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ROBOTS AND AUTOMATION

The Smart Machine Strategy and the future of concrete construction and repair

ROBOTICS AND AUTOMATION: THE FUTURE OF CONCRETE CONSTRUCTION AND REPAIR

Following the presentation of an overview of the UK Government's Smart Machine Strategy 2035 at the Evolving Concrete technical conference in June of this year, Steve Davies of Beton Bauen examines the strategy in greater detail, outlining its ambition to modernise construction through automation and advanced technologies. He goes on to cover issues facing the construction industry and how robotics might reshape the jobsite, as well as considering the topic of automation when concrete drilling, in particular.

If you stand on a construction site today, it probably looks and feels much like it did 40 or 50 years ago. Despite advances in design and digital co-ordination, on-site delivery remains heavily manual, high-risk and unpredictable.

Over the next ten years, the UK's construction sector faces a defining technological transformation. Traditional methods of building infrastructure – heavily reliant on manual labour, time-consuming manual measurements and repetitive physical tasks are increasingly unsustainable in an era defined by skilled labour shortages, tightening commercial margins and rising expectations for sustainable project delivery.

The introduction of new technologies by concrete specialists looks set to accelerate a transition toward smart, semi-autonomous robotics, specifically engineered to perform highly repetitive, physically taxing and hazardous tasks on active job sites.

BELOW:
Hilti Jaibot robotic drill.

(Photo: Hilti Canada)

> "The Robotics Adoption Programme is a £52 million initiative running from April 2026 to March 2030, backed by Innovate UK and the Department for Science, Innovation and Technology, providing regional hubs to help businesses trial and integrate automation."

ISSUES FACING OUR INDUSTRY

LOW PRODUCTIVITY

Global and UK construction productivity is low, driven by slow technology adoption, industry fragmentation and labour shortages. Research[1] shows global construction productivity grew by just 0.4% annually from 2000 to 2022, while UK output per operative hour sits approximately 13.5% behind the national economic average.

Core processes such as concrete drilling still rely on manual techniques similar to those used decades ago. The global construction sector also struggles with poor performance because it relies heavily on traditional methods and manual labour rather than automation. In the UK, the industry faces similar barriers, including a high reliance on subcontractors, increasing costs, decreasing profits, difficulties in measuring efficiency metrics and persistent skills gaps. These issues can lead to frequent project delays and higher costs.

LABOUR CRISIS

A skilled labour shortage is predicted to affect the UK construction sector, driven by an ageing workforce, post-Brexit immigration changes and high apprenticeship dropout rates. This gap delays infrastructure projects and increases building costs. The Construction Industry Training Board (CITB) estimates the industry needs an extra 41,200 operatives each year through to 2030, just to keep pace with demand. Meanwhile, 35% of the current workforce is over 50, while fewer than 19% are under 25. Approximately 750,000 operatives are expected to retire by 2036, taking vital knowledge with them. Post-Brexit losses have further reduced the pool of available EU tradespeople in core areas such as bricklaying and carpentry (see UKR Group[2] and Site Diary[3]).

Compounding these demographic challenges, training initiatives struggle to retain new talent. Industry figures show that construction apprenticeships suffer from a high drop-out rate of nearly 47%.

With demand growing for housing and green energy infrastructure, finding qualified carpenters, electricians and bricklayers remains a critical hurdle for the UK construction industry. A critical shortage of skilled labour to operate modern machinery is also required. Age, availability and fundamental

(Photo: Fischer Group.)

The KUKA Baubot has been trialled and deployed on-site in the UK by Taylor Woodrow.

skillsets are all expected to continually decline.

HEALTH, SAFETY AND ENVIRONMENT

Construction remains one of the most dangerous industries globally. Every construction project introduces a certain level of physical risk to on-site operatives. Protecting our workforce is not optional; it's a legal responsibility.

The industry faces specific critical health and safety challenges when it comes to concrete drilling, including chronic occupational illnesses – specifically respirable crystalline silica (RCS) dust, hand–arm vibration syndrome (HAVS), working at height and noise. In the UK, the Health and Safety Executive (HSE) enforces strict limits under the Control of Vibration and Noise at Work Regulations, targeting high-risk activities such as concrete drilling and breaking.

A MOVE TOWARD AUTONOMOUS ROBOTIC CONCRETE DRILLING

WHY IS CONCRETE DRILLING AN ENTRY POINT?

Historically, marking and drilling thousands of overhead or floor-level holes for mechanical, electrical and plumbing (MEP) supports required operatives to interpret 2D paper or digital drawings, climb ladders or scaffolding, mark co-ordinates manually and operate heavy rotary hammers for hours at a time. It is the same process for concrete repair and refurbishment projects, reinforcing bar and anchor installation, cathodic protection and chemical injection.

The workflow of modern robotic drilling begins firmly in the digital space via building information modelling (BIM). Engineers upload detailed CAD or Revit files containing exact co-ordinates, hole depths and diameters straight to a cloud environment.

Semi-autonomous robots drill directly into concrete material, using onboard lidar, cameras, collision-avoidance sensors and local positioning systems to navigate the terrain and orient themselves against the digital blueprint. Once aligned, a stabilised robotic arm or drilling mast executes the task with pinpoint accuracy, repeating the drilling process across massive commercial, residential and infrastructure projects.

