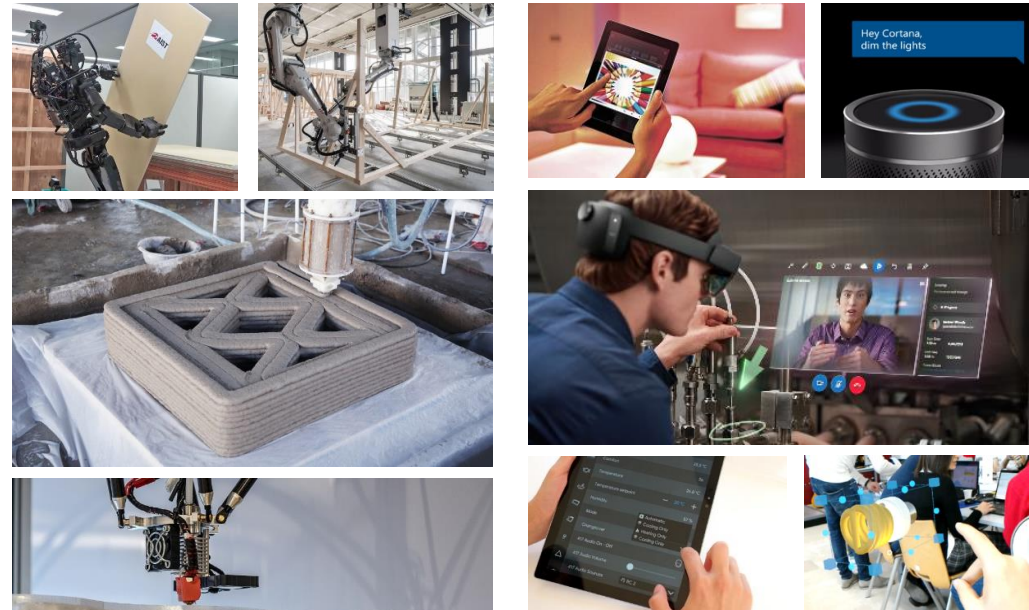# Changing the way we

New technologies have begun transforming the way that infrastructure, real estate and other built assets can be **designed, constructed and operated**
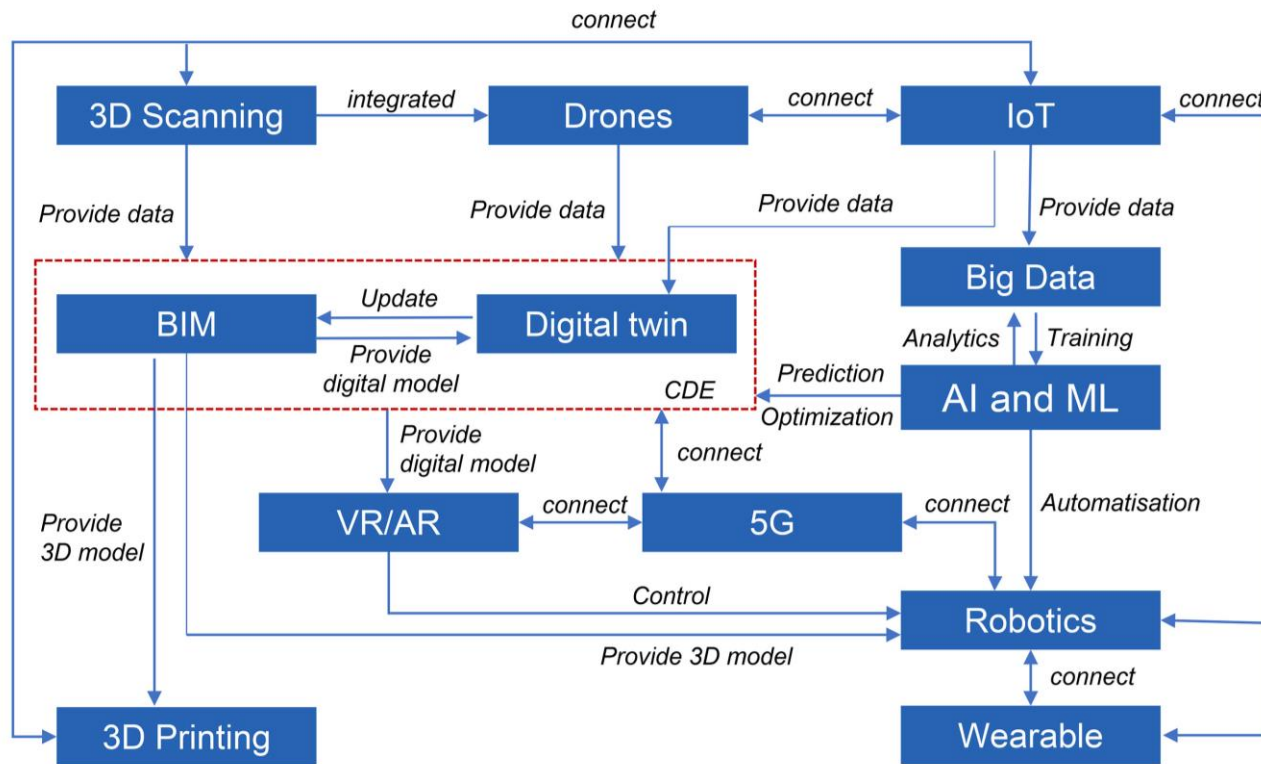

