Innovation Alliance for the West Midlands

Smart Places Working Group

The Circular Economy Approach & Digital Construction

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THE UNIVERSITY OF OPPORTUNITY

Presentation Outline

This presentation will cover the following;

- The definition of Circular Economy & Digital Construction
- The drivers of Digital construction & Circular Economy
- Examples and application of Digital Construction
- The Circular Economy approach in Construction

Innovation: Robotics in Construction

Other drivers of change/ innovation such as Circular Econonmy & Digital Construction include:

- ✓ Poor Collaboration and Improvement culture
- ✓ Health and Safety (poor safety records in construction)
- ✓ Climate change and need to decarbonise the Built Environment and reduced GHG by 50%
- ✓ Improve productivity and integrated digital delivery




DRIVERS OF INNOVATION such as Digital Construction & CE

- Decarbonisation initiative (Net Zero Carbon 2050 target)
- A reduction in Greenhouse Gases in the Built Environmen (Sustainability)
- Workforce size and failing demographics

Portfolio Decarbonization Coalition

✓ Heat Pumps/ Solar Electric Panels/ Electric Vehicles

What is digital construction?

- Digital construction is the use of technology and digital tools in the construction processes, like design, material specification, construction management and project planning.

- Digital construction involves the generation, management and sharing of digital information throughout the building and asset lifecycle. (BIM)

- Any type of digital software or technology used as part of a construction process can be considered digital construction.

- The construction industry is changing to reflect the more common uses of digital technology. New skills are having an impact on almost every aspect of how a construction project works.

Digital Construction Technology Categories and Sector Application

Category	Innovation	Sector Challenges Addressed
AUTOMATION	MMC/ IoT 3D Printing Robotics	• Health and Safety • Climate change • Low Productivity • Collaboration • Decarbonisation • Reduction in GHG • Workforce size + failing demographics
SIMULATION + MODELLING	Environmental Simulation and Modeling Tools (Design Builder) VR AR BIM GIS Photogrammetry	• Health and Safety • Climate change • Low Productivity • Collaboration • Decarbonisation • Reduction in GHG • Workforce size + failing demographics
DIGITIZATION + VISUALIZATION	5G Mobile Apps Digital Twin CDE (Common Data Environment)	• Communication • Visualization • Design

