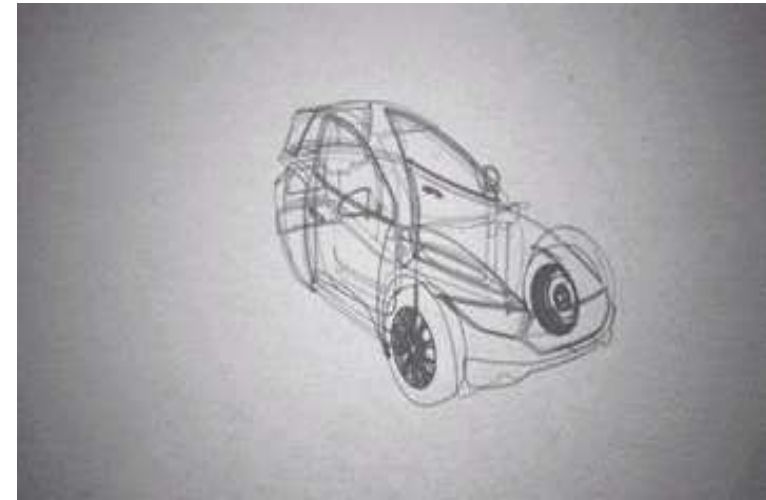
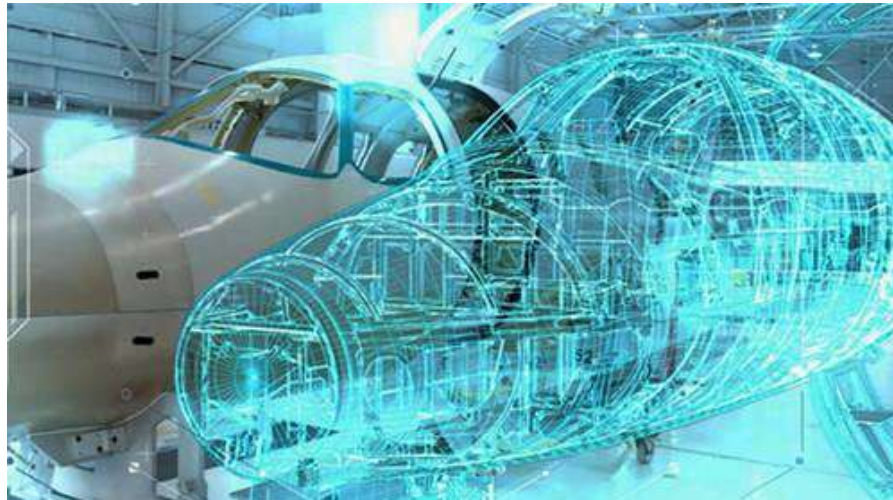


