Digital Twins in Construction

CE441B Class Industry Seminar Presentation (Group 1)
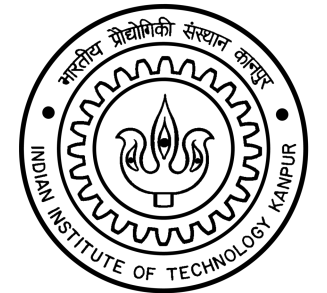
Aman Kumar Singh (200100)

Kaushal Kumar Jha (200498)

Abhinav Kumar Singh (200018)

Astik Yadav (200217)

Smriti Triparthi (200988)

Dr. Chirag Kothari
Department of Civil Engineering
Indian Institute of Technology Kanpur

Image courtesy : Tesla
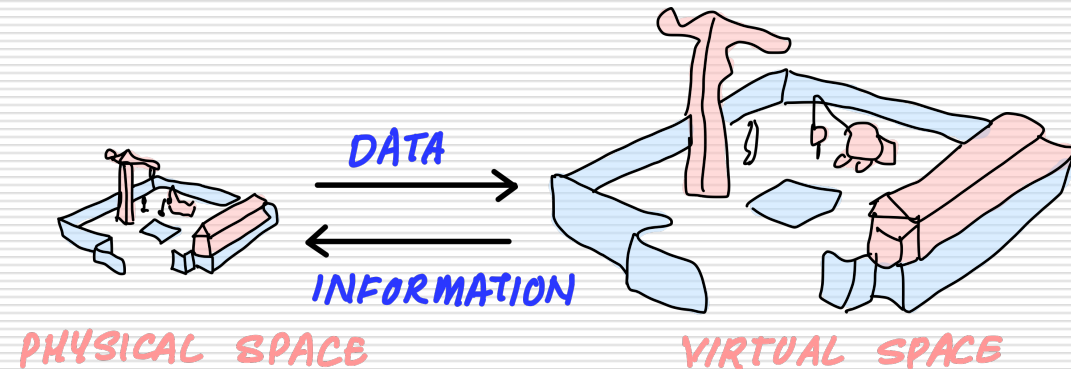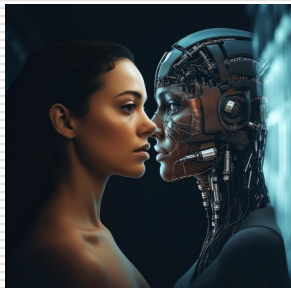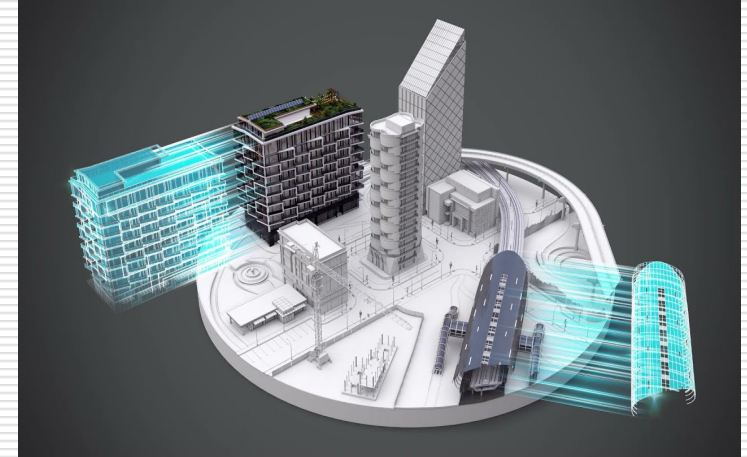
BIM (Building Information Modeling)

- ☐ A **digital model** of a **building** that has all its **information**
- ☐ What does BIM contain?
  - ■ A 3D model of the building
  - ■ Information about materials, dimensions, costs, strength, etc
  - ■ Construction schedule and progress
- ☐ Why BIM is important?
  - ■ Plan, design, & build better buildings
  - ■ Time and Cost Savings
  - ■ Enhanced Sustainability
  - ■ Easy Management
- ☐ Foundation for **Digital Twins**