Automation in Construction

MMC

IoT

3D Printing

MMC

Robotics

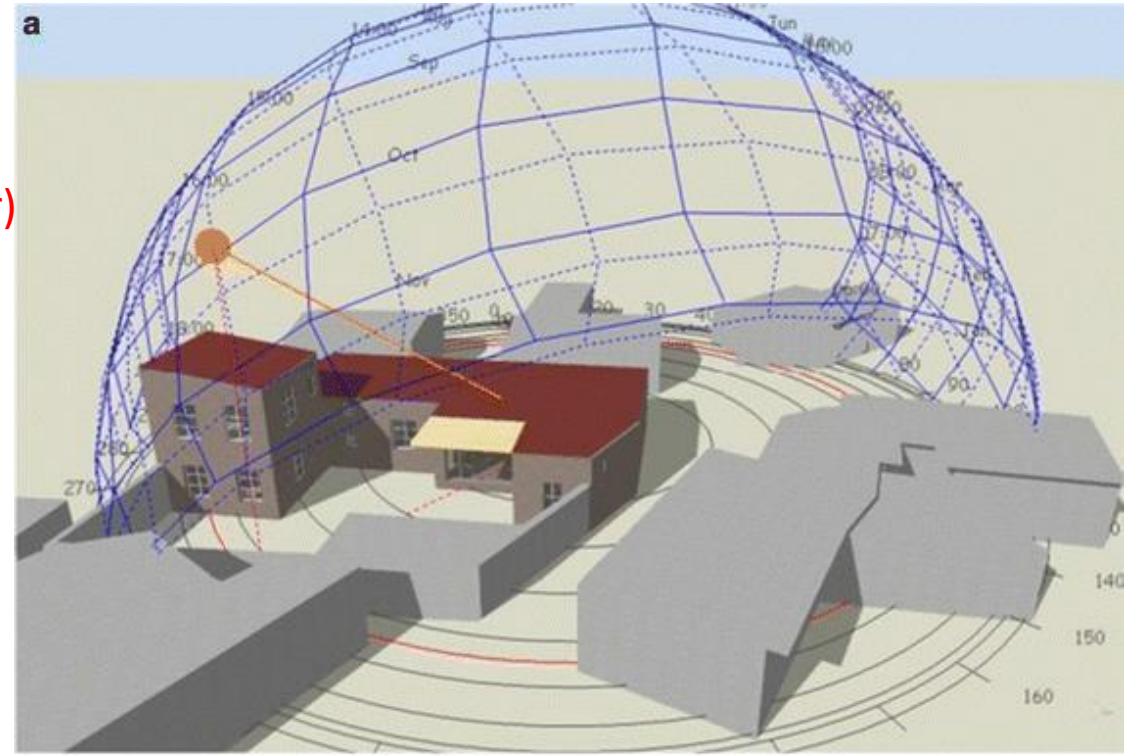
Robotics

Category	Innovation
AUTOMATION	MMC/ IoT 3D Printing Robotics

SIMULATION + MODELLING in Construction

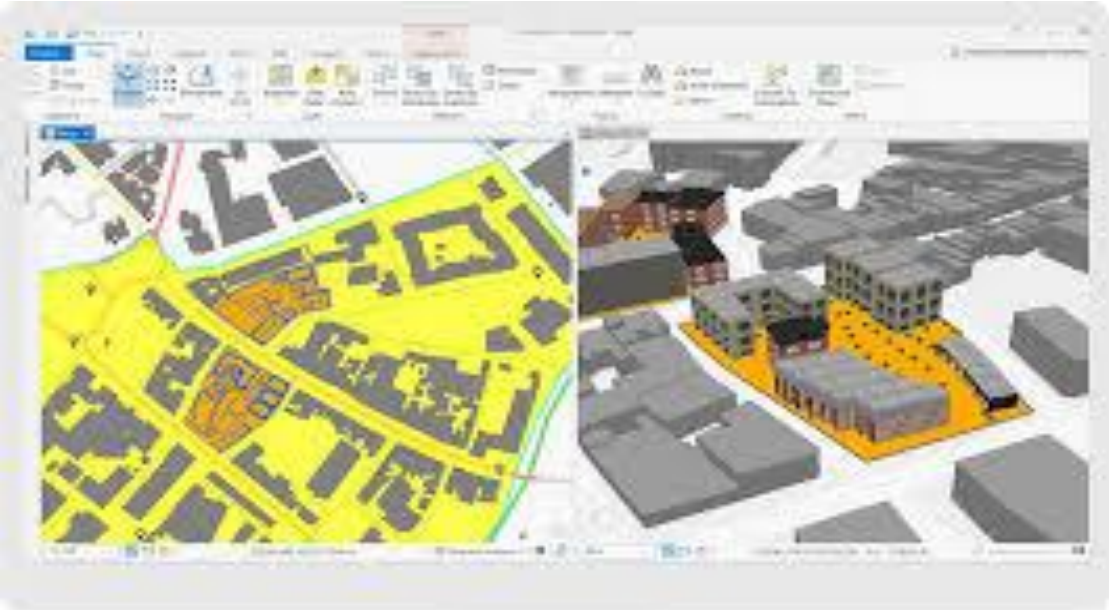
VR

Tools (Design Builder)



BIM

GIS for AEC



SIMULATION + MODELLING	Environmental Simulation and Modelling
	Tools (Design Builder)
	VR
	AR
	BIM
	GIS
	Photogrammetry

