

TRANSFORMING METRO CONSTRUCTION AND MANAGEMENT DIGITAL TWIN AND SMART AUTOMATION

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DEPUTY CHIEF ARCHITECT

DELHI METRO RAIL CORPORATION LIMITED





BRIEF INTRODUCTION ABOUT DMRC

Set up on May 3rd
1995, under the Indian
Companies Act

A joint venture
between GOI and
GNCTD (50:50)

Construction started on
01st October 1998

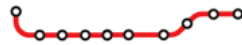
The first section
Shahdara to Tis Hazari
(8.35 km) opened on
25th December 2002

Operates 394.258 km
with 289 stations,
including 29 km of
NGN and 13 Km of
Rapid Metro

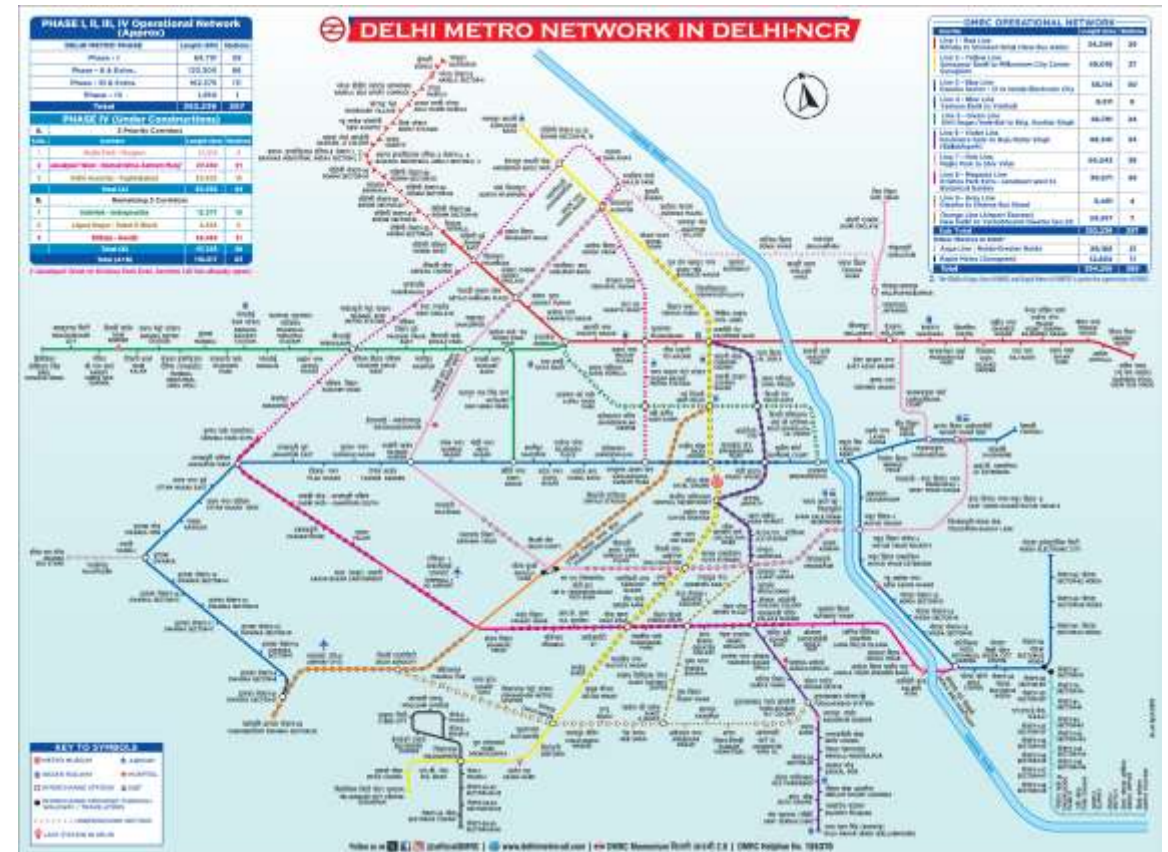
Carries around 7
million passenger
journeys/day



ABOUT DELHI METRO - GROWTH



2003



DMRC HAS ESTABLISHED A VAST NETWORK OF 394.258 KM AND 289 STATIONS, INCLUDING THE NOIDA-GREATER NOIDA CORRIDOR AND RAPID METRO, GURUGRAM, IN RECORD TIME, SETTING A BENCHMARK FOR EFFICIENT GOVERNMENT INFRASTRUCTURE PROJECTS.