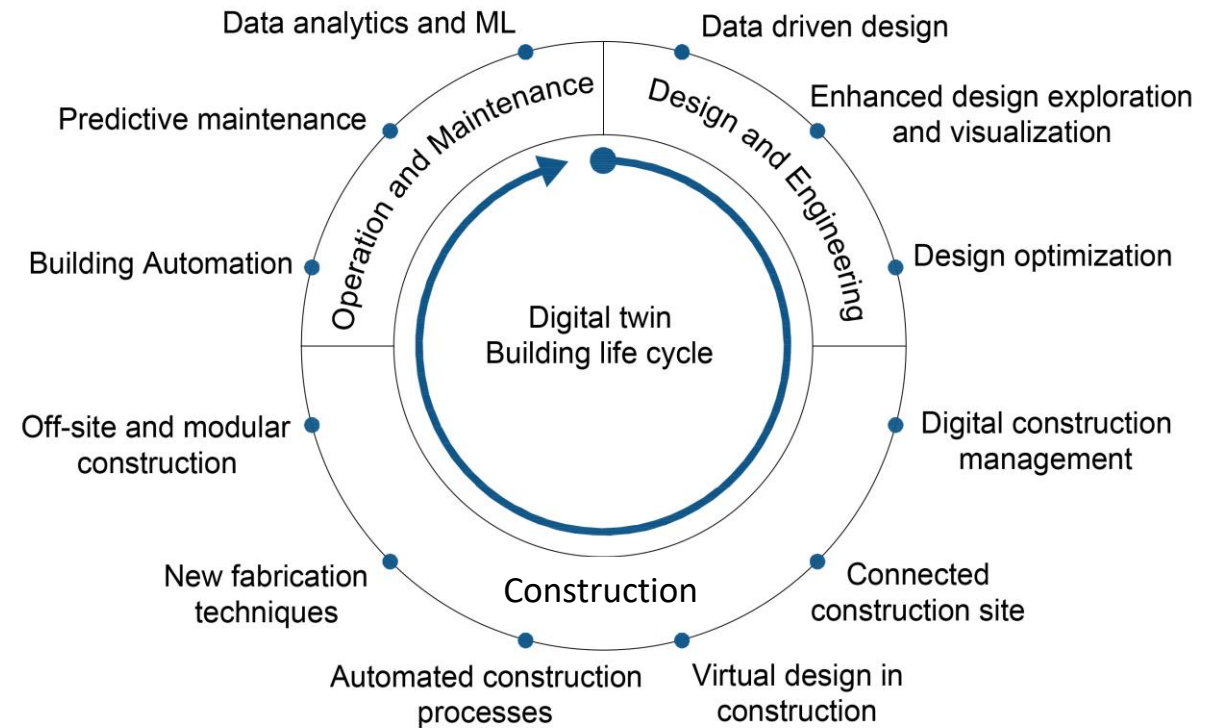**DESIGN**

CONSTRUCT

OPERATE

Construction **D**igital **T**win & **A**rtificial **I**ntelligence
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Diagram:

