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EDITORIAL

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The research filed of construction robotics broadens increasingly in terms of complexity, approaches, technologies used, active stakeholders, and application areas. Worldwide labour and resource shortages, the need to increase circularity and resource efficiency, new materials and the increasing utilisation of digital construction tools in the planning and construction industry massively spur the uptake of robotic solutions for on-site construction.

The initial boom of construction robots happened in the 1970s, driven by the Japanese construction industry. In the 1980s, a combination with parallel developments was supposed to achieve complete, integrated robotic on-site factories. From the mid-1980s onwards, the global interest in construction robots decreased gradually. Bulky and expensive systems, complex on-site navigation and logistics approaches, a narrow scope of tasks, inflexibility, incompatibility with on-site work organisation and professional qualification, low usability and insufficient inter-robot coordination capabilities revealed the immaturity of the systems. Only a few organisations predominantly situated in Asia such as Takenaka, Obayashi, Kajima Corporation, Nihon Bisho Co., Samsung, and Hitachi maintained development activities.

However, since the mid-2010s, development activities are gaining traction again. On the application side, this is mainly driven by trends such as the need to upgrade the energy performance of buildings in Europe, a global necessity to remove asbestos from existing structures, and a demand for enormous quantities of high-rise buildings all over East Asia. On the system side, the renewed interest stems from major advances in physical–mechanical robot technology in other automation-driven industries such as the automotive industry. Robots became lighter, more flexible, their parts modular and interchangeable, more user friendly as well as significantly cheaper. On the digital side, the BIM-to-Robot pipeline was subject of intensive reserach and development. More and more methods and tools help to increase the usability of robots and facilitate the simulation and optimisation of robot-driven construction processes.

In the last 4–5 years, the worldwide growing need and interest in construction robotics became highly evident. More than 200 robot systems are pushed by start-ups and spin-offs and their investors to the market. This is backed by an enormous number of activities and projects carried out in the academic area pushing to the boundaries of what is technologically possible.

Major associations and their conferences increase significantly in popularity such as ISARC (International Association for Automation and Robotics in Construction), EC3 (European Council of Computing in Construction), and Robots in Architecture. Competency in digital construction, automation and robotics becomes a key for all stakeholders in the construction industry and many universities worldwide launch dedicated interdisciplinary programs. Powerful governments (China) and major funding programs such as Horizon Europe (Europe) massively request and fund the development of robotic solutions for construction such as drones, mobile robots, 3D-printing solutions, cable-driven robots, and exoskeletons. Regulators and standardisation organisation start to develop the first certification and standardisation schemes for construction robots and large software companies make attempts to allow to simulate and program robotic construction processes efficiently and robustly based on digital building and construction data.

To showcase the diversity of cutting-edge research in the area, this special issue invited eight extended versions of selected papers from the ISARC 2021 conference. As such, this issue covers digital approaches to embed fabrication and robot information in BIM and IFC and program robots directly from digital building models. New robot systems spur novel robotic production processes, and machine learning enable novel logistics approaches for building components that may ultimately lead to robotic cranes and other robotic on-site logistics and handling solutions (including

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autonomous construction machines). In parallel, systematic evaluation and robot development methods are developed that allow to shed light on their performance in the construction process.

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