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Research Article

The Impact of Poor Documentation and Time Management on Construction Waste and Efficiency

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ABSTRACT

Inefficiencies in paperwork, time management, rework, and design processes during the design and planning phases significantly impact construction projects, leading to increased waste and reduced project efficiency. This research has investigated how these factors contribute to waste, focusing on errors, omissions/lack of information and poor-quality documentation, delays in decision-making, lack of clear communications and design-related issues that affect overall project outcomes. Employing a mixed-methods approach, the study has combined primary data from surveys with construction professionals, project managers, and designers, alongside secondary data from industry reports and academic literature on construction waste and project management. The research has identified critical inefficiencies in the design and planning phases that lead to increased waste, such as inaccuracies in project documentation, extended approval times, lack of waste minimization considerations in the design phase and frequent design revisions. These inefficiencies are expected to cause cascading effects throughout the project lifecycle, including unnecessary material handling, rework, and delays. The study has also explored opportunities for improvement by examining enhanced documentation practices, better time management, and more effective design coordination. Additionally, it investigated the benefits of adopting digital tools for accurate documentation, implementing more efficient scheduling techniques, and improving design-for-construction approaches to minimize rework. Therefore, the primary goal of this research was to investigate and identify inefficiencies in order to streamline the design and planning phases, reduce waste, and enhance project efficiency, thereby contributing to more sustainable and cost-effective construction practices in New Zealand.

Keywords: Construction waste, Time management, Project documentation. Rework in construction, Design inefficiencies

INTRODUCTION

The construction industry has been identified as one of the significant contributors to overall waste generation, and it has affected both environmental sustainability and overall project efficiency (Khuc et al., 2025). Apart from the usual material waste produced during construction projects, there is also substantial waste resulting from ineffective procedures, design flaws, and inadequate management techniques. If the construction waste factors are identified and tackled during the design phase, there are fewer chances of overall waste generation on site and loss due to time delays and incorrect work. The construction sector is essential for progressing contemporary infrastructure and economic advancement (Fei et al., 2021). Recent studies have shown that persistent issues such as inadequate documentation, design flaws, communication breakdowns, and poor time management are major contributors to rework and material waste in construction projects. For instance, Rehan et al. (2024) found that design errors and Requests for Information (RFIs) significantly increase project delays and costs, while also contributing to material inefficiencies and waste due to rework and miscommunication. Similarly, Afzal et al. (2024) emphasized that ineffective communication and weak leadership are critical barriers to successful project implementation, often resulting in coordination failures and inefficiencies. These operational shortcomings not only reduce productivity but also hinder the achievement of sustainability goals in the construction sector. As Kabirifar et al. (2020) argue, addressing these challenges through effective waste management and improved project coordination is essential for enhancing both environmental and economic performance.

Construction waste is a well-documented contributor to environmental degradation, with global studies identifying material mismanagement, rework, and inefficiencies during early project phases such as planning and design as key causes (Ajayi & Oyedele, 2018; Osmani et al., 2008). Although advancements in construction technologies and project management practices have been made, these challenges continue to affect project outcomes across various international contexts. This highlights the ongoing need to improve documentation, communication, and coordination processes within the industry.

In contrast, there is limited empirical research that specifically examines these issues within the New Zealand construction sector. The local context remains underexplored, particularly in relation to how paperwork inefficiencies, time management, and design-related rework contribute to construction waste. This study aims to address that gap by investigating the specific factors influencing waste generation in New Zealand. It also explores how targeted improvements in documentation and project coordination can enhance efficiency and support more sustainable construction practices.

LITERATURE REVIEW

Globally, the construction sector generates a substantial amount of waste. In New Zealand, construction and demolition (C&D) waste presents a growing challenge, with approximately 7 million tonnes produced annually. This volume places significant pressure on landfills and contributes to environmental concerns such as greenhouse gas emissions and resource depletion (Equip2 Team, 2024). Approximately half of the waste sent to landfills originates from C&D activities, and each new home constructed generates around four tonnes of waste (BRANZ, 2022). Despite a focus on improving the operational performance of buildings, C&D waste remains a significant issue (OffsiteNZ, 2021). Accounting for 40–50% of total landfill waste (BRANZ, 2024), this highlights the pressing need for more sustainable construction practices. Strategies such as deconstruction, design for deconstruction, and offsite construction are being explored in New Zealand to reduce waste, cut carbon emissions, and conserve resources.

Global Perspectives on Construction Waste Generation

Internationally, construction waste is a persistent issue. In Europe, the construction sector generates around 820 million tonnes of C&D waste annually, accounting for 46% of total waste (Gálvez-Martos et al., 2018). Deconstruction is increasingly seen as a sustainable alternative to demolition Bertino et al. (2021) highlight its role in material recovery and resource efficiency, while Zaman et al. (2018) emphasize its potential for repurposing materials and raising public awareness.