- 3D Scanning —integrated→ Drones —connect→ IoT —connect→ (loops)
- connect (3D Scanning → IoT, top)
- 3D Scanning —Provide data→ BIM
- Drones —Provide data→ Digital twin
- IoT —Provide data→ Big Data (and Digital twin)
- BIM ⇄ Digital twin (Update / Provide digital model)
- CDE (box around BIM and Digital twin)
- BIM —Provide digital model→ VR/AR
- BIM —Provide 3D model→ 3D Printing
- Digital twin —connect→ 5G
- Big Data —Analytics / Training→ AI and ML
- AI and ML —Prediction / Optimization→ Digital twin
- AI and ML —Automatisation→ Robotics
- VR/AR —connect→ 5G
- 5G —connect→ Robotics
- VR/AR —Control→ Robotics
- 3D Printing —Provide 3D model→ Robotics
- Robotics —connect→ Wearable

TABLE 3.1 The digital world of AECO industry.

Construction 4.0 technologies	Key technologies						
	BIM	Cloud and edge computing	IoT	5G	AI and ML	Big Data and analytics	Nanotechnology
3D mapping and scanning	■	■		■			
Additive manufacturing	■						■
Advanced materials					■		■
Autonomous vehicles	■	■	■	■	■		
Blockchain	■	■					
Building automation system	■	■	■	■	■	■	■
Building energy storage							■
Building integrated PV							■
Building performance simulation	■	■	■		■	■	
Common data environment		■		■			
Connected construction site	■	■	■	■	■	■	
Digital fabrication	■						■
Digital twin	■	■	■	■	■	■	
Extended reality (VR/AR/MR)	■	■		■			
Generative design	■	■			■	■	
Machine vision		■	■		■		
Mobile Internet		■		■			
Parametric design	■	■					
Predictive maintenance	■	■	■		■	■	
Real-time 3D visualization	■	■		■			
Robots in construction	■	■	■		■		
Smart grids		■	■	■	■	■	■
Smart home		■	■	■		■	
Smart objects		■	■	■	■		
UAVs	■	■			■		
Virtual assistants		■	■		■	■	
Wearable technology		■	■	■	■	■	

TABLE 1.13 The use of digital technologies in the construction sector.

	Design and engineering	Construction	Operation and management	Renovation and demolition
3D mapping and scanning	■	■		■
Additive manufacturing	■	■	■	
AI and ML	■	■	■	■
Autonomous vehicles		■	■	■
Big Data and analytics	■	■	■	■
BIM	■	■	■	■
Blockchain	■	■		
Building performance simulation	■		■	
Common data environment	■	■	■	■
Digital fabrication	■	■		
Digital twin	■	■	■	■
Extended reality (VR/AR/Mr)	■	■	■	■
IoT		■	■	■
Mobile Internet		■	■	■
Robots		■	■	■
UAVs	■	■	■	■
Wearable technology		■	■	

Construction 4.0

The combination of Digital technologies enables, in addition to a full collaboration between all actors of the building process, the adoption of a **digital building life-cycle model** that allows to:

- create the digital virtual buildings first
- assemble the physical artifact and
- commission the digital-physical building as a new tool for real estate and facility management.

In particular, the **Construction 4.0** approach allows to:

- virtually erect the building by simulating and monitoring its performance at all process stages from design, construction, management to decommissioning

- automate the processes of design (via parametric/generative tools), construction (site automation) and building management (BAS, digital twin)

- analyze the operational data of the construction and management phases for predictive analysis, optimization and decision making

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Partner

Construction Digital Twin & Artificial Intelligence Master Course

- Department of Urban Planning Design Architecture Technologies

  Sapienza University of Rome

  Faculty of Architecture

  Master Degree in Architecture, Engineering, Computer & Data science

  One year

  Classes (on line)

  Workshop & Laboratories (blended)