BIM
DIGITAL MODEL

DIGITAL TWIN
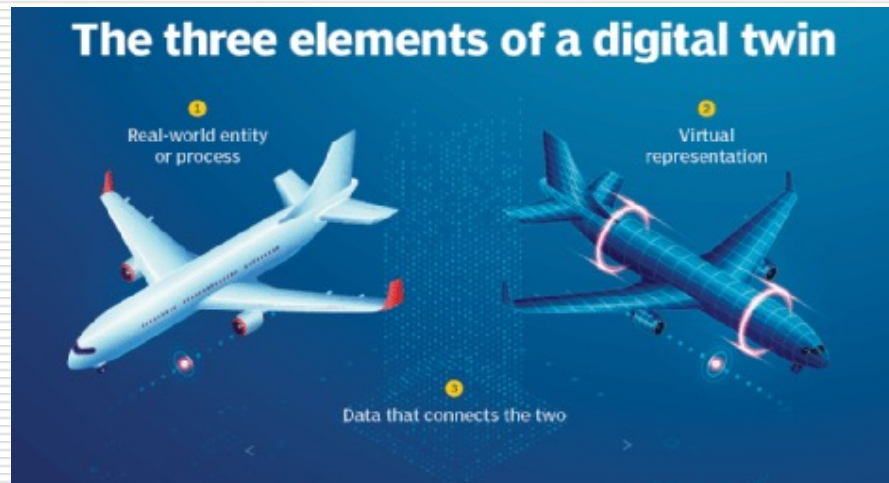DIGITAL MODEL + REAL TIME DATA + ANALYTICS
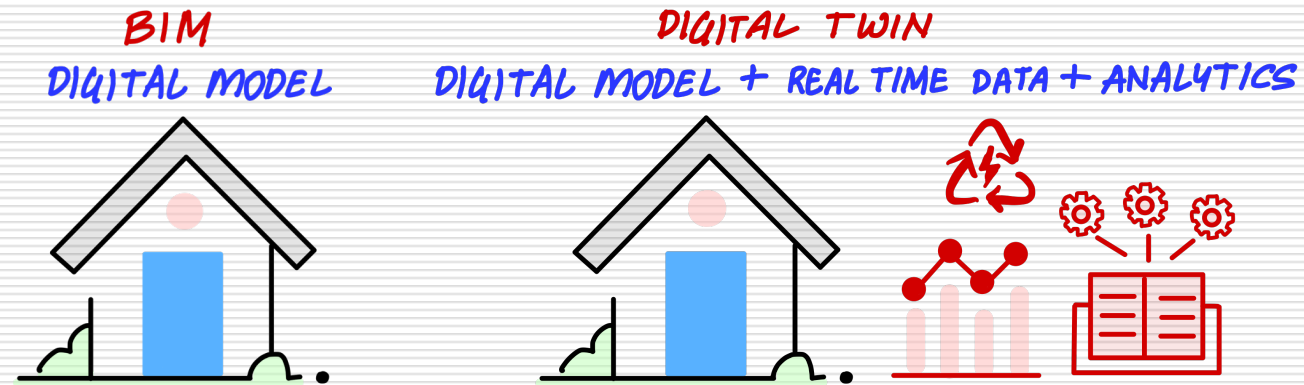
Digital Twin = BIM + Interactivity

Digital Twins

- **Real-time replicas** of physical assets in industries
- **Dynamic Nature** reflecting real-world changes
- Created using data from a lot of **sensors**
- Encompasses entire objects or systems, such as buildings, campuses, cities, or railways
- Utilized for simulation, testing, monitoring, and maintenance throughout product lifecycle

DATA

INFORMATION

PHYSICAL SPACE

VIRTUAL SPACE

Images Courtesy : Freepik, Mckinsey, Network World, Autodesk

Key Components

☐ Physical object/process and its physical environment

☐ Digital representation of the object/process

☐ Communication channel b/w the physical and virtual representations for continuous synchronization

The three elements of a digital twin

1 Real-world entity or process

2 Virtual representation

3 Data that connects the two

Example of Digital Twin

☐ **NEST** (Next Evolution in Sustainable Building Technologies)

- ■ Laser scanned to create Digital Twin
- ■ Located on Empa's campus in Zurich
- ■ To get a virtual tour, go to *https://empa-virtual.ch/nest/en/*
- ■ Research platform for testing construction materials and practices, driving innovation in sustainable building technologies


Images Courtesy NEST, ETH Zurich
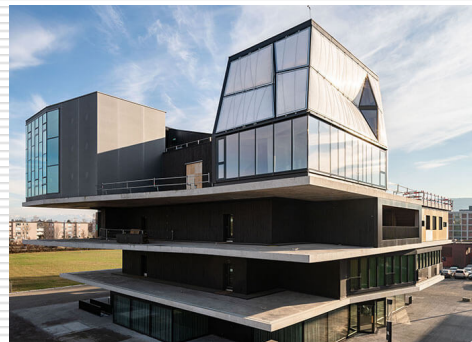
Benefits of Digital Twins

- ☐ Cost Savings
- ☐ Time Savings
- ☐ Improved Safety & Decision making
  - ▪ Automating dangerous tasks
  - ▪ Real time information about potential hazards
- ☐ Increased Efficiency and Productivity
- ☐ Enhanced Stakeholder Collaboration
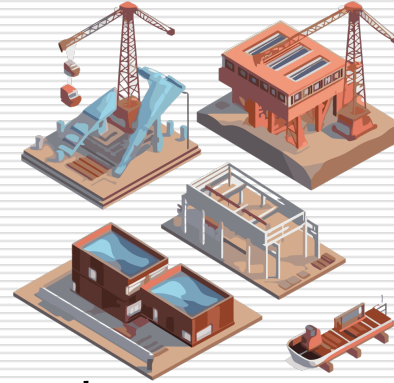
Applications of Digital Twins

