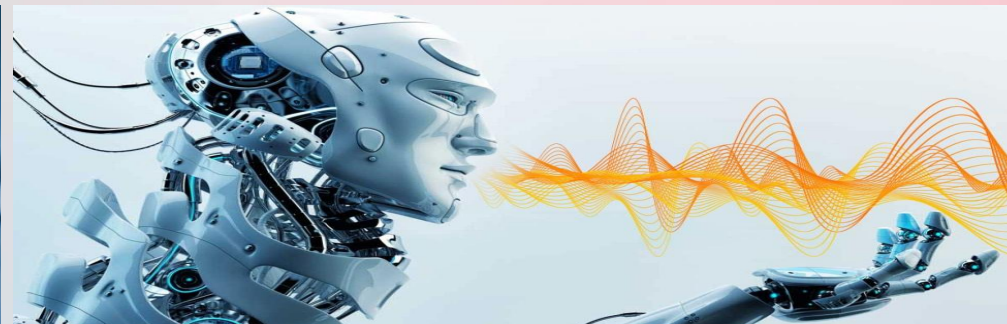


# THE EMERGING ENGINEERING TECHNOLOGIES IN CONSTRUCTION AND MANUFACTURING

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## EMERGING TECHNOLOGIES IN ENGINEERING AND CONSTRUCTION



### 1. INTRODUCTION

### 2. CHALLENGES FACED IN THE CONSTRUCTION INDUSTRY

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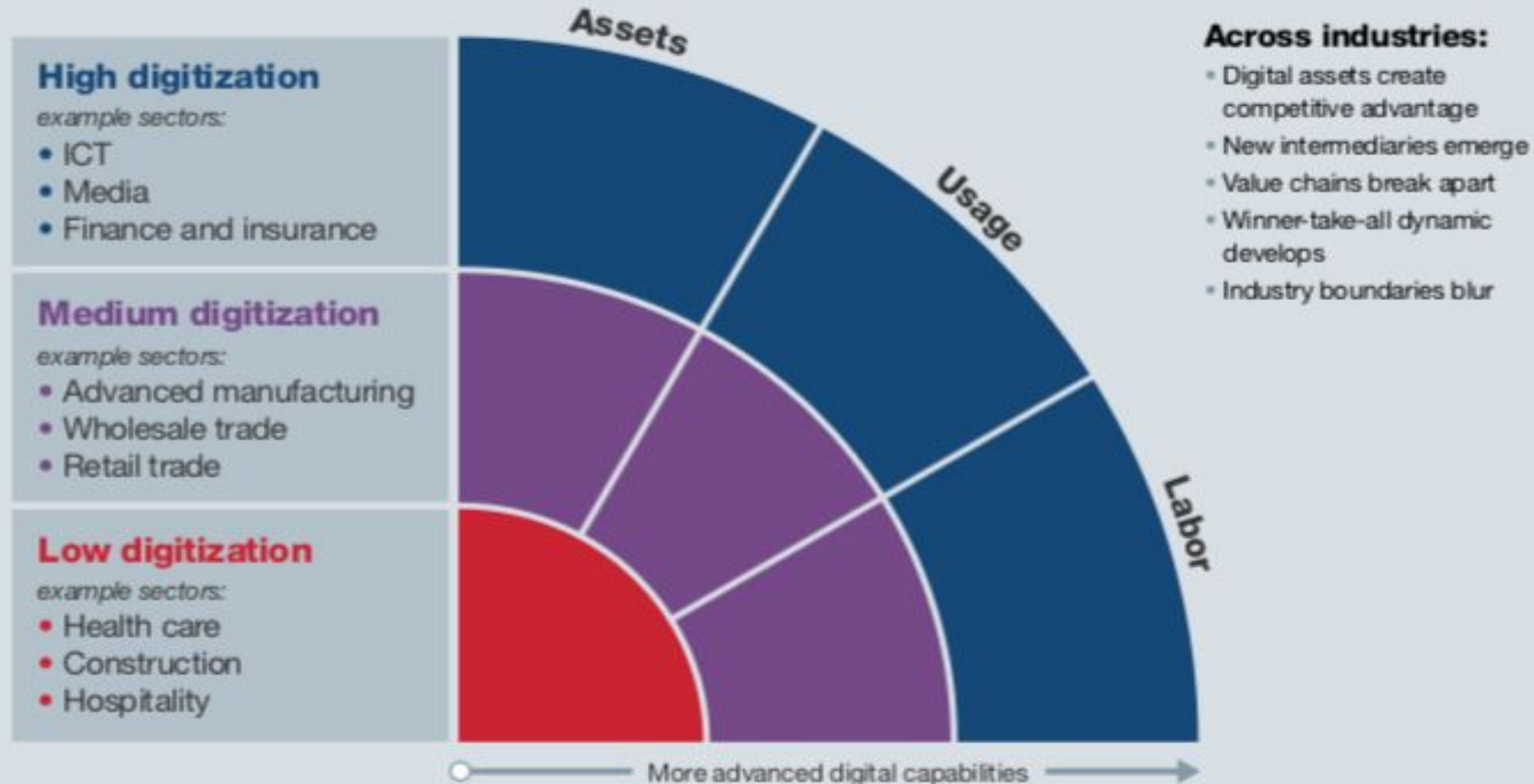
# INTRODUCTION



- The Engineering and Construction industry accounts for USD10 trillion globally (expected to increase to USD14 trillion by 2025) and has a large contribution to the world economy. In addition, the engineering and construction industry also has a large multiplier effect (x 2.86) on a country's economy.
- This sector has been slow in adopting digital technologies compared to other sectors and generally still operates with traditional methods.
- The low adoption of digital technology impacts on productivity through manpower challenges, poor project progress tracking, high volume of rework and poor quality control.
- McKinsey Global Institute had come up with Digitalisation Index and measured across various industries in the US in 2015.