  Internship | 2 months

  Final thesis

Construction
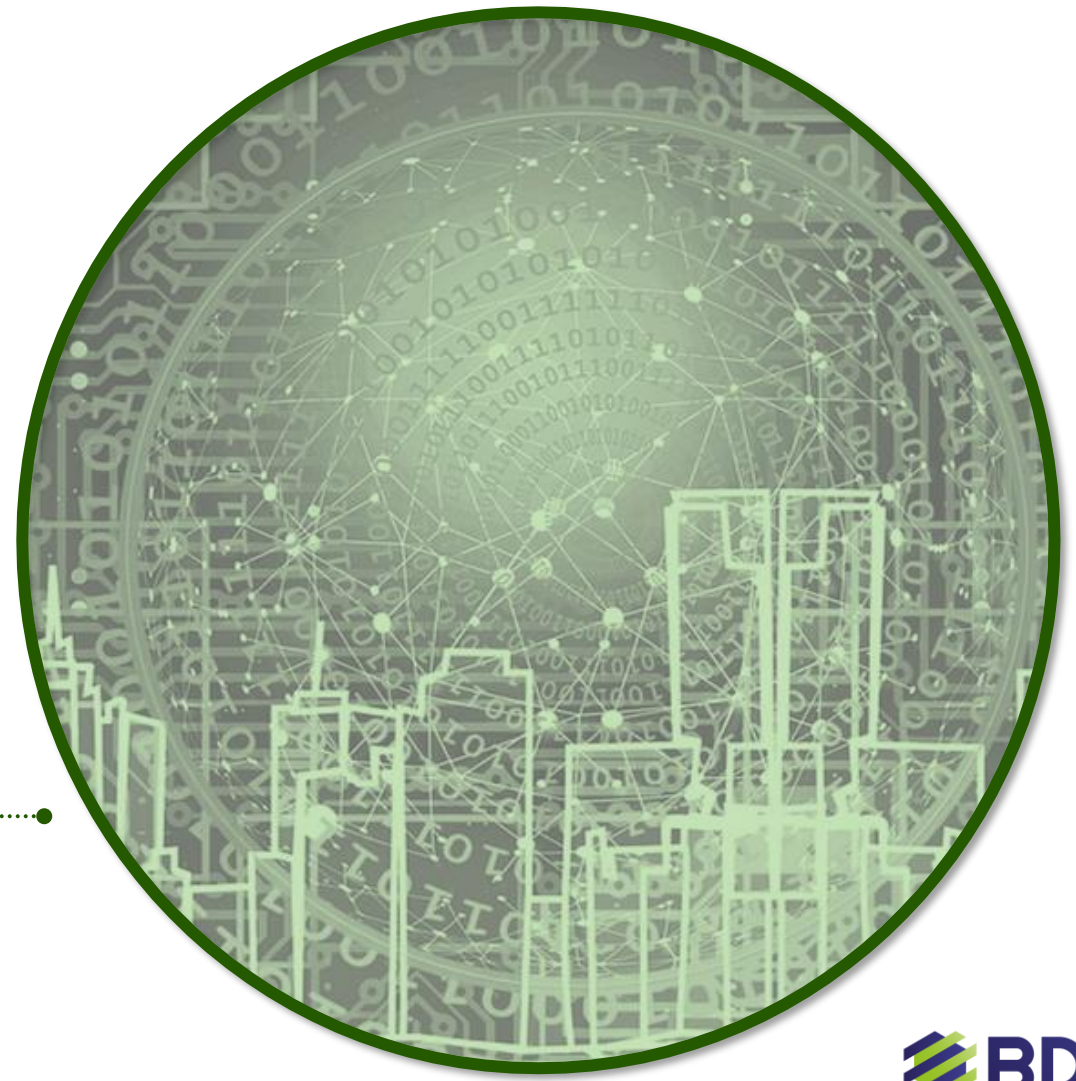Digital **Twin**
& **Artificial**
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Section I
Industry 4.0 for the AECO sector

