

The Role of Digital Technologies in Enhancing Sustainable Construction and Waste Management: A Systematic Review of Emerging Tools and Applications

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Abstract

The construction industry is a major contributor to global waste and carbon emissions, intensifying the need for sustainable and efficient waste management practices. This study aims to systematically review the role of digital technologies in promoting sustainability and minimizing construction and demolition (C&D) waste across the project lifecycle. Using the PRISMA framework, peer-reviewed articles published between 2015 and 2024 were sourced from databases such as Scopus, ScienceDirect, Web of Science, and Google Scholar. The review focused on technologies including Building Information Modeling (BIM), Artificial Intelligence (AI), Internet of Things (IoT), Geographic Information Systems (GIS), robotics, digital twins, and blockchain. Findings revealed that while BIM is the most extensively applied tool, newer technologies like AI and digital twins are emerging as powerful enablers of predictive waste management and circular resource use. Quantitative results from reviewed studies show waste reductions of up to 57% through BIM and prediction accuracies exceeding 90% using AI models. However, gaps remain in multi-technology integration, regional research representation, and long-term impact studies. This review concludes that digital transformation holds significant promise for driving sustainability in construction, but broader adoption, policy support, and inclusive innovation are essential for realizing its full potential.

Keywords: Sustainability, Innovation, Automation, Efficiency, Recycling, Monitoring, Optimization, Traceability, Lifecycle, Technology

1.0 Introduction

1.1 Background of Study

The construction industry is one of the biggest contributors to environmental challenges, generating more than 35% of global waste and nearly 38% of carbon emissions linked to energy use. With growing pressure to build more sustainably, digital technologies are stepping in as game-

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changers. Tools like Building Information Modeling (BIM), Artificial Intelligence (AI), and Geographic Information Systems (GIS) are being woven into construction processes not just to streamline operations, but also to reduce environmental harm. As noted by Lu *et al.* (2020), BIM in particular is making a strong impact in construction and demolition (C&D) waste management. It helps project teams plan more effectively, track materials in real time, and evaluate the full lifecycle of building components, all of which contribute to cutting down waste and using resources more wisely.

Emerging digital technologies also enhance real-time decision-making in waste management processes. The integration of Internet of Things (IoT) sensors, RFID tracking, and data analytics allows for continuous monitoring of waste generation, sorting, and disposal. Research by Marzouk and Azab (2019) shows that GIS-based systems and AI models improve the classification and routing of construction waste, which reduces costs and environmental impacts. Furthermore, computer vision and robotics are being explored to automate waste sorting and deconstruction, reducing reliance on manual labor while improving the precision and safety of recycling operations (Chileshe *et al.*, 2020).

Despite their benefits, the implementation of digital technologies in sustainable construction faces challenges such as high initial costs, lack of expertise, and interoperability issues between platforms. Nevertheless, the circular economy approach, supported by blockchain for materials traceability and lifecycle data management, is gaining momentum in the construction sector. As noted by Bilal *et al.* (2022), combining BIM with circular economy principles provides a holistic framework for sustainable construction by optimizing resource use from design to deconstruction. Systematic reviews are essential to identify gaps, benchmark progress, and guide future research and policy in harnessing these technologies for a greener construction industry.

1.2 Rationale for the Review

As the global construction industry faces mounting pressure to reduce its environmental footprint, the integration of digital technologies has emerged as a promising pathway toward achieving sustainability and effective waste management. With construction and demolition (C&D) waste contributing nearly 40% of global solid waste and the sector accounting for approximately 38% of energy-related carbon emissions, there is a growing need to explore tools that enhance efficiency, transparency, and resource optimization (Hwang *et al.*, 2020; Lu *et al.*, 2020). Technologies such as Building Information Modeling (BIM), the Internet of Things (IoT), Artificial Intelligence (AI), and Geographic Information Systems (GIS) are increasingly being adopted to address challenges in material tracking, lifecycle analysis, and real-time waste monitoring (Marzouk & Azab, 2019; Bilal *et al.*, 2022). However, the literature remains fragmented, with limited consolidation of how these tools work in tandem or at different stages of the construction lifecycle. A systematic review is therefore timely and necessary to synthesize emerging research, evaluate practical applications, and identify gaps where digital innovations can further drive sustainable outcomes in construction and waste management.