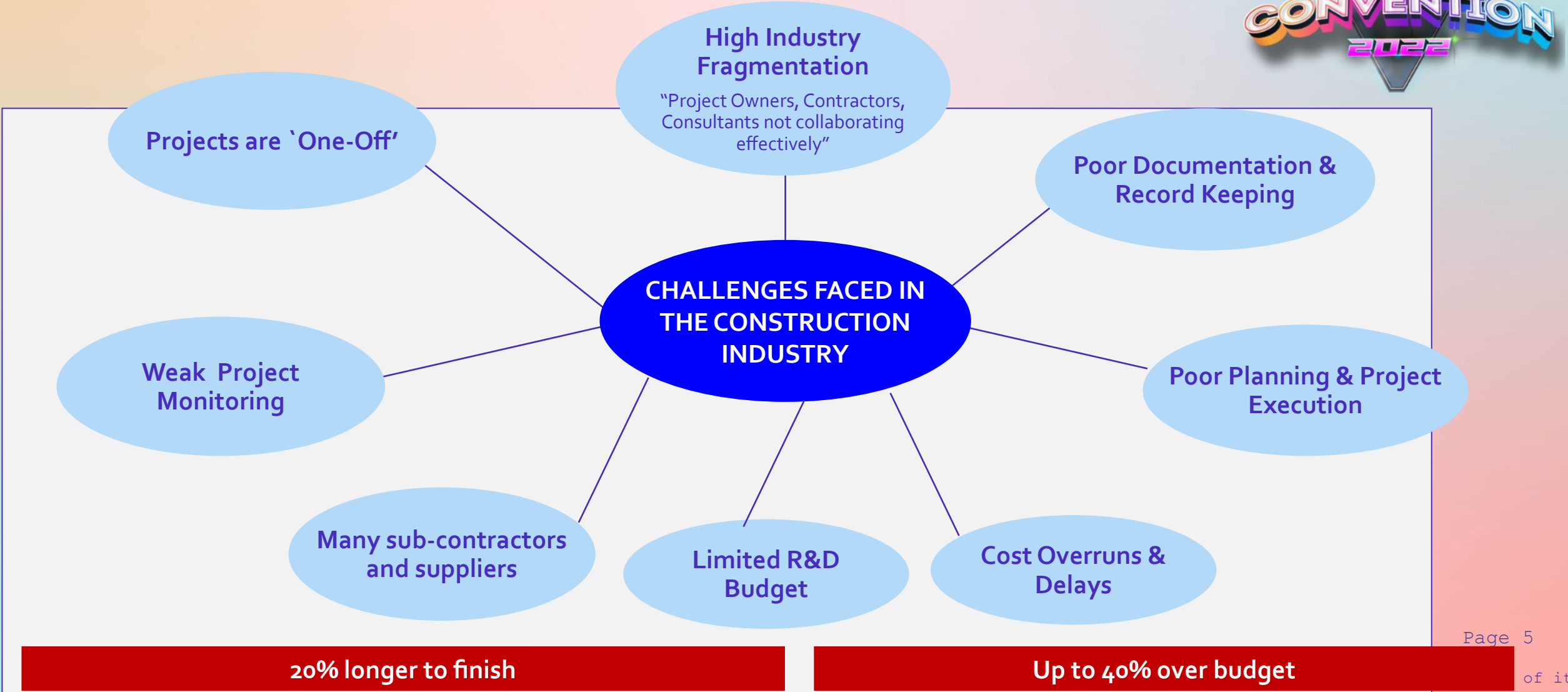


MGI's **Industry Digitization Index** combines 27 indicators to measure the digital assets, digital usage, and digital workers in each sector