AI BASED DIGITAL TWINS: EARTH OBSERVATION AND GEOSPATIAL AN ENABLER



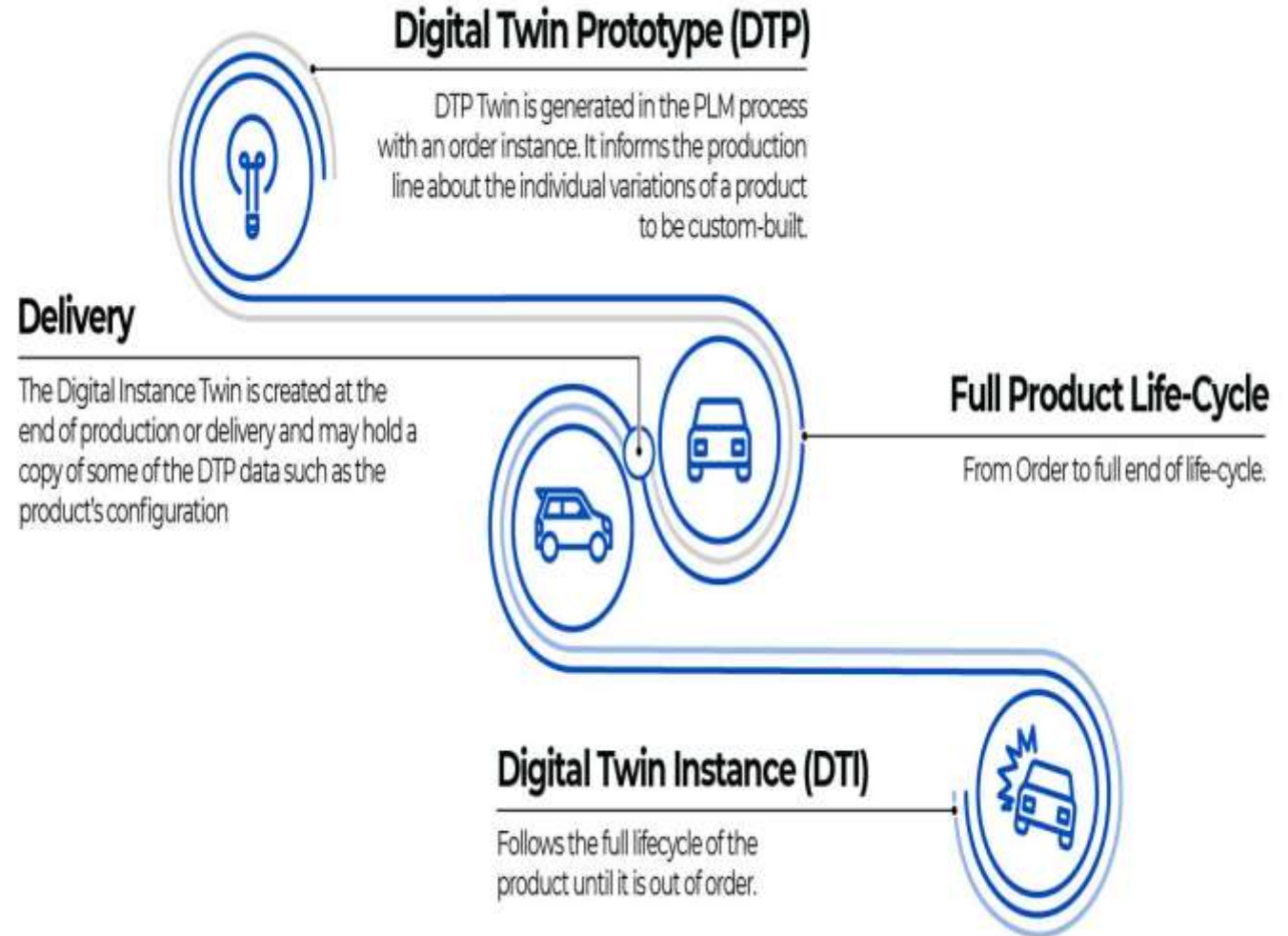
HISTORY



Houston, We have a Problem!!!

PRESENT

- Tesla – DT of every car
- **Virtual Singapore – 3D model**
- Chevron -Save Millions of \$ in maintenance costs- DT oil refineries
- **Spring Festival China - 4 human hosts joined by an AI copy**
- Formula 1 - DT of car - every second counts, simulation - helps improve performance



SCOPE

01

1

Demystify Digital Twin Technology

02

2

Earth Observation Geospatial Technology

03

3

Integration of Earth observation Geospatial & Digital Twin Technology

04

4

Use Cases of Digital Twin Technology

05

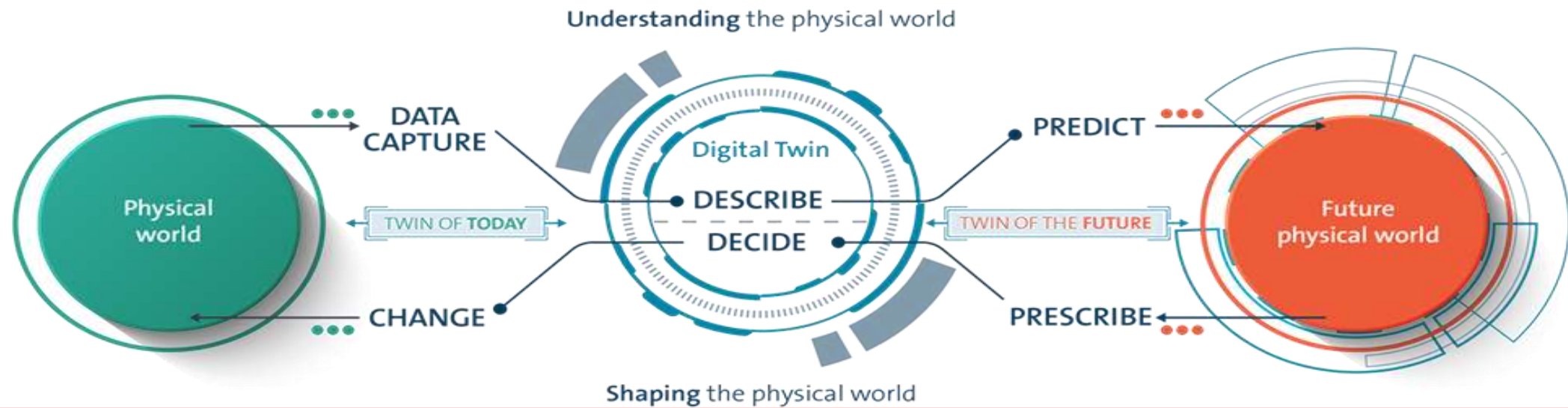
5

Indian Forays

06

6

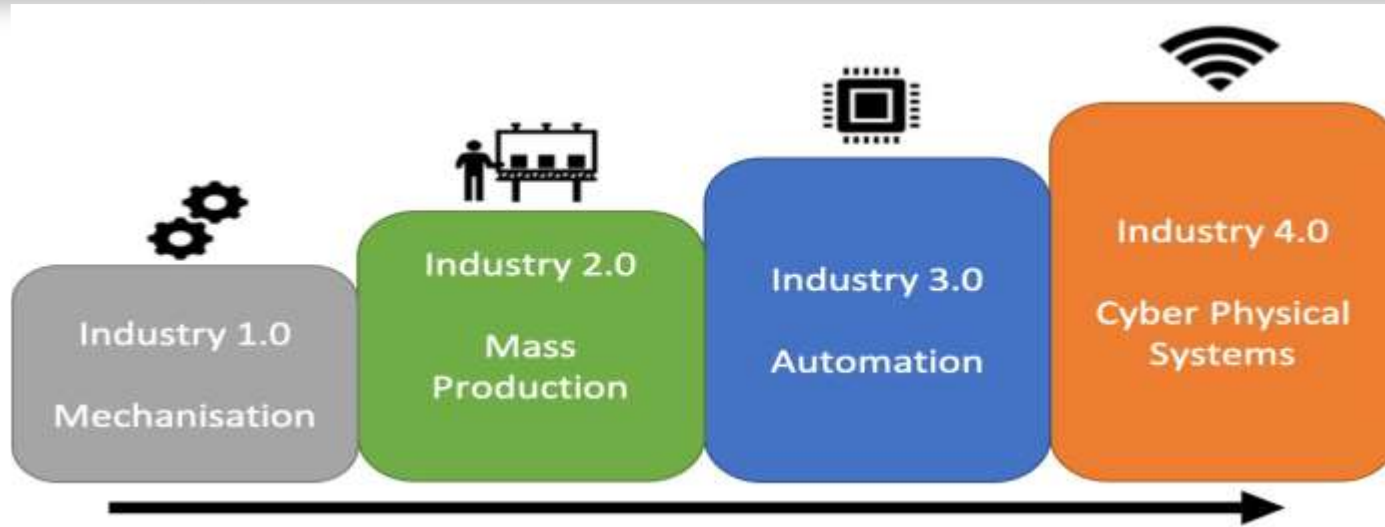
Challenges & Opportunities



DEMISTIFYING DIGITAL TWIN

- **Overview of Digital Twins**
- **Types of Digital Twins**
- **Enabling Technologies**
- **Benefits & Use Cases**

