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LEARN HOW CONSTRUCTION AUTOMATION PLAYS A KEY ROLE IN THE INDUSTRY'S DIGITAL TRANSFORMATION AND IN SOLVING THE GLOBAL HOUSING CRISIS.

While development and adoption of automation technologies has evolved more slowly in construction than in manufacturing

simply, automated construction has the potential to enable the industry to safely meet the global building and infrastructure needs of an increasing population. New technological developments and industry trends signal that now is the time for automation to take hold, productivity, and worker health and safety, as well as

What Is Construction Automation?

The term construction automation captures the processes, tools, and equipment that use digital technologies to build buildings and infrastructure. This includes the use of automation in construction (en-UIBDsdi0 315005bc0 1 T



compensating for labor shortages, reducing environmental impacts, creating new design opportunities, and so on. Put

aspects of off-site and on-site construction, and ending by sharing collected data on the systems and energy use of

Several core development strategies are needed to realize this integrated feedback loop, both in software and hardware. For example, collaborative robotics; industrialized construction strategies; new types of robots and automated machines; and real-time in-situ sensing, feedback, and adaptation are among the technologies and strategies that are converging to make automation in construction a widespread reality.

strategic deployment of materials, processes, and systems within the construction processes in ways that take cues from manufacturing. Industrialized construction is not synonymous with construction automation, but the two are fundamentally linked as the increased adoption of automated tools is enabling industrialized-construction strategies to have a radical impact on the way construction happens. Currently, the term industrialized construction mostly involves off-site construction, where the application of manufacturing techniques to the built environment is more widely spread.

Industrialized-construction processes produce elements of buildings and infrastructure, from single parts to components or entire assemblies, using technologies and strategies typically reserved for manufacturing processes. In the case of volumetric industrialized construction, complete volumetric

job. In some cases, existing equipment, such as heavy earth-

host the 3D-printed habitat challenge, focusing on 3D printing

self-driving trucks and other vehicles to work on its iron-ore mining operations. Although it's not yet a construction application, this example portends what's on the horizon for construction. Rio Tinto's driverless vehicles keep their remote

Boston Dynamics has commercialized a robotic platform for a variety of construction scenarios, including as-built laser scanning for inspection and construction scheduling. Its Spot autonomous quadruped can easily navigate a construction site every night with a Lidar scanning attachment to collect rich,

The future is bright for automation on the construction site as new typologies, technologies, and attitudes emerge. Even as more on-site equipment becomes automated, skilled labor is necessary to ensure things run smoothly, and new staging and sequencing strategies must take robots into account.