THE EVOLUTION

CAD

Computer-Aided Design ushered in a new era for architects and engineers, enabling the ability to create 2D and 3D representations with enhanced precision and details. It also found uses in space planning, maintaining blueprints, and asset mapping.

1960s

BIM

1970s

Digital Twins

Now



THE EVOLUTION

CAD

1960s

BIM

Building Information Modeling was a more evolved digital representation of the physical and functional characteristics of a facility. It bridges the gap of understanding between architects, engineers, and contractors, ensuring everyone's on the same page.

1970s

Digital Twins

Now



THE EVOLUTION

CAD

1960s

BIM

1970s

Digital Twins

Digital Twins have emerged as a next-gen solution, building on foundations laid by CAD and BIM to redefine how we interact with, maintain, and operate built environments. No longer static representations, these dynamic models mirror real-time objects or systems.

Now

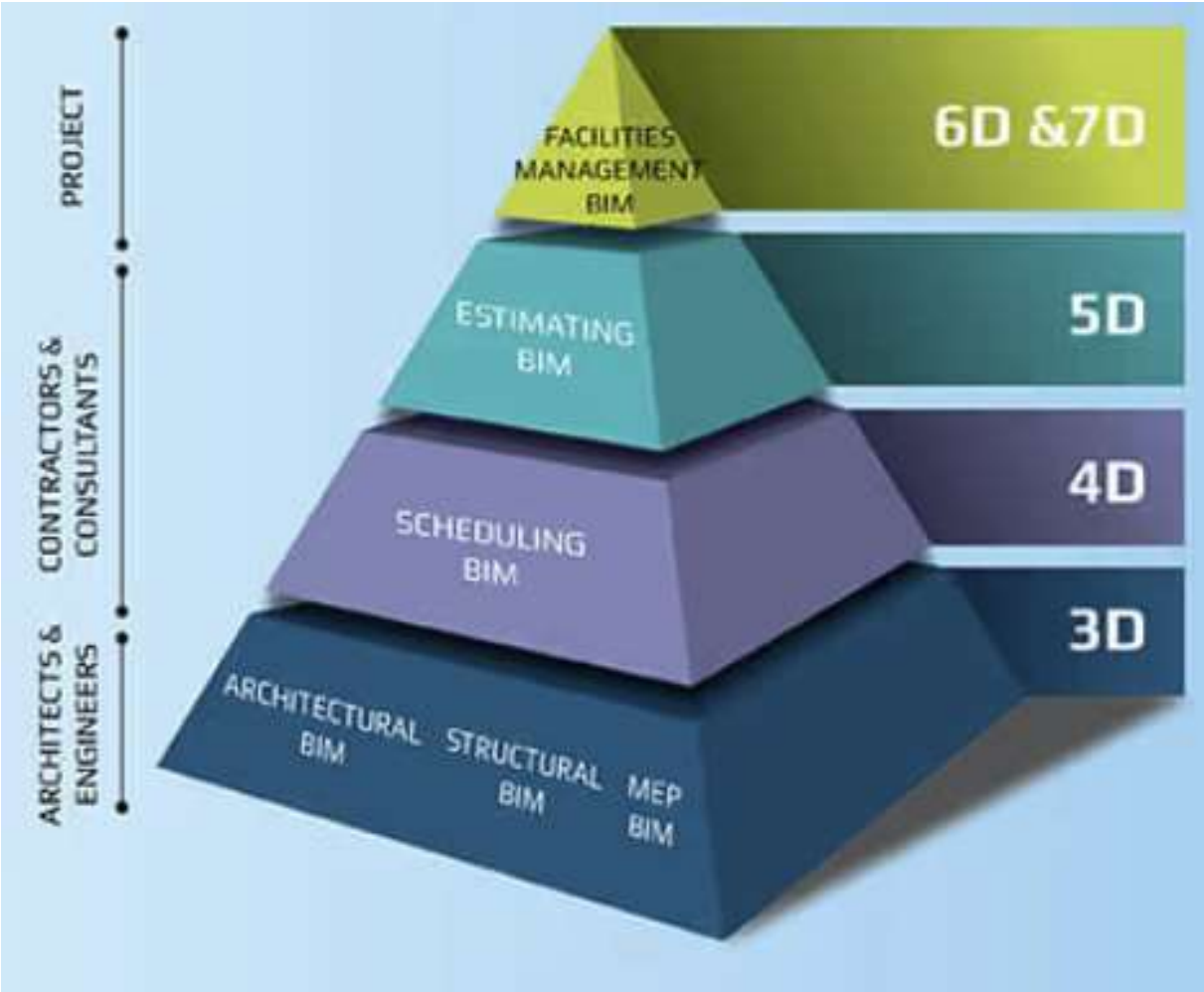