In Australia, urbanisation and economic growth have driven construction activity, resulting in 27 million tonnes of C&D waste in 2019–2020; a 61% increase since 2006–2007 (Department of Agriculture, Water and the Environment, 2020). C&D waste now accounts for over 44% of total waste, with a 47% recycling rate.

The UK's Zero Avoidable Waste (ZAW) strategy aims to eliminate avoidable waste by 2050 (Adams et al., 2020).

Despite a 90% recovery rate, significant landfill use persists (Government, 2022). ZAW implementation requires circular economy principles, design for deconstruction, and life cycle assessments. Key challenges include poor data, inconsistent classifications, and over-specification.

Singapore, a land-scarce nation, has maintained a 99% C&D waste recycling rate since 2013 (NEA, 2024). This success is attributed to coordinated efforts and strict regulatory frameworks, including mandatory demolition plans and risk assessments (BCA, 2011). Singapore's model demonstrates how strong policy and documentation requirements can drive sustainable outcomes.

Construction Waste Regulations and Policies in New Zealand

New Zealand, like other nations, faces significant climate challenges exacerbated by construction-related activities. The Building for Climate Change (BfCC) programme aims for "near- zero- carbon" buildings by 2050 (MBIE, 2020). However, despite this vision, traditional construction practices often resist change. This resistance is compounded by gaps between policy intent and on-site implementation. For example, while regulations promote sustainability, stakeholder practices often lag behind due to economic, cultural, or informational barriers. Bridging this policy-practice gap requires not only regulatory enforcement but also improved documentation, clearer responsibilities, and stronger stakeholder engagement (Doan et al., 2023).

Influence of Construction Practices and Technologies

The planning and design phases of construction projects are pivotal in shaping the trajectory of waste generation across different stages of a project. These early stages involve defining project objectives, allocating resources, and establishing workflows, all of which directly impact efficiency, material usage, and sustainability downstream. The adoption of advanced construction practices and technologies during these phases can significantly mitigate material wastage, enhance efficiency, and promote sustainability. Integrating Building Information Modelling (BIM) is a key strategy for reducing construction waste. BIM enables early clash detection and coordinates design, minimising errors and rework (Eze et al., 2024). Virtual Reality (VR) complements BIM by allowing stakeholders to visualise designs and identify issues before construction, improving communication and decision-making (Wang, 2021). Lean construction further reduces waste by eliminating non-value-adding activities and enhancing workflow. In New Zealand, combining Lean with BIM has shown promise in improving efficiency(Likita et al., 2022). Prefabrication and modular construction also contribute by reducing on-site waste and improving quality control, with higher prefabrication levels linked to lower waste generation (Shahzad & Luo, 2020).

Despite these advances, traditional practices still lead to waste due to poor coordination and resistance to adopting new technologies like VR and Lean-BIM(Likita et al., 2022). Embracing modern methods and fostering stakeholder engagement during planning and design can significantly enhance sustainability and project efficiency.

Stakeholder Contributions to Waste Generation

The design and planning phase of construction projects plays a pivotal role in influencing waste generation across the project lifecycle. Effective coordination among architects, engineers, clients, project managers, and contractors—particularly through early contractor involvement (ECI)—is essential to minimizing inefficiencies and material waste. Architects shape the project's vision, but misalignments with engineering designs due to poor communication can often lead to rework and resource loss (Eze et al., 2024). Clients also contribute to waste through late-stage changes in scope or preferences, which trigger redesigns and delays (Jalaei, 2019). Project managers serve as key facilitators, and when communication breaks down or oversight is lacking, conflicting priorities can emerge, further exacerbating inefficiencies(Likita et al., 2022).

Contractors engaged early in the process offer valuable insights into constructability and cost-effective solutions, helping to prevent impractical designs and overlooked constraints (Shahzad & Luo, 2020). However, when their input is underutilized, opportunities for waste reduction are missed. To address these challenges, fostering collaboration among stakeholders is vital. Tools like Building Information Modelling (BIM) enhance coordination by enabling early conflict resolution and shared visualization(Eze et al., 2024). Lean principles also support waste-minimisation through streamlined processes and continuous improvement.

Although tools and frameworks exist, their effectiveness depends on stakeholder willingness to collaborate and share information. This reinforces the earlier point that policy alone is insufficient. Practical implementation requires cultural and procedural shifts within the industry. Linking this back to New Zealand's regulatory context, the success of waste reduction strategies depends not only on policy design but also on how well stakeholders align their practices with these goals through proactive engagement and integrated workflows.

Economic and Environmental Implications of Construction Waste

The construction sector is a major contributor to global resource consumption, accounting for 39% of energy-related CO_2 emissions (UN, 2021) and 35% of landfill waste (OECD, 2020). Waste on-site leads to additional costs for replacement, rework, transport, and disposal, negatively impacting project economics. Studies have assessed the environmental impact of construction waste using methods like Life Cycle Assessment (LCA) (Ortiz et al., 2009) and various waste management strategies including selective demolition and deconstruction (Coelho & de Brito, 2012, 2013; Lu et al., 2011). Significant waste also arises from design and planning inefficiencies, such as poor coordination and over-specification, which lead to rework, delays, and excess material use (Akinade et al., 2017; Hossain et al., 2020; Sassanelli et al., 2019). These issues contradict Lean construction principles, which aim to minimize waste and maximise value.