DIGITAL TWIN: DEFINITION



Digital Twins are Virtual Representations of the Real World that Incorporate Physical Objects, Processes, Relationships and Behaviors

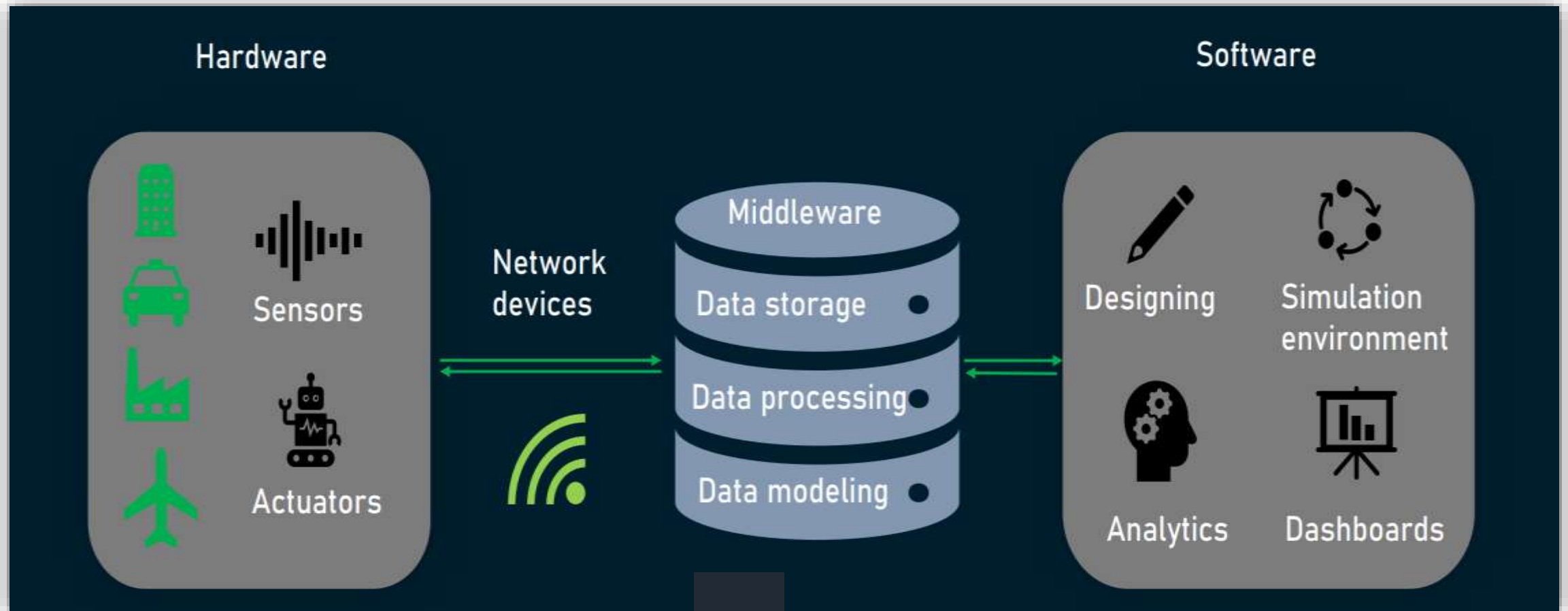
An Adaptive Model of a *Complex Physical System*