Digital transition in the AECO sector tools and methods ●┄┄┄┄┄┄┄┄┄┄┄●

Key enabling technologies ●┄┄┄┄┄┄┄┄┄┄┄●

Construction Digital Twin ●┄┄┄┄┄┄┄┄┄┄┄●

Section II
Computer Science, Data Interoperability & Artificial Intelligence

Data Management

5G Network

Data Analytics & Machine Learning

Artificial Intelligence
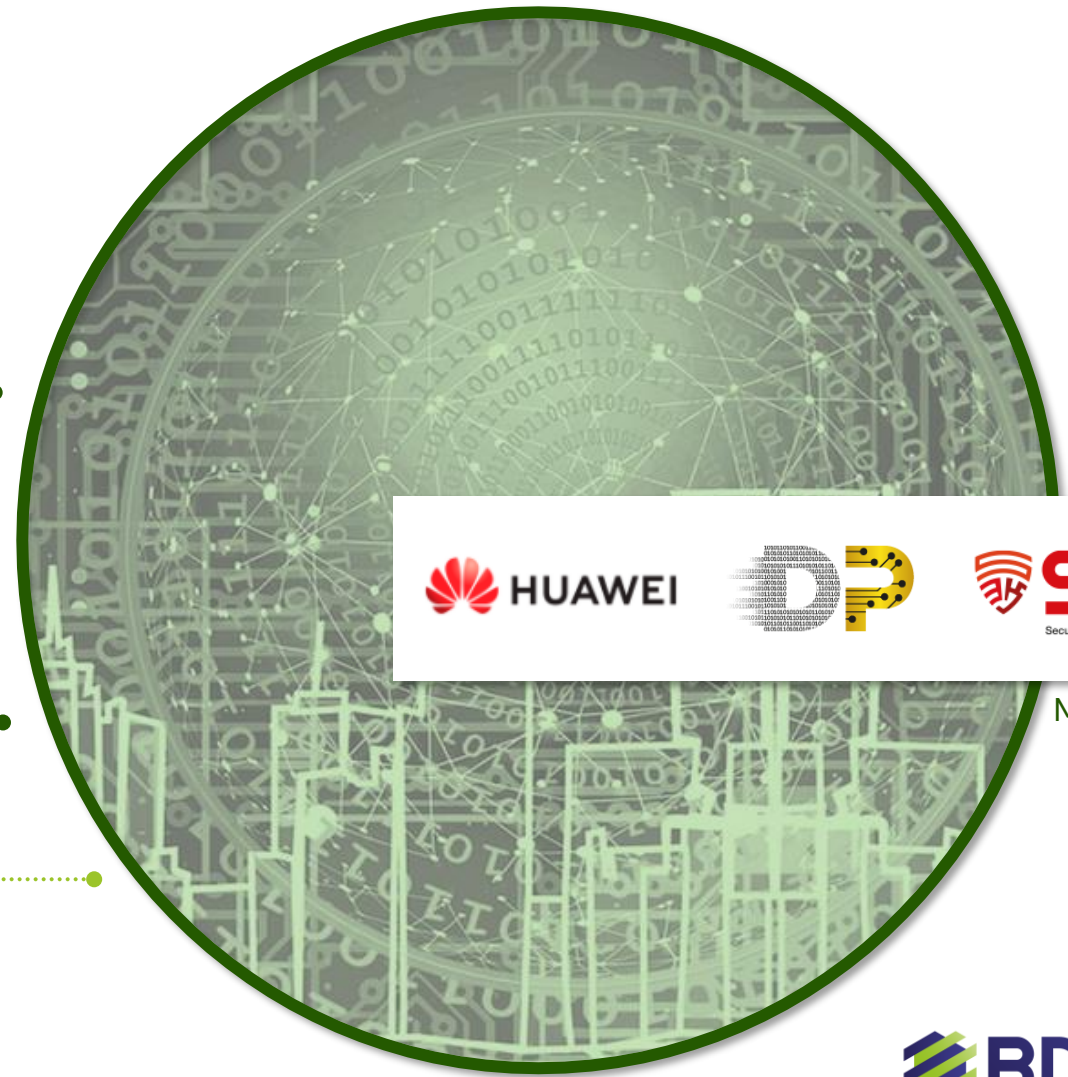
HUAWEI

DP

S3K
Security of the Third Millennium

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Section IV

From BIM to Digital Twin of the built the environment

BIM in Construction

Digitalization of the costruction sector