Environmental consequences of poor planning include resource depletion, pollution, and carbon emissions due to overuse of materials, extended equipment use, and increased transportation (Stanitsas et al., 2021; Martins et al., 2019). Improper disposal and rework can also contaminate soil and water, affecting ecosystems and human health. Sustainable design choices and maintenance practices significantly influence a building's recyclability and reusability at end-of-life (Jalaei, Zoghi & Khoshand, 2021). Addressing inefficiencies through Lean methodologies, early collaboration, and iterative design can reduce both economic and environmental impacts.

Barriers to Waste Minimization in Construction

Numerous barriers towards waste minimization have been identified in the literature (Boser et al., 2010; WALGA, 2013). These studies identified significant barriers to recycling and reuse of construction and demolition (C&D) waste in the Australian Capital Region, mirroring global findings. Key obstacles include limited knowledge about recycling opportunities, contamination of recyclables due to improper separation or space constraints, and a lack of markets for recycled materials. Technological challenges, higher costs of recycling processes compared to virgin material production, and the absence of design for deconstruction further hinder recycling efforts. Economic disincentives, such as low landfill gate prices, inadequate government policy support, and a lack of industry confidence in recycled materials, exacerbate the issue. Additionally, poor communication within the industry and insufficient infrastructure contribute to the problem. Low-value and low-volume materials are often landfilled because stockpiling for recycling is uneconomical. While the study highlights these barriers, its findings may not be universally applicable beyond the Australian Capital Region. Of the 20 proposed strategies, many emphasize the need for stronger government policies and improved information sharing, alongside the necessity for enhanced education and further research to shift industry perceptions. Olanrewaju and Ogunmakinde (2020) identified the primary barriers to construction waste minimization as a lack of training, poorly defined responsibilities, lack of interest from clients and the widespread acceptance of waste as inevitable. Their research employed a survey of architects with at least three years of experience, analyzing the data using the Relative Importance Index (RII). The study concludes that architects play a pivotal role in minimising construction waste and emphasizes the importance of enhancing training programs and educating clients to reduce waste in the construction process further. Ding et al. (2018) identified several key barriers to construction waste reduction during the design phase. First, improper design was noted as a major contributor to construction rework and material waste. Despite the recognized importance of waste minimization through design, its implementation remains limited. Frequent design modifications further increase waste generation. Additionally, the attitudes of designers and the constraints they encounter often impede the adoption of effective waste-minimization practices. Historically, the lack of focus on waste reduction during the design stage has been prevalent, with more attention given to waste management during construction. These barriers underscore the need for more integrated, proactive approaches to waste reduction that begin at the design phase.