NEED OF THE HOUR



WHY METRO CONSTRUCTION NEEDS DIGITAL TWINS

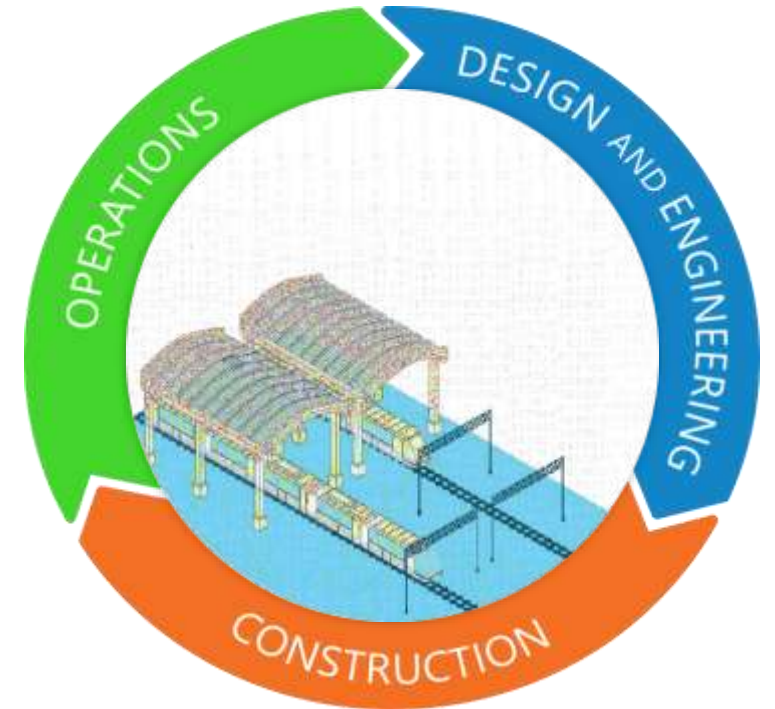


WHY METRO CONSTRUCTION NEEDS DIGITAL TWINS

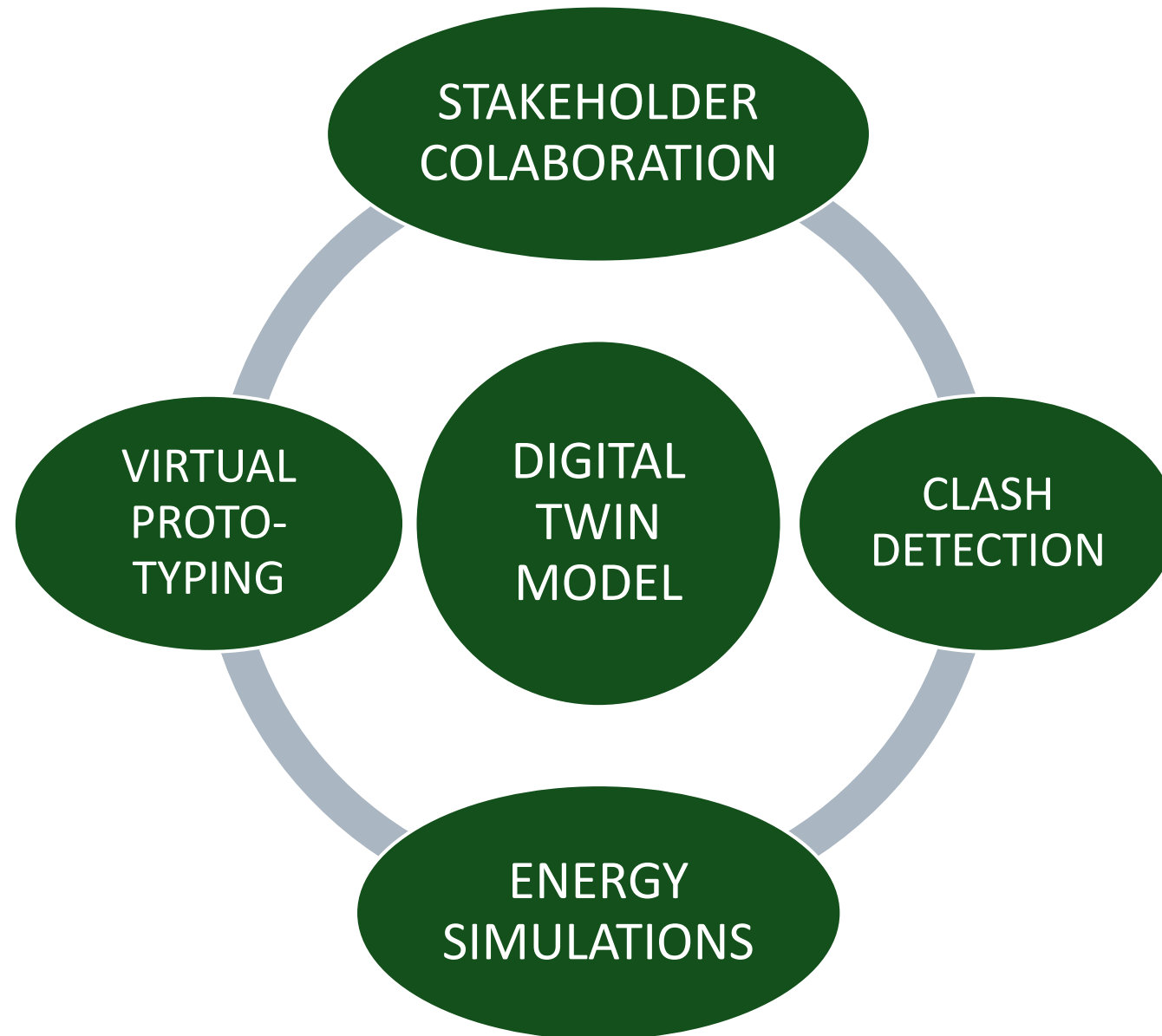
LARGE SCALE COMPLEXITY

SAFETY CRITICAL OPERATIONS

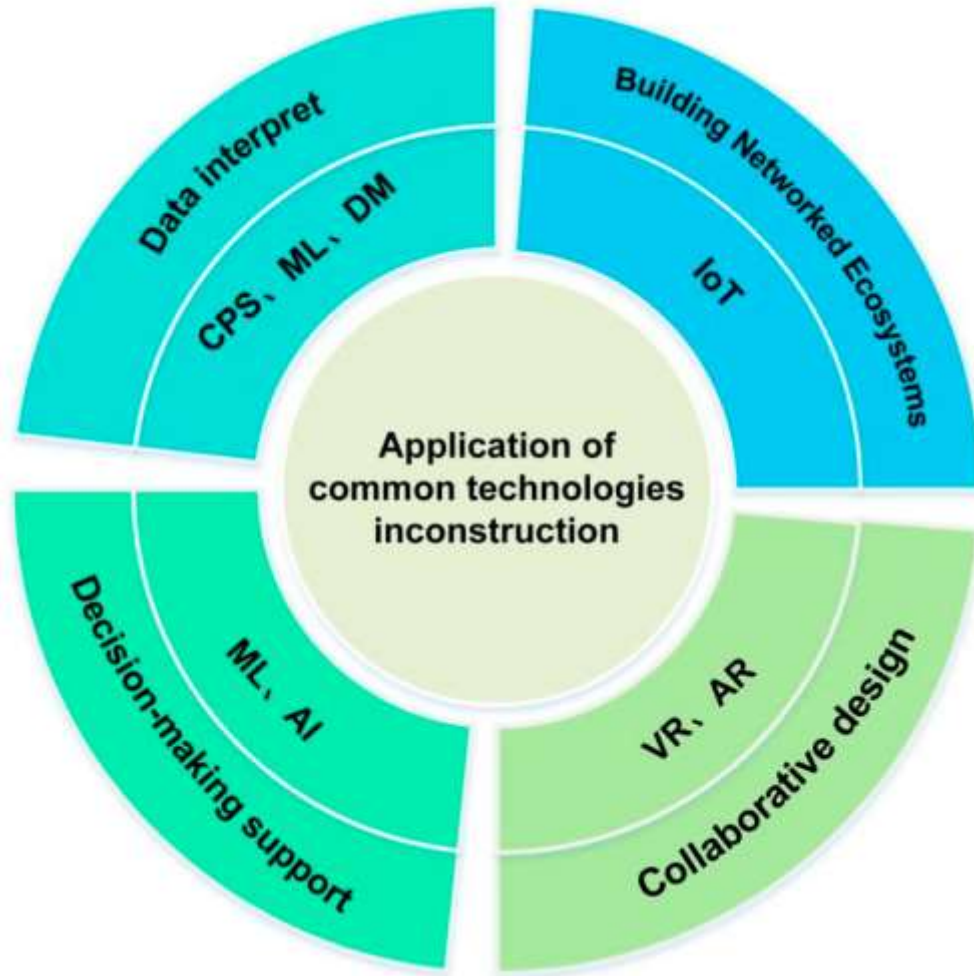
LONG ASSET LIFECYCLE - 100+ YEARS



APPLICATIONS DURING DESIGN PHASE



APPLICATIONS DURING DESIGN PHASE



Application of Digital twin across the lifecycle

Design

- Reduces the overall design process
- Planning and design decision-making