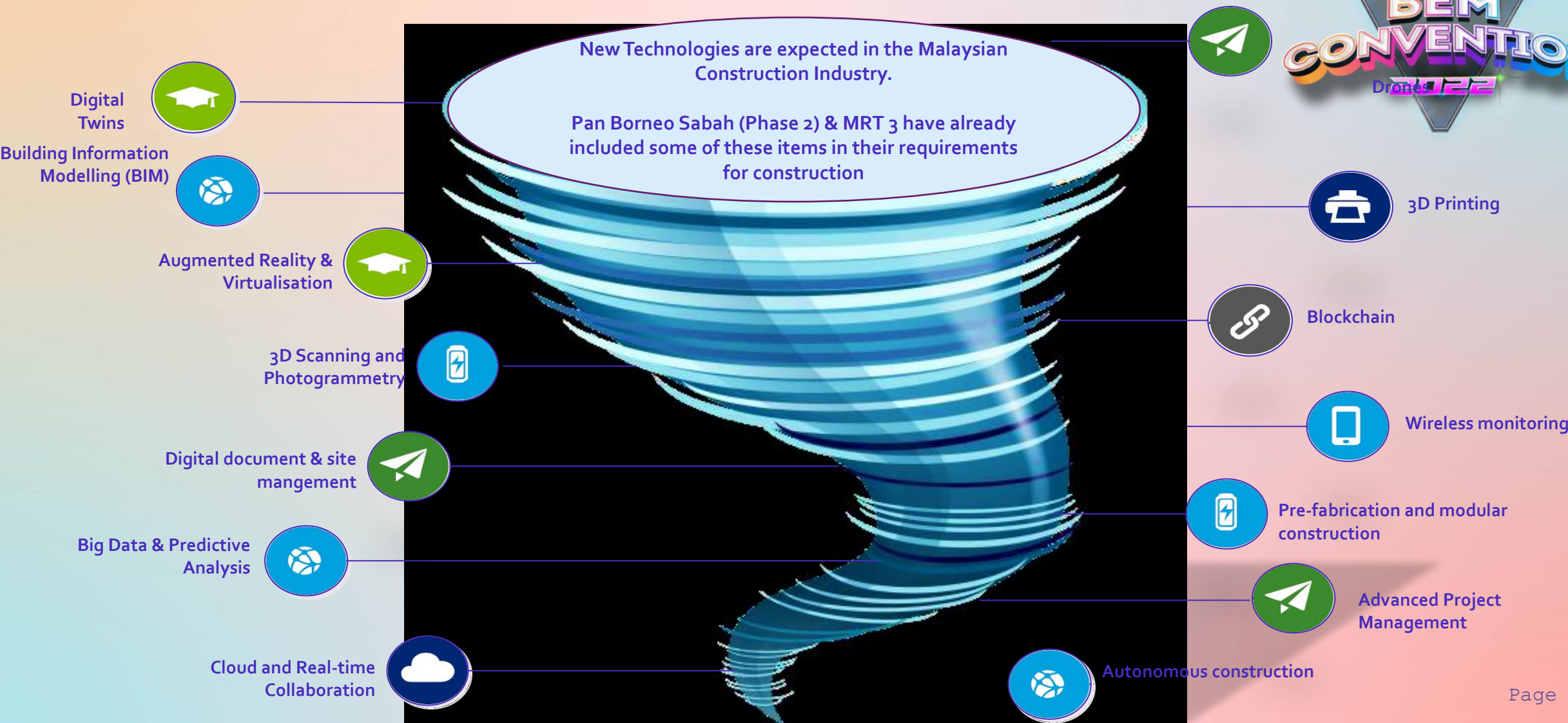


# CHALLENGES FACED IN THE CONSTRUCTION INDUSTRY





# NEW TECHNOLOGIES EXPECTED IN THE CONSTRUCTION INDUSTRY







## TECHNOLOGIES AVAILABLE



# ADVANCED PROJECT MANAGEMENT



## Project Management & Collaboration

- Manage all project-related communications and subcontractor activity while gaining instant access to information captured from every site.

## Drawing Management

- Regain productivity by deploying a single system with native drawing management capabilities

## Project Controls

- Maximizes the profitability of every job by continuously monitoring and adjusting project budgets.



# ADVANCED PROJECT MANAGEMENT

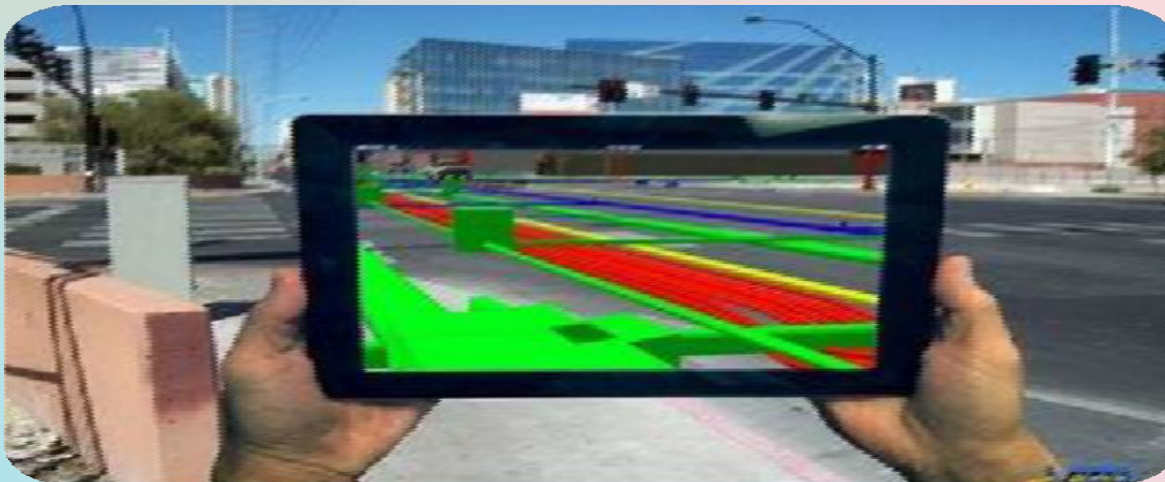


## DOCUMENT MANAGEMENT

- Facilitates the exchange of communications, drawings and other assets throughout the design and approval process.
- Manage the project closeout documents that smooth out the transition to the next project.
- Maintain all versions of revised documents
- Detect project anomalies early enough to implement course corrections

## SITE MANAGEMENT

- Enter critical information from the job site in real time,
- Access to up-to-date snapshots of where a project is and where it's headed.



# SMART WEARABLE TECHNOLOGY IN CONSTRUCTION



Wearable devices can be worn physically by people at a construction site. These devices collect data from the surrounding environment and provide insights based on which actions can be taken. These can range from smartwatches and smart helmets to bionic suits, smart glasses, and sensors to name a few.



## AR Glasses Features

- Detect leading edges**
- Identify hazardous material
- Display safety protocols



