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RSST008 - A REVIEW OF INNOVATIONS IN MOBILE AND REMOTE INSPECTION TECHNOLOGIES FOR THE CONSTRUCTION INDUSTRY (2020 TO 2025)

Mohd Dhiya Hafreez Kamil[1,2]*, Mohd Najib Abd Rashid[3], and Mohamed Rizal Mohamed[4]

[1]Dasacon Sdn Bhd, Taman Sri Mawar, Port Dickson, 71000, Negeri Sembilan, Malaysia
[2]Centre of Postgraduate Studies, Universiti Teknologi MARA, Seri Iskandar Campus, 32610, Perak, Malaysia
[3]Department of Built Environment Studies and Technology, College of Built Environment, Universiti Teknologi MARA, Perak Branch, 32610, Seri Iskandar, Perak, Malaysia
[4]Centre of Studies for Construction, Faculty of Built Environment, Universiti Teknologi MARA Shah Alam, Selangor, Malaysia

*Corresponding author: mohdn613@uitm.edu.my

ABSTRACT

This paper reviews recent innovations in mobile and remote inspection technologies applied to the construction industry from 2020 to 2025. Using a structured literature review of 673 peer-reviewed studies retrieved from Scopus, the study synthesises trends in Building Information Modelling (BIM), cloud-driven platforms, Internet of Things (IoT), unmanned aerial vehicles (UAVs), robotics, and artificial intelligence (AI) applications. Results indicate that digital and ICT frameworks dominate research output, followed by AI-based defect detection and innovations in construction materials. In contrast, UAV-enabled inspection and IoT integration remain underrepresented although they are highly relevant to safety and accessibility. The analysis highlights benefits such as reduced inspection time, improved accuracy, and enhanced stakeholder communication, while persistent barriers include cost, interoperability, and digital literacy challenges, especially for small and medium-sized enterprises (SMEs). The review identifies a research gap in integrating emerging tools such as digital twins, robotics, and renewable energy linked inspection frameworks. It concludes with recommendations for cost-effective deployment, targeted training, and regulatory support to strengthen the adoption of Construction 4.0 practices.

Keywords – Mobile inspection, remote inspection, construction technology, BIM integration, digital twin, SME adoption

INTRODUCTION

Mobile and remote inspection technologies have advanced rapidly over the past five years, offering innovative solutions to improve monitoring, assessment, and documentation processes in construction projects. This review synthesises recent literature on mobile applications, smartphone-based tools, and virtual inspection platforms, with emphasis on their applications in both building and infrastructure projects and adoption by small and medium-sized enterprises (SMEs). Key innovations include real time defect logging,

automated compliance checklists, and integration with Building Information Modelling (BIM) (Boje et al., 2020; Hu et al., 2022). Emerging tools such as unmanned aerial vehicles (UAVs), laser scanning, and digital twin frameworks enable predictive maintenance and enhance safety oversight (Mohammadi et al., 2021; Saback et al., 2024). Benefits include faster inspection processes, improved stakeholder communication, and greater transparency, although barriers such as digital literacy gaps, inconsistent connectivity, and high implementation costs persist (Dah & Hussin, 2021).

The construction industry has traditionally relied on manual inspection methods that are time consuming, resource intensive, and prone to human error. Recent advancements in mobile and remote inspection technologies have created opportunities for more efficient and reliable quality monitoring in both building and infrastructure projects (Baduge et al., 2022). SMEs, which make up a significant portion of the sector, face unique challenges in adopting such innovations due to limited resources and technical capacity. The shift toward Construction 4.0 underscores the importance of integrating digital solutions such as mobile applications, BIM, UAVs, IoT sensors, and digital twins to enhance project quality, safety, and productivity (Saback et al., 2024).

However, despite these advances, most studies remain concentrated on digital and ICT frameworks and AI applications, while UAV adoption, IoT integration, and SME-focused research are still limited. This gap highlights the need for a comprehensive review that not only synthesises technological innovations but also identifies barriers and opportunities for more inclusive adoption within the framework of Construction 4.0.

OBJECTIVE

The objectives of this review are to:

i. Examine key innovations in mobile and remote inspection technologies in the construction industry.
ii. Analyse benefits, challenges, and opportunities for SMEs in adopting these technologies.
iii. Provide recommendations for broader industry implementation within the framework of Construction 4.0.

METHODOLOGY

A systematic review was conducted using the Scopus database covering publications from January 2020 to July 2025. A comprehensive Boolean search strategy was designed to capture studies focusing on inspection technologies, construction applications, and innovation adoption. The inclusion criteria were peer-reviewed journal articles and conference papers published in English that clearly addressed construction inspection. From an initial pool of 1,791 records, 673 studies met the criteria. Thematic synthesis was then applied to group studies into categories such as BIM integration, UAV inspections, AI-driven defect detection, IoT adoption, and SME implementation.

RESULTS AND DISCUSSION

The findings demonstrate that digital and ICT frameworks, with 317 studies, dominate the research landscape, underscoring their role in enabling interoperability and real time reporting (Boje et al., 2020; Hu et al., 2022). AI and machine learning, represented in 150 studies, show growing application in computer vision and predictive modelling (Baduge et al., 2022). Innovations in construction materials, covered in 200 studies, are frequently associated with inspection feasibility and quality assurance. IoT sensors, found in 109 studies, and robotics, in 76 studies, indicate significant potential although they remain moderately represented. UAV-based inspection is reported in only 11 studies, despite its importance in reaching hazardous or inaccessible areas (Mohammadi et al., 2021). Emerging technologies such as digital twins and mixed reality, with 94 studies, illustrate promising directions but are not yet widely adopted (Saback et al., 2024).

The review identifies key benefits such as faster inspection processes, higher accuracy, and better communication among stakeholders. However, barriers persist. SMEs in particular encounter difficulties due to high initial costs, limited expertise, and inconsistent connectivity (Dah & Hussin, 2021). The uneven distribution of adoption suggests the need for more inclusive strategies that enable wider participation in Construction 4.0.

CONCLUSION

Mobile and remote inspection technologies represent a major transformation in construction quality management. Evidence from 673 reviewed studies shows that ICT frameworks and AI applications are the dominant focus, while UAVs, IoT, and robotics remain underutilised although they offer significant practical advantages. Addressing adoption challenges, particularly those faced by SMEs, will require cost effective solutions, targeted training, and regulatory support. Strengthening integration across ICT, AI, UAV, IoT, and digital twin systems will be critical for achieving the productivity, safety, and sustainability objectives of Construction 4.0. Based on these findings, it is recommended that industry stakeholders prioritise affordable deployment models, invest in capacity building programmes, and develop clear regulatory standards for interoperability. In addition, collaboration between industry, government, and academia should be encouraged to ensure that technological innovations lead to wider adoption and tangible improvements in construction practice.

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