Physical System Comprises of *Multiple Sensors*

Sensors Produce *Relevant Data* About Physical System's Performance

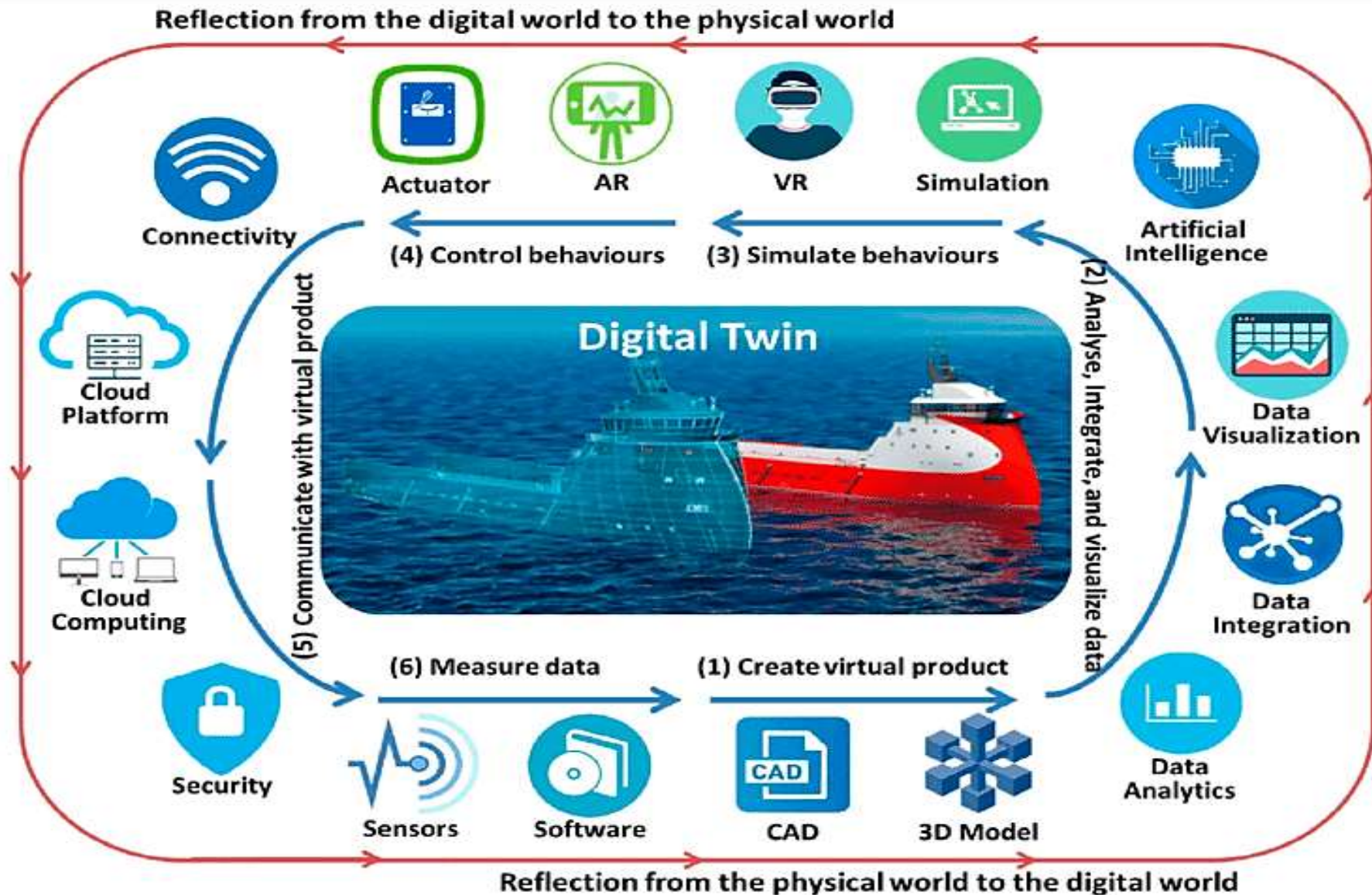
Data is *Relayed* to a *Processing System* & Applied to a *Digital Copy*

DIGITAL TWIN TECHNOLOGY



Create Real-world Scenarios Virtually

ENABLING TECHNOLOGY : DIGITAL TWIN



Enablers

IoT

High Bandwidth

AI & ML

Cloud Computing

DIGITAL TWIN : TYPES

Component Twins/Parts Twins

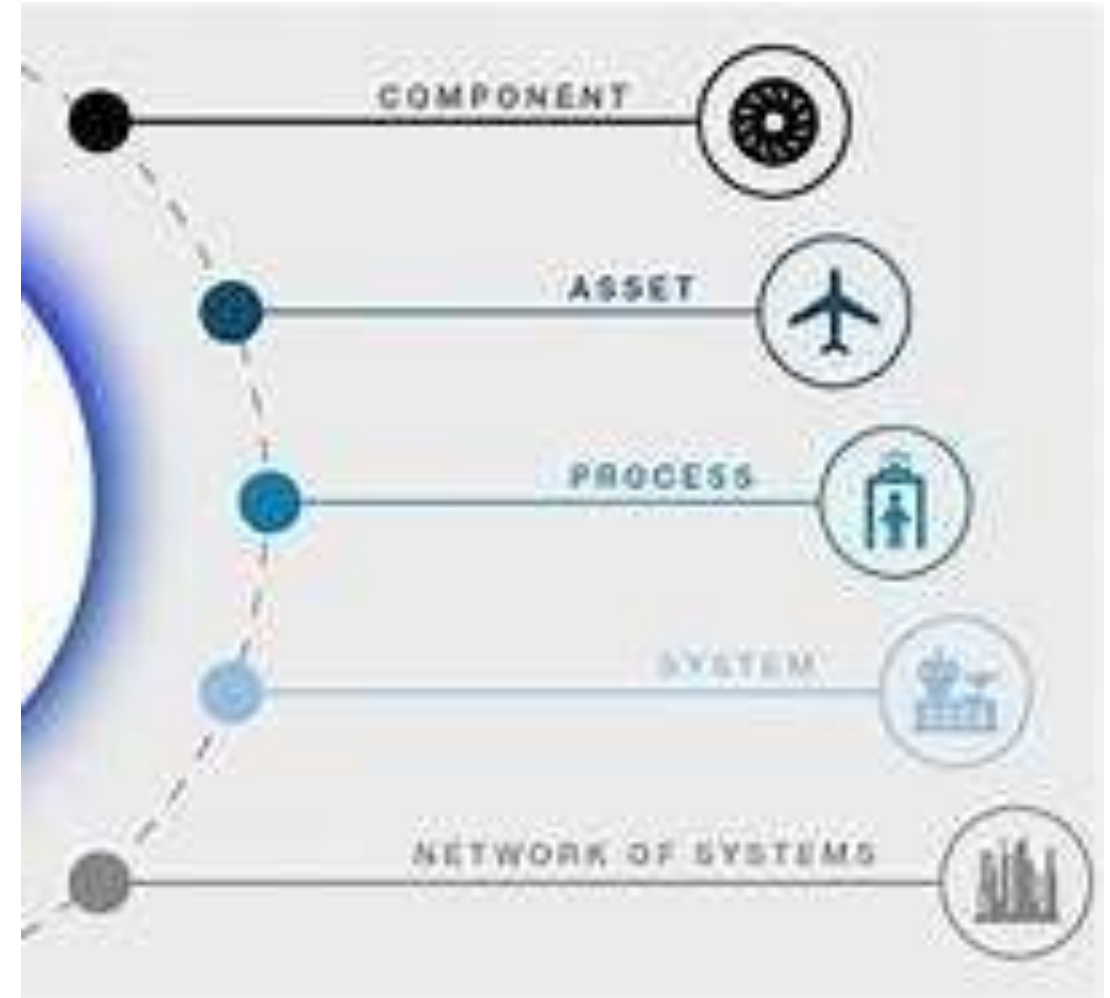
Asset Twins

System or Unit Twins

Process Twins

Network Twins

Performance Digital Twins



DIGITAL TWIN : LEVELS

- **Level 1: Descriptive Twin – Displays data collected**
- **Level 2: Informative Twin – Aggregates data & presents**
- **Level 3: Predictive Twin – Predictive**
- **Level 4: Comprehensive Twin- What if Future**