## Smart Monitor Features

- Track core body temperature**
- Detect harmful gases
- Improve contact tracing



## Smart Boot Features

- Detect pressure from shocks and falls**
- Sense location
- Charge by walking



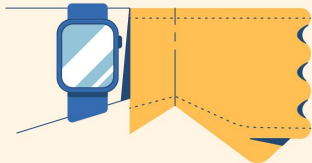
## Smart Hard Hat Features

- Monitor fatigue**
- Prevent microsleeps
- Detect collisions



## Smart Watch Features

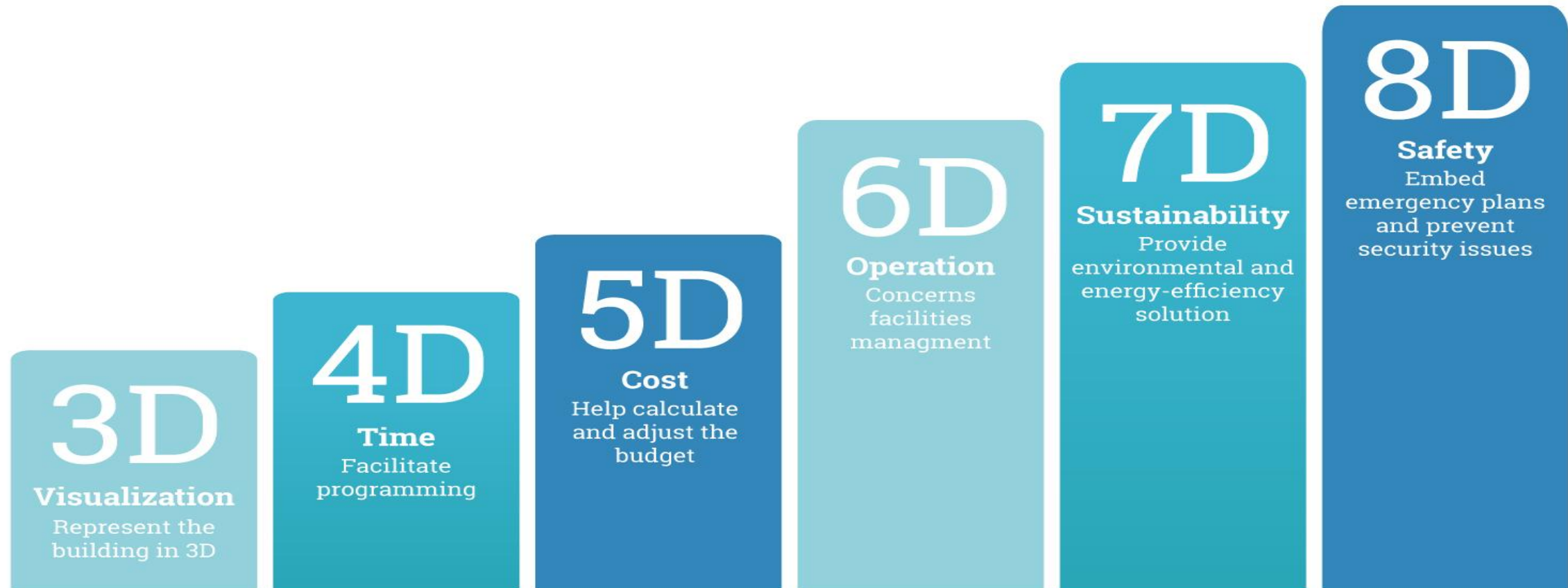
- Monitor health and activity**
- Detect falls and send alerts
- Enable hands-free communication



# BUILDING INFORMATION MODELING



Building Information Modeling (BIM) is a dynamic process of creating information-rich models for the entire lifecycle of a construction project. According to project stage requirements and project complexity, specific parameters are added to the existing information contained in BIM. These additions of pre-defined used cases can be described as BIM dimensions..



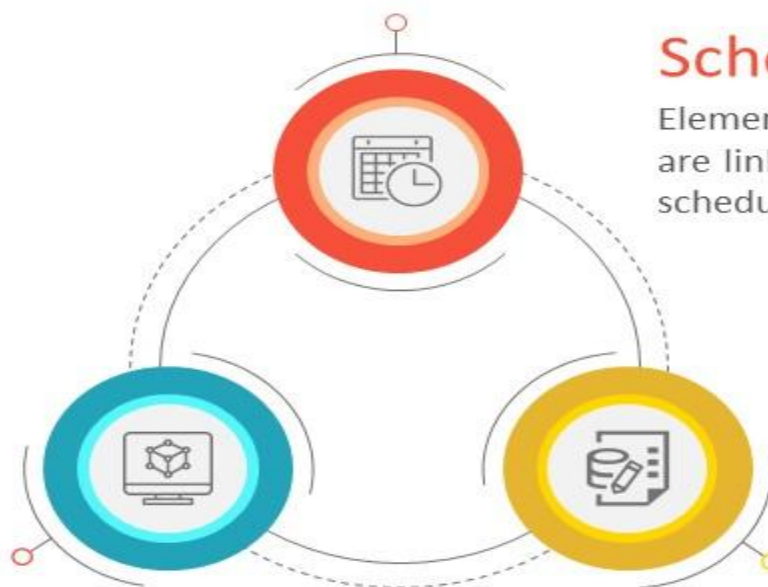


**Building Information Modeling (BIM)** is a digital representation of the physical characteristics of a project, forming a reliable basis for decisions during the project's life cycle

## Design (3D)

Information that can be embedded in 3-D model

- Geometry
- Spatial data (from geographic information systems/lidar)
- Specifications
- Aesthetics (e.g. color)
- Thermal properties
- Acoustic properties