Multidimensional digital models BIM

Common Data Environment (CDE) and interoperability
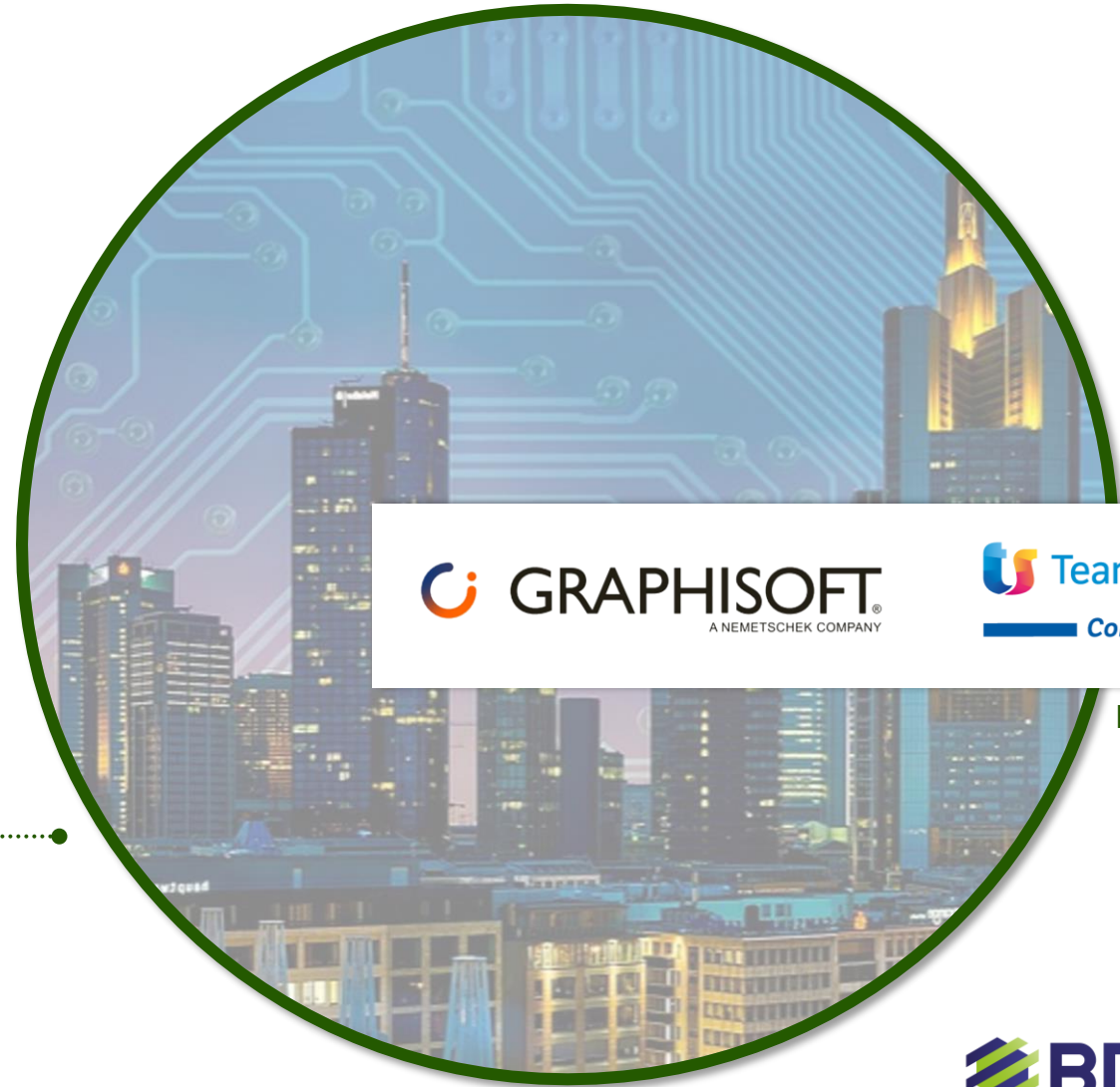
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Section VII
Virtual Construction and Operation: Extended Realities

XR in Construction

Virtual Design & Construction ········•

AR/VR/MR ········•

Collaborative frameworks, platforms and devices ········•

The metaverse ········•

Hevolus   Trimble

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Section V
Construction Project Management & data-driven decision making

