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# MAN news

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IN FOCUS

## Latest Trends and Technologies in Construction

# Latest Trends & Technologies in Construction

**The pace of digitalization and the use of innovative methodologies is accelerating. Digitalization has already transformed many industries and now there are significant developments revolutionizing construction. Many technological advances and other innovative methodologies have the potential to substantially change the way owners, designers, construction managers, and contractors perform their work.**

Once these changes are more widely adopted in construction, productivity will increase, cost and duration will decrease, harm to the environment will decrease, and site safety will improve.

There are many advances reshaping the construction industry that are grouped into the following categories:

- Sustainability
- Lean construction
- Digital collaboration and mobility
- Modular offsite construction
- Building Information Modeling (BIM)
- High definition surveying and geospatial technology
- IoT, RFID and advanced analytics
- City Information Modeling (CIM)
- Drones
- Robotics and autonomous equipment
- Wearable technology

# 1. SUSTAINABILITY

The common objective of green buildings and sustainability options in the construction industry is to reduce the overall impact of the built environment, human health, and the natural environment. In MAN News Issue 9 in June 2016, green building was addressed. However, there is another green revolution in public works which has started to take shape. A few of the latest trends that will reshape roadways and hardscapes are:

## Energy Producing Roads and Hardscapes

These roadways and hardscapes aim to replace standard asphalt roads, parking spaces, pavements, and bike paths with advanced solar panels that generate clean and renewable power. They could also blend into local energy systems, capture the heat from the sun in summer, store it for several months, and release it when needed.

## Recycled Roads

Made of recycled plastic waste.

## Reflective Mixes that Reduce Lighting Expenditure

With the right lighting system in place, roads would reflect light, look more appealing and lower the public lighting costs by up to 40%.

ENERGY PRODUCING ROAD

ENERGY PRODUCING ROAD

RECYCLED ROAD

# 2. LEAN CONSTRUCTION

We have tackled this topic in the previous ninth issue and have presented how we are adopting the Lean principles in MAN Enterprise. We will only briefly reintroduce Lean Construction in this article.

Lean construction is concerned with the alignment and holistic pursuit of concurrent and continuous improvements in all dimensions of the built and natural environment: design, construction, activation, maintenance, salvaging, and recycling. This approach aims to manage and improve construction processes with minimal cost and maximum value by considering customer needs.


THE 8 WASTES

Studies conducted on multiple construction projects in the USA have revealed the following:

- 50% of all construction projects run behind schedule
- The biggest cost impacting construction is that of inefficiencies built into the way projects are run and managed

Getting work to flow efficiently and predictably on a construction site requires the impeccable alignment of the entire supply chain responsible for constructed facilities such that value is maximized and waste is minimized.

With such a broad scope, tools found in lean manufacturing and lean production, as practiced by Toyota and others, have been adapted to be used in the fulfillment of lean construction principles.

The three unique tools and methods that were specifically conceived for lean construction are:

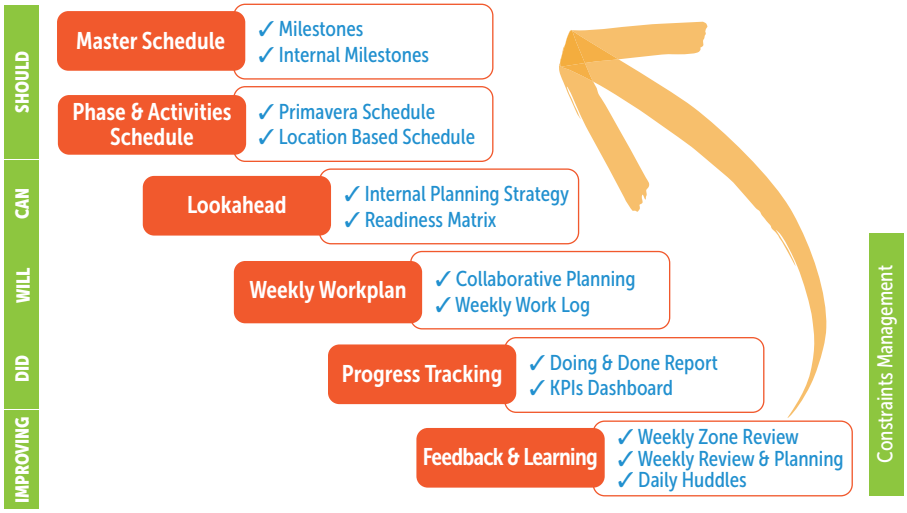
- The Last Planner System
- The Target Value Design
- The Lean Project Delivery System