DIGITIZATION + VISUALIZATION in Construction

DIGITIZATION

DIGITIZATION

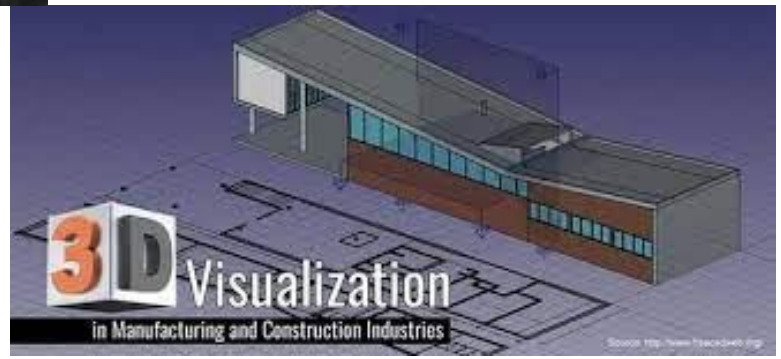
VISUALIZATION

Novade

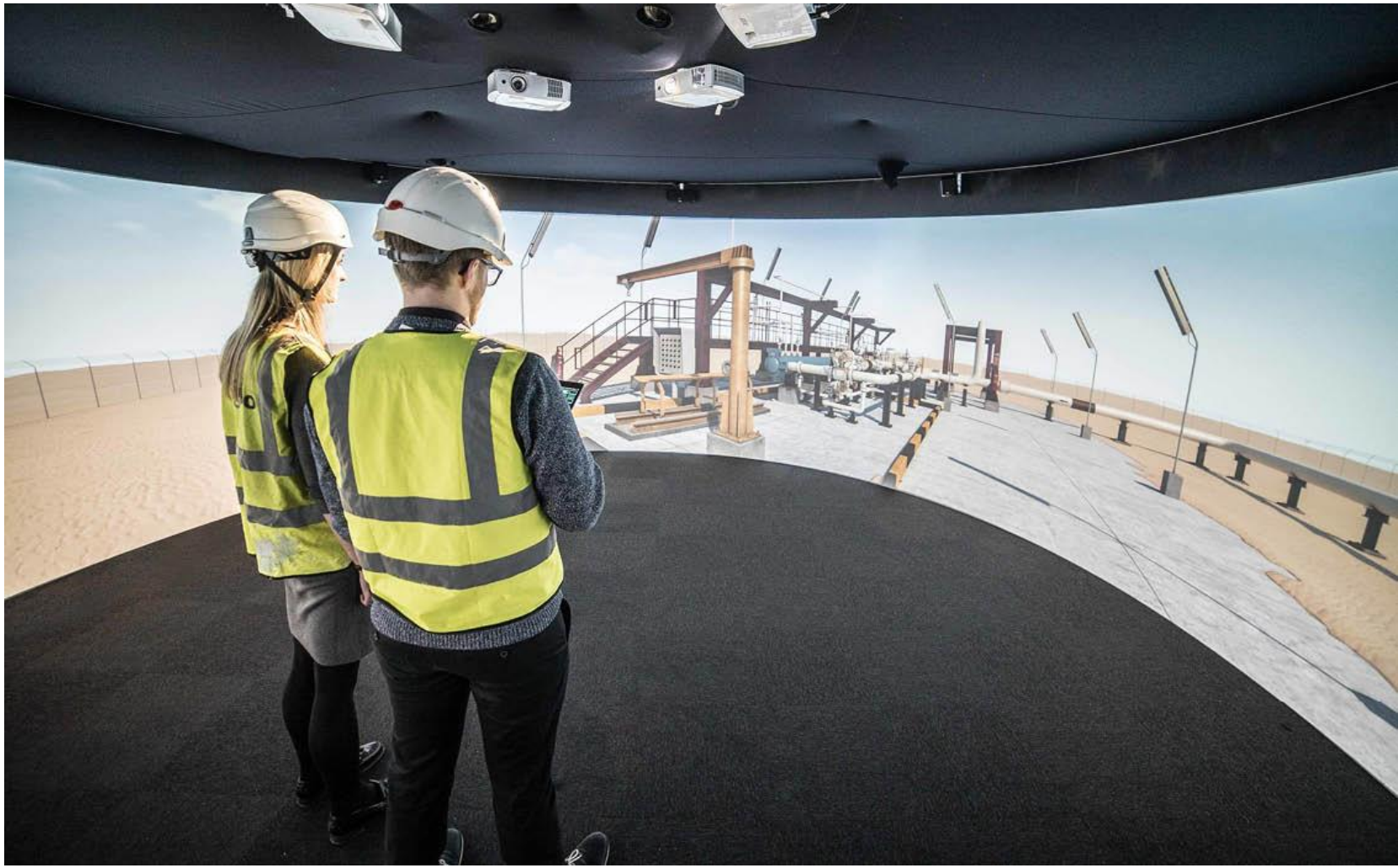
DIGITIZATION

VISUALIZATION

DIGITIZATION + VISUALIZATION	5G Mobile Apps Digital Twin CDE (Common Data Environment)