## Schedule (4D)

Elements of a 3-D model are linked to the execution schedule

## Budget (5D)

Elements of a 3-D model are used to develop budget and linked to cost heads

## DRONE TECHNOLOGY

### WHAT CAN BE DONE TODAY ON A CONSTRUCTION SITE WITH A DRONE?

3D modeling

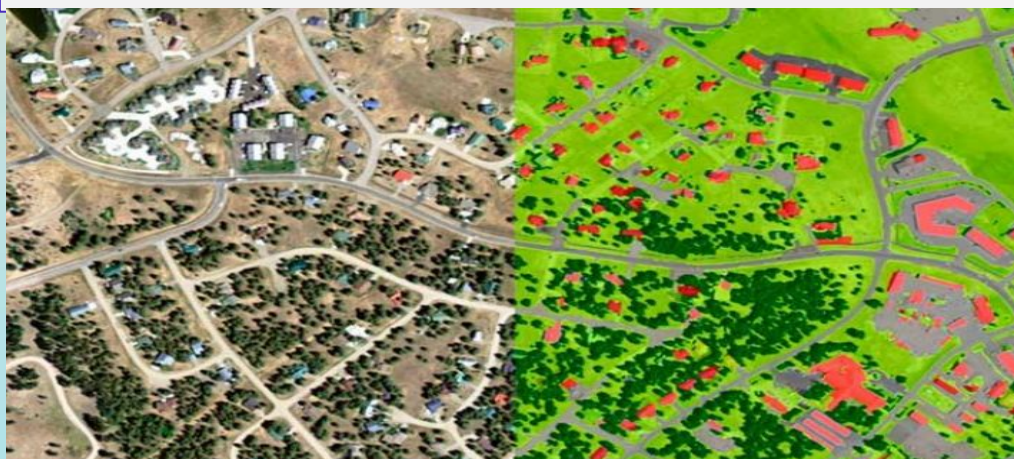
Volume  
calculation

Position check

Progress  
monitoring

BIM integration for  
collaboration

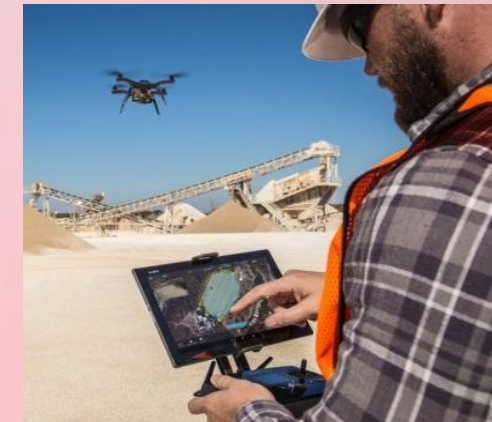
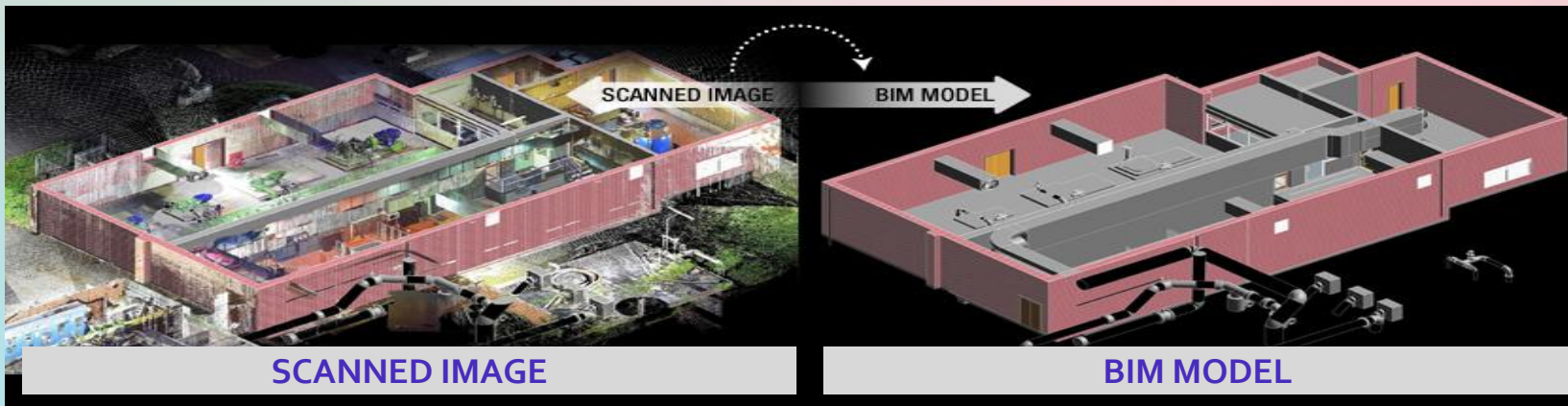
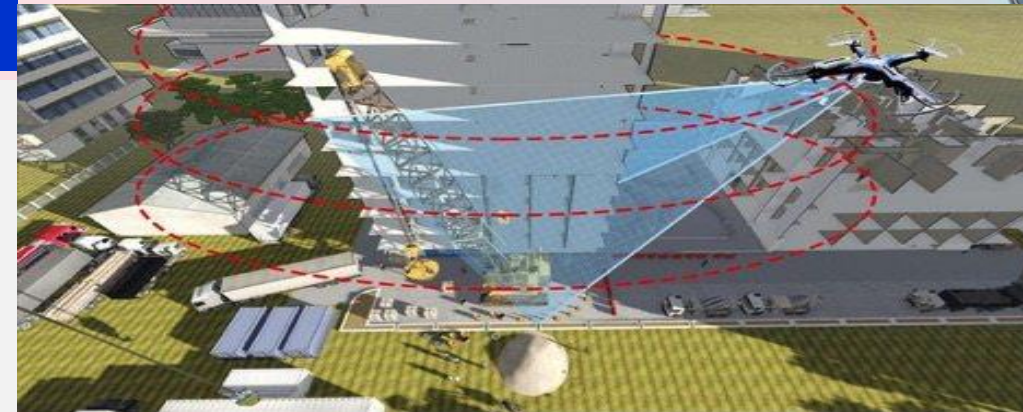
Clash detection





## DRONES + BIM

- One of the key benefits of drone usage is precision. The degree of accuracy in the data is phenomenal, better than any other method. Drones provide a controllable, repeatable process not rivaled by manual techniques.





## BIM WITH VR

### VIRTUAL REALITY (VR) TECHNOLOGIES / AUGMENTED REALITY (AR)

- **Integrate BIM with VR.** When a BIM 3D model of a project is placed into VR technology, designers can “walk” through the building at full scale to better visualize and experience it. For example, they can look for clashing objects, further optimize wall and ceiling cavities for ducts and piping, and adjust the building layout to improve employee and visitor way finding—all before the building is built.