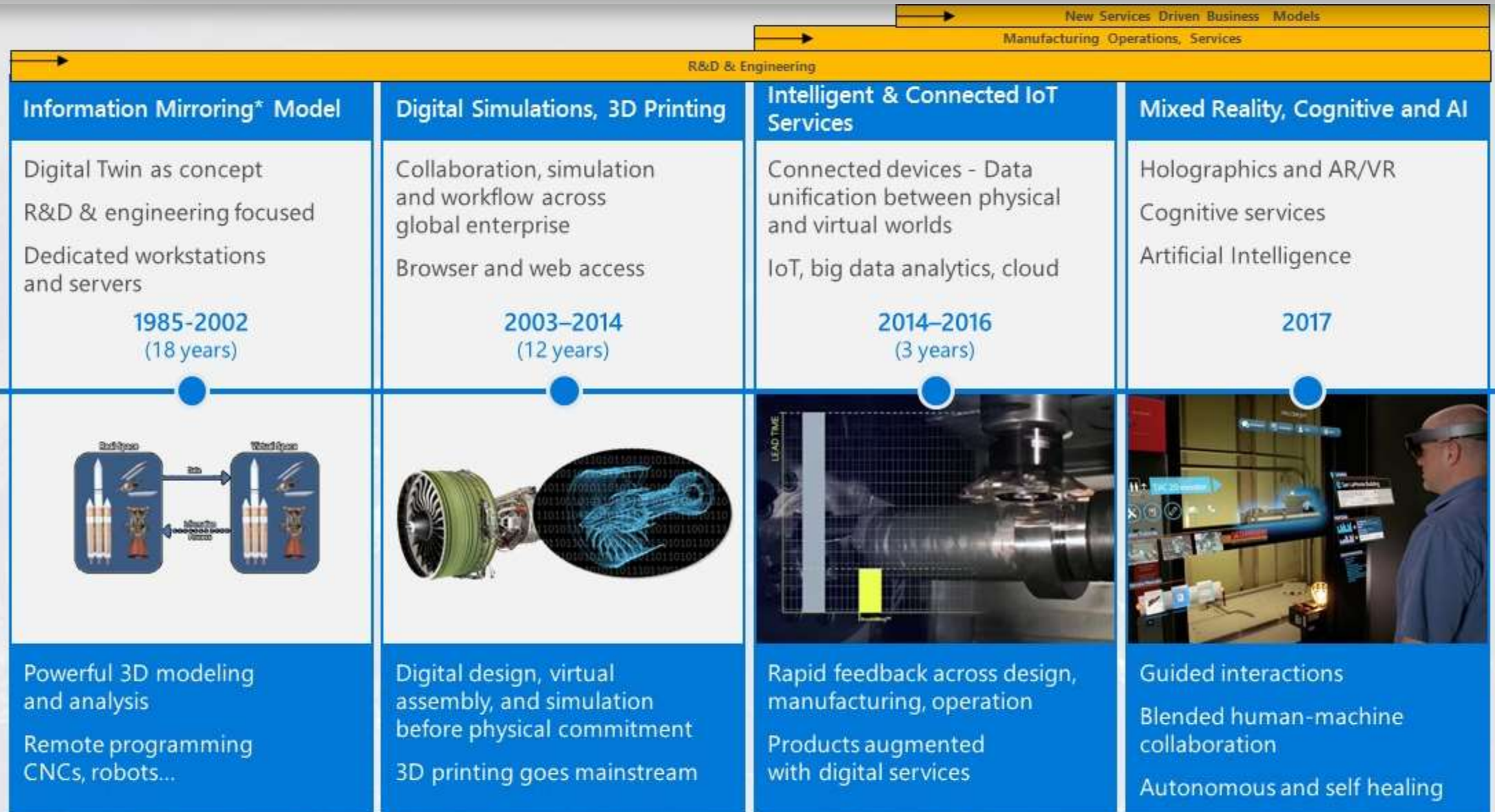


us Twin – Learn & Act on



AI ENABLEMENT : DIGITAL TWIN

Digital Twin evolution



*Dr. Michael Grieves and John Vickers – University of Michigan

BENEFITS: DIGITAL TWIN



DIGITAL TWIN: APPLICATIONS



Automotive/ Aerospace

Twin Transport
Maintenance

Twin Weight
Monitoring

Twin Conditions
Stipulation



Real Estate

Twin Building
Maintenance

Twin Space
Optimization

Twin Asset
Tracking



Utilities

Twin Remote
Assistance

Twin Asset
Visualisation

Twin Asset
Performance
Management

DIGITAL TWIN : APPLICATIONS

Manufacturing

- Shop floor performance improvement
- Self-driving car development
- Design customization
- Predictive maintenance



Healthcare

- Improving operational efficiency of healthcare operations
- Improving personalized care



Use Cases by Industry

Supply Chain

- Predicting the performance of packaging materials
- Optimizing warehouse design
- Creating a logistics network