What construction jobs of the future will look like



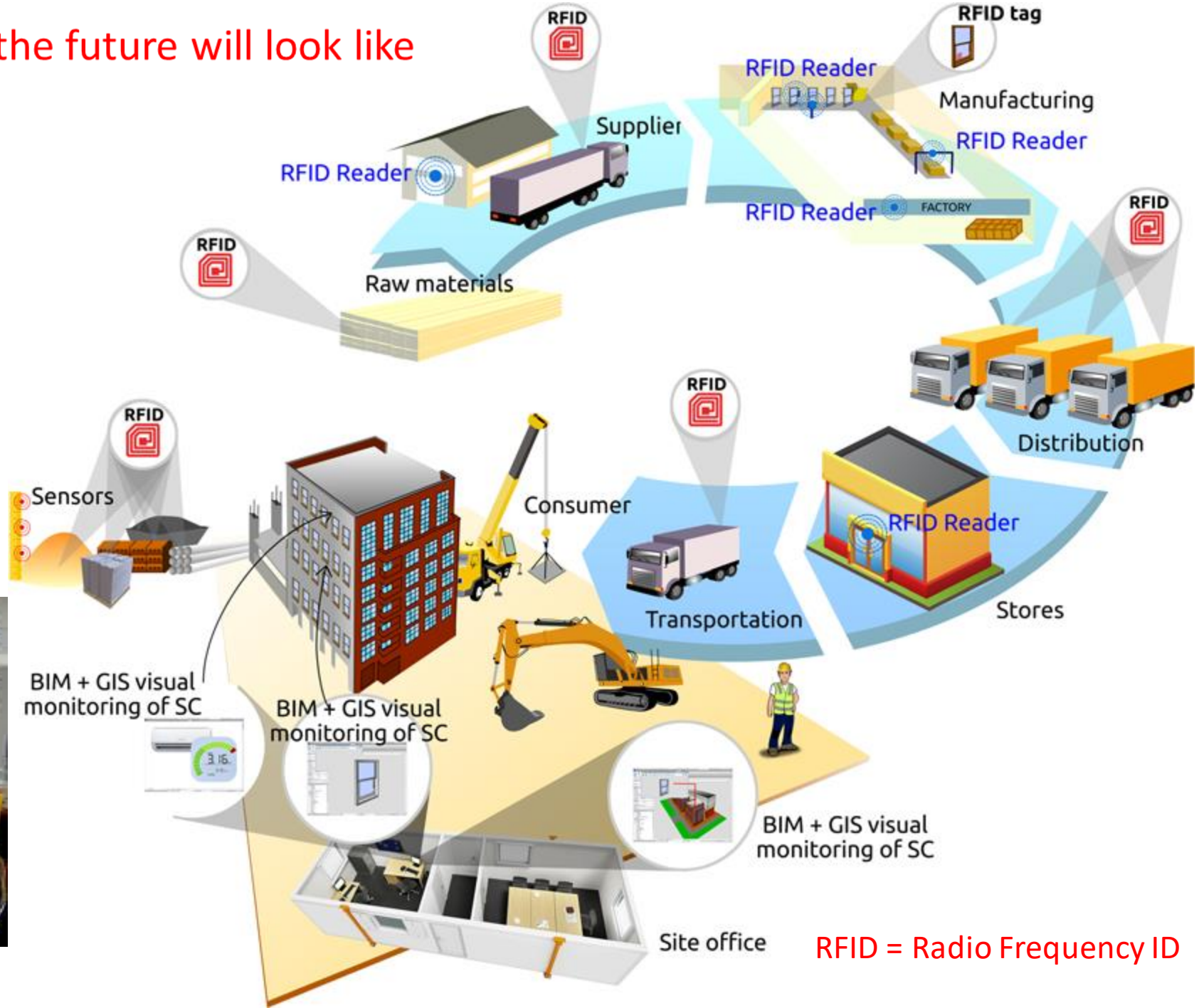
Igloo

What construction jobs of the future will look like

What construction jobs of the future will look like

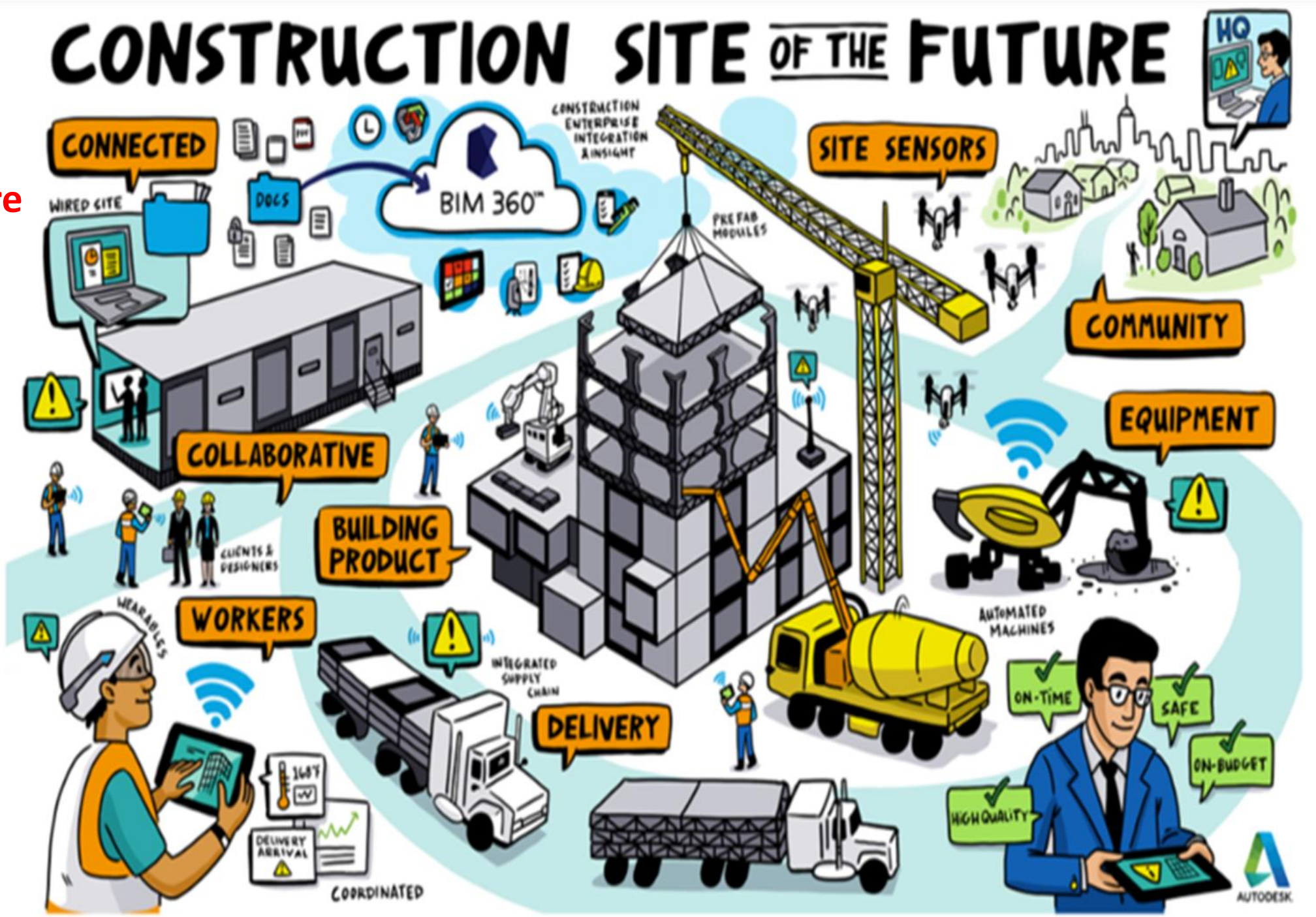
Virtual Reality Building

Office-base Construction Consultants



RFID = Radio Frequency ID

Jobs in the future
In Construction



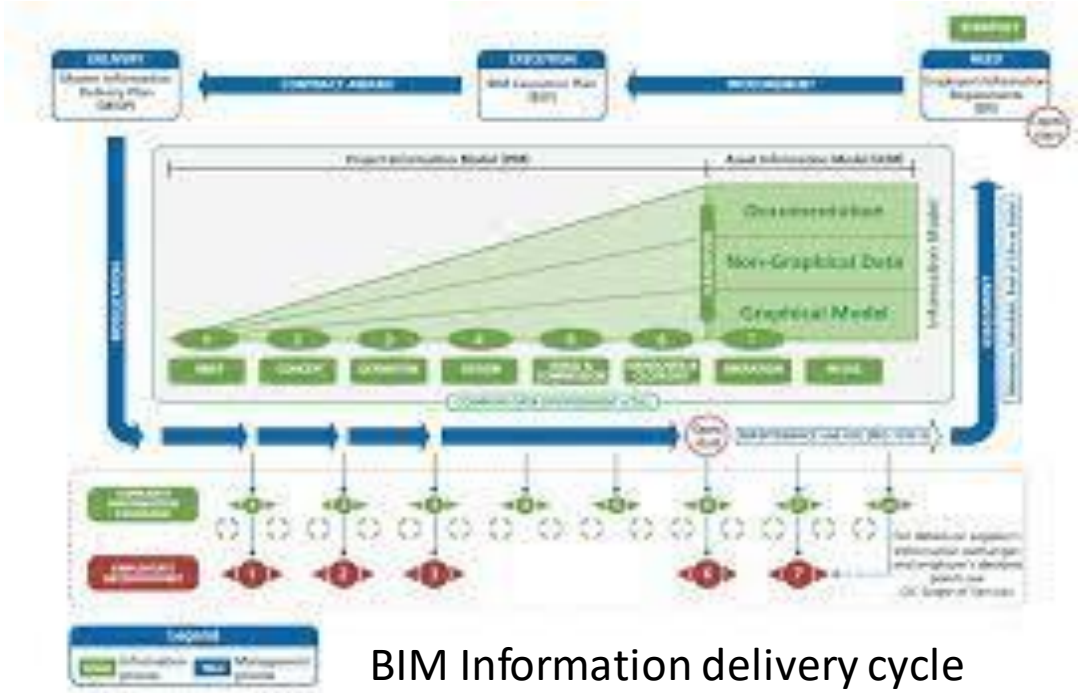
Mobile technology

Mobile technology, including apps and instant messaging software, has improved communication and time-management on construction sites. It means that changes, accidents, design questions, any communication you can imagine, can be communicated using mobile tech, to keep everyone up-to-date almost instantly

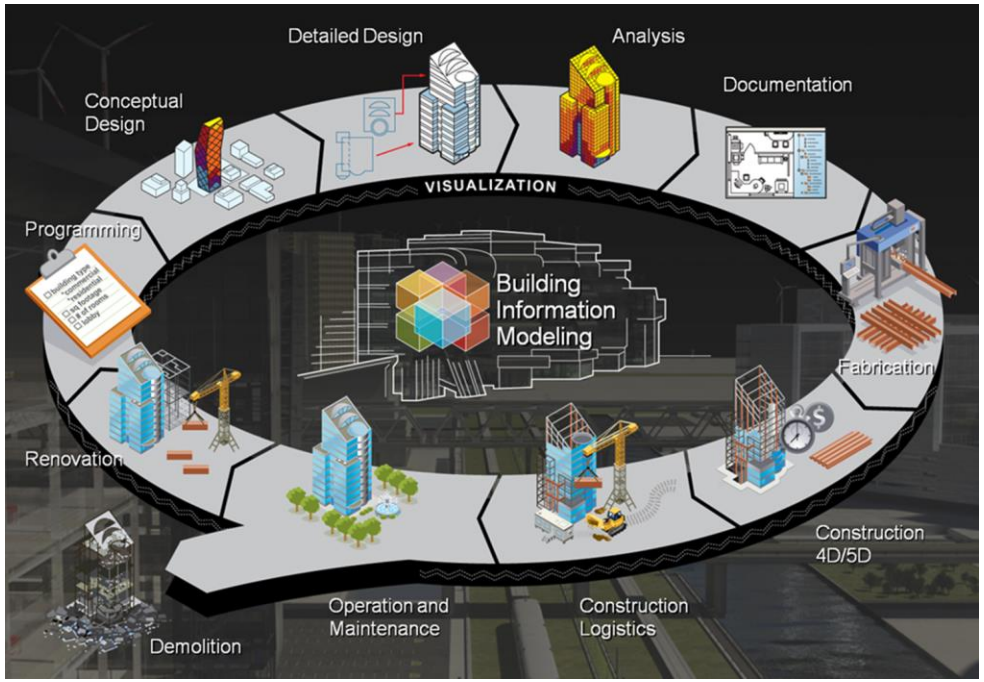
Building Information Modelling (BIM)

Building Information Modelling (BIM) is a process than underpins the design of buildings and infrastructure with the help of interactive digital models, rather than traditional paper blueprints.

BIM and Integrated digital delivery an important development as it advances closer collaboration between consultants, contractors and Employers as they can all see the design and all information related to it, as well as ask questions and suggest changes