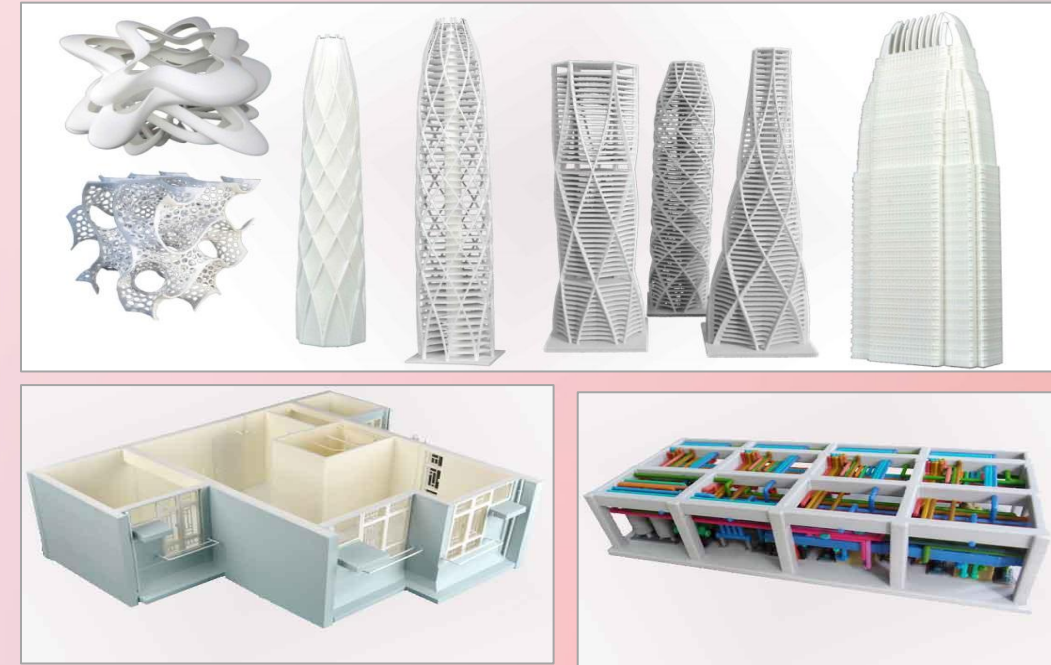
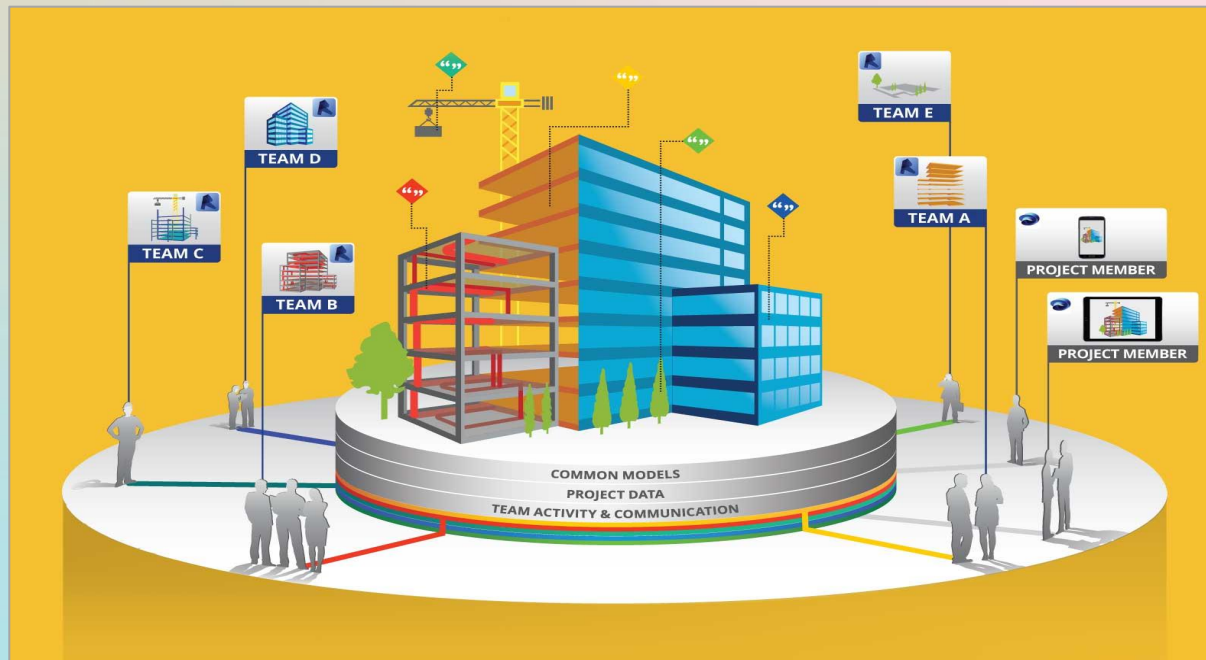


## BIM - USE OF CLOUD SOFTWARE

- Using a cloud framework, the BIM data can be accessed by anyone from any location in real time simplifying BIM model sharing.
- Reporting also can happen more swiftly, paving way for a more constructive and positive collaboration leading to reduced wastage of time, efforts and money in project communication and collaboration.

## BIM 3D PRINTING

- 3D printing is a fundamental extension of the 3D modeling process in BIM. Using the technology, teams can collaborate better on digital projects by seeing an element in the physical form.
- This helps them understand the dynamics, functioning, and efficiency by analyzing a structure through its look and feel, which was not possible earlier in BIM.





## 3D SCANNING & PHOTOGRAMMETRY



- 3D scanning and photogrammetry allows us to make a digital copy of real world spaces.
- The key usage is in creating accurate capture of the as-is condition of a building, facility and even infrastructure. This helps in as-built documentation, site monitoring and facilitates renovations, retrofits and facility maintenance.