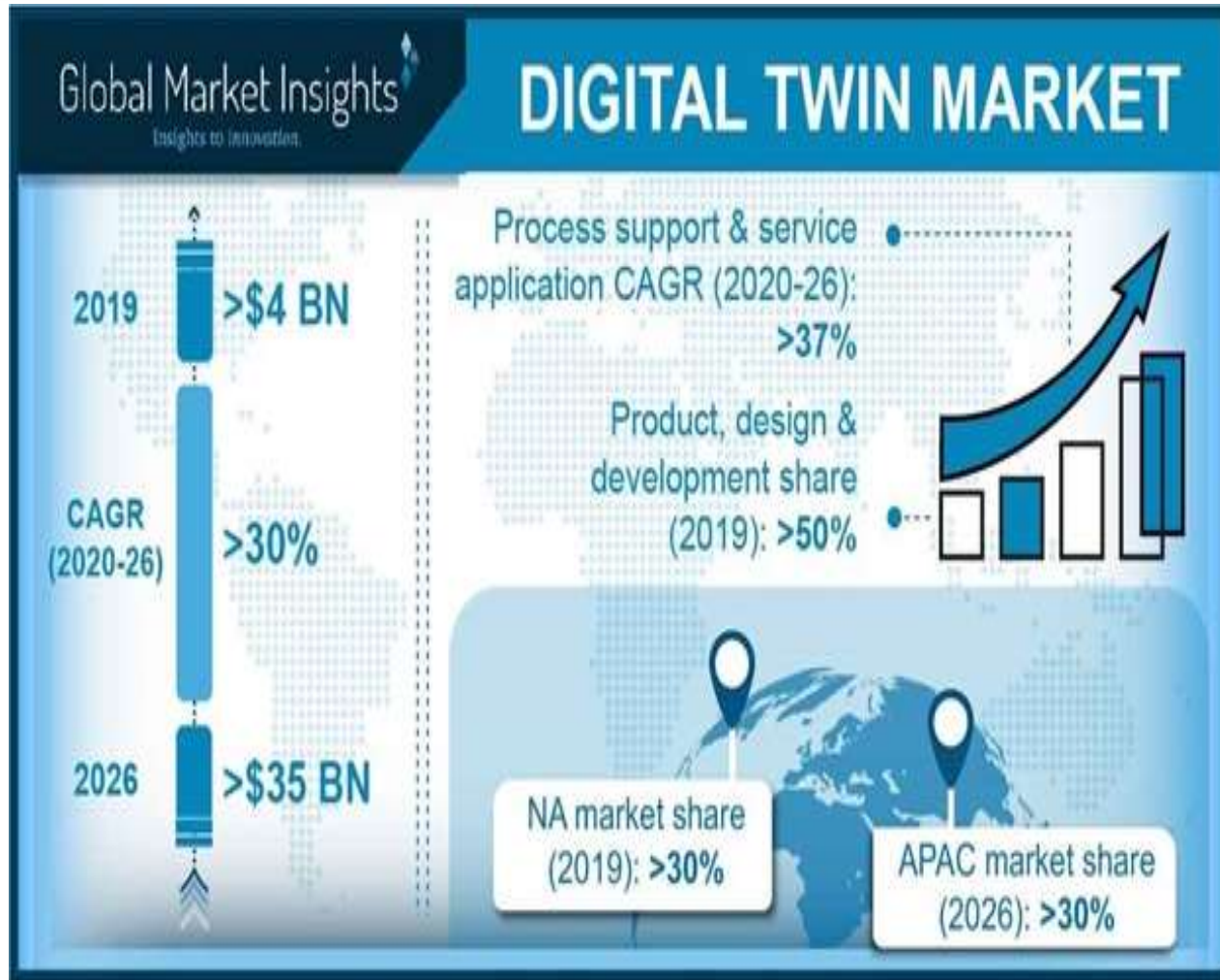


Retail

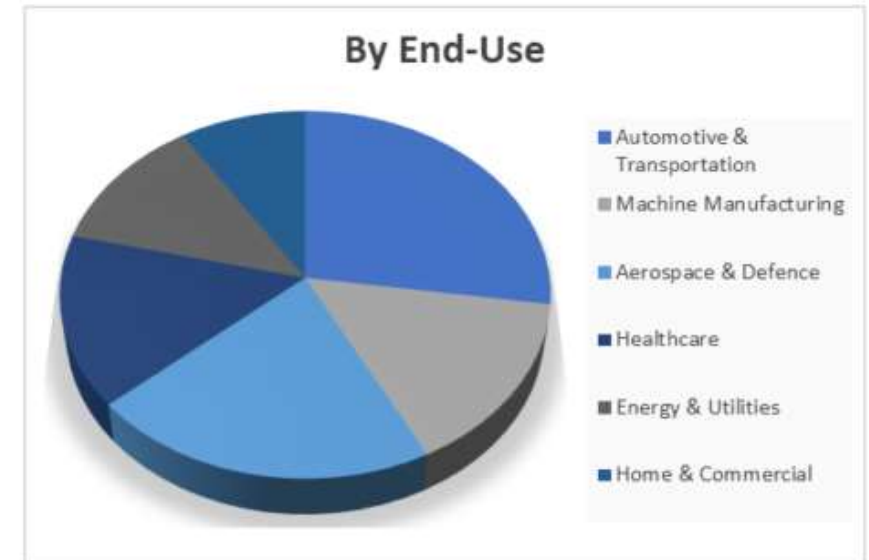
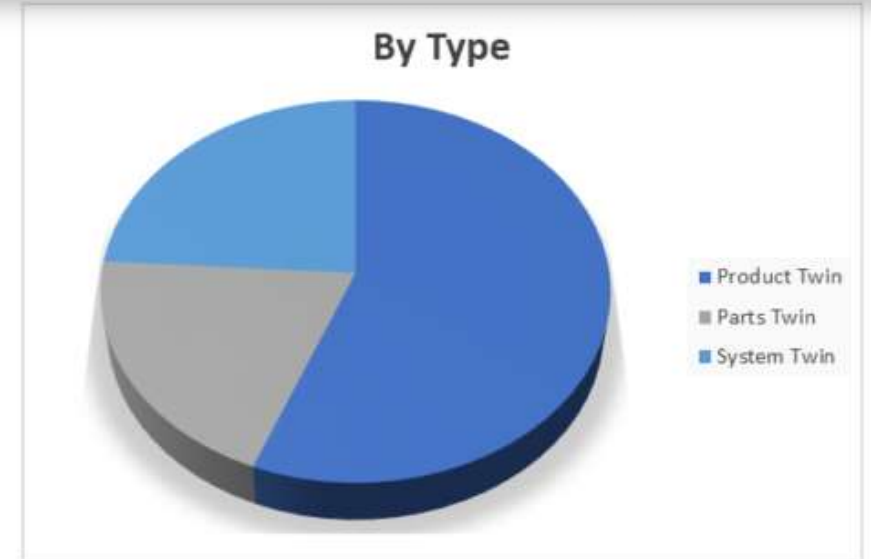
- Customer modeling & simulations

