Development of Robotics in Construction industry

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The construction industry is one of the most labour-intensive industries in the world. Yet, due to a continuing labor shortage (and right now, social distancing), the industry has needed to adapt to a lack of people who can do this labour. Adapting has always been one of the industry's strongest skills, and with technology advancements occurring every day, a new solution has developed: construction robots. History has shown that innovative new technologies are key contributors to improving productivity, quality and ensuring safety in construction. The purpose of this paper is to present the research information on the new emerging technology called robotics. This paper on robotics first involves that the robotics will be utilized in the upstream industries, either in component manufacture or in construction process capable of being undertaken in a traditional factory setting. This paper studies about the basic construction activities, research and development, social implications, automation technologies, construction robots economic feasibility and robots productivity.

Key words: Robotics, construction industry, labor intensive industry, Engineering Technology

Introduction:

Robots are used in several industries .Application of robots in the construction industry for performing various tasks is growing. Basic activities in building construction and civil engineering projects are: positioning, connecting, finishing, coating, concreting, building, inlaying, covering, tunnelling, inspecting and repairing elements. Many construction companies use this application in construction projects.If robotics aims to replace men with machines, then the construction industry is a vast field for the development of its applications. One of its chief characteristics is enormous labor costs, which account for almost 50% of the total, though these are considerable variations depending on the type of project and work involved.

Objectives:

1. With the goal of automating processes and increasing productivity, robotics are being used to get work done quicker, cheaper and with more precise.
2. The main objective of robotics in construction is enhancing productivity and work efficiency with reduced costs.
3. To provide solid quality with higher accuracy than that provided by skilled workers.

Robots on the building site:

When considering using robots for construction, the building site has to be characterized as this is a production site par excellence. Building sites are hostile in that they are replete with obstacles, uneven surfaces and ladders etc. The task involved in this are complex, therefore the use of robots in building site would enhance the productivity of the work and the safety of workers. Construction robots are a subset of industrial robots used for building and infrastructure construction at site. These robots have able to move and fix itself to working zone, handle construction materials and interact with humans and other machineries.

Construction robots have been tested to carry out the building walls, monitor the construction progress and are used to inspect and investigate the infrastructures, mainly in dangerous locations. Currently most of the activities are in research level while some real world application has been done such as dam construction in Japan.Robotic automation offers huge potential to enhance productivity and manufacturing flexibility throughout the construction industry, including automating the fabrication of modular homes and building components off-site, robotic welding and material handling on building sites and robot 3D printing houses.

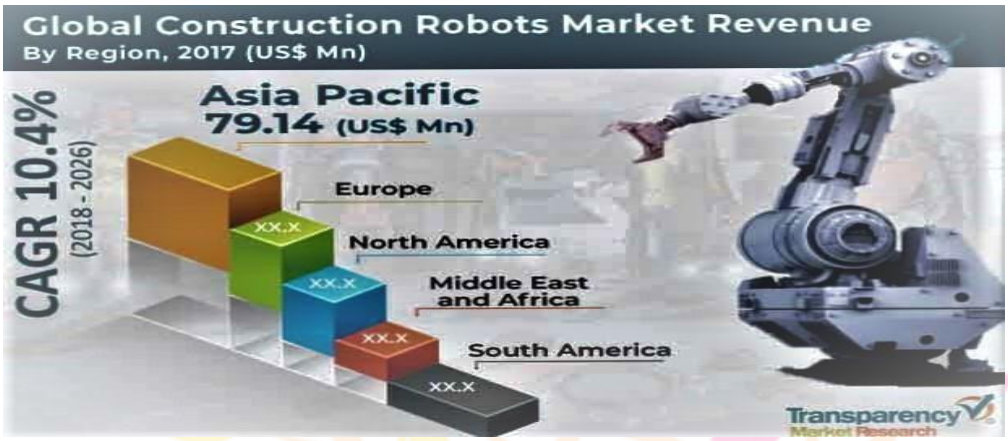

Figure1: Global construction Robots market revenue

Automated construction:

Robots are primed to revolutionize the construction industry. The study claims that about 49%of all construction jobs can be automated, which would save time and money. Specifically a report found that there is an automation potential of about 50% of carpenter jobs, 42% of electricians, 50% of plumbers and 88% of operating engineers.

