Smart and
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Editorial: Artificial intelligence (AI) shaping modern construction practices

Artificial intelligence (AI) dominates the current socio-political-economic landscape and continues to shape economies globally (Imbusch and Steg, 2024). This transformation is founded upon massive investments in technology (Zhu and Sun, 2025), underpinned by the financial markets that foresee the monetary and transformative value that advanced technology will have upon human life (Bonaparte, 2024). Indeed, economic projections anticipate that in the next 10 years, AI revenue could reach $2.74 trillion (Bonaparte, 2024). One only has to review the huge growth in technology-oriented stocks and shares investment (e.g. Individual Savings Account in the UK or similar investment builders worldwide). Such investments typically attract high growth margins over the long term, albeit they are also prone to sporadic and periodic collapse in the short term. Given the power of financial markets, vast investments in technology yield profits for shareholders which in-turn fuels further and greater investment (Chen *et al.*, 2026). Power within countries and between former global alliances is now being challenged (or at least influenced) by the tech giants who increasingly shape national and international policy (Sheng, 2022). Humanity is fuelling this changing world order as the relentless consumer of AI. That said, consider when you were last able to conduct a web search without the use of AI being present(?) – there appears to be no choice for those who may object to the huge environmental cost of the massive data centres that power the technology.

AI has become a ubiquitous terminology within the general public – a “one shoe fits all” mantra – accompanied by a wider misunderstanding of the risks posed by some AI variants when abused. Many different varieties of AI exist and furthermore, a simple, clever or unique programme will sometimes be erroneously promoted as AI to generate a sale. Prominent AI derivatives include: neural networks for prediction or classification-type problems (Yang *et al.*, 2004); convolutional neural networks for classification-type problems (Elghaish *et al.*, 2025); and Generative AI (GenAI) that can generate text, images and graphics (and more) based upon a simple request (Albishri *et al.*, 2026). Across this expansive range of AI uses and applications, the boundaries between good and appropriate applications that benefit humanity versus poorly judged applications that erode human intellect have become blurred. Take, for example, the epistemic contamination of academic literature that has filtered into science. This contamination chain involves: papers written using GenAI; reviewers adopting GenAI to review the papers; early academics using the polluted papers to inform their own work or writing using GenAI; and students then using the polluted literature to inform their own studies or writing their own coursework using GenAI. This uncomfortable scenario is here now and ill-informed educational policies are trying to manage the risk when they should be striving to eliminate it. Ask yourself these questions: What is the value of a parrot that can speak English, yet cannot comprehend what it has said? And in a similar vein, what is the value of a degree premised upon GenAI that produces a graduate unable to think critically for themselves? GenAI is clearly not sentient and a worrying cognitive-atrophy gap has emerged between the developers of AI and its subsequent consumers. These new areas of science await our most talented future researchers to investigate and report upon definitively.

Subject to the aforementioned caveats, AI more broadly has undoubtedly the innate ability to drive positive societal change, provided that its application is not at the expense of human governance and wisdom. Areas such as the development of sustainable cities and infrastructure (Adabre *et al.*, 2022), human safety (Bayramova *et al.*, 2024; Bortey *et al.*, 2024) and procurement security (Ameyaw *et al.*, 2024) are prominent on research agendas.

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However, one area that has not yet attracted sufficient attention is affordable housing. Taylor *et al.* (2023), for example, previously reported on the extent of the UK housing crisis and similar issues have been highlighted internationally (Coupe, 2021). Modern methods of construction (Mubashar *et al.*, 2026) have often been proposed as a panacea, but innovative "dark" or "lights out" factories (dark factories hereafter for brevity) are rarely mentioned, yet these could hold the key to solving the global affordable housing crisis. In essence, a dark factory is void of human life, being a fully automated, controlled environment powered by robotics couched within the constraints of Industry 4.0 (Newman *et al.*, 2021). In other words, AI, sensor-based technologies, robots and other advanced digital technologies coalesce (Edwards *et al.*, 2025) to create products for humanity but without human involvement (other than the build, installation, programming and maintenance of the dark factory).

Affordable housing could realistically be built in dark factory-controlled conditions to create repeatable designs that are simply placed on the foundations built on site. AI algorithms such as neural networks could be used to, for example, monitor the costs and production rates of the factory. Convolutional neural networks could search for fault diagnosis in the structures created. AI in such circumstances could also link to housing of the future built using concrete printing. Such buildings may initially be utilitarian in design and/or lack architectural finesse or individuality, but they would serve as important starter homes that are safe and habitable for those first entering the property market. Large multinational companies already adopt portable offices for site management so why not housing? In the UK, a public relations exercise may well be required to untarnish the image following the prefabricated era at the end of the Second World War, but short of this, there appears to be no sound reason preventing dark factories from supplying this housing need? This is a classic example of where AI and automation find a natural home (pardon the pun!) that creates societal value and impact but does not diminish human creativity or intellect. Rather, work roles evolve (Edwards *et al.*, 2017) as people change occupations to be the programmers, maintenance crews and manufacturers of dark factories and the automation and intelligence within. The opportunity is not a threat.