- Simulate new building construction & identify potential problems
- Optimize performance to improve efficiency & reduce waste
- Infrastructure management of bridges, dams, & roads to ensure safety & longevity
- Smart cities
 - Traffic Management & Improved Safety
  - Urban Planning
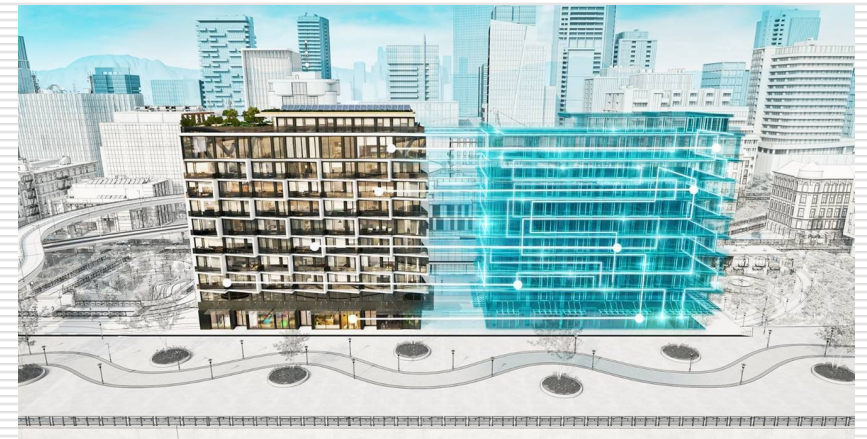
Challenges of Implementing digital twins

- [ ] High costs of installing sensors
- [ ] Data Privacy & Security
- [ ] Accurate data feeding from stakeholders
- [ ] Lack of standards and guidelines

Images Courtesy : Freepik

Future of Digital Twins

- Expected Growth over years
- Enhanced Decision Making
- Aid for Virtual Reality & Metaverse
- Integration with other technologies like GIS,IoTs, 5G etc
- Emphasis on sustainability & environmental impact

Images Courtesy : Confectionary News, Smart Cities World, ESRI
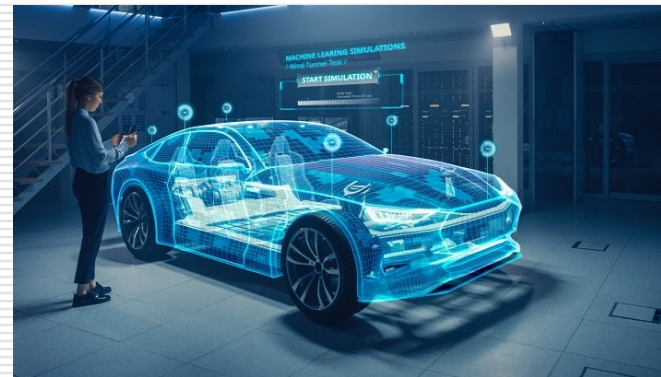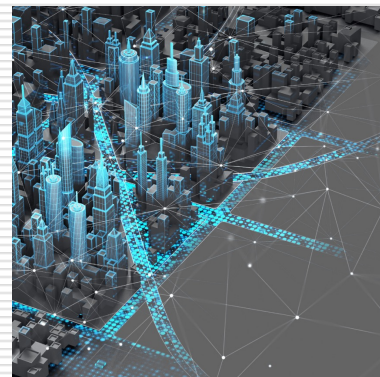
Think of PK Kelkar Library's digital twin