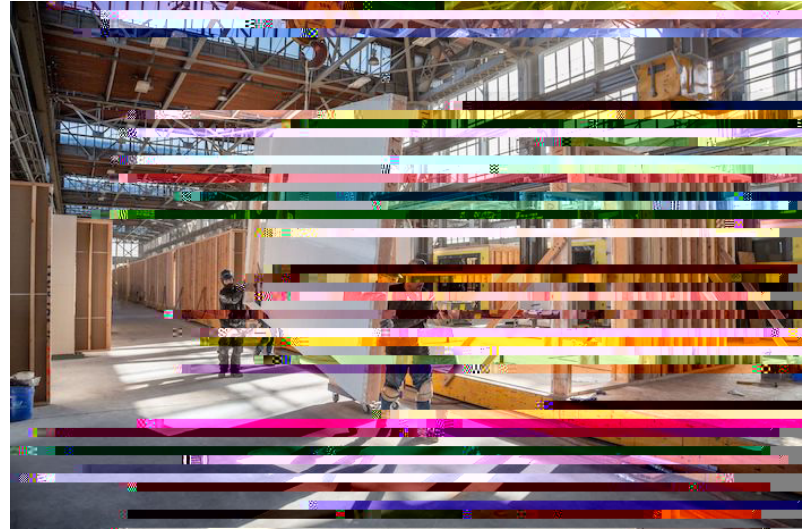
Examples of Construction Automation

HOWICK

Headquartered in New Zealand, Howick has been building high-tech machinery for more than 40 years and is currently specializing in precision steel roll-forming machines that produce framing for construction. In a recent project, Windover Construction's Virtual Design & Construction team used a Howick X-Tenda 3600 telescopic steel-framing machine to fabricate 935 predrilled, pre-labeled roof trusses in 15 hours for the Cape Ann YMCA in Gloucester, MA. Then, with the help of Fologram's mixed-reality (MR) technology, which applies using connected 3D-model data, Windover assembled the trusses in three days with just one person working at a time, shasnBDC BT13.1 (omcX 1 T1) dingindoosts bomcX 1y c BT1 half.

Howick's machines simplify assembly by Cutomating the production of complex roll-form parts oBT1 of a coil of steel

and providing detailed assembly instructions within the parts. Howick and Virginia Tech's Center for Design Research are deploying this ngindoe areas of Zambia to reduce the production miahBof community medical clinics in from six months to six weeks.



FACTORY_OS

JU`Y`cZ75` VUgYX` : UMcfnSCG`YI Ya d`] Yg`]bXi g`fU`]nYX` V`b`g`f`i` V`]`c`b` V`m`V`i`]`X`]`b`[` `a`i` `h`]`Z`J`a`]`m`U`d`U`f`h`a` Y`b`h`V`i`]`X`]`b`[` g` a`i` V`:`c`Z`h`Y`a` `X`Y`g`]`[` b`U`H`X` `U`g` `U`Z`c`f`X`U`V` `c`f` `U`g`g`]`h`j` `Y` `c`i` g`]`b`[` k`]`h` `a` U`i`]`a`i` a` `Y`Z` V`Y`b`V`h`]`b` `U`g`a` U`f`h`Z`U`M`c`f`m`g`Y`h`]`b`[` "H`Y` company is constructing units on a 33-station assembly line. By leaning on proven manufacturing technology Cand onstruction d`f`c`W`g`g`Y`g`z` : UMcfnSCG`V`U`b` `V`i`]`X`]`b`[` [`!`e`i` U`]`m`a` c`X`i` `U`f` `c`a` Y`g` faster, at a lower cost, aandwith less waste than mraditional on-site construction.

5`h`U`a` `Z`f`c`a` `5`i` h`c`X`Y`g`_`F`Y`g`Y`U`F`W` `]`g`k` c`f`_`]`b`[` `k`]`h` `: UMcfnSCG` on an ambitious projngindoo make the production of affordable, g`j`g`U`]`b`U`V` `Y` `c`i` g`]`b`[` `U`g` `Y`Z` V`Y`b`h`U`g` `d`c`g`g`]`V` `Y` `V`m`]`a` d`f`c`j`]`b`[` `h`Y` company's connection from design to fabrication to assembly, aandultimately, to building operations.

: UMcfnSCG`i` g`Y`g`E`F` `V`e`X`Y`g` `h`c` `f`U`W`_`U` `d`U`f`h`g` `U`b`X` `U`g`g`Y`a` V`]`Y`g`z` so when parts for a walld ome off a saw, they're allIdindexed U`b`X` `f`U`W`Y`X`" `H` `U`h`g` `U` `d`U`f`h`c`Z`h`Y` `a` `U`b`i` Z`U`M` `f`]`b`[` `]`b` `i` `Y`b`W`:` repeatability, quality, taking the variability out. If you need 10 of those walls, the automated saw cuts 10 kits; a mobile robotic platform can deliver the kits to a framing station.

K`Y` `U`F`Y` `k` `c`f`_`]`b`[` `h`c` `X`Y`a` `c`b`g`f`U`H` `U`X`]`[`]`h`U` `V`e`b`b`Y`M`]`c`b` `h`c` : UMcfnS

5`fYUXm\UzcZH`Y`[YbYfU` \wbhU`Mfcg`Zfca` h`Y`5; 7#5i hcXYg` survey reported being engaged with career-building programs.