Social implications:

The objective need for any technology change, which may contribute towards the advancement of the building sector in terms of work productivity and quality. This trend of productivity and quality decline in building attributed by various sources to the aging of construction workers, decline the traditional working skills, and tendency of youth to move to more challenging and more convenient tasks.Displaced workers are given preferential treatment in the type of work.A changing to a new technology requires planning, education, participation, communication and feedback. The automation of construction works will require some changes in the composition of labor force involved in them.Workers in charge of robotized construction tasks must be able to tech the robots, start them, monitor their work, and cope the malfunctions of the robot and its material system. The robotization process in construction will certainly be slow, gradual, and unconfined, at least initially to large and well adaptable projects.

Economic feasibility:

Figure2. Smart construction

As mentioned earlier, robots can play a vital role in reducing the overall cost of the construction process. The feasibility is examined using the value estimation method. It compares the purchase price of robots with the value of the robot to the user and the use of labor costs operation, maintenance and other expenses. The use of robots will be profitable under the following circumstances,

- ✓ In task hazardous to human health and safety.
- ✓ In tasks where the precision of work is associated with the economic gains.
- ✓ Under circumstances which adversely affects the productivity of human labor.

The minimization of project delays in conjugation with the lower amount of time will be required for the completion of a task that can limit the expenses. This can eventually lead to more affordable housing options.

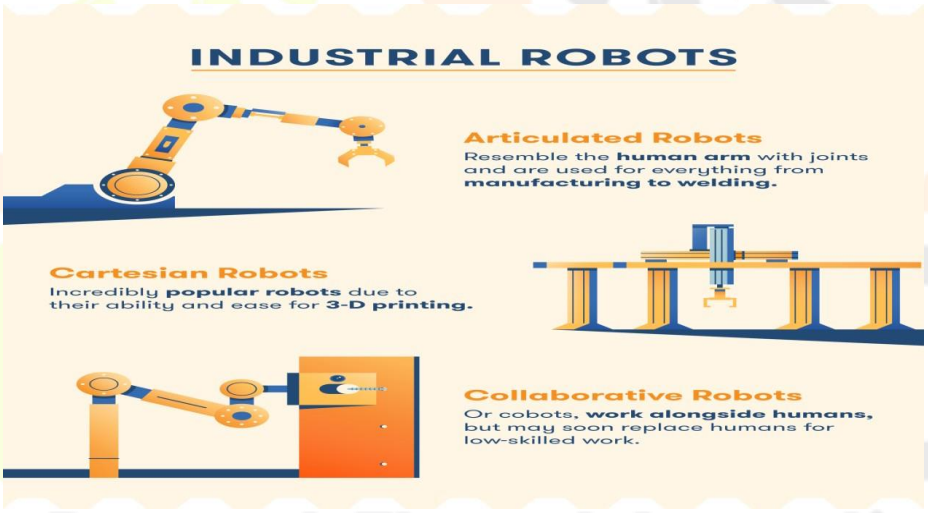

Figure3. Industrial Robots

Robotic improve construction safety:

Construction is an inherently a dangerous job. Robots can improve the work safety in construction environments by taking over some of the most dangerous tasks and allowing human to complete more cognitive tasks.

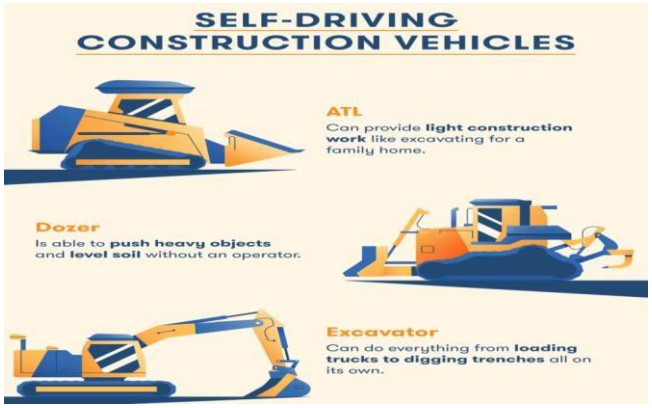

Figure 4. Self Driving Construction vehicles

Robotic applications in construction industry:

- ✓ Currently construction processes are heavily reliant on manual processes, but there are number of exciting new application just around the corner. For example a multipurpose drone flies over the construction site, monitoring deliveries, inventory and overall progress. Additionally a drone creates a 3D map of construction site, which it then feeds to an unmanned bulldozer – the information is used to direct the bulldozer without the need for a driver.
- ✓ Another example is the combination of a 3D printer with a robotic arm. The robotic arm controls the motion of the 3D printer, allowing it to create large structures at once.
- ✓ In offshore construction industry robots are used as remote – operated aerial drones and as under water vehicles, they are also used in drilling and underwater welding.