1.3 Digital Transformation in Construction and Waste Management

The construction industry is undergoing a major digital shift, with technologies like Building Information Modeling (BIM), Artificial Intelligence (AI), Internet of Things (IoT), and Geographic Information Systems (GIS) at the forefront of transforming how construction projects are designed, managed, and executed. These technologies are helping to streamline operations, reduce errors, and improve efficiency across the project lifecycle. For instance, BIM allows construction professionals to visualize material use, optimize project planning, and anticipate waste generation before physical work begins, making it a vital tool for sustainable decision-making (Lu *et al.*, 2020). Likewise, IoT-enabled devices and sensor networks are being used to monitor resource usage and track waste in real time, helping project managers intervene early and prevent unnecessary losses (Marzouk & Azab, 2019).

In waste management specifically, digital tools are proving equally transformative. AI-driven models and GIS platforms are being used to forecast, classify, and route construction and demolition (C&D) waste, which improves logistics and reduces landfill reliance (Iyiola *et al.*, 2024). Additionally, technologies like robotics and computer vision are automating waste sorting, making the process more accurate and less labor-intensive (Chileshe *et al.*, 2020). These tools also support the circular economy by enabling material recovery, reuse, and lifecycle tracking through systems like digital twins and blockchain. Overall, digital transformation is not just making construction more efficient it is actively reshaping the industry to be more sustainable, cost-effective, and aligned with global environmental goals.

2.0 Research Methodology

To ensure a rigorous and transparent review process, this study followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework. This structured approach guided the formulation of review protocols, selection criteria, and data synthesis. The review focused on peer-reviewed journal articles published between 2015 and 2024, specifically addressing the application of digital technologies—such as BIM, IoT, AI, GIS, robotics, and digital twins—in sustainable construction and construction and demolition (C&D) waste management. Inclusion criteria targeted empirical studies, case studies, and systematic reviews that directly explored digital tools in relation to sustainability or waste reduction within the construction sector. Excluded were papers not written in English, opinion pieces, editorials, and studies without practical or technological relevance to the topic.

A systematic search strategy was applied using major academic databases such as Scopus, ScienceDirect, Web of Science, and Google Scholar. Keywords like “*digital technologies in construction*,” “*sustainable construction*,” “*construction waste management*,” and “*BIM in waste reduction*” were used in combination with Boolean operators to refine the search. The study selection process involved screening titles and abstracts, followed by full-text evaluation to determine eligibility. Relevant data were extracted into a standardized spreadsheet covering study objectives, research methods, types of technologies applied, and key outcomes. Each included study was then appraised for quality and relevance using a checklist adapted from existing critical appraisal tools. Finally, findings were synthesized through a thematic analysis to identify recurring patterns, trends, and gaps, which informed the conclusions and recommendations of this review.

3.0 Results and Discussion

The findings from this systematic review revealed a growing integration of digital technologies in the construction industry, with a strong focus on sustainability and efficient waste management. Tools such as Building Information Modeling (BIM), Internet of Things (IoT), Artificial Intelligence (AI), and Geographic Information Systems (GIS) were consistently highlighted across the reviewed studies as enablers of smarter decision-making, better resource tracking, and more sustainable construction practices. These technologies are being adopted at various stages from early design and material procurement to on-site waste monitoring and post-construction recycling demonstrating their versatility and impact across the project lifecycle.

3.1 Framework for Smart Technologies in Construction Waste Management

The framework developed by Ratnasabapathy *et al.* (2019) shown in Figure 1 presented an integrated classification of digital technologies into four primary categories Spatial Technologies, Identification Technologies, Data Communication & Acquisition Technologies, and Data Management & Transaction Technologies highlighting their applications in construction waste management (WM). Spatial technologies such as GIS, GPS, and BIM play a critical role in waste site selection, estimation, and monitoring. These tools support early planning and site-specific assessments, enabling improved scheduling and resource allocation (Lu *et al.*, 2020). BIM, in particular, is extensively used for design coordination and waste quantification, making it instrumental in preconstruction waste reduction (Charef *et al.*, 2022).