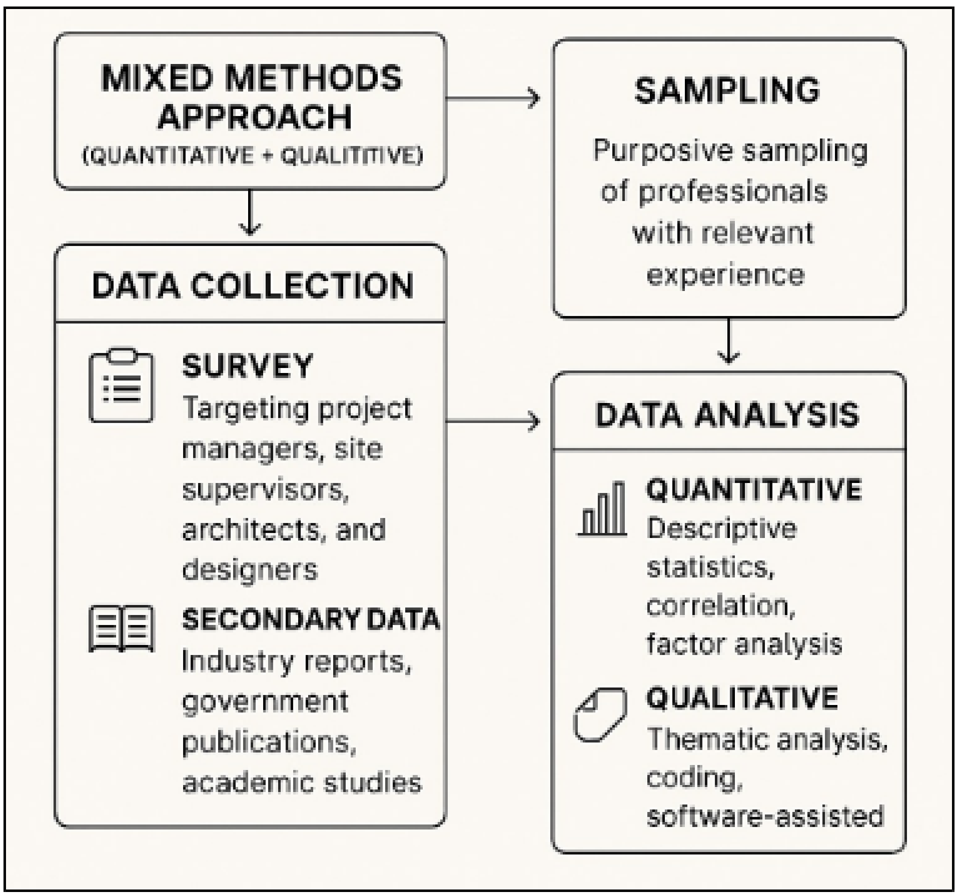
Summary

The reviewed literature highlights a consistent global concern regarding construction and demolition waste, with significant contributions to environmental degradation and project inefficiencies. While international studies have explored the roles of documentation, planning, stakeholder coordination, and technological interventions in waste reduction, there remains a notable gap in localized research specific to New Zealand. The integration of Lean and BIM practices, though promising, is still limited in the local context. Furthermore, policy frameworks such as the Building for Climate Change programme signal intent, but practical implementation is hindered by stakeholder misalignment and systemic barriers. This review underscores the interconnected nature of poor documentation, time delays, rework, and waste, all of which contribute to broader inefficiencies. Addressing these challenges requires a more integrated approach that aligns policy, practice, and stakeholder engagement to support sustainable construction outcomes in New Zealand.

METHODOLOGY

This study adopted a mixed methods approach to provide a balanced understanding of the factors contributing to construction waste. The quantitative component captured prevalent inefficiencies, while the qualitative aspect explored deeper, context-specific insights from professionals in the field. Data for the quantitative component were collected through a structured online survey administered via Google Forms, comprising both closed and open-ended questions. The survey targeted professionals involved in the planning and design stages of construction projects in New Zealand, including project managers, designers, engineers, architects, contractors, and quantity surveyors. Participants were recruited using a convenience sampling method, primarily through professional networks and social media platforms such as LinkedIn. Interested individuals received a formal invitation via email, which included a Participant Information Sheet, a consent statement, and a link to the questionnaire. To broaden the participant pool, a snowball sampling approach was also employed, whereby participants were encouraged to share the survey with other eligible professionals. Inclusion criteria required participants to be 18 years or older and have relevant construction experience. Participation was voluntary and anonymous, and respondents could withdraw at any time before submitting their responses. For the qualitative component, open-ended survey responses were analysed using reflexive thematic analysis, which acknowledges the active role of the researcher in interpreting and developing themes (Braun & Clarke, 2006). The six-phase process outlined by Braun and Clarke was followed: (1) familiarization with the data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the report. Survey responses were analysed using descriptive statistics to highlight the most frequently cited inefficiencies. Correlation analysis was conducted to examine relationships, such as those between poor time management and rework incidents. Where appropriate, factor analysis was used to uncover underlying patterns within the data. For the qualitative component, thematic analysis was applied to identify recurring themes in the interview data. Responses were coded and categorized into key themes, such as communication gaps and specific design inefficiencies. Qualitative analysis software supported the coding process and enhanced analytical rigor. Figure 1 presents the flowchart of the methodology used in this research.

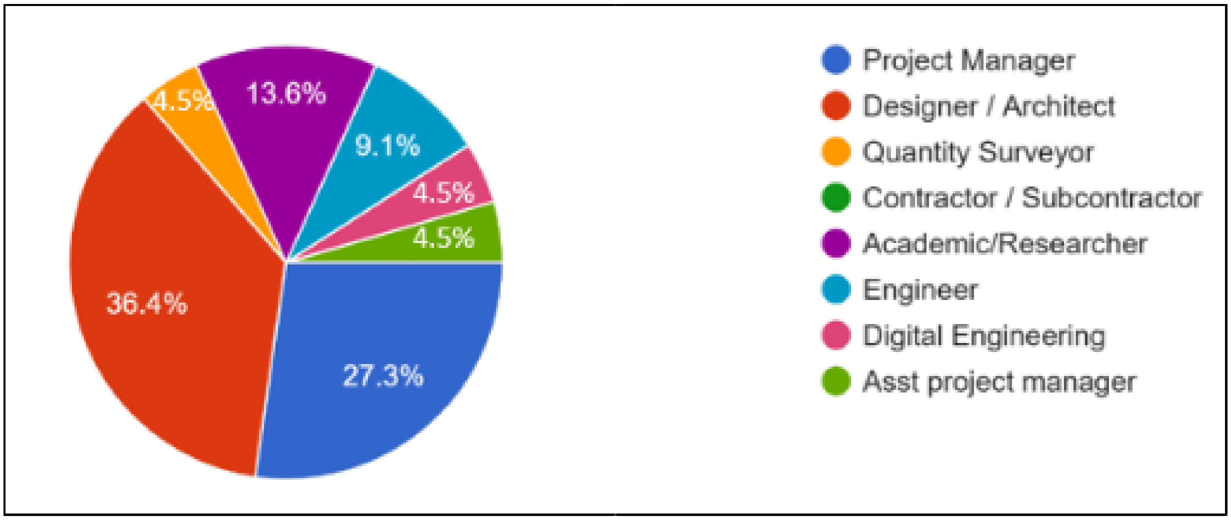
Figure 1: Methodology overview adopted in this research.