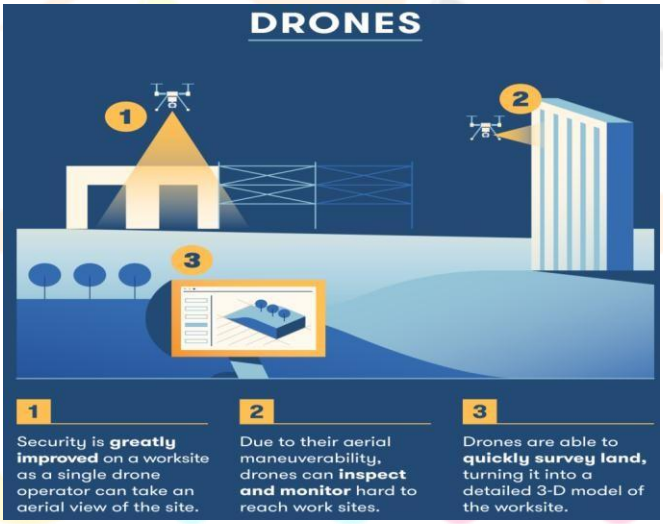

Figure 5. Applications of Drones

Types of Construction Robots

There are a few different types of construction robots that are poised to break into the construction market at a mass scale. First is a 3D-printing robot that can build large buildings on demand. A mobile robotic arm controls a 3D-printer, and with a set of preprogrammed instructions, this system 3D prints an entire structurally-safe building.

This technology is also beginning to be used for building bridges, with the first ever 3D printed bridge recently being built in the Netherlands. This combination of 3D printing and industrial robots is some of the most promising automation technology in the construction industry.

There are also construction robots for brick-laying and masonry, and even robots that lay an entire street at one time. These types of robots dramatically improve the speed and quality of construction work.

Demolition robots are another type of construction robot that's about to break into mainstream applications. While they're slower than demolition crews, they're far safer and cheaper when it comes to demolishing concrete and structural components of a building at the end of its lifecycle.

There are several other types of construction robots, such as remote controlled or autonomous vehicles, but the few mentioned above are the most prepared to function in a current construction site and may be the most impactful.

As a highly unautomated industry, construction robots will have a major impact on the construction industry. As construction companies look to automate more and more tasks for the sake of efficiency and productivity, demand for construction robots will grow steadily.

To learn more about trends in the robotics industry, browse our Robotics Industry Insights section to learn about the latest developments in robotic technology.

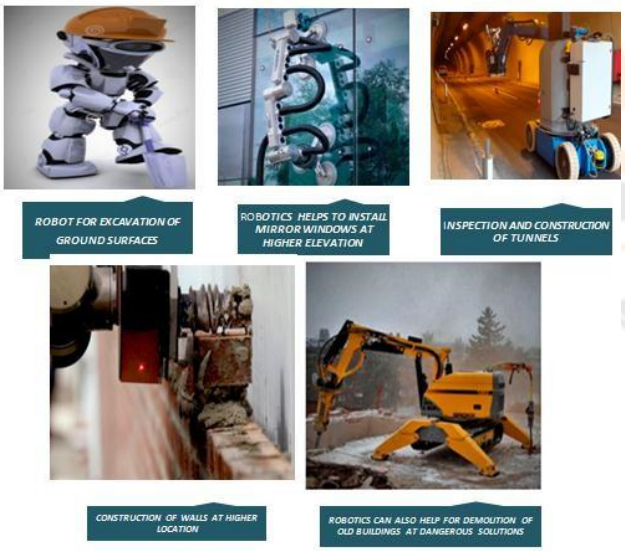

Figure 6. Robotics In Construction Industry

Advantages of using robots in construction:

Robots and construction-automated systems are complex, not only in design but also in operation. However, they present the following advantages

a) improvement in work quality
b) reduction of labour costs
c) savings accrued on safety and health improvements
d) time saving
e) improvement in productivity.