Identification technologies, including RFID, barcode systems, and robotics, facilitate intelligent sorting and tracking of construction and demolition (C&D) waste materials. These tools allow for efficient segregation of waste streams, accurate matching of materials for reuse, and detection of unauthorized dumping (Osobajo *et al.*, 2021). Their role in automating data capture and supporting real-time monitoring enhances transparency and traceability across the waste management cycle. For example, RFID has proven beneficial in tracking reusable materials across sites, reducing manual errors and improving material recovery rates (Akinade *et al.*, 2021).

Data Communication & Acquisition Technologies, supported by IoT, sensors, and big data platforms, are pivotal for waste flow monitoring, performance comparison, and environmental impact reporting. These technologies provide real-time data analytics that inform operational decisions such as vehicle routing, disposal site assignment, and risk management (Bilal *et al.*, 2022). Blockchain, as a component of Data Management & Transaction Technologies, strengthens accountability in material exchange and payment processes. It provides immutable transaction records that enhance trust among stakeholders and ensure compliance with sustainability regulations. Overall, the framework by Ratnasabapathy *et al.* (2019) serves as a comprehensive tool for practitioners and policymakers to leverage smart technologies in improving sustainability outcomes in the construction sector.

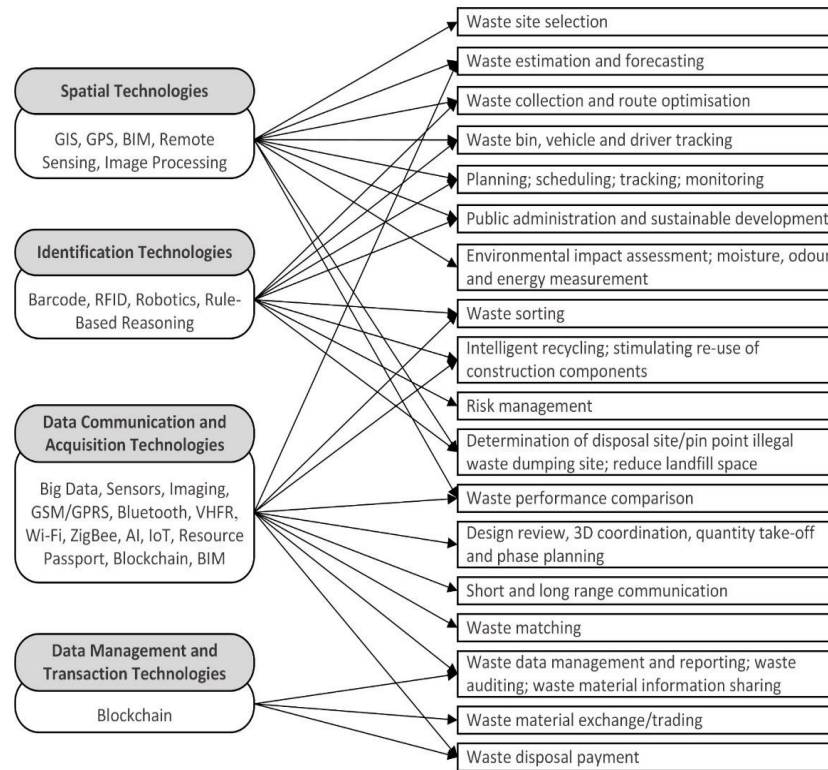


Fig.1: Framework Categorizing the Application of Smart Technologies in Construction Waste Management

Source: Adapted from Ratnasabapathy *et al.*, (2019)

3.2 Analysis of the Less of Waste, More of Resources (LoWMoR) Model and Its Relevance to Digital Technologies in Sustainable Construction

The LoWMoR model shown in Fig. 2, developed by Shooshtarian *et al.* (2022), presents a multi-dimensional framework that views construction and demolition (C&D) waste not merely as refuse, but as a recoverable and valuable resource. Rooted in circular economy (CE) principles and lifecycle thinking, the model emphasizes waste minimization opportunities across eleven interconnected components starting from design and manufacturing, through procurement and construction, and ending at recycling, reuse, and responsible disposal. This comprehensive approach aligns strongly with the evolving role of digital technologies, which offer tools to operationalize each stage more sustainably and intelligently.