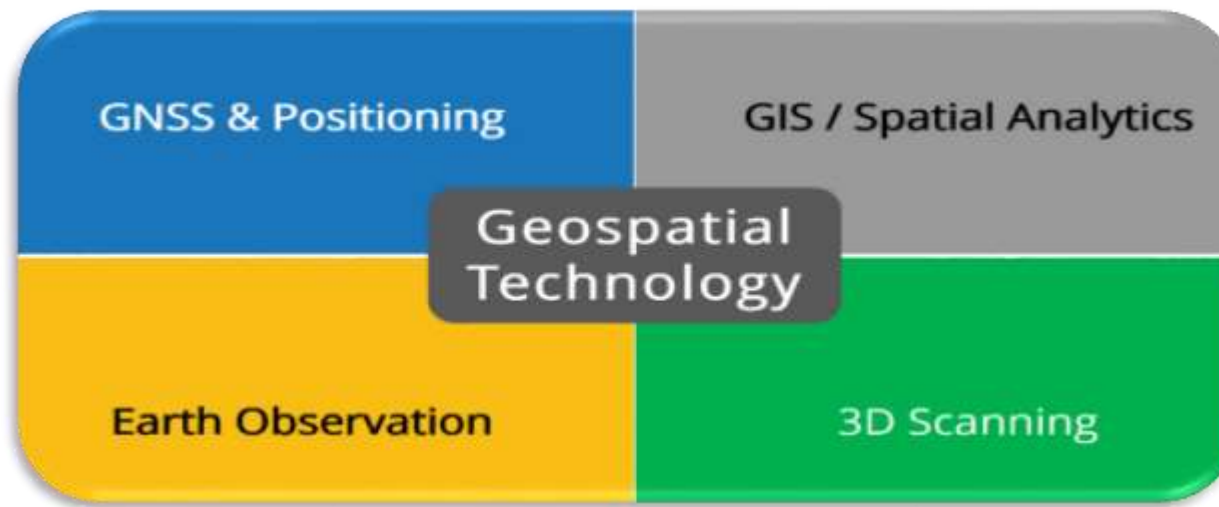


DIGITAL TWIN : PROSPECTS



APAC 61 % Growth rate



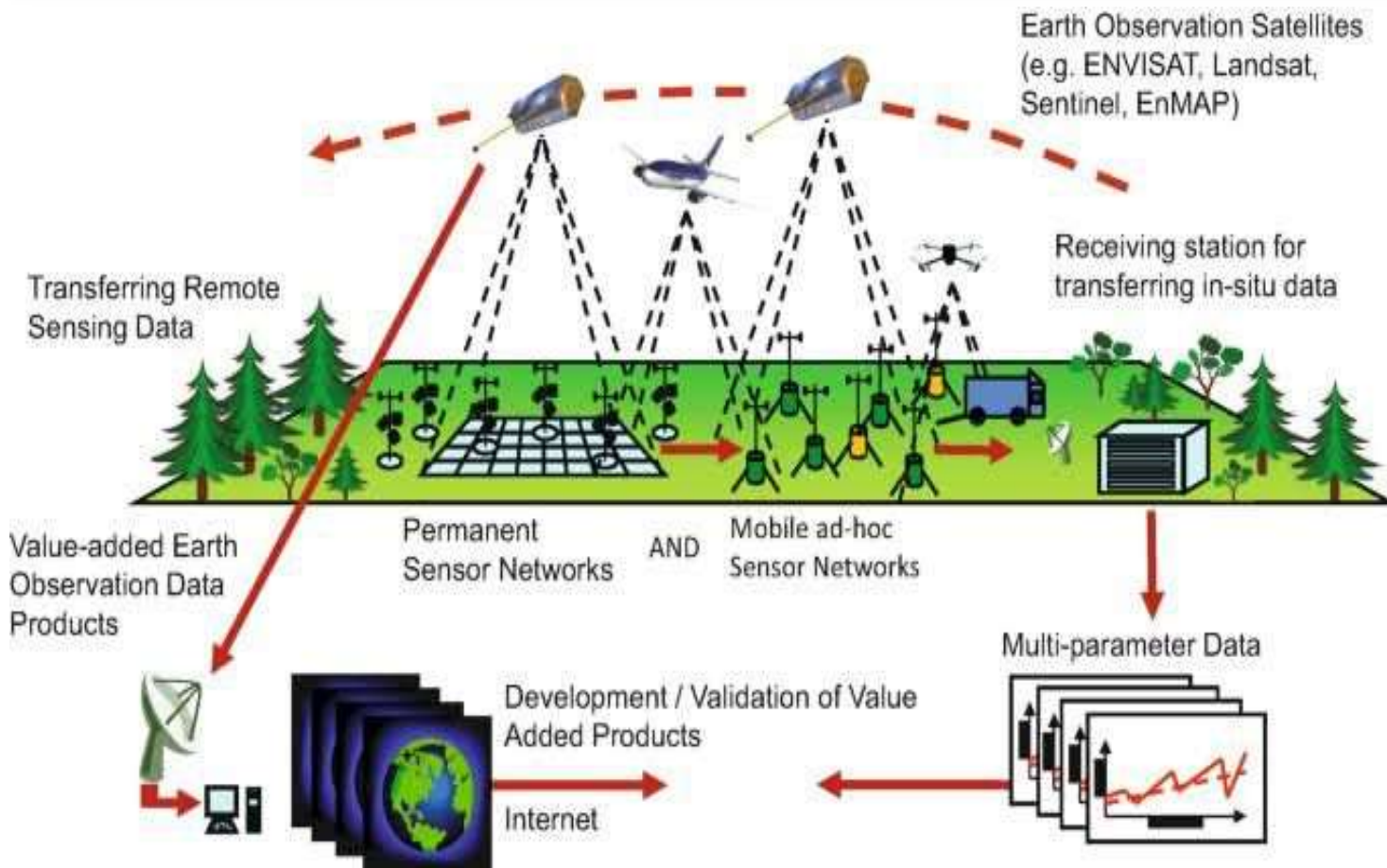


EARTH OBSN & GEOSPATIAL TECHNOLOGY



Source: Geospatial Media Analysis

GEOSPATIAL TECHNOLOGY



Advances in Spatial, Spectral & Temporal Resolution

Quantum of Small Satellites & UAVs has Exploded

**Currently 1052 (971 Apr 21) Earth Observation Satellites are orbiting Earth.
India has 17(38) Operational Earth Observation Satellites.**

<https://www.geospatialworld.net/blogs/how-many-satellites-are-orbiting-the-earth-in-2021/>
<https://www.isro.gov.in/spacecraft/earth-observation-satellites>

EARTH OBSN GEOSPATIAL TECHNOLOGY

Fraud and Abuse



Detect patterns of fraud and collusion (e.g. claims fraud, credit card fraud)

Retail



Site selection, urban planning, foot traffic analysis