DATA SUMMARY

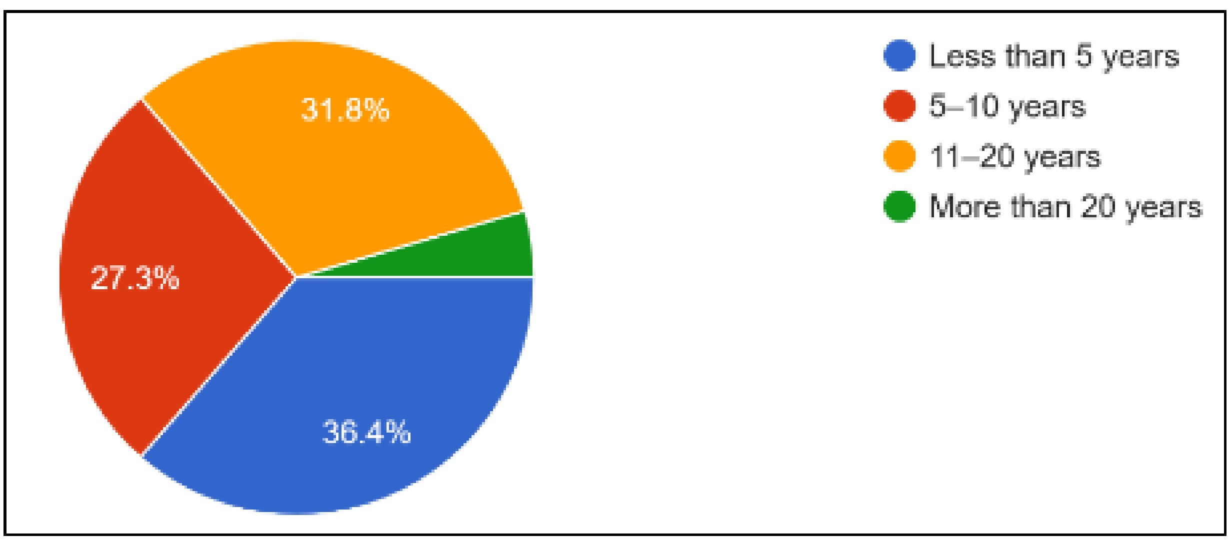
The survey gathered responses from 30 professionals in the construction industry, representing a diverse mix of roles. As shown in Figure 2, Designers and architects made up the largest group at 36%, followed by project managers at 27%, who highlighted coordination and scheduling issues. Academics and researchers accounted for 14%, offering broader industry perspectives. Engineers represented 9%, focusing on technical impacts of unclear documentation. The remaining 14% included quantity surveyors, assistant project managers, and digital engineering specialists, providing additional insights on cost, planning, and digital practices. This diversity supports a balanced view of how poor documentation and time management contribute to construction waste and inefficiency.

Figure 2: Role distribution of survey respondents in the construction industry.



In terms of industry experience, 36% of respondents had less than 5 years of experience, 27% had between 5 and 10 years, 32% had between 11 and 20 years, and 5% had more than 20 years as shown in Figure 3. This indicates a strong representation from early and mid-career professionals, with limited input from highly experienced individuals.

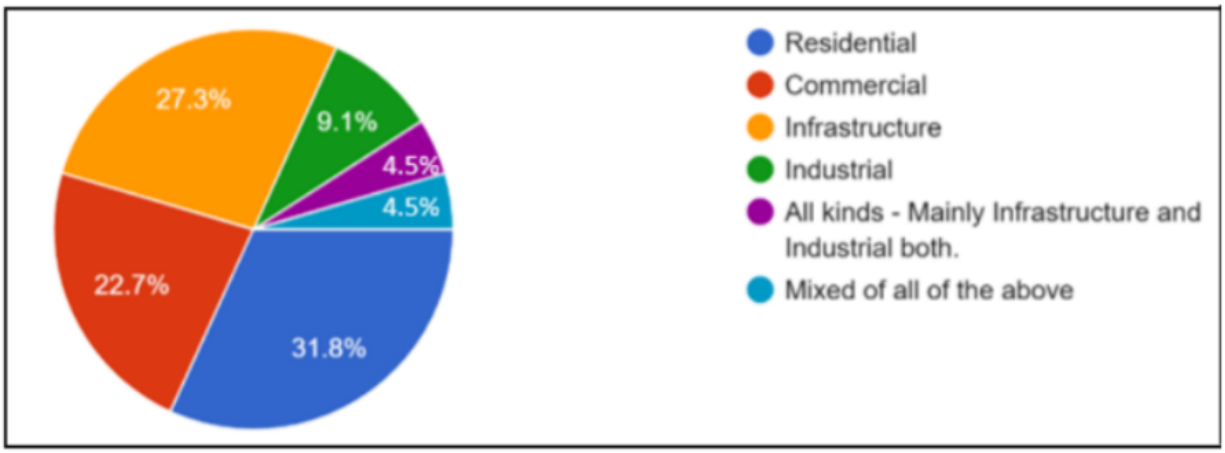
Figure 3: Years of industry experience among survey respondents.