Table 1 – Manual labour vs semi-autonomous drilling robot comparison[4].

Metric	Manual labour	Semi-autonomous overhead drilling robot
Speed	30–60 holes per day	Up to 300 holes per day
Operative strain	High risk of neck, shoulder and back injuries	Minimal physical strain; operator supervises
Dust exposure	Significant airborne dust created	Integrated dust removal system captures debris at the source
Precision	Reliant on human measurement; potential for error	Digitally mapped for precise, repeatable accuracy

(Photo: CSC Robotic Engineering Ltd.)

ABOVE:
The Drillcorpio D3 model offers automated drilling and anchor installation.

Drilling robotics have the potential to transform the concrete industry by increasing drilling speeds up to ten times, eliminating physical strain and hazardous silica dust, multiplying labour output and delivering 99.97% positional accuracy to eliminate performance variance.

PRODUCTIVITY BENEFITS OF SEMI-AUTONOMOUS ROBOTICS

There are several compelling operational and economic benefits underpinning the accelerated shift towards semi-autonomous concrete drilling:

- Enhanced productivity and speed – robotic systems operate at speeds significantly faster than manual counterparts, consistently executing serial drilling patterns without fatigue-induced slowdowns. Fleet-based deployment allows multiple units to work in parallel, drastically shortening structural fit-out timelines.
- Precision and quality control – human error in layout and measurement can lead to costly rework or structural misalignments. Autonomous drilling units reduce rework due to precision layout and QA automation. The robotics reference direct BIM data to ensure absolute dimensional consistency, eliminating deviations in hole depth, angle and placement. Built-in smart technology means every action

(Photo: Hilti Canada.)

ABOVE:
Hilti Jaibot robotic drill.

produces data and that data feeds improvement, enabling improved QA/QC traceability.

- Resource optimisation – robotic systems have no fatigue, minimal downtime, almost no variability in output and predictable execution rates, contractors can align schedules, material deliveries and subsequent trade works with high reliability. Enabling extended operating hours and a more predictable delivery can help minimise idle time on-site, in turn offering an immediate ROI on deployment. In theory, multiple robotic units can operate simultaneously under a single guidance station, significantly compressing massive project schedules.

HOW ROBOTICS COULD RESHAPE THE JOBSITE

The construction industry's contribution to the UK's GDP is significant, but declining productivity linked to labour shortages is a threat. A primary cause is the ageing workforce, with large numbers of experienced and skilled professionals heading into retirement. At the same time, attracting younger generations to the trade seems a constant battle. This gap puts a strain on every project, impacting timelines, increasing labour costs and challenging construction management to do more with less. Autonomous and semi-autonomous machines offer a solution, transferring operator skill to technology. From enhancing safety and productivity to reducing rework, autonomy is reshaping job sites and enabling contractors to do more with fewer resources. The robotic technologies we see today are not about replacement; they are about collaboration.

These machines are made to handle the most repetitive, physically demanding and often dangerous construction tasks. Onboard sensors and self-positioning arms handle complex operations, allowing general operatives to manage tasks requiring years of specialised training. By taking over strenuous, repetitive drilling, these robots prevent physical fatigue and reduce injuries. This allows a single operator to manage output equivalent to a multi-person crew, helping contractors maintain project timelines despite shrinking skilled labour pools, mitigating critical operative deficits across major infrastructure and housing targets.

Table 2 – Deployment of smart technology to concrete drilling projects.

Semi-autonomous robotic drilling: concrete solutions	Semi-autonomous robotic drilling: project scenarios
Floor-plan layout and marking	Highways and transport infrastructure (including bridges, overpasses and tunnels)
Anchor fixings and wall ties	Warehousing and storage facilities
Resin injection (water stopping)	Data centre construction
Epoxy application (structural)	Manufacturing, industrial and retail floor layout
Cathodic protection	Utilities infrastructure (including solar farms wind turbine fixings, conduit/utilidor, etc)
Drilled penetrations (cabling, utilities, etc)	Ceiling installation

Source: Beton Bauen.

ADOPTING SMART TECHNOLOGY

The UK *Smart Machines Strategy 2035*[5] is effectively a roadmap designed to bridge the gap between academic research in robotics and commercial industrial adoption. By boosting both supply and demand, it aims to scale the smart machine sector and increase UK gross value added from £6.4 billion to as much as £150 billion by 2035, driven by lowered operational costs, heightened productivity and the cultivation of advanced technical employment roles.

The wider adoption of smart technology within the UK construction sector aligns directly with macro-economic national objectives. Meeting the directives of the *Smart Machines Strategy* means moving past fragmented pilot projects into standardised, demand-led robotics solutions. The strategy aims to position the UK as a global leader in robotics and AI by driving technology adoption, boosting economic value and transforming labour-intensive sectors such as construction through automated precision and safety.

WHAT DRILLING ROBOTICS ARE AVAILABLE IN THE UK?