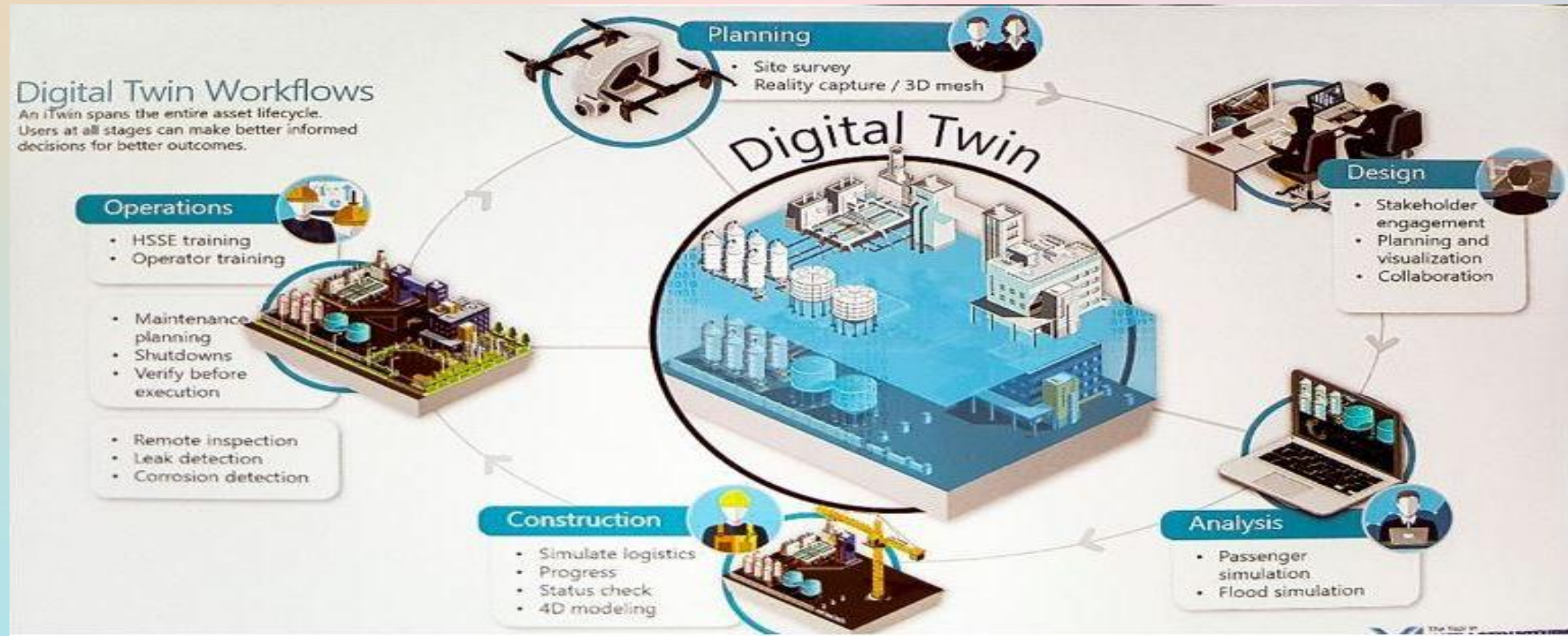






# DIGITAL TWINS

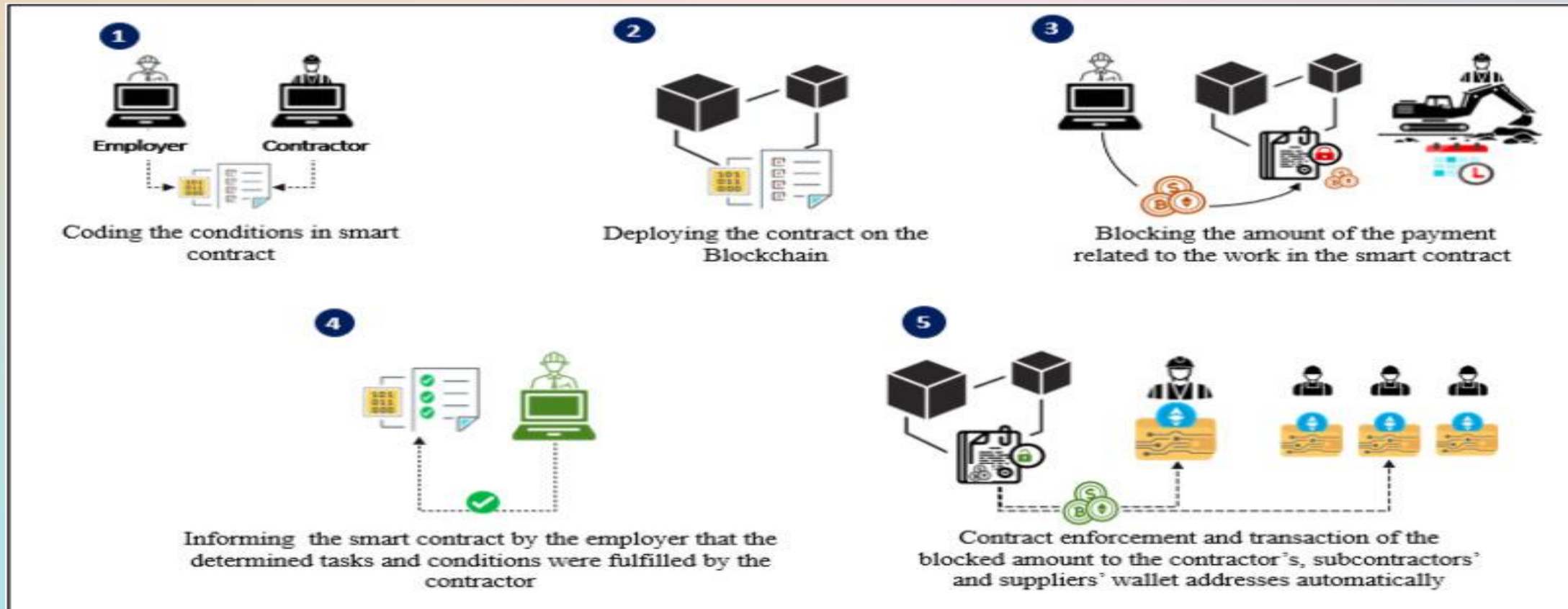
A digital twin integrates real-time data from a built asset with its digital representation to create insights across the project lifecycle. Digital twins give multi-dimensional views into how an asset is designed and how it's performing. A digital twin offers a means to test "what-if" scenarios, including the impact of design changes, weather disruptions, and security events.