In addition, universities are responding to the emerging opportunities for new career paths related to automation. Schools such as ETH Zurich, University of Pennsylvania, Carnegie Mellon, and others have created specialized undergraduate and graduate programs focusing on the automated future of the construction industry.

INCREASED SAFETY

The construction industry is known as one of the more dangerous industries for workers. In 2019, 1.7% of American construction workers missed work due to injury, according to the U.S. Bureau of Labor Statistics, and about 20% of all American worker fatalities were in construction, according to the Occupational Safety and Health Administration (OSHA).

By automating more construction processes and tasks with off-site industrialized construction, drones, autonomous robots, and more, the industry can protect more people from the risks that cause most construction injuries and fatalities, such as falls and collisions with objects. Robots can also handle larger and heavier loads and work in spaces that are unsafe for people.

Automation and industrialized construction can bring more construction processes into controlled environments, with less risk to human safety. There are factories in Sacramento, CA, that

system that gets smarter as it is constantly refreshed, resulting in both the human knowledge and machine knowledge getting richer and each project going better.



INCREASED PREDICTABILITY AND BETTER QUALITY

Standard construction processes for inspection and permitting. A manufacturer proves that it can build something repeatedly at a certain predictable level of quality, it receives a United Laboratories (UL) Listing, which is an inspection approval. The more the construction industry adopts automation and industrialized construction, the more it can cut down on the inspection process while relying on repeatable, predictable quality building components.

On-site who work for the county but who stay at the factory for when they're needed. They inspect all of the processes that

SCALABILITY

Industrialized construction makes large-scale projects easier when components are standardized. If a building needs, for example, 2,000 plumbing walls or a large number of bathroom pods, an off-site manufacturer can prefabricate those components in advance, store them, and deliver them to the site exactly when they're needed. Not having to wait for the materials, supplies, and labor to source components allows

large projects to proceed on schedule. And if those components are standardized (with degrees of customizability), a building

What Is the Future of Construction Automation?

As the manufacturing sector has shown, once automation reaches a threshold of adoption, there's a point of no return when businesses of a certain size must implement automation to stay competitive. ABB Robotics's global survey found that only 55% of construction companies use robotics as of 2017. However, stated interest in implementing construction automation, the skills shortage, and the push to improve sustainability in construction, heavy adoption of automation and robotics will likely become the norm in construction before too long. But how will that adoption look?

For one thing, construction automation will continue to adapt manufacturing technologies for shaping the built environment. Autodesk's affordable, sustainable housing project with technologies for producing volumetric modular construction. The Autodesk Technology Centers are also involved with several other companies working in construction-automation innovation lab to deploy more automation technologies into its factory.

Shimizu's latest deployed robot, the Robo-Buddy Floor, is an industrial robotic system that assists craftspeople with Smart Site is a three-robot team where one robot takes materials, such as drywall, to a robotic elevator that moves things up to a third robot that unloads the elevator. If you squint your eyes, that's an automated manufacturing facility. It just happens to go vertically as well as horizontally. Shimizu's system essentially views the entire building site as a factory. It has different interconnected robotic technologies that treat construction as a system of interconnected rather than distinct trades.

Construction automation is starting to move in a direction like distributed manufacturing, where sophisticated automation

aids on-site assembly like Shimizu's Smart Site with ever-improving modular, prefabricated industrialized construction. Industrialized construction plays a role in potential for automation to improve the way things are built.

5. The same problems as in the building industry. Automation has been the way the manufacturing industry has solved, or is attempting to solve, all of those things. Now, construction automation is poised to tackle the mounting challenges in developing the built environment.

It's clear that during the past 50 years, construction automation solve some of the problems plaguing the current construction industry. It will help address the skilled-labor gap by attracting

younger workers who are excited by advanced technology. It can help make jobsites safer for all workers and increase insight and analysis through data collection. And perhaps most importantly, it can help tackle the housing crisis. Construction has been notoriously environmentally unfriendly, and with the global population on the rise, designing and building technologies, off-site modular construction, robotics, and for many generations to come. 