☐ Digital Twin of PK Kelkar Library

■ AC Temperature Adjustment

■ Lighting Adjustment

■ Maintenance and Operations
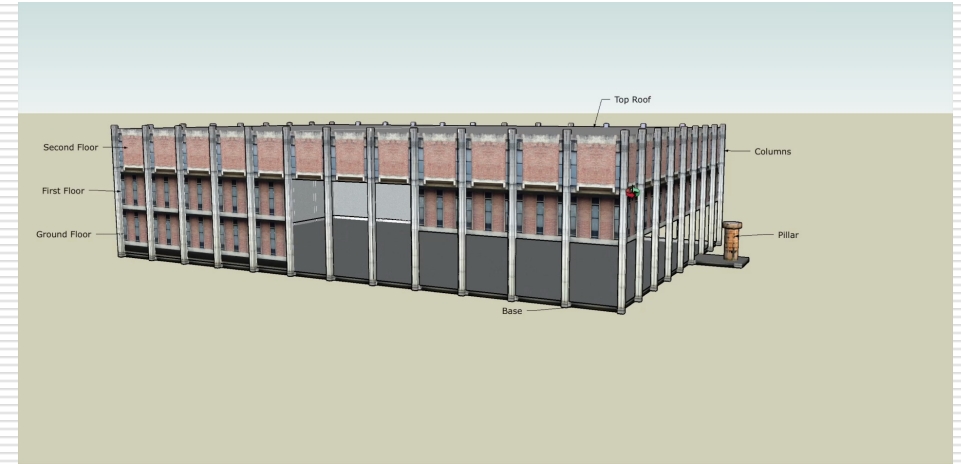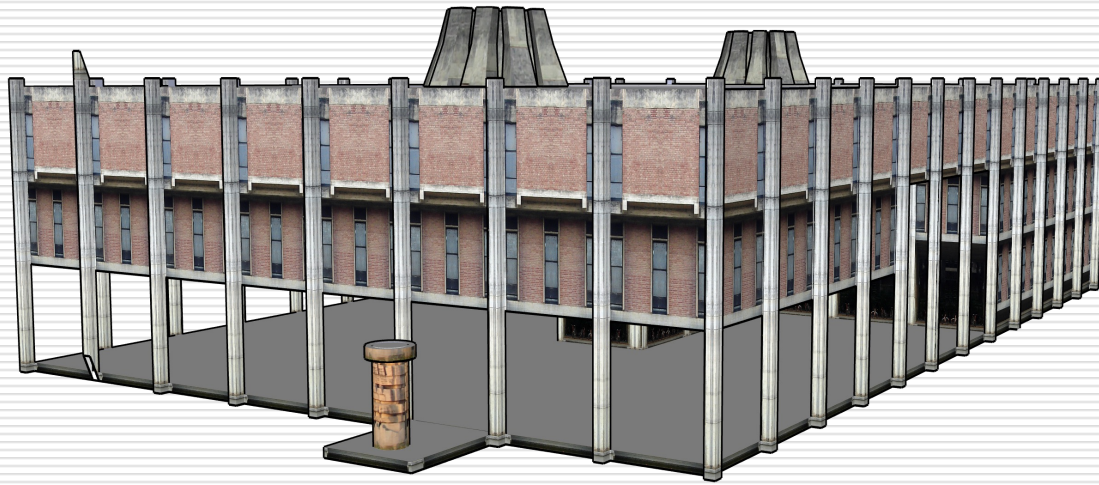
Conclusions for Digital Twin

- ☐ Real time replica of physical world

- ☐ Potential to revolutionize construction

- ☐ Numerous Benefits
  - ■ Costs Savings
  - ■ Time Savings
  - ■ Efficiency & Safety

- ☐ Not just limited to construction: broader term

- ☐ Implementation challenges exist

- ☐ The future of construction is virtual

Images Courtesy pngtree & Techtarget
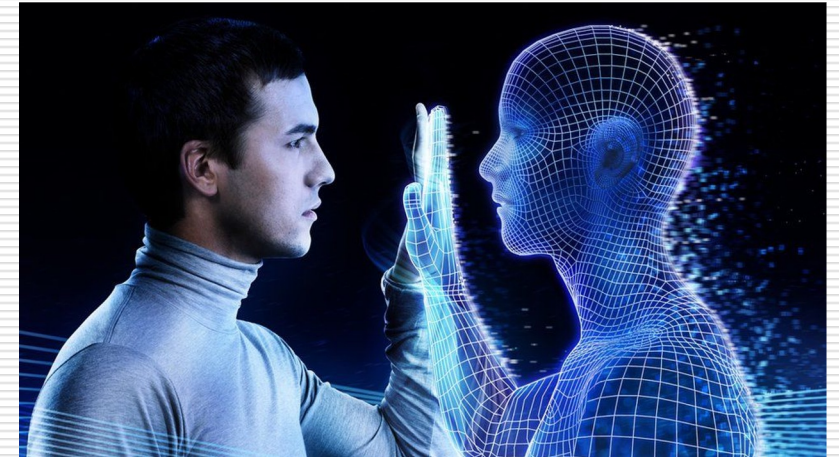
References

- *McKinsey & Company*, Featured Insights, July 2023
  - *https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-digital-twin-technology*
- *Wikipedia*
  - *https://en.wikipedia.org/wiki/Digital_twin*
- Autodesk
  - *https://www.autodesk.com/solutions/digital-twin/architecture-engineering-construction*
- ESRI
  - *https://www.esri.com/en-us/digital-twin/overview*
- Trimble
  - *https://constructible.trimble.com/construction-industry/what-are-digital-twins*

Thank You!

CE441B Industry Seminar Presentation
(Group 1)