- Iteratively optimize product information and physical models

Construction

- Reduce construction cost, improve quality
- Assessing the structural systems integrity of the object
- Resource, materials, schedule, quality and asset management

Operation and management

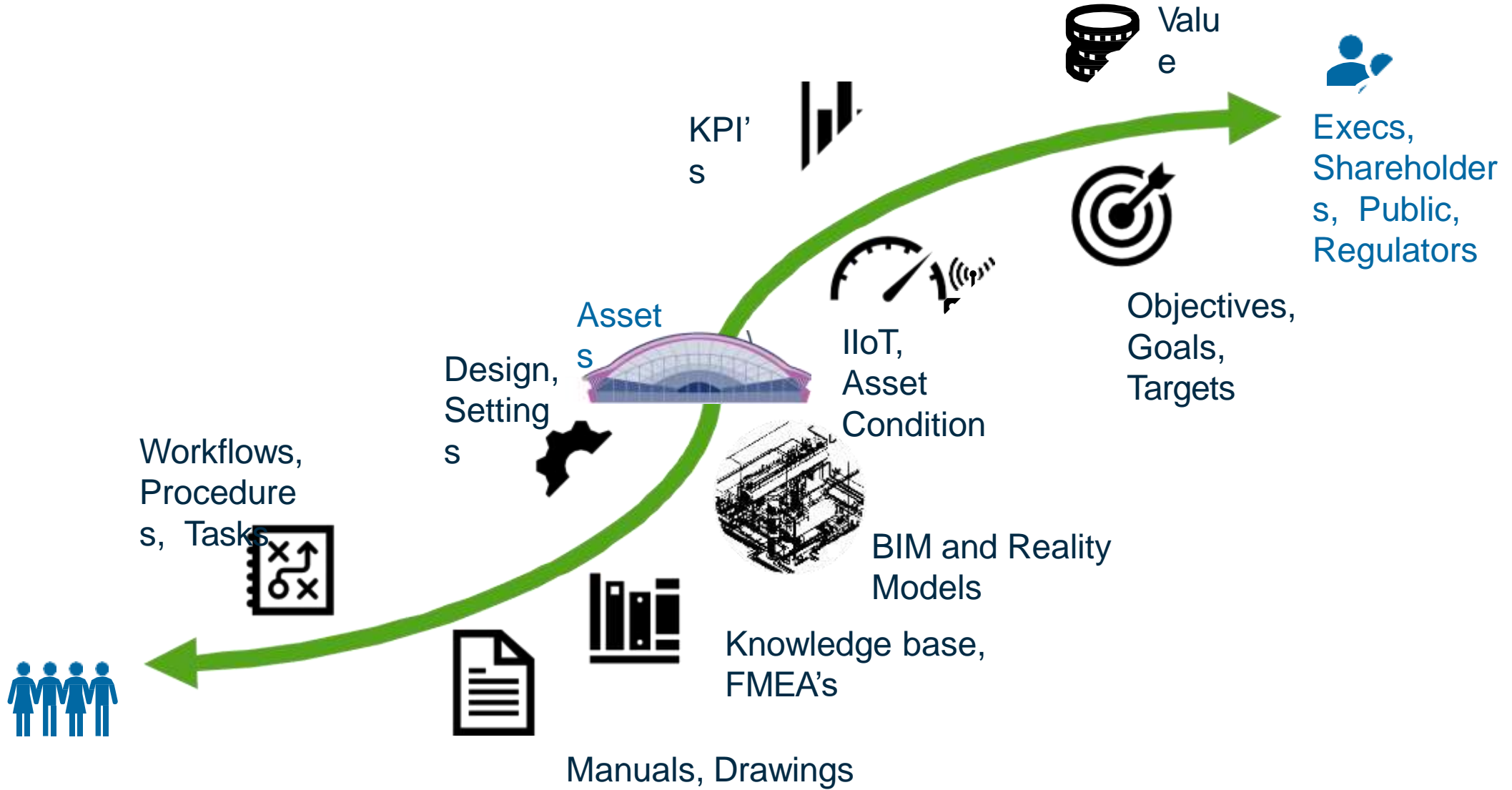
- Real-time monitoring to predictive maintenance
- Enhance information flow among the different stakeholders
- Performance management and energy optimisation decision-making