BIM Information delivery cycle



Artificial intelligence

AI is about using machines or software that can copy human functions and process enormous amounts of data. In construction, this could be robotics or machines that take on the manual labour aspects of a project to save time and money,
or programmes that take data and turn it into 3D models of projects so they can be analysed for safety and cost-effectiveness etc. before they are physically built.

3D printing

3D printing helps to create scaled down complex or bespoke design structures, reducing material and labour costs and producing less waste. It might also allow for construction to be completed in environments not suitable for people to work in or used to reduce accidents.

Digital careers available in construction?

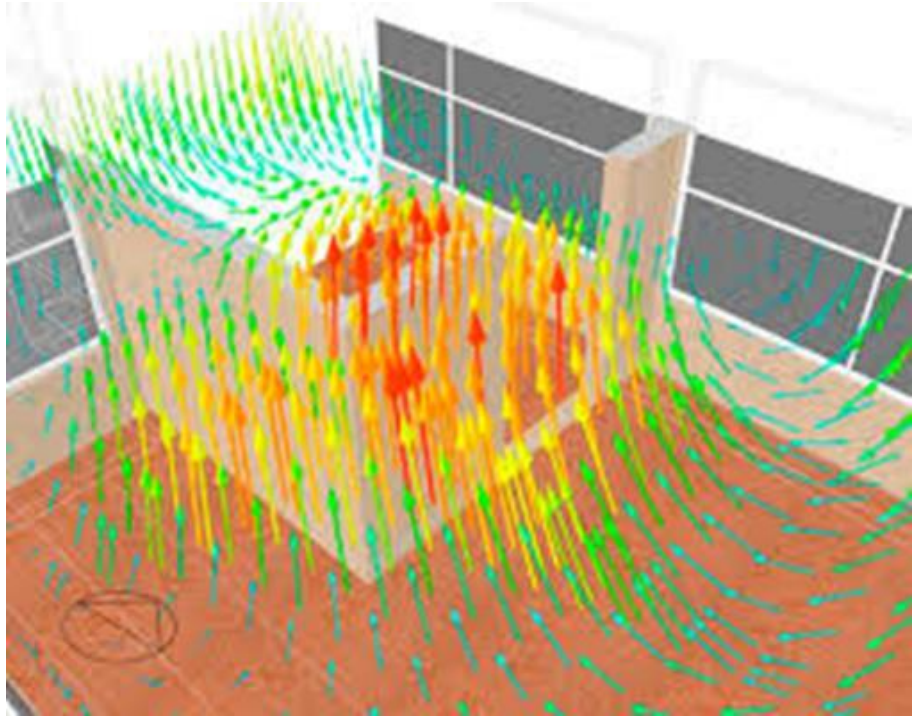
Digital construction is exciting because it is only just getting started. The changes it is influencing across the industry are having a positive impact, including a rise in eco-friendly materials and more in-depth planning for projects of every size.