Financial Services



Economic distribution, loan risk analysis, predicting sales at retail investments

Healthcare



Identifying disease epicenters, environmental impact on health, planning care

Disaster Recovery



Flood surveys, earthquake mapping, response planning

Defense and Intel



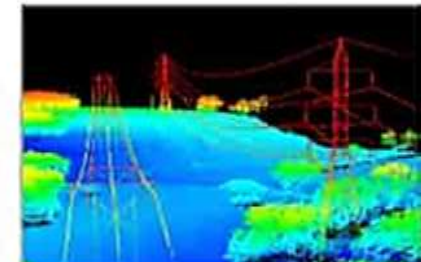
Reconnaissance, threat detection, damage assessment

Infrastructure



Transportation planning, agriculture management, housing development

Energy



Climate change analysis, energy asset inspection, oil discovery

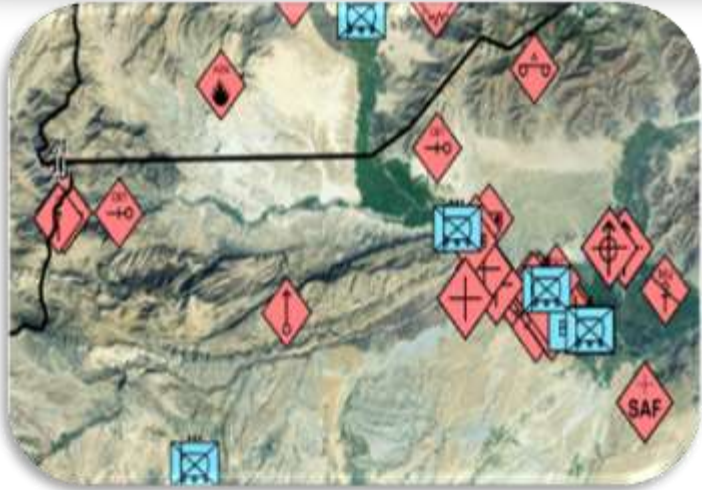
Urban Planning & Modelling

Land Use Changes

Public Safety

Biodiversity

GEOSPATIAL FOR MILITARY



Mapping & Change Detection



Synchronization



Enhanced Situational Awareness



Real Time Location

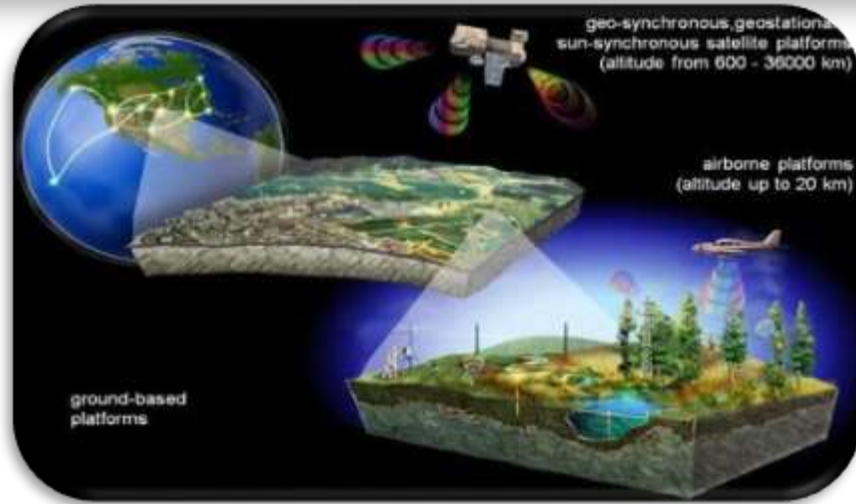


Communication