In today's market, semi-autonomous drilling robotics may seem a distant proposition. In reality, there are a small number of international manufacturers pioneering specialised robotic drilling machines that are currently available in the UK, either for outright purchase or for hire (listed alphabetically):

- KUKA Baubot – owned by the Fischer Group (Austria), the Baubot uses robust industrial mechanics such as articulated robotic arms mounted on versatile tracked mobile robotic systems to perform multi-faceted, heavy-duty on-site tasks, including autonomous drilling, milling and fastening across civil engineering and infrastructure markets. General availability in the UK is reported as being imminent,

(Photo: Fischer Group.)

although the Baubot has been trialled and deployed for on-site civil engineering work in Newcastle by Taylor Woodrow.

- Drillcorpio (Model Df & D3) – CSC Robotic Engineering machines are available to purchase or hire in the UK. Self-navigating systems, such as the Drillcorpio series, integrate with BIM files and advanced alignment technologies to execute semi-automated drilling and anchoring, with significant dust-control systems.
- Hilti Jaibot – a semi-autonomous, cordless mobile ceiling-drilling robot designed specifically for MEP serial overhead applications, complete with integrated dust control and total station navigation. Hilti does not offer the Jaibot drilling robot through standard short-term tool hire depots at this time. Instead, it can be acquired via enterprise consultation, project-based specialist robotics channels or long-term fleet management agreements.

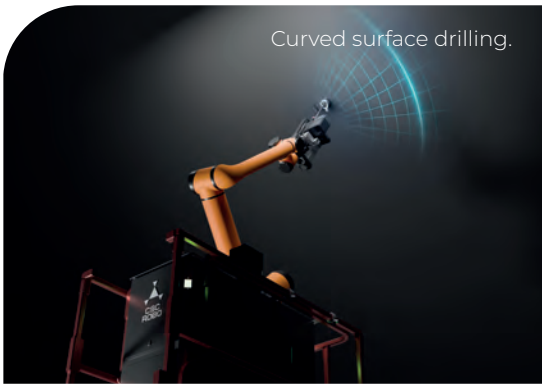
KEY FUNDING CHANNELS

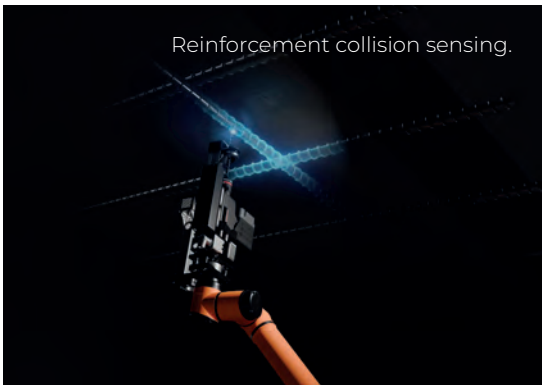
There is already financial support for the UK construction industry to adopt smart technology and autonomous robotic drilling:

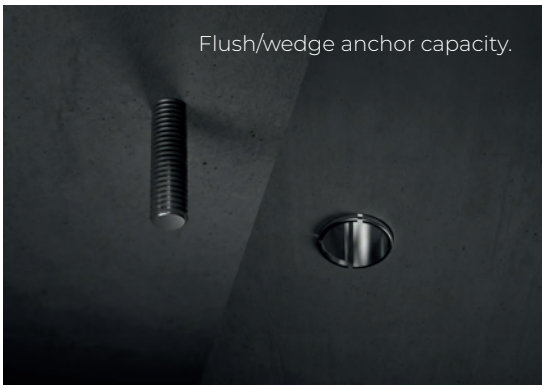
- Robotics adoption programme[6] – a £52 million initiative running from April 2026 to March 2030, backed by Innovate UK and the Department for Science, Innovation and Technology, providing regional hubs to help businesses trial and integrate automation.
- Innovate UK competitions[7] – targeted grants for late-stage R&D and industry-ready automation, supporting deployment of intelligent machinery such as autonomous drilling rigs.
- R&D and business growth support[8] – expanded British Business Bank investment supporting growth and digital transformation across industrial strategy sectors. C

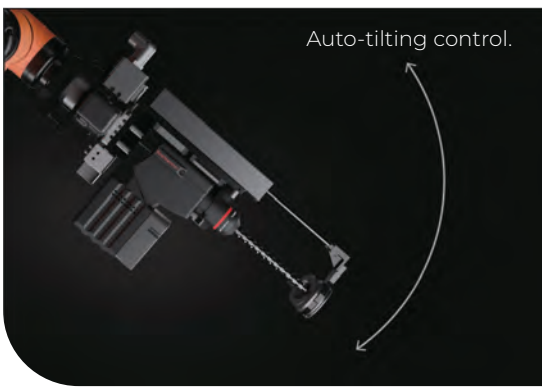
ABOVE:
The KUKA Baubot.

RIGHT:
Common features of semi-autonomous robotic drilling machines, in this case the Drillcorpio Model D3.









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Further information:

Beton Bauen and the Concrete Society are hosting a Lunch & Learn for Society members – 'Robotics and Automation: The Future of Concrete Construction' – on 21 October. Visit: *https://tinyurl.com/3x5yte5t*.