If the tool, method, or technique would assist in fulfilling the aims of lean construction, it is also considered a part of the toolkit available for use.

The application of lean construction has proven to have the following positive impacts:

- Reducing waste
- Creating stable schedules
- Reducing cost
- Improving quality
- Promoting employee participation which leads to improved satisfaction
- Improving customer satisfaction


**LEAN CONSTRUCTION TARGETS**




**THE LAST PLANNER SYSTEM**

## 3. DIGITAL COLLABORATION AND MOBILITY

Process digitization means moving away from paper and toward the web and real time sharing of information. Replacing the paper process with digitization enhances and speeds up information sharing and collaboration and makes information more accurate. Digitization of project information is intended to improve design management, project scheduling, materials management, crew tracking, quality control, cost control, safety control, contract management, performance management and document management, in addition to helping in the timely consolidation of multiple project information.

There are already many digital collaboration solutions available, and this field is continuously evolving and improving at a fast rate.

# 4. MODULAR OFFSITE CONSTRUCTION

Modular offsite construction is a process in which a building or parts of a building are constructed offsite, under controlled plant conditions, using the same materials and design to the same codes and standards as conventionally built facilities but in up to half the time. Buildings are produced in modules that when put together onsite, reflect the identical design intent and specifications of the most sophisticated site-built facility without compromise.

The key benefits of modular buildings and modular offsite construction are the following:

## 4.1 Greener

Greater Flexibility and Reuse: Modular buildings can be disassembled and the modules relocated or refurbished for new use, reducing the demand for raw materials and minimizing the amount of energy expended to create a building to meet the new need.

Less Material Waste: When building in a factory, waste is eliminated by recycling materials, controlling inventory, and better maintaining building materials.

Improved Air Quality: When building in a factory, improved air quality is achieved.

## 4.2 Faster construction process and ROI

Reduced Construction Schedule: Because construction of modular buildings can occur simultaneously with enabling and foundation works, projects can be completed 30% to 50% sooner than traditional construction.

Elimination of Weather Delays: 60 - 90% of the construction is completed inside a factory, which mitigates the risk of weather delays. Buildings are occupied sooner, creating a faster return on investment.

