

Background



Robotics and Automation

Problem Statement																																																																																																																																																																											
Everyday use of robotics and automation within the construction industry is of great appeal to i3P members due to the expected improvements in productivity and quality that can be achieved in the automated technology. Many types of autonomous systems and the benefits they would bring to the construction sector have not yet been fully explored. This discovery poster is intended to clarify what technology is available, the benefits it could bring and the barriers to its adoption.																																																																																																																																																																											
Observations																																																																																																																																																																											
<ul style="list-style-type: none"> Obstacles such as task complexity and challenging working environments are some of the reasons that make automatic construction methods difficult both on & off-site. Although automation is difficult there are many gains for automating these tasks with already proven methods. Currently the construction industry is facing many challenges; the result of legacy working practices. Being an industry which strives to improve on health and safety, reduce project risk and increase productivity, automation can improve on: <ul style="list-style-type: none"> Risk first time Reliance on skilled labor Product quality Health & safety Waste reduction There is a desire in the industry to automate dirty, dangerous or dull tasks either through direct or remotely operated automation. There were a reported 196 fatalities within the UK construction industry between 2012/13-2016/17 that were reported under RIDDOR. Additionally, the UK Labour force survey shows 64,000 non-fatal injuries to workers each year within the UK construction sector. Automation has the potential benefits of reducing fatalities and injury to workers, if implemented correctly. Automation offers the ability to operate outside of shift hours and is not reliant on human operators. Currently (as of 2011 census) 32.1% of the employees in UK construction are over 50 years old with an aging population bringing fewer young people into the construction industry. In other industries the adoption of automation and robotics had reduced operating costs and increased efficiency and productivity. 																																																																																																																																																																											
i3P Survey: Current Uses of Automation Technology																																																																																																																																																																											
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<p>The main drivers for the current use of automation technologies by i3P members in the construction industry:</p> <ul style="list-style-type: none"> Productivity (29%) Health and safety (23%) Economic (19%) Quality (11%) Accessibility to challenging environments (9%) Combating skilled labour shortage (3%) Marketing of cutting edge technology (2%) Waste reduction including CO2 emissions (2%) Improved lead times (1%) Operation risk (1%) <p>A drone in operation at a construction site. Source: DroneDeploy</p> <p>An image taken by drone of a tower block in construction. Source: Pexels</p> <p>Most commonly, drones carry high resolution cameras for inspection purposes, however more specialised systems can also be used. Drones are commonly implemented at the initial planning stage of a project. Images and data collected is used for engaging key stakeholders and to support planning permission applications. Throughout the project they are often used to track progress and monitor planning applications. Once construction is complete, drones are often used to inspect structures that are difficult to access or present high risk to employees, such as tall buildings, tunnels and hazardous environments.</p> <p>The uptake in drone use has been helped by the relatively low operating cost and initial investment, which has made drones more accessible to the industry. There are some restrictions regarding no-fly zones and data collection, however these are not extensive and the European Aviation Safety Agency is developing EU-wide safety standards. The UK Department for Transport are looking to act on EASA's consultation on drone to improve and enforce safety standards. Overall drones are a tool that is used for planning, design, construction and maintenance across the construction sector.</p>																																																																																																																																																																											
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<p>Installing new underground track and services into tunnels below London streets is an immensely challenging task. Tracks must be laid down, embedded into concrete and services including; power, signalling and emergency walk ways must be installed. This process has been largely automated through multiple automated systems:</p> <p>Gantry system for placing rails</p> <p>This is a track-mounted linear production line that was used for one purpose: mixing and delivery of concrete material. Dry material is loaded into the 405 metre long vehicle and the mixing and batching is done on the move. This allows peak production of 300 metres of high-quality concrete slabs per day.</p> <p>Automated drilling rig</p> <p>Installation of services requires the drilling and mounting of services onto the tunnel walls. The automated drilling rig designed for the Crossrail project uses a laser tracker to collect 3D data of the tunnel sections. This data is used to identify the locations of the services. Once again the system drills holes through the soil to an array of electric drills and hydraulics. The holes of the drilled holes are stored and can then be referenced when installing the services. This system comprises of off the shelf technology (drills, hydraulics, rail and chassis) and intelligent automation (sensors and processing of data) to create a complex hard automated system that is mobile and capable of drilling 200m of tunnel per shift. In addition to increased productivity, this system removes workers from the risk of vibrations from using conventional hand tools.</p> <p>All of the systems above are designed to do one set of tasks in a very specific environment. For the 57km of track laid and the 250,000 drilled holes this investment in bespoke automation was deemed cost efficient to invest in due to the improvements offered in increased productivity and improved health and safety for workers.</p> <p>Case Study: Demolition Robotics</p> <p>Demolition of structures present a number of risks to workers that includes; crushing, entrapment, inhalation of dust, possible exposure to carcinogenic asbestos particles and, in the case of decommissioning of nuclear power stations, ionising radiation. These high risk areas present hazards to human operators and, where it is possible to mitigate the risk, the cost of demolishing a structure safely can be extensive.</p> <p>This drive to improve safety of workers and reduce cost has resulted in the development and uptake of demolition robotics. These systems are remote tele-operated hydraulic robots mounted on a mobile platform. These can be fitted with a variety of tooling such as: breakers, concrete crushers, grapples, grapples and steel shear.</p> <p>These machines allow workers to perform their tasks by distancing or removing them entirely from the hazards of the demolition process and by not having to use construction tools themselves.</p> <p>This machinery can be purchased or rented like other construction machinery on the commercial market.</p>																																																																																																																																																																											
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