Disadvantages of using robots in construction:

Robots and construction automation were born from robots of the manufacturing industry. Therefore, many problems faced by industrial robots are similar to robots in the construction industry. Problems valid include among others

a) robot mobility
b) weight and seize of robots
c) robot accuracy

d) robot operation

e) external factors such as dispersion of projects, lack of repetition, dependability among workers, negative attitudes to change, fragmentation of the construction industry, and instability of the
market

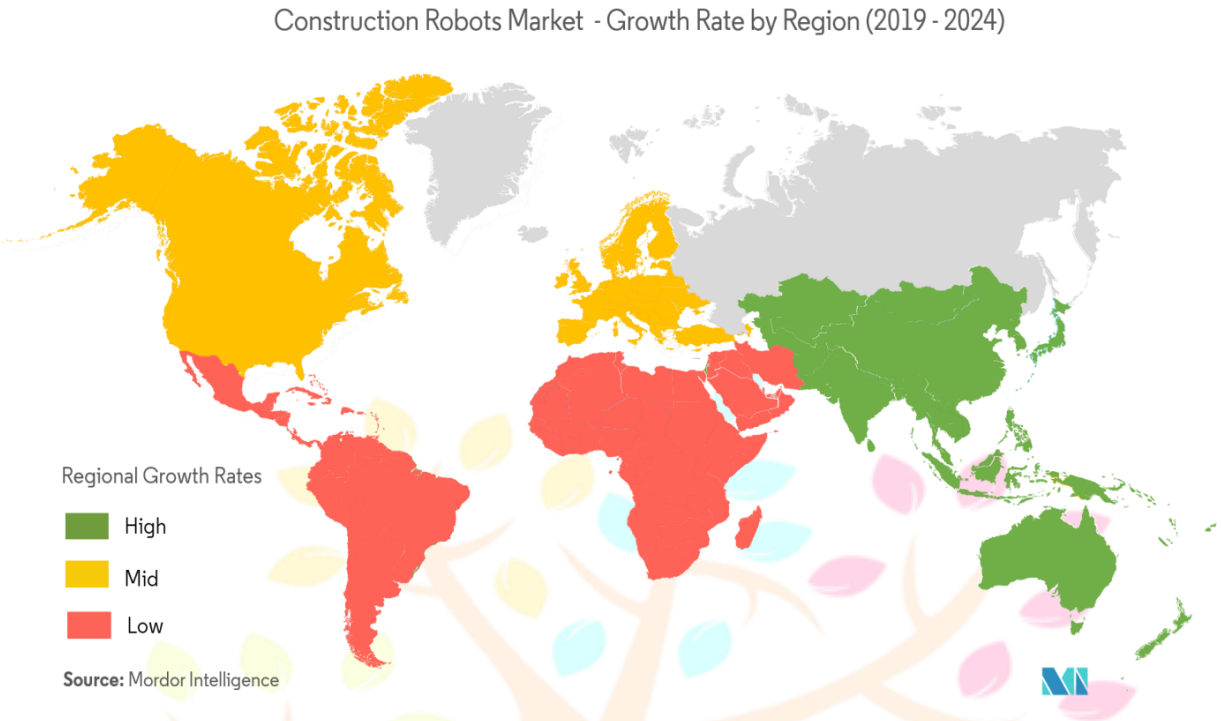

Figure 7. Construction Robots Market Growth rate by region (2019-24)

Conclusion:

Construction is ready for automation. Productivity needs to be enhanced and labor shortages need to be addressed. Robots and advanced automation system holds the key to solving problems, while at the same time making construction a safer industry.Productivity and quality in single -tasks robots has successfully being achieved when a specific work is repetitive. However, due to limitations of robots and the complex environment where construction industry is developed, additional work force is still necessary reducing productivity. Once the automated building construction system be refined and used more repeatedly, it is expected a reduction in construction time and costs. Architects and design engineers should address their efforts in designing structures and materials adaptable to the limited capabilities of robots and automated construction systems.Cheap labour is an impediment tosignificant change in current construction processes, and to the large-scale introduction of roboticsin this industry. While research continues in this area, implementation will increase in fields where productivity gains outweigh the equipment and implementation costs.

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