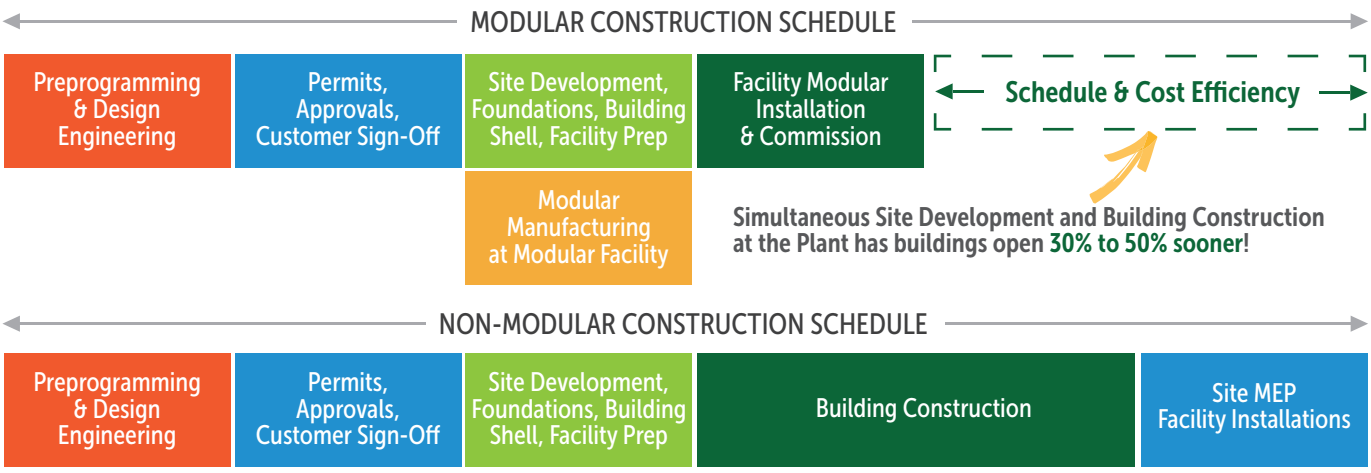
MODULAR BUILDING

## 4.3 Improved quality

Building the major components in a factory, in a very well controlled environment and where materials are well maintained, results in improved quality.

## 4.4 Safer

The indoor construction environment reduces the risks of accidents and related liabilities for workers.




MODULAR VS. NON-MODULAR SCHEDULE

# 5. BUILDING INFORMATION MODELING (BIM)


EXTRACTS FROM 3D BIM MODELS

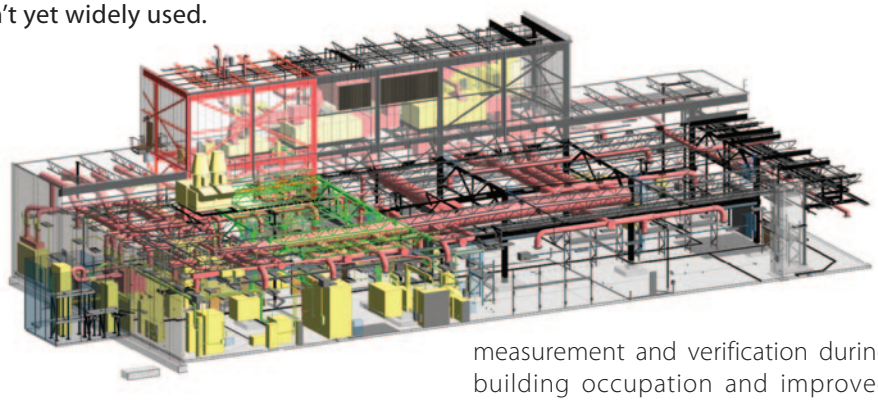
BIM is creating a revolution in the construction sector. It involves creating a digital model, as soon as the project begins, for everyone working on the project to use throughout the process. These models reduce risks during design, construction, and operation while streamlining schedules and reducing costs.

BIM 3D is the BIM that most are familiar with. However, there are other BIM dimensions (4D, 5D, 6D and 7D) that aren't yet widely used.

## 5.1 3D BIM

The major benefits of 3D-BIM are the following:

- Visualization capabilities used to envision the building in three dimensions before ground is ever broken.
- Improved multidisciplinary collaboration
- Fabrication and shop drawing generation for various trades is made easier
- Conflict, interference, and collision detection
- Quantity take off



## 5.2 4D BIM - Time

A Building Information Model (BIM) can be effectively used for construction sequencing and scheduling, material ordering, fabrication, and delivery schedules for all building components. The concept is to allow stakeholders to visualize all scheduled activities and events in advance and through the lifetime of the project before execution. Being able to picture both the design and the construction plan well in advance of actual construction allows project participants to foresee and avoid problems such as the congestion of trades which is difficult to spot when reviewing a typical Critical Path Method (CPM) schedule. It also allows the simulation of various construction sequencing options and therefore optimize scheduling.

## 5.3 5D BIM - Cost

Considerations may include capital costs (the costs of purchasing and installing a component), its associated running costs, and the cost of renewal or replacement down the line. These calculations can be made based on the data and associated information linked to components within the graphical model. 5D-BIM provides methods for extracting and analyzing costs, evaluating scenarios, and changing impacts.