Estimating – planning – construction ●·············●

Simulating & quantifying, time and costs control ●·············●

Simulation of the progress of works ●·············●
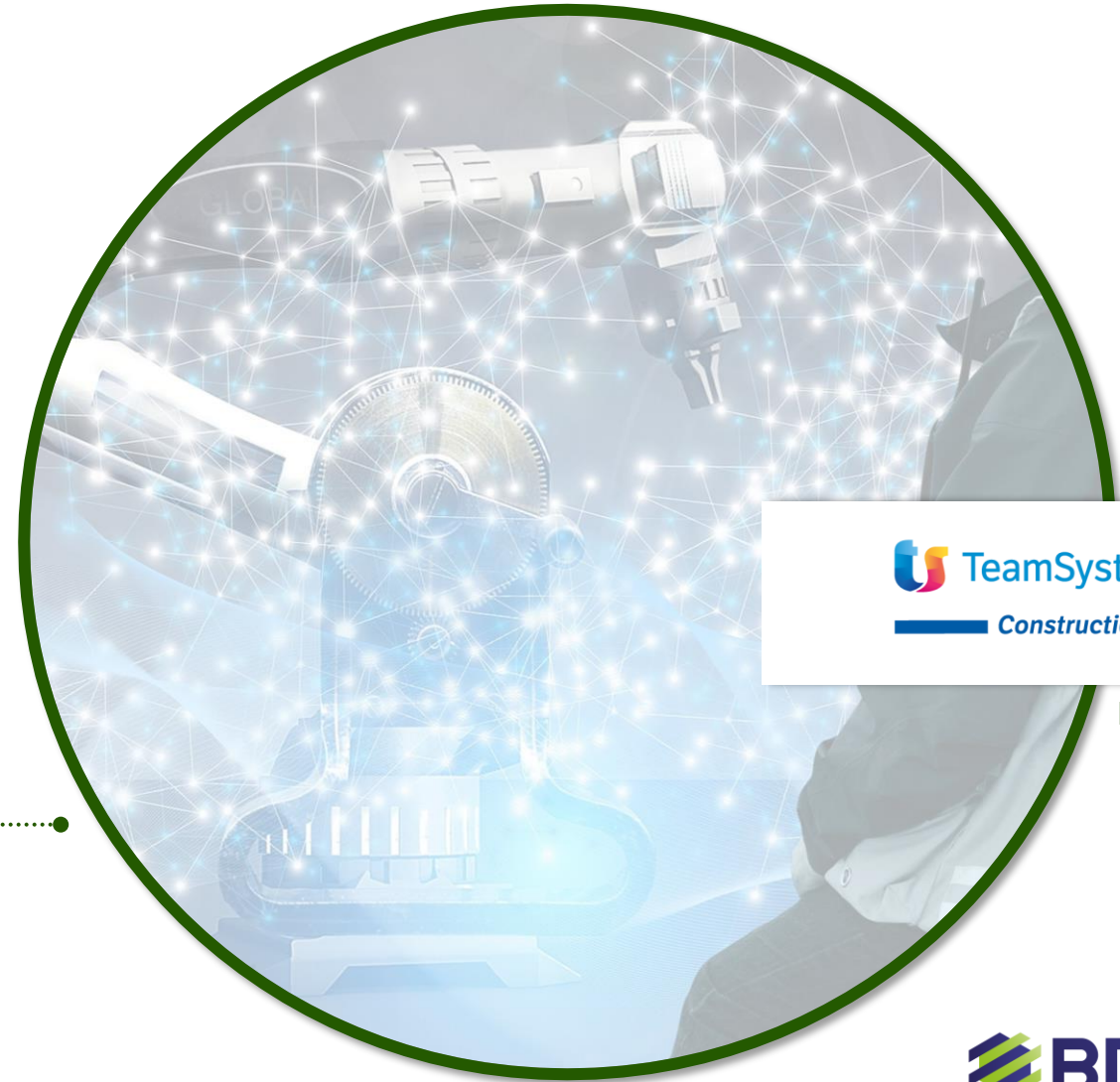
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Section III
IoT Systems and Artificial Intelligence for Built Environment Management

AI in Construction

Overview and basics of AI ●····················●

Artificial Neural Networks ●····················●

Computer vision ●····················●

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Section III
IoT Systems and Artificial Intelligence for Built Environment Management