A similar process of industrial transformation occurred in the Black Country region (and other industrialised areas of the UK) when Industry 1.0 was born. At that time, the Luddites smashed the looms to save jobs and the trade union movement was born. Time has proven that smashing the looms did not halt technological progress and the progression of AI is similarly almost inevitable, changing jobs and upskilling people's cognitive potential for the future. This potential pathway to the future using AI is very different from the application GenAI that engenders cognitive atrophy. These finer nuances for the appropriate application of AI justify further academic investigation to create an objective truth that informs and educates industry and the general public.

On this latter note, it is a pleasure to read that this issue of Smart and Sustainable Built Environment brings together 14 papers that collectively advance these interconnected agendas. Papers range from sustainable solutions using AI to decision support systems for infrastructure management. Such research cumulatively demonstrates a vibrant research community that is working together, using human ingenuity and academic prowess, to solve real-world problems via AI and advanced digital adoption.

A first cluster of papers addresses smart cities, urban environments and heritage. Patil *et al.* (2026) introduce the "YouWalk-YouReclaim" mobile application as a co-assessment tool for evaluating university campus environments in a post-pandemic context. A case study at Northumbria University, involving over 100 students, demonstrates how digital technology enables user-centred campus improvements through real-time feedback. Geng *et al.* (2026) examine Chinatown Melbourne as a case study for Smart Heritage implementation. Through expert interviews in community development, heritage conservation and the built environment, the study identifies enablers and challenges of adopting smart technologies to strengthen cultural identity in heritage precincts. Mavahebi Tabatabai *et al.* (2026) present a generative design framework for optimising urban block layouts under constant density constraints. Applied to a residential district in Tehran, the computational workflow demonstrates substantial improvements in spatial daylight autonomy and radiation performance compared to conventional parallel layouts.

A second cluster focuses on digital technologies and information management across the construction lifecycle. Lu *et al.* (2026) present an OpenBIM-based method for simulating building operational carbon across design stages. Using IFC as the integration framework and accommodating varying levels of information availability, the method demonstrates a 16.9% carbon reduction through scheme optimisation. Naanaa *et al.* (2026) introduce a knowledge graph-based semantic search system for the construction domain, structured around linked data principles. Three evaluation indicators—relevance, contextual awareness and integrity—are developed to ensure the system delivers the right information to the right stakeholder at the right time. Sarigul and Gunaydin (2026) conduct a systematic literature review of BIM and GIS integration across the construction lifecycle, analysing 141 articles from 2007 to 2024. The study identifies geometric and semantic data conversion as the foremost technical challenge and points towards digital twin integration as a critical direction for future development.

A third cluster examines AI, machine learning and decision support applications. Soltanmohammadlou *et al.* (2026) contribute a systematic literature review of technological functionalities addressing risk factors in earthmoving equipment operations. Applying Rasmussen's risk management framework, social network analysis and Pareto analysis, the study maps current technological coverage and identifies a need for holistic, AI-driven approaches to construction site safety. Shafi *et al.* (2026) address air quality prediction in support of SDG-11 using multiple deep learning classifiers trained on 8.1 million records from US cities. The Bidirectional GRU model achieves 99.98% accuracy, setting a new benchmark for automated air quality level classification. Shu *et al.* (2026) present a reinforcement learning-driven decision support framework for urban tree pruning. A tree growth simulation environment is coupled with a deep reinforcement learning network to guide management specialists in achieving target canopy shapes that optimise thermal comfort and direct sunlight utilisation. The cluster concludes with Rasoulimanesh *et al.* (2026), who present an integrated digital decision support system for strategic budget allocation in bridge infrastructure maintenance. The system combines BIM, a web-based data management platform and a genetic algorithm to generate cost-effective maintenance and repair schedules, scoring highly in sustainability, labour savings and time efficiency.

A fourth cluster addresses workforce development, governance, resilience and long-term sustainability. Alhamoudi and Osunsanmi (2026) develop a structural equation model framework for reskilling UK construction workers in the Fourth Industrial Revolution era. The framework identifies immersive training, experiential learning and collaborative workforce development as the key strategies, with virtual and augmented reality central to equipping workers with technical and soft skills. Abdullah Sani and Jaafar (2026) examine the impact of IoT adoption in Malaysia's public sector through semi-structured interviews with 17 participants across ministries, state governments and local councils. The study identifies 21 key themes spanning operational excellence, service delivery transformation, data-driven governance and citizen engagement. Nikolic and Ewart (2026) review large-scale digital twin research to assess the extent of socio-ecological and systems thinking in the sustainable built environment. The review reveals that DT development remains largely domain-specific, and a preliminary framework is proposed for purpose-driven DTs that support interdisciplinary dialogue beyond net-zero targets. The issue concludes with Kaplan and Abrishami (2026), who develop a disaster risk management framework integrating Heritage BIM and Big Data analytics for cultural heritage conservation. Validated through expert questionnaires with ICOMOS Turkey affiliates, the framework provides tools for disaster preparedness, emergency response and post-disaster recovery.

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