# SMART CONTRACTS USING BLOCKCHAIN



A smart contract is generally an executable code that runs on the blockchain to facilitate, execute and enforce the terms of an agreement, where the main aim is to automatically execute the terms of an agreement once the specific conditions are met. A smart contract system is presented for security of payment of construction contracts. Benefits are better apportionment of risks, self-executing contract, less room for disputes, guaranteed payment and elimination of third parties. Challenges are lack of expertise, human error in coding, cybersecurity, uncertainty in cryptocurrency and the terms are immutable.





## PREFABRICATION AND MODULAR CONSTRUCTION

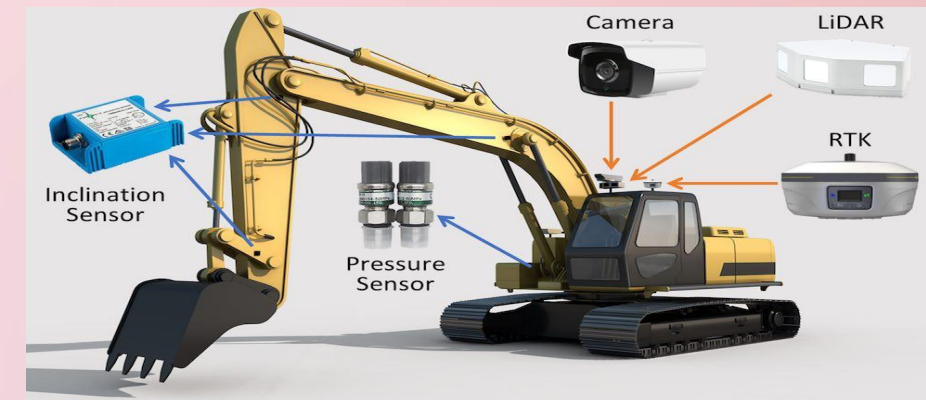
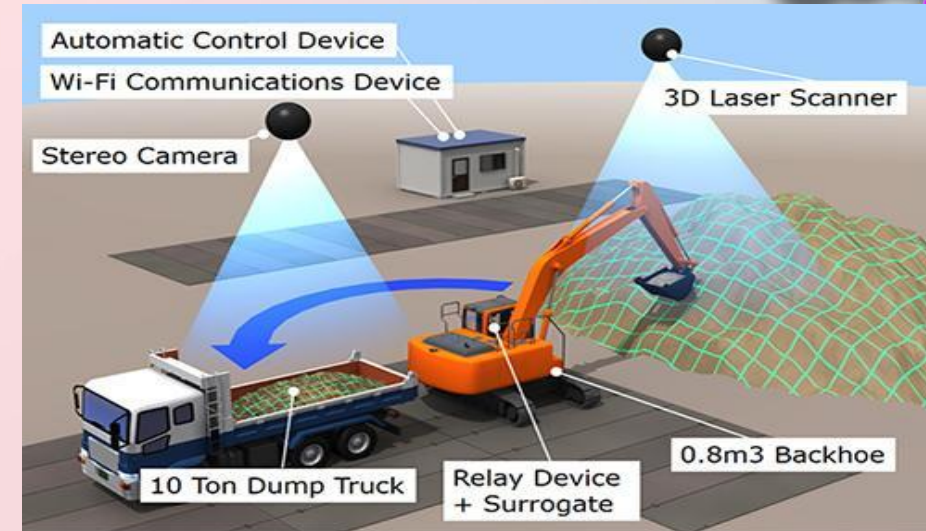
- The key benefits from the use of prefabrication and modular construction is
  - Shorter construction period
  - Improved workmanship
  - Reduced local area disruption
  - Improved working environment and site safety
  - Sustainability and environmentally friendly
  - Better management





## AUTONOMOUS CONSTRUCTION

- The key benefits from autonomous construction would be higher productivity and a safer environment.
- Although in its infancy, some examples of automation in construction would be
  - The use of drones to survey the work site and workers
  - Autonomous machines in the work site such as self driving trucks to transport materials, unmanned forklifts and backhoes, etc.
  - Robotics in concrete works ie. From mixing to laying of the cement
  - Using IoT sensors to trigger activities which include welding and fabrication machines.





MyDIGITAL is a national initiative to successfully transform Malaysia into a digitally-driven, high income nation and a regional leader in digital economy.

Strategic Thrust 2 aims to accelerate digital adoption, empower digital stewardship as well as shape new value pools and emerging business models.

S1: Facilitating digital adoption, access and effective use of digital technology across all firm sizes & digital maturity level with the aim to achieve an increase of 30% in productivity by 2030 through digitalisation.



## CONCLUSIONS



Whilst the advantages of digitalization of the engineering and construction industry seems obvious there are many technical challenges specific to the construction sector that have a role in the slow pace of digitalization. Key challenges are

- Cost, effort and changes needed to digitalise is high and the return on investment is unclear.
- Coming out with similar digital solutions across various construction sites for different sectors that are geographically dispersed is difficult.
- The varying sophistication levels of smaller construction firms that often function as subcontractors and suppliers creates another challenge when you try to build new capabilities at scale coupled with the fact that different project sites have their own set of subcontractors and suppliers.

## CONCLUSIONS

However, projects are getting more complex and larger in scale. The growing demand for environmentally sensitive and safe construction means traditional practices must change. The shortage of skilled labor and supervisory staff will only get worse. Margins are getting thinner. These are deep issues that require new ways of thinking and working.

Engineering and construction firms really need to look at how adoption of digitalization can solve some of these issues whilst taking cognizance of the many challenges for this adoption.







# THANK YOU



Committed to Engineering Excellence

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