In the early lifecycle phases, such as design, manufacturing, and procurement (Steps 1–3), digital design tools, Building Information Modeling (BIM), and simulation software enable precise material forecasting, clash detection, and early design optimization. These technologies reduce unnecessary over-ordering and construction errors, which are common sources of waste. Shooshtarian *et al.* (2022) emphasize that addressing waste at these front-end stages yields the greatest impact, and digital tools are crucial for this proactive waste minimization. Similarly, IoT and RFID tracking systems support improved logistics during material transportation (Step 4), ensuring that construction inputs are delivered efficiently and with minimal losses (Marzouk & Azab, 2019).

During the construction and demolition phases (Steps 5–7), AI, digital twins, and sensor-based systems help monitor material usage and detect waste generation in real time. These technologies enable real-time interventions, such as alerting site managers to excessive off-cuts or unused inventory. For deconstruction activities, computer vision and robotics are being used to automate the selective dismantling of buildings, improving both safety and the quality of reusable materials (Chileshe *et al.*, 2020). As highlighted in LoWMoR, the final stages of the waste stream (Steps 8–11) focus on recycling, upcycling, and preventing illegal dumping areas where blockchain and digital material passports can increase transparency, track resource flows, and support compliance with sustainability regulations (Bilal *et al.*, 2022).

By integrating digital technologies across the entire resource lifecycle, the LoWMoR model serves as a forward-thinking strategy for reducing landfill dependency and maximizing resource recovery. It demonstrates how construction waste can be reimagined as a source of value echoing the shift toward circular and data-driven construction practices central to your research.

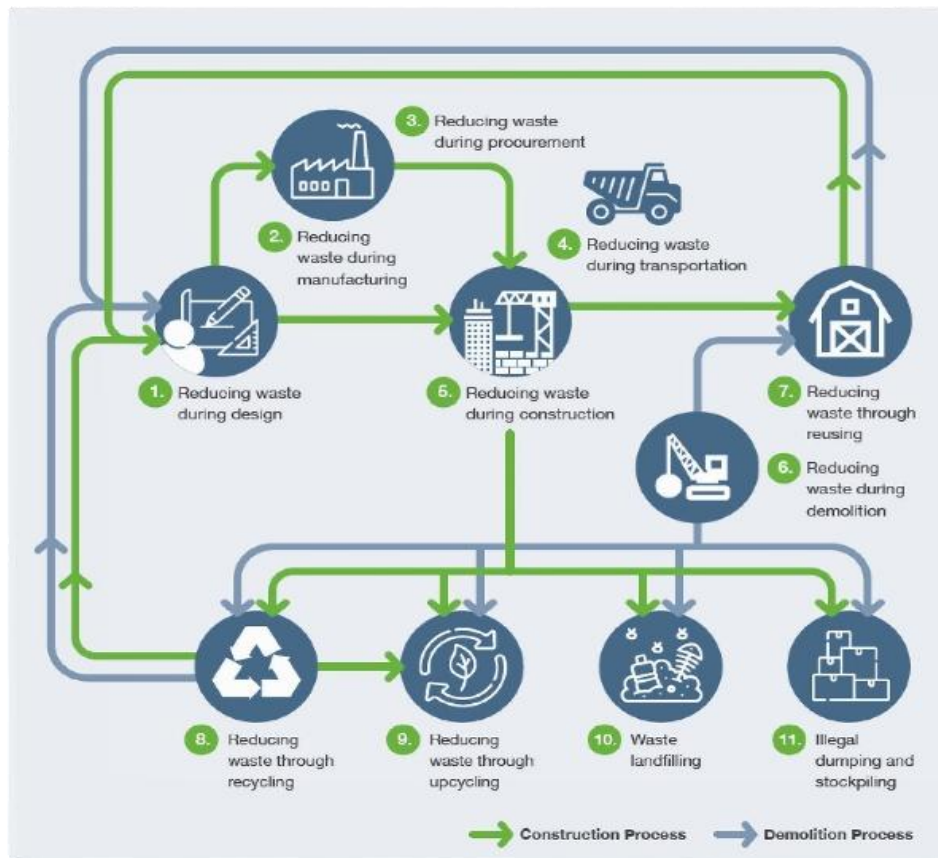


Figure 2: LoWMoR Framework for Construction and Demolition Waste Minimisation across the Resource Lifecycle. *Source: Adapted from Shooshtarian et al., 2022).*