AI in Operation & Management

Overview and basics of AI ·············

Artificial Neural Networks ·············

Computer vision ·············

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Section VII
Virtual Construction and Operation: Extended Realities

XR in Operation & Management

Virtual Construction & Operation

AR/VR/MR

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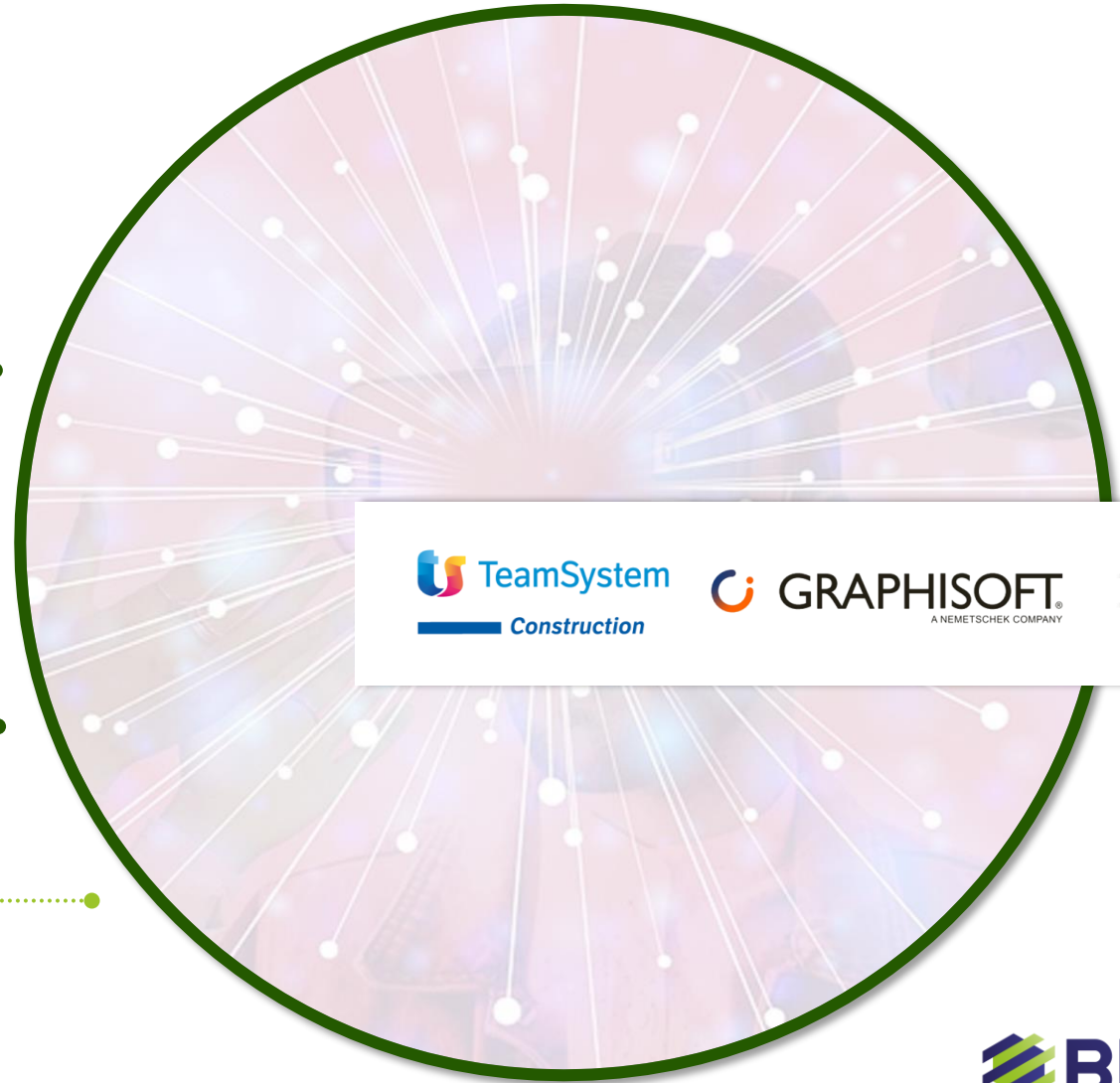
Case histories

Thanks for your attention