Demolition and restoration

- Minimal cost of maintaining virtual space
- Automatic identification of potential hazards, technical solutions



DIGITAL TWIN FOR DIGITAL LINE OF SIGHT



Plan

Design

Construct

Commission

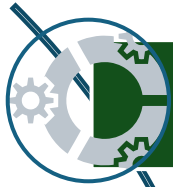
Operate & Maintain

Retire & Recycle

APPLICATIONS DURING CONSTRUCTION PHASE



APPLICATIONS IN OPERATIONS & MAINTENANCE



PREDICTIVE & PREVENTIVE MAINTENANCE



PASSENGER FLOW OPTIMIZATION



SAFETY & INCIDENT RESPONSE



ENERGY EFFICIENCY MONITORING



INTELLIGENT CONTROL SYSTEM (CBTC, i-ATS integration)



ASSET & INVENTORY MANAGEMENT

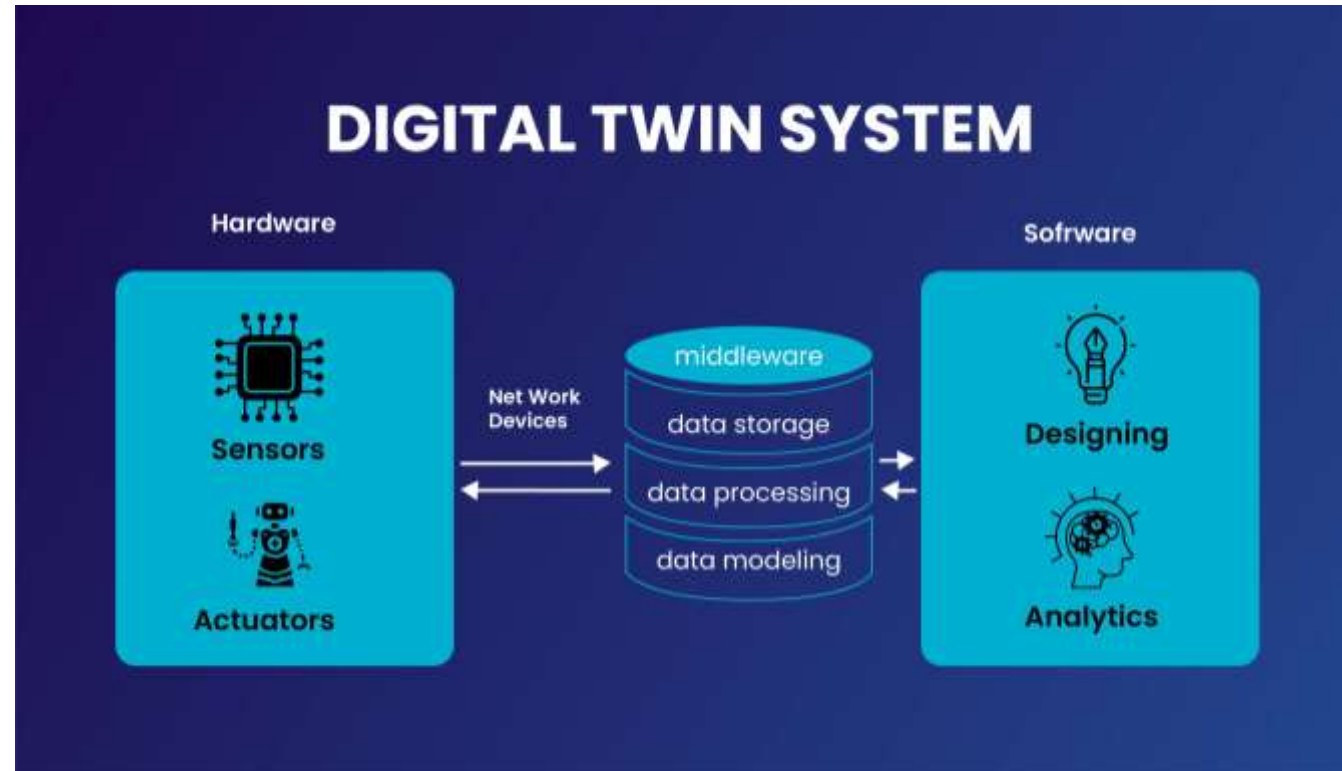


DATA INTEGRATION & IOT

REAL-TIME MONITORING OF
TUNNELS, BRIDGES, TRACKS

ENVIRONMENTAL SENSORS