Photogrammetry

Surveying drones

QS Software

Environmental Simulation



Building Environmental Performance

Construction in a virtual world

A virtual world in construction terms means things like 3D modelling and printing, virtual reality (VR) and augmented reality (AR) being used to plan and design construction projects.

For example, using new technology and software, a detailed virtual model of a construction project can be produced, sometimes even placing the user directly inside the virtual environment, for full immersion into the space.

3D Printing

VR (Virtual Reality)

AR (Augmented Reality)

Creating a 3D miniature model of a construction site can be a complex physical process requiring space, time and materials. The construction industry can now take advantage of numerous methods to create a VR model of a site, making it possible to generate a detailed, accurate model more quickly and cheaply, but also making it easier to share those models across teams.

Physical Miniature model

Digital VR model

VR gives teams the ability to ‘see’ a project site without traveling to it, saving time and money. Teams can collaborate and ask questions about or make changes to the design without it requiring a physical rebuild as it would with a real 3D model.

VR will change construction

VR Remote Expert Assistance

Advanced manufacturing processes

Traditional manufacturing refers to the process of converting raw materials into a finished, ready-to-sell product using manual and/or mechanical techniques.

Advanced manufacturing typically involves manufacturing processes that use advanced techniques and equipment, for example factories that use robotics or computer software to make tools or building materials instead of manual labour.

Manufacturing companies producing products using advanced manufacturing should embrace the following characteristics:

OSM

Offsite

Offsite Manufacturing Construction – (OSM) Products

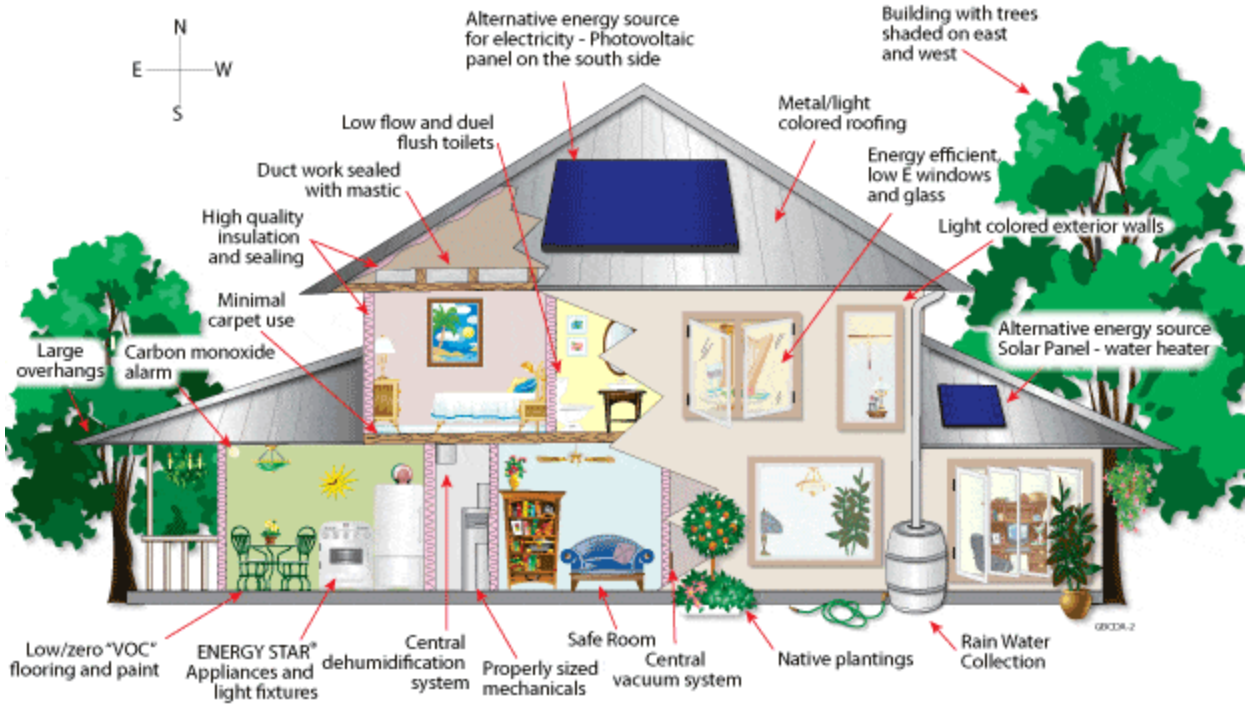
Products produced using advanced manufacturing techniques often have a high level of design or are considered ‘cutting edge’, meaning they are unlike previous products or superior to them. Companies that embrace advanced manufacturing often report producing newer, better and more exciting products for construction purposes

Sustainable technologies

The construction industry is working hard to improve sustainability at every step of a project. Here are just some of the technologies being used to do that:

Biodegradable materials

To avoid materials ending up in a landfill, projects are sourcing readily biodegradable materials like sustainably sourced bamboo, timber, mycelium (a kind of fungus) and organic paints. These all breakdown easily, without releasing toxins, reducing their impact on the environment.