Regarding project types, 32% of respondents primarily work on residential projects, 27% on infrastructure, and 23%

on commercial developments. The remaining 18% indicated involvement in other types, including industrial, mixed-use, or a variety of project types. This mix reflects a broad exposure to different construction contexts relevant to documentation and time management practices. Figure 4 illustrates the distribution of the type of work of the respondents.

Figure 4: Primary project types worked on by respondents.



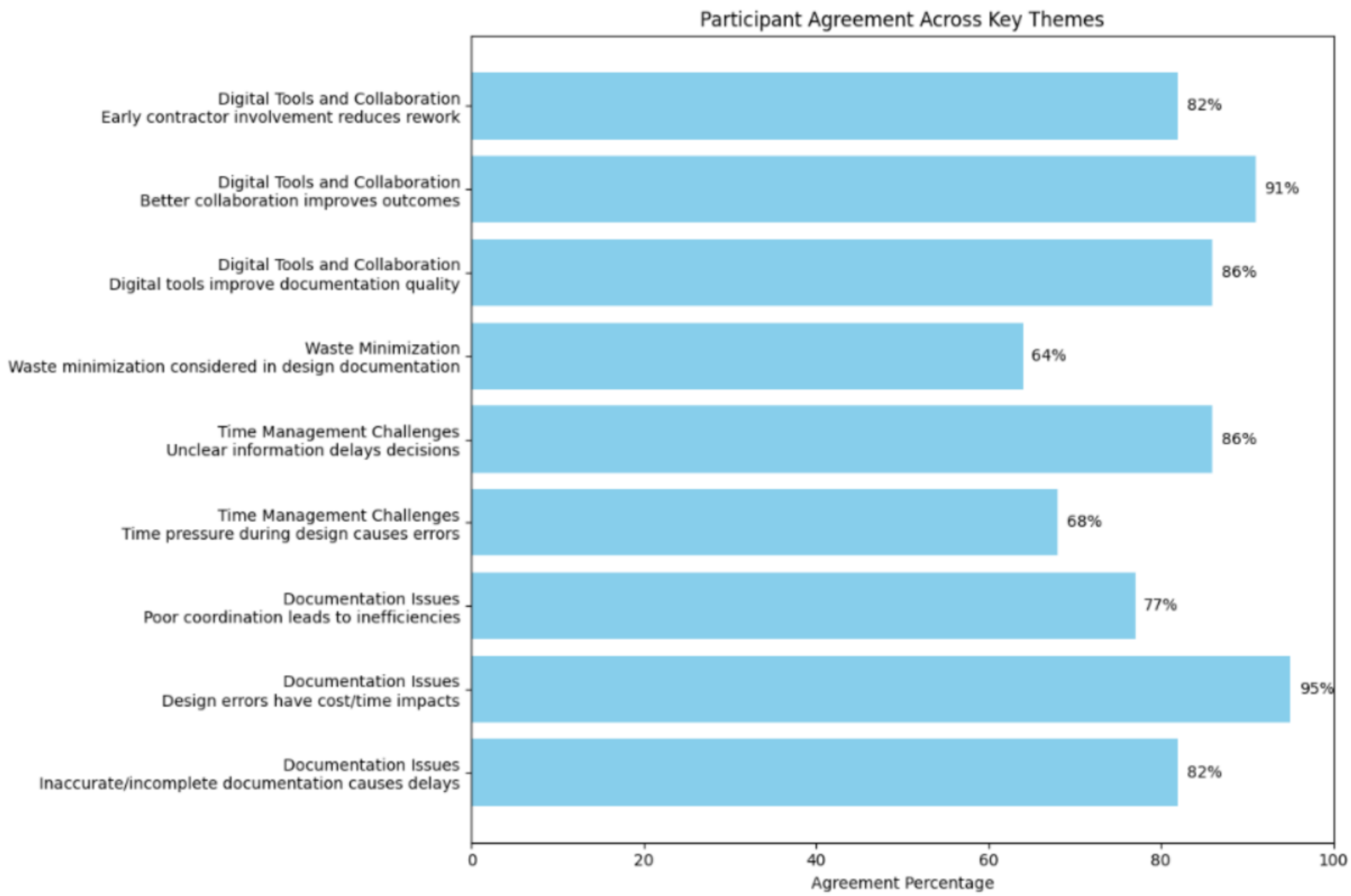
Key Findings from Likert Scale Responses

Participants were asked to rate their agreement with statements related to documentation, time management, waste, and collaboration. The responses highlight several areas of strong consensus:

- **Documentation Issues**. A large majority (82%) agreed that inaccurate or incomplete documentation causes delays, while 95% felt that design errors have clear cost and time impacts. Additionally, 77% agreed that poor coordination between design and construction teams leads to inefficiencies.
- **Time Management Challenges.** About 68% agreed that time pressure during the design phase results in errors, and 86% believed that unclear information delays decision-making.
- **Waste Minimization.** Responses were more varied, with only 64% agreeing that waste minimization is considered in design documentation, suggesting room for improvement in this area.
- **Digital Tools and Collaboration**. Most participants supported the use of digital solutions, with 86% agreeing that digital tools improve documentation quality. A strong 91% agreed that better collaboration between designers and builders leads to improved project outcomes. Additionally, 82% supported early contractor involvement to help reduce rework. Figure 5 summarises the findings of this analysis.

These findings reflect a shared industry view that improving documentation quality, communication, and collaboration can significantly reduce inefficiencies and waste.

Figure 5: Participant agreement percentages across key themes in design and construction practices



Additional Insights from Communication and Collaboration Metrics

Communication challenges during the planning and design phases were frequently reported, with 55% of respondents indicating such issues occur ”sometimes” and 45% stating they happen ”often” or ”very often.” These results reinforce earlier findings that unclear communication is a major contributor to inefficiencies and rework. Documentation issues were also prominent, with missing details (36%) and contradictions between disciplines (27%) being the most cited problems. Additional concerns included version control, ambiguous language, outdated specifications, and conflicting information, highlighting the need for improved document management and interdisciplinary coordination. Figure 6 summarises the frequency of communication issues during the planning and design phase.

Respondents expressed strong support for digital tools, with 86% agreeing or strongly agreeing that such technologies have improved documentation quality. Similarly, 91% endorsed improved scheduling techniques to reduced planning-related delays. Early contractor involvement (ECI) was supported by 82% of participants, and 91% favoured better collaboration between designers and builders. These findings emphasize the importance of integrated project teams, early stakeholder engagement, and the adoption of digital and planning tools to enhance project outcomes and reduce rework. Figure 7 summarises the distribution of the most common documentation issues by the respondents.

Figure 6: Frequency of communication issues during the planning and design phase

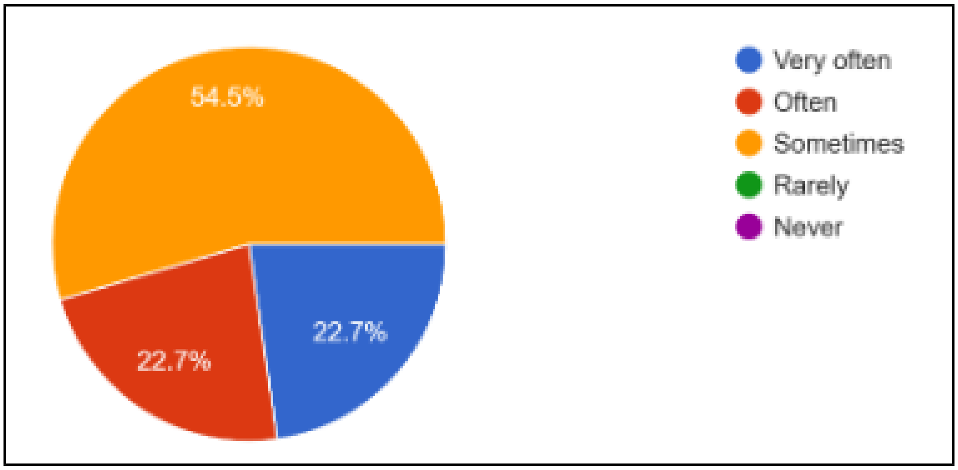
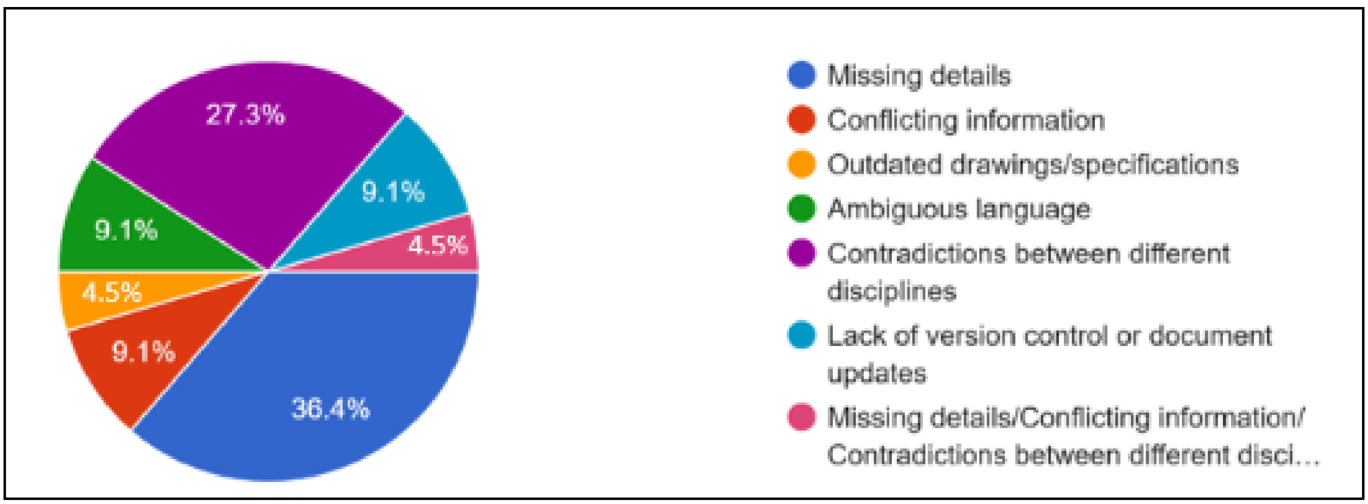


