benefits of DMS and providing ongoing support to users. Juhary (2014) underscored the need for institutional responses and support in introducing a new system. Aziz et al. (2020) provided specific guidelines for implementing a Digital Document Management System in the public sector. Implementing and training employees on a new DMS should be conducted by providing comprehensive training to employees using the DMS (Ryan et al., 2012). These findings underscore the significance of change management, continuous improvement, and comprehensive training for successfully implementing DMS.

The final phase of adopting a DMS involves continuous improvement that can be achieved through an integrated management system (Agus et al., 2020). This system should include maintenance planning, in-service performance monitoring, fault isolation, and repair features (Domemann et al., 2019). To ensure that the DMS meets the organisation's needs, performance improvements tools and practices, such as process mapping and performance measurement models, should be used (Eriksson 2017). In addition, the DMS should be regularly updated using the latest features, security patches, and compatibility updates (Agus et al., 2020).

Theories that provide insights and guidance underpinned the practical framework for DMS adoption for centralised document collaboration and communication in the construction industry. Here are some theories: The organisation's DMS needs and goals were defined using the Diffusion of Innovations Theory. Document types, collaboration requirements, and desired outcomes must be understood (García-Avilés, 2020). Using Organisational Change Management Theory, the organisation's document management practices were analysed for improvements and challenges (Hanelt et al., 2021). According to the Diffusion of Innovations Theory, DMS solutions should be evaluated based on features, scalability, compatibility, and integration with existing systems (Rogers, 2003). Organisational Change Management Theory helps organisations create precise implementation plans that outline roles, responsibilities, timelines, and communication strategies for adoption (Hanelt et al., 2021). In phase two, knowledge Management Theory was considered for organisations to migrate data to the DMS to ensure proper categorisation, indexing, and access permissions. Paré et al., (2015) The Social Learning Theory was considered for DMS user training because it covers key features, navigation, and collaboration. (Bandura, 1977) Organisational Change Management Theory emphasises the benefits of the DDMS and provides ongoing support to users to overcome resistance to change in management. Lewin, 1951. In the final phase, Knowledge Management Theory helps gather user feedback to identify areas for improvement and address pain points (Alavi & Leidner, 2001). For DMS performance and usage to meet the organisation's needs and goals, the Information Systems Success Model was considered (Dwivedi et al., 2019). Diffusion of Innovations Theory was considered to keep the DMS updated with new features, security patches, and compatibility. (Rogers, 2003). Using this practical framework and relevant theories, organisations can adopt DMS and use their centralised platform for document collaboration and communication, improving productivity, efficiency, and organisational success.

Summary of the Findings

The results of an analysis of various mobile apps for document management on construction projects indicate that mobile apps offer several significant advantages over conventional document management systems (DMS). These mobile applications provide construction professionals with an efficient and convenient means of document management and collaboration. These applications expedite document

management and improve the accuracy and efficiency of document verification through real-time communication, immediate access to project files, and seamless document-sharing. The addition of offline access, cloud storage, and integration with other applications enhances organisation and collaboration. The mobile apps demonstrated in the study, such as iConfirm, Evernote, Aconex Mobile, Microsoft Office, Good Reader, Bridgit Closeout, Autodesk BIM 360, PlanGrid, Procore, Dropbox, Bluebeam Revu, Project Planning Pro, Fieldlens, Smartsheet, Monday.com, Assemble, DocuSign, and BIMx, enable architects, engineers, project managers, and contractors to work efficiently, reduce errors, and foster better communication and collaboration among project stakeholders. These mobile apps are indispensable for managing construction project documents in the digital era owing to their user-friendly interfaces, powerful editing and annotation tools, and access to real-time updates and project information.

The study thus demonstrates the significant advantages of mobile apps for construction project document management compared to conventional DMS. Mobile apps offer efficient and convenient document management, real-time communication, immediate access to project files, seamless document-sharing, offline access, cloud storage, and integration with other applications. These features enhance organisation, collaboration, and project efficiency. The study showcased several mobile apps like iConfirm, Evernote, Aconex Mobile, Microsoft Office, GoodReader, Bridgit Closeout, Autodesk BIM 360, PlanGrid, Procore, Dropbox, Bluebeam Revu, Project Planning Pro, Fieldlens, Smartsheet, Monday.com, Assemble, DocuSign, and BIMx, demonstrating their positive impact on project efficiency, communication, and collaboration. These user-friendly apps with powerful editing and annotation tools, access to real-time updates, and project information are indispensable for managing construction project documents in the digital age.

CONCLUSION AND RECOMMENDATIONS

Conclusions

This study has practical implications for the construction industry, specifically in the realm of project resource management. The results indicate that the use of mobile applications, or mobile apps, can enhance construction resource management by providing real-time access and remote collaboration, improving accessibility beyond traditional methods. These tools often have user-friendly interfaces that promote efficiency and simplify tasks. In particular, specific apps like EZ Office Inventory offer a range of functionalities that are crucial for managing construction projects. Additionally, the wide variety of available apps allows for customization, meeting the unique needs of each project. The work provides an extensive review of the capabilities of mobile applications in construction project resource management. By assessing the empirical evidence, this study validates the functionalities of the identified apps and offers insights for construction professionals seeking innovative solutions for effective resource management. This study highlights the role of mobile apps in streamlining workflows, improving communication, and enhancing overall project efficiency. It is therefore evident that inconsistent project data can be handled effectively with enhanced teamwork and streamlining of project operations; improving document accuracy and promoting efficient communication are both vital to successful project management. Furthermore, when mobile apps are used project managers and contractors can benefit from systems that allow the creation, distribution, and preservation of project papers, plans, and models and thus allowing significantly facilitating access to BIM models and contributing to efficient real-time collaboration.

Recommendations

It is therefore recommended that mobile application systems should be deployed to allow project participants to modify and access documents without requiring a constant network connection. The use of mobile applications that allow project status monitoring and metadata inspection to ensure high-quality project control should be encouraged. Priority to digitization of documentation should be given over physical documents to increase accessibility and save both money and time. Stakeholders must leverage productivity

applications already used in the construction industry, such as Microsoft Office, to support efficient document creation, editing, and sharing.

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