Research based statistics NBS Annual Digital Survey 2021-22

- 80% of the UK construction industry workers are of the opinion that the adaptation digital technologies is delivering a better built environment.
- 75% agree that digital construction technology is offering sustainability benefits
- Although the vast majority of UK construction workers believe that digital working and BIM adaptation will be essential to realise the golden Thread; only 51% are clear on how they may achieved this.
- 74% believe digital technology is helping to create a safer built environment.

- Digital Twin adaptation is still relatively slow only 16% have worked on a project that uses a Digital Twin in the past one year.

- 71% are of the opinion that BIM has been embedded across the AEC sector

- 50% have worked on an Offsite Manufacturing (OSM) project – a clear sign of a move towards Morden Methods of Construction (MMC)

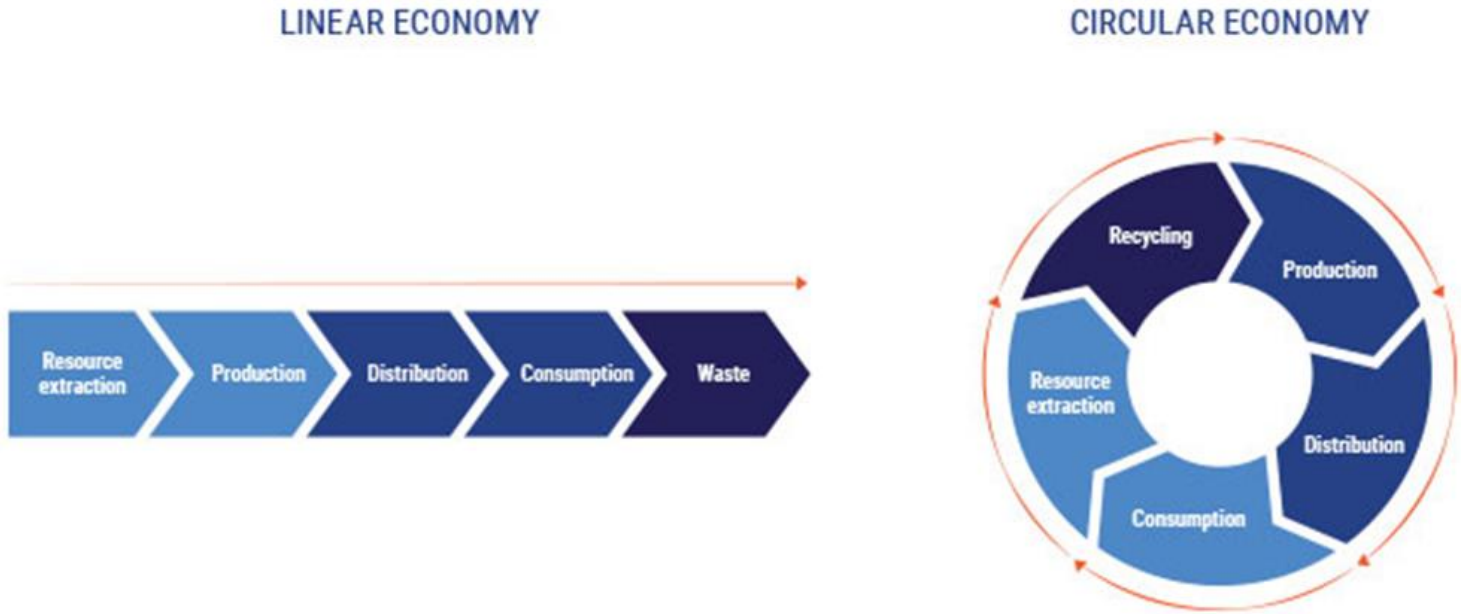
- 35% are already using immersive tech such as VR/AR and 50% plan to do so within five years.

Circular Economy

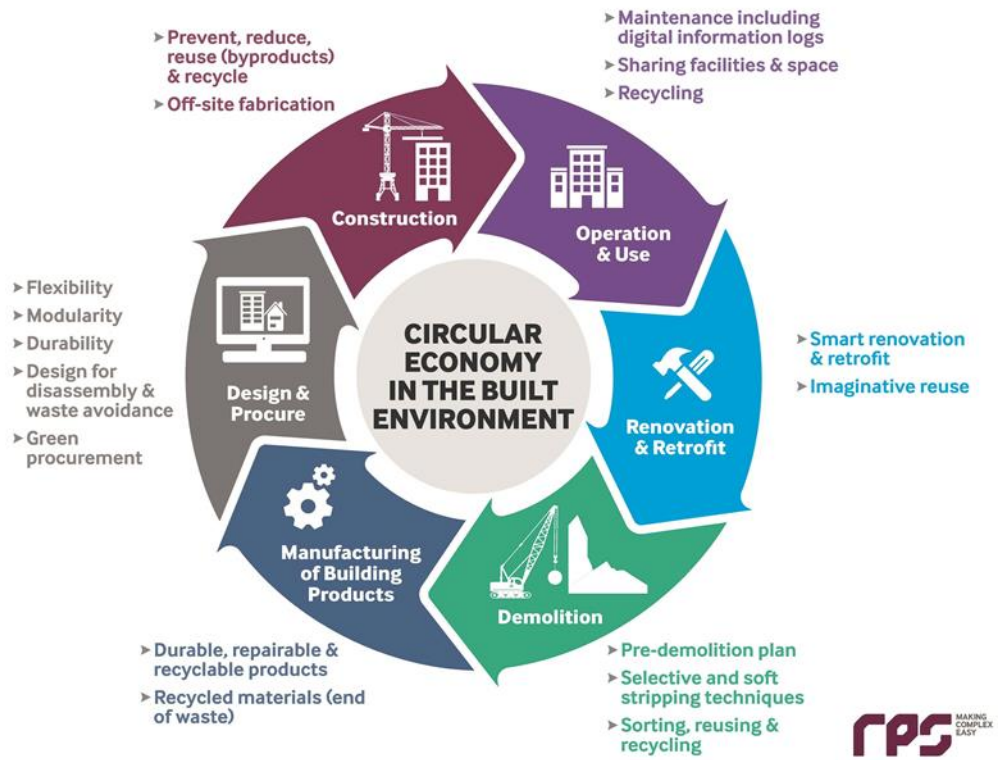
What is a Circular Economy?