Figure 7: Distribution of the most common documentation issues reported by respondents.



Thematic Analysis of Open-Ended Responses

Participants provided detailed qualitative feedback highlighting key challenges and potential improvements in construction documentation and time management. A thematic analysis, supported by word frequency counts, revealed several recurring patterns:

1. Documentation Issues

Many respondents cited missing or unclear details, ambiguous language, and outdated or contradictory drawings across disciplines. Lack of version control and inconsistencies between architectural, structural, and services documentation were frequently mentioned as sources of confusion and rework.

2. Causes of Rework

Frequent design changes during construction and poor coordination were dominant themes. Several participants highlighted client-driven changes and early-phase planning issues, particularly the lack of clarity in initial project stages.

3. Suggestions for Improvement

Common suggestions included early contractor involvement (ECI), improved cross-disciplinary collaboration, and wider adoption of digital tools such as BIM for clash detection and visual coordination. Others emphasized sustainable design practices like modular construction and deconstruction planning, alongside training and stronger stakeholder engagement.

DISCUSSION

The findings from both the Likert scale responses and thematic analysis reveal consistent challenges in documentation, time management, and collaboration within construction projects. These issues are not isolated but interconnected, contributing to inefficiencies, rework, and waste. The high level of agreement among participants regarding the impact of poor documentation highlights its role as a systemic issue. Inaccurate, incomplete, or contradictory documents not only delay decision-making but also lead to costly rework. This reinforces existing literature on fragmented design processes and suggests a pressing need for integrated documentation systems and standardised practices across disciplines. Time management challenges, particularly during the design phase, were strongly linked to errors and delays. This suggests that current project timelines may undervalue the importance of thorough planning and coordination. The findings support calls for more realistic scheduling and better front-end planning to reduce downstream inefficiencies. While sustainability was acknowledged, the relatively lower agreement on its consideration in design documentation indicates that it remains a secondary priority. This gap between sustainability goals and actual design practices points to the need for stronger frameworks and incentives to embed waste minimisation into early project stages.

Participants overwhelmingly supported digital tools and collaborative practices such as early contractor involvement (ECI). These are seen as key enablers of improved documentation and reduced rework. However, their practical implementation may be hindered by procurement models, training gaps, and resistance to change. This suggests that while the industry is conceptually aligned with integrated project delivery (IPD), operational barriers remain. Frequent communication issues, especially during planning and design, were identified as major contributors to inefficiencies. The qualitative data revealed problems such as ambiguous language, outdated specifications, and conflicting information. These findings highlight the importance of not just technical coordination but also clear communication protocols and interdisciplinary collaboration.

CONCLUSIONS AND RECOMMENDATIONS

This study examined how poor documentation and time management contribute to construction waste and inefficiencies. Drawing on responses from 30 professionals across diverse roles and experience levels, several key conclusions can be made:

- Documentation deficiencies including missing details, contradictory information, and lack of version control are widespread and significantly contribute to delays and rework.
- Time management challenges, especially during design and planning, often arise from unclear communication and delayed decision-making due to insufficient or ambiguous information.
- Rework is frequently driven by design changes, poor interdisciplinary coordination, and misaligned stakeholder expectations.
- Digital tools such as BIM and project management software are widely recognised for improving documentation quality and reducing errors.
- Early contractor involvement (ECI) and collaborative planning between designers and builders are strongly supported as strategies to enhance project outcomes and minimise waste.
- Improved scheduling techniques are seen as effective in mitigating planning-related delays.

These findings reinforce the need for integrated project delivery, robust documentation practices, and proactive communication strategies to reduce inefficiencies and construction waste.

Recommendations include:

- Encouraging early stakeholder engagement and cross-disciplinary collaboration from the design phase.
- Investing in digital tools and training to support better documentation and coordination.
- Revisiting procurement and scheduling models to allow sufficient time for planning and review.
- Embedding sustainability and waste minimisation into design documentation standards.

Future research could explore the real-world effectiveness of specific digital tools and collaborative frameworks, particularly in complex or large-scale projects.

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