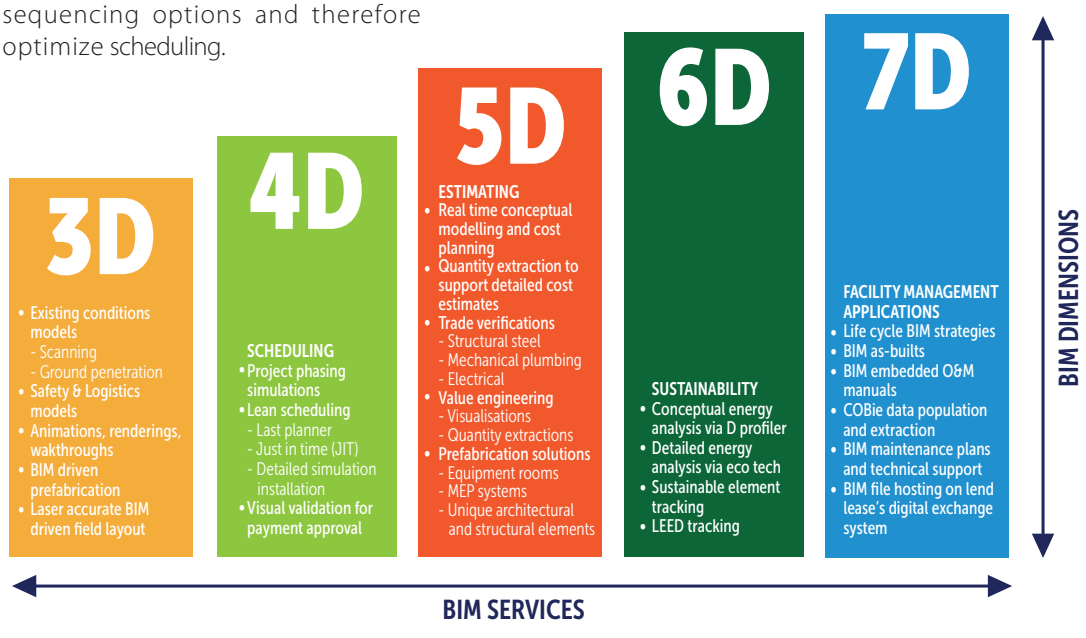
## 5.4 6D BIM - Sustainability

6D-BIM helps perform energy consumption analyses. The utilization of 6D-BIM technology can result in more complete and accurate energy estimates earlier in the design process. It also allows for measurement and verification during building occupation and improved processes for collecting data in high performance facilities.

## 5.5 7D BIM - Facility Management Applications

7D-BIM is used by managers in the operation and maintenance of the facility throughout its life cycle. It allows participants to extract and track relevant asset data such as component status, specifications, maintenance/operation manuals, and warranty data.

The utilization of 7D-BIM technology can result in faster part replacement, optimized compliance, and streamlined asset life cycle management over time. 7D BIM provides processes for managing subcontractor/supplier data and facility components through the entire facility life cycle.



# 6. DRONES OR UAVS

Drone technology, also known as Unmanned Aerial Vehicles (UAVs), has already started to be used for different purposes in the construction industry.

## 6.1 Surveys

Most building surveys, for instance, require visibility of the building's roof to identify its condition and assess any defects. Using a small drone to perform the survey can save time, money, and reduce health and safety risks.

## 6.2 Construction Site Inspections

The ability of a drone to carry out a visual inspection of high-risk areas can save time and reduce health and safety issues. Site inspections can be undertaken more regularly and cover larger areas more efficiently.

## 6.3 Health and Safety Inductions

Using a drone to fly over a site can show new site operatives H&S risks in real-time, and enable site managers to demonstrate moving vehicles, moving cranes, or active excavation areas.

## 6.4 Maintenance Inspections

Drones can provide a quicker and easier way of carrying out the inspections of bridges, high-rise building, roofs and scaffolding, feeding back HD real-time footage to the inspector.

## 6.5 Project Progress Reports

Construction progress reports are often prepared weekly and monthly. A regular drone flight can be a speedy way to record and visualize project progress.