- Circular Economy is an approach/system that keeps products at their highest use/value for as long as possible

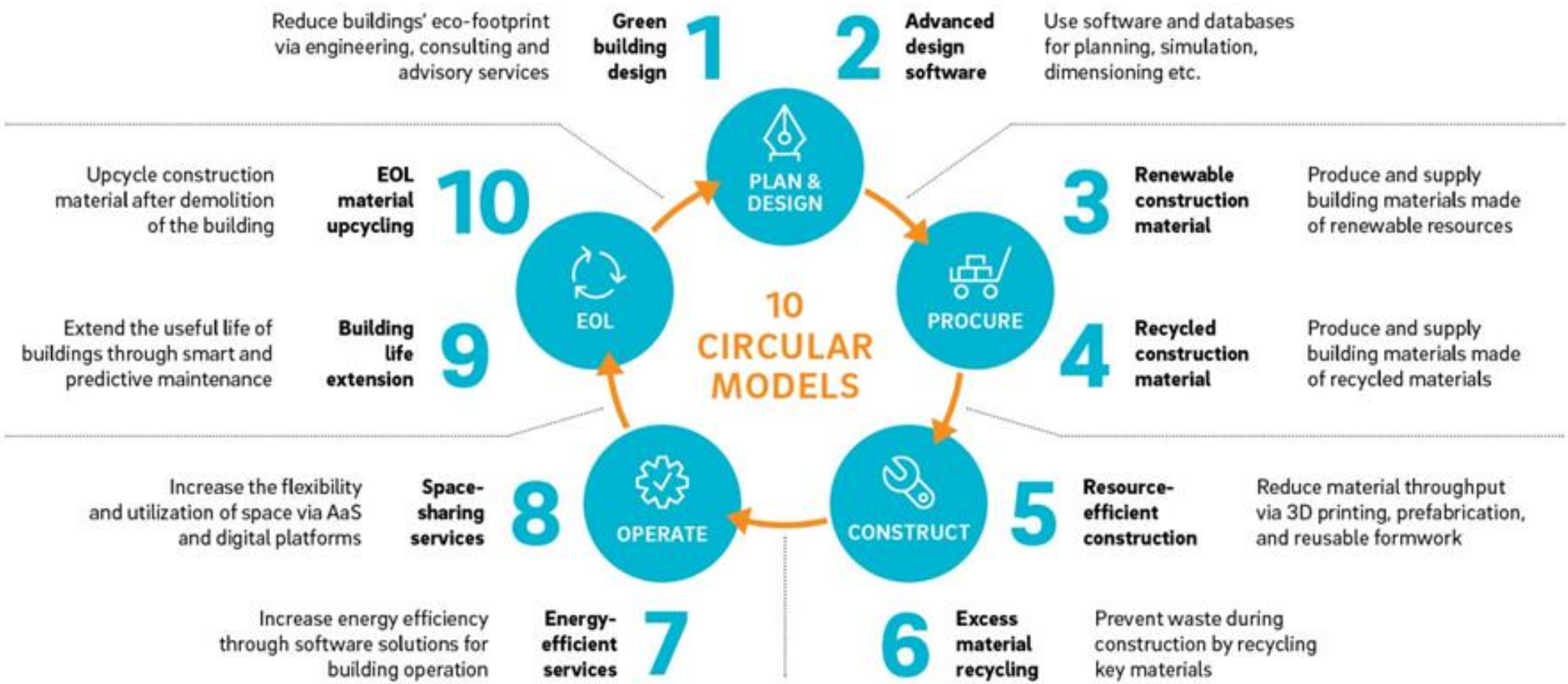
A Circular Economy is regenerative by design and aims to gradually decouple growth from the consumption of finite resource and GHGs emissions




Infinite resources
Resource extraction
Production
Distribution
Consumption
Dispose
Infinite regenerative capacity of the Earth
TAKE
MAKE
WASTE


Prevent, reduce, reuse (byproducts) & recycle
Off-site fabrication
Maintenance including digital information logs
Sharing facilities & space
Recycling
Construction
Operation & Use
Flexibility
Modularity
Durability
Design for disassembly & waste avoidance
Green procurement
Design & Procure
CIRCULAR ECONOMY IN THE BUILT ENVIRONMENT
Smart renovation & retrofit
Imaginative reuse
Renovation & Retrofit
Manufacturing of Building Products
Demolition
Durable, repairable & recyclable products
Recycled materials (end of waste)
Pre-demolition plan
Selective and soft stripping techniques
Sorting, reusing & recycling
MAKING COMPLEX EASY

10 circular business models for more sustainable construction



Source Roland Berger

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EXTRACTING RAW MATERIAL
PRODUCTION
DISTRIBUTION
RETAIL
USER
UNRECYCLABLE WASTE
RECYCLE
PARTS HARVESTING
REFURBISH
SERVICE
CIRCULAR ECONOMY

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