(AIR QUALITY, VIBRATION,
NOISE)

SAFETY ALARMS & PREDICTIVE
ALERTS



BENEFITS FOR METRO AUTHORITIES

FASTER PROJECT DELIVERY

REDUCED COST OVERRUNS

HIGHER SAFETY & QUALITY STANDARDS

SUSTAINABLE OPERATIONS

DATA-DRIVEN DECISION MAKING

FUTURE-READY INNOVATION PLATFORM



CHALLENGES IN ADOPTION



HIGH INITIAL INVESTMENT



DATA SECURITY & PRIVACY



SKILLS & TRAINING GAP



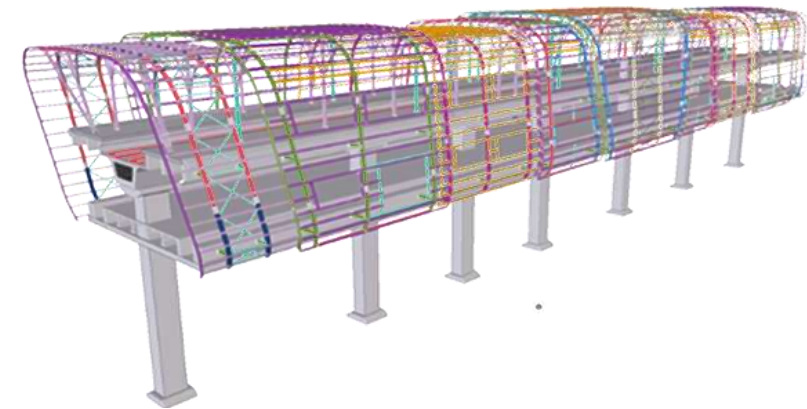
INTEROPERABILITY OF SYSTEM



INTEGRATION WITH LEGACY SYSTEMS



REGULATORY & POLICY FRAMEWORK GAPS



FUTURE OF METRO CONSTRUCTION



AI-ML DRIVEN DECISION MAKING



AI & AUTOMATION SYNERGY



INTEGRATION WITH NET ZERO GOALS



PASSENGER CENTRIC SMART METRO TRANSPORT



LIFE CYCLE INTEGRATION



TOWARDS SMART CITIES & MaaS





THANK YOU