## 6.6 Promotional Photography

The ability to capture high-res videos and photos from unique angles can provide an interesting insight into a project or building, rendering it marketing material.

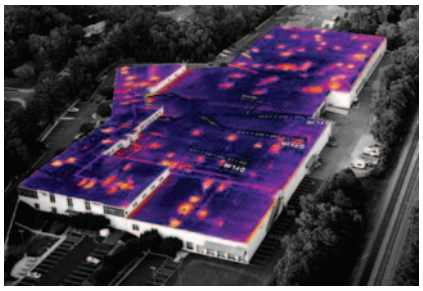
## 6.7 Live Feed - Virtual Walk Around

Utilizing First Person View (FPV) technology, a drone camera can stream HD footage to the project team or stakeholders in real-time. This experience could also be enhanced by the use of VR glasses.

## 6.8 Site Logistics

Drones can provide a real-time update of site logistics and what is happening around the site.

DRONE



INSPECTION AND PROGRESS TRACKING USING A DRONE

## 6.9 Point Cloud - Laser Scanning

It could often be difficult for a surveyor to gain access to a suitable location to laser scan elevated areas of a building. Laser scanning using drones has become a recognized method of capturing specific topography detail.

## 6.10 Thermal Imaging Recording

Similar to laser scanning, drones can be used to take aerial thermal image recordings which can be used to assess potential cold or heat spots in buildings in areas holding electrical components. This can give engineers essential information when trying to identify and rectify building defects.

# 7. ROBOTICS AND AUTONOMOUS EQUIPMENT

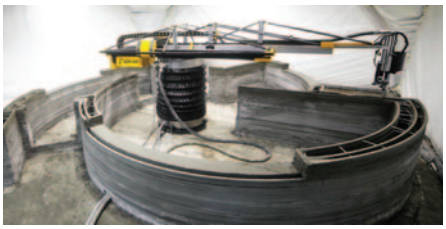
Robotics in construction, until recently, have been used in a very standard and rudimentary manner. Robots can, be used in construction in multiple ways, including the following:

- **Demolition Robots**
- **Printing and Contour Crafting Robots – 3D Printing**
- **Unmanned Drones**
- **Bricklaying Robots**
- **Welding Robots**
- **Roadwork Robot**
- **Autonomous Construction Vehicles**


WELDING ROBOTS

DEMOLITION ROBOT

AUTONOMOUS CONSTRUCTION VEHICLES



3D PRINTING AND CONTOUR CRAFTING

BRICKLAYING ROBOTS

# 8. WEARABLE TECHNOLOGY

Wearable technology has become common in everyday life with the advent of fitness trackers, wearable cameras, smartwatches, heart rate monitors, GPS tracking devices, and smart virtual assistants. Wearable technology is now being used in the construction industry. Some examples are:

## 8.1 Virtual Reality (VR)

Early adopters, mainly in the gaming and entertainment sector, have been significantly transformed by this ground-breaking technology. Construction is one of the sectors that has recently started to adopt this technology. This is primarily being encouraged by the widespread use of BIM. VR enables developers to interact with the design, spot inaccuracies and introduce amendments.

## 8.2 Augmented Reality (AR)

Augmented Reality (AR) is a view of the real-world environment that has been augmented or supplemented by computer generated input such as graphics or video.

## 8.3 Smart Helmet

These helmets include an AR display that provides real time data.

## 8.4. Smartwatches and Health Trackers

Health bands track construction worker heart rates, perspiration, temperature, and activity. Armband monitors can manipulate the environment around the wearers and/or interact with smart glasses.

## 8.5. Safety Vests

The safety vests currently in development are intended to alert highway workers of moving objects (such as cars or trucks) that are approaching. Other safety vests in development include touch sensors that will be able to monitor worker conditions.

## 8.6. Pulse Oximeter

Fitted to a hard hat, these devices detect the onset of carbon monoxide poisoning and alert laborers in the area.

## 8.7. Wearable Safety Badges

Such badges track crew locations in real time with 20cm accuracy. They alert workers when they enter hazardous areas.

VIRTUAL REALITY

AUGMENTED REALITY