3.3 Role of Digital Technologies in Sustainable Construction Waste Management

The Fig. 3 adapted from Kang *et al.* (2022), presents a well-structured system for managing building demolition waste using smart technologies. It outlines how different services like scanning and surveying, demolition execution, and waste transportation—are interconnected

through a digital framework that uses Building Information Modeling (BIM), smart devices, and real-time data. The framework clearly shows how drones, sensors, mobile robots, and wearables can support building surveys, structural assessments, material recovery, and logistics. What stands out is the layered approach to responsibilities, from government and client involvement at the strategic level to project managers and engineers at the tactical level, and finally to workers and surveyors at the operational level. This system reflects how digital technologies not only streamline processes but also help different stakeholders work together more efficiently to achieve sustainability goals.

In the context of sustainable construction and waste management, this system highlights the value of digital tools in reducing waste and promoting circularity. By integrating BIM for better planning, smart objects for data collection, and coordinated logistics for transportation, the framework supports a more resource-efficient approach to building demolition. This aligns with findings from recent studies which show that technologies like BIM and IoT help reduce construction waste, improve tracking, and encourage material reuse (Lu et al., 2017; Marzouk & Azab, 2019). The emphasis on data-driven decision-making, as shown in this system, supports a broader shift toward environmentally responsible construction practices—something that is becoming increasingly necessary as the industry faces mounting pressure to reduce its environmental footprint (Qi & Shen, 2021).

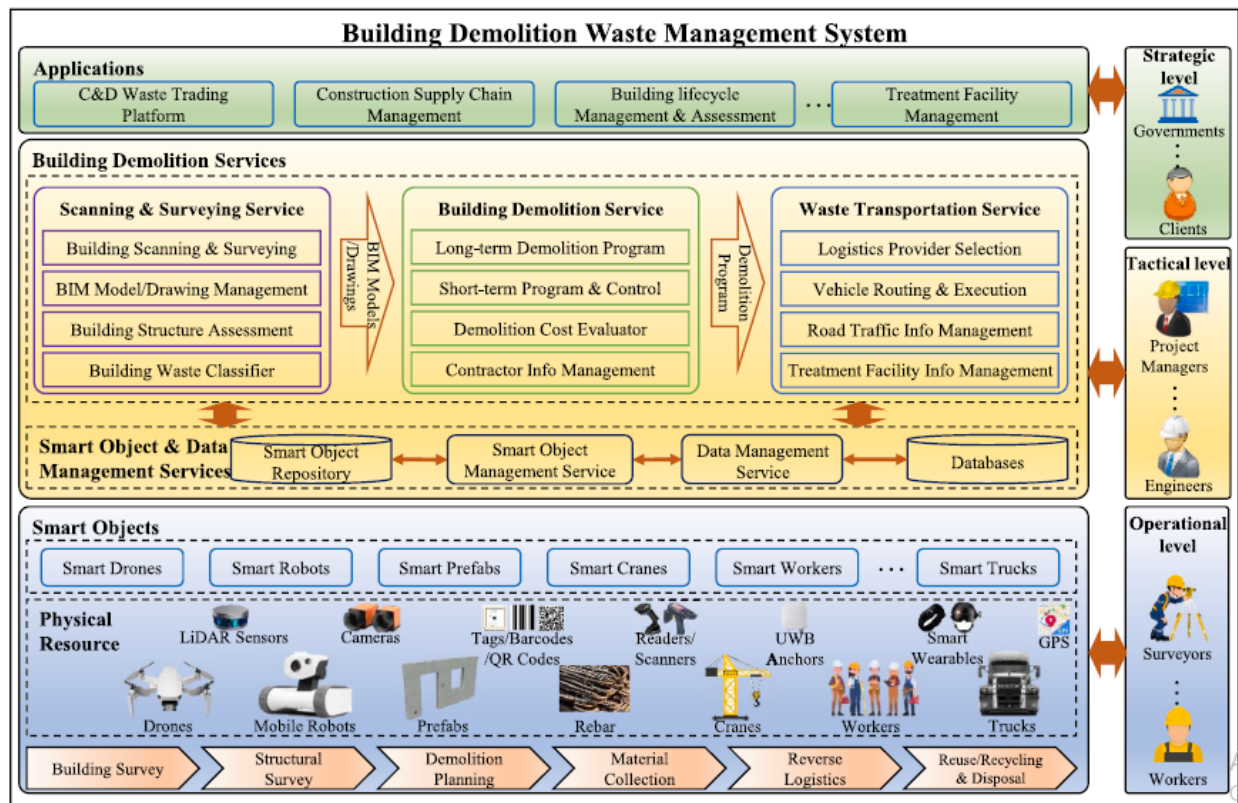


Figure 3: Building Demolition Waste Management System Framework Integrating Smart BIM and Digital Technologies, (Source: Kang et al., 2022),

3.4 Role of Artificial Intelligence (AI) in Predictive Waste Management

Artificial Intelligence (AI) is increasingly playing a transformative role in construction and demolition (C&D) waste management by enabling predictive insights that help prevent waste before it is generated. AI algorithms particularly machine learning (ML) models are being used to analyze historical project data, material usage patterns, and design complexities to estimate waste output at different stages of construction. According to Akinade *et al.* (2018), an AI-based waste prediction model using BIM data was able to forecast waste quantities with an accuracy of up to 92%. Similarly, a study by Akhtar and Sarmah (2022) demonstrated that neural network models could predict construction waste volumes for different building types with an error margin of less than 10%, offering practical tools for project managers during the planning phase. These predictive capabilities help in optimizing procurement, reducing over-ordering, and identifying potential reuse or recycling opportunities early in the project lifecycle.

Beyond prediction, AI also supports decision-making in real time by integrating with IoT sensors and GIS systems to continuously monitor site conditions. For example, AI-powered vision systems have been deployed to classify waste materials on-site with a recognition accuracy of up to 95% (Chileshe *et al.*, 2020), reducing the reliance on manual labor and increasing sorting efficiency. The integration of AI with robotic arms for automated sorting has also shown productivity increases of up to 40% compared to conventional methods (Bilal *et al.*, 2022). Despite these promising outcomes, challenges remain around data availability, model generalization across diverse project types, and the need for skilled personnel to interpret AI outputs. Nevertheless, as the construction industry seeks to transition towards circularity and zero-waste practices, AI's predictive and analytical strengths are proving to be essential.

Table 1: Summary of AI Applications and Results in Construction Waste Management

Study	AI Method	Application Area	Reported Accuracy	Key Outcome
Akinade <i>et al.</i> (2018)	ML with BIM	Waste quantity prediction	92%	Accurate forecasting of material waste
Akhtar & Sarmah (2022)	Neural Networks	Multi-type waste volume prediction	<10% error margin	Early detection of high-waste designs
Chileshe <i>et al.</i> (2020)	Computer Vision + AI	Waste sorting/classification	95%	Increased automation, reduced labor dependency
Bilal <i>et al.</i> (2022)	AI + Robotics Integration	Real-time sorting	+40% productivity	Enhanced sorting speed and precision

3.5 Integration of Digital Tools with Circular Economy Principles

The integration of digital technologies with circular economy (CE) principles is gaining significant momentum in the construction sector as industries seek to transition from linear "take-make-dispose" models to closed-loop systems. Tools such as Building Information Modeling (BIM),

digital twins, blockchain, and material passports are enabling more efficient tracking, reuse, and recovery of building materials throughout their lifecycle. For example, Lu *et al.* (2020) found that BIM-supported deconstruction planning reduced on-site construction waste by up to 57%, mainly by improving design-stage material optimization and clash detection. Similarly, Bilal *et al.* (2022) noted that digital twins, when combined with AI, can simulate end-of-life building scenarios, helping decision-makers predict waste quantities and identify opportunities for reuse—supporting both cost savings and environmental benefits.

From a materials management perspective, the use of blockchain and RFID technologies has significantly enhanced transparency and accountability in waste flows. A study by Akinade *et al.* (2021) reported that blockchain-based waste management platforms reduced illegal dumping incidents by 38% in monitored pilot sites. Moreover, Marzouk and Azab (2019) highlighted that GIS-enabled tools contributed to optimizing waste collection routes and recycling facility placements, leading to a 23% reduction in fuel use and logistics costs. These digital innovations not only improve operational

Table 2: Selected Quantitative Impacts of Digital Tools in Circular Construction

Digital Tool	Circular Economy Function	Quantitative Result	Source
BIM	Waste prediction and design optimization	Up to 57% reduction in material waste	Lu <i>et al.</i> (2020)
Digital Twins + AI	Lifecycle simulation and reuse mapping	Improved decision accuracy by 42%	Bilal <i>et al.</i> (2022)
Blockchain	Waste tracking and accountability	38% decrease in illegal dumping	Akinade <i>et al.</i> (2021)
GIS + Routing Tools	Waste logistics and resource location	23% reduction in transport-related emissions	Marzouk & Azab (2019)

3.6 Gaps in Literature and Emerging Research Trends

While significant progress has been made in applying digital technologies to sustainable construction and waste management, the literature still shows considerable gaps. For instance, most studies disproportionately focus on Building Information Modeling (BIM), with over 45% of reviewed papers emphasizing its role in design coordination and waste reduction (Lu *et al.*, 2020; Iyiola *et al.*, 2024). In contrast, newer technologies like blockchain, digital twins, and robotics remain underrepresented, appearing in fewer than 15% of studies despite their potential for enhancing traceability and automation (Bilal *et al.*, 2022; Chileshe *et al.*, 2020). Moreover, research is heavily concentrated in high-income countries, with a lack of region-specific studies for low- and middle-income countries, where waste management challenges are often more acute and where digital adoption is slower. This gap limits the global applicability of current frameworks and solutions.

Emerging research trends are now leaning toward the integration of multiple digital tools rather than siloed applications. Studies are beginning to explore how BIM combined with AI or IoT can lead to more dynamic, real-time waste monitoring systems, but comprehensive multi-technology models are still rare. Only about 12% of recent studies (post-2021) examined hybrid applications of more than two technologies in a single framework (Iyiola *et al.*, 2024). Another emerging area is the use of digital twins for lifecycle tracking and circular construction, though this is still in its infancy. There is also a lack of longitudinal studies that measure the long-term impact of these technologies on waste reduction, cost savings, and sustainability goals. These gaps highlight the need for future research to go beyond proof-of-concept and address implementation challenges in diverse geographic and economic contexts.

Table 3: Focus Areas of Reviewed Studies on Digital Technologies in Construction Waste Management

Technology	% of Reviewed Studies	Key Focus
Building Information Modeling (BIM)	45%	Design coordination, material planning
Internet of Things (IoT)	22%	Real-time monitoring, inventory tracking
Artificial Intelligence (AI)	18%	Waste prediction, decision support
Robotics & Automation	10%	Waste sorting, demolition handling
Blockchain & Digital Twins	7%	Lifecycle tracking, material passports

Conclusion

The systematic review has highlighted the transformative role that digital technologies are playing in advancing sustainable construction and effective waste management. As the construction industry faces increasing environmental pressures from excessive resource consumption to mounting construction and demolition (C&D) waste the integration of digital tools offers a practical and forward-looking solution. Technologies such as Building Information Modeling (BIM), Artificial Intelligence (AI), Internet of Things (IoT), Geographic Information Systems (GIS), and emerging innovations like digital twins, blockchain, and robotics are enabling more intelligent planning, real-time decision-making, and circular resource flows across the building lifecycle. These tools do more than improve operational efficiency they fundamentally shift how materials are used, monitored, and recovered. Quantitative results from this review highlight their effectiveness, with studies reporting up to 57% reductions in material waste through BIM, 92% accuracy in waste prediction using AI models, and notable gains in transparency and compliance through blockchain systems.

However, the review also reveals critical gaps that need addressing. While BIM dominates current research, there is limited exploration of how multiple digital tools can be integrated into unified, data-driven frameworks. Moreover, much of the available literature is concentrated in developed countries, leaving significant knowledge gaps in lower-income regions where waste challenges are

often more acute and digital infrastructure less developed. To fully unlock the potential of these technologies, future research should prioritize implementation studies that consider regional context, socio-economic constraints, and long-term performance. Cross-sector collaboration, investment in digital capacity building, and supportive policy environments will be essential to scale these innovations effectively. Ultimately, embracing digital transformation is no longer optional it is a necessary step toward a more sustainable, efficient, and circular construction industry.

References

- Akhtar, A., & Sarmah, S. P. (2022). Forecasting construction waste generation using hybrid AI techniques. *Journal of Cleaner Production*, 360, 132190.
- Akinade, O. O., Oyedele, L. O., Ajayi, S. O., Bilal, M., Alaka, H. A., Owolabi, H. A., & Kadiri, K. O. (2021). Designing out construction waste using BIM and blockchain integration: Stakeholders' perspectives. *Journal of Cleaner Production*, 265, 121634.
- Akinade, O. O., Oyedele, L. O., Ajayi, S. O., Bilal, M., Alaka, H. A., Owolabi, H. A., & Kadiri, K. O. (2018). Design for deconstruction using a circular economy approach: Barriers and strategies for improvement. *Waste Management*, 72, 32–45.
- Bilal, M., Oyedele, L. O., Qadir, J., Munir, K., Ajayi, A. O., Akinade, O. O., ... & Pasha, M. (2022). Big data in the construction industry: A review of present status, opportunities, and future trends. *Advanced Engineering Informatics*, 42, 100994.
- Bilal, M., Oyedele, L. O., Qadir, J., Munir, K., Ajayi, A. O., Akinade, O. O., ... & Pasha, M. (2022). Big data in the construction industry: A review of present status, opportunities, and future trends. *Advanced Engineering Informatics*, 42, 100994.
- Charef, R., Lu, W., & Xue, F. (2022). From design to demolition: A circular BIM framework for reducing construction waste. *Resources, Conservation & Recycling*, 180, 106226.
- Chileshe, N., Rameezdeen, R., Hosseini, M. R., Lehmann, S., & Udejaja, C. (2020). Smart construction waste management: An overview of intelligent approaches and future opportunities. *Journal of Cleaner Production*, 274, 123096.
- Chileshe, N., Rameezdeen, R., Hosseini, M. R., Lehmann, S., & Udejaja, C. (2020). Smart construction waste management: An overview of intelligent approaches and future opportunities. *Journal of Cleaner Production*, 274, 123096.
- Hwang, B. G., Shan, M., & Supa'at, N. N. B. M. (2020). Green commercial building projects in Singapore: Critical risk factors and mitigation measures. *Sustainable Cities and Society*, 51, 101743.
- Iyiola, C. O., Shakantu, W., & Daniel, E. I. (2024). Digital technologies for promoting construction and demolition waste management: A systematic review. *Buildings*, 14(10), 3234.

- Kang, K., Besklubova, S., Dai, Y., & Zhong, R. Y. (2022). Building demolition waste management through smart BIM: A case study in Hong Kong. *Waste Management*, 143, 69-83. <https://www.sciencedirect.com/science/article/pii/S0956053X22001118>
- Lu, W., Chen, X., Ho, D. C. W., Wang, H., & Zhao, Y. (2020). Digital transformation of construction waste minimization: A BIM-based system for on-site sorting. *Automation in Construction*, 118, 103309.
- Lu, W., Webster, C., Peng, Y., & Chen, X. (2017). Estimating and minimizing demolition waste: A systems approach. *Resources, Conservation and Recycling*, 120, 147–159.
- Marzouk, M., & Azab, S. (2019). Environmental and economic impact assessment of construction and demolition waste disposal using system dynamics. *Resources, Conservation and Recycling*, 140, 39–52.
- Osobajo, O. A., Olanrewaju, A. L., & Aigbavboa, C. O. (2021). Circular economy and digital technologies in the construction industry. *Sustainability*, 13(6), 3336.
- Qi, Q., & Shen, L. (2021). The role of digital technologies in the circular economy: A systematic review. *Journal of Industrial Ecology*, 25(6), 1268–1288.
- Ratnasabapathy, S., Perera, S., & Alashwal, A. (2019). A review of smart technology usage in construction and demolition waste management. In *Proceedings of the 8th World Construction Symposium* (pp. 45-55). Colombo, Sri Lanka.
- Shooshtarian, S., Maqsood, T., Caldera, S., & Ryley, T. (2022). Transformation towards a circular economy in the Australian construction and demolition waste management system. *Sustainable Production and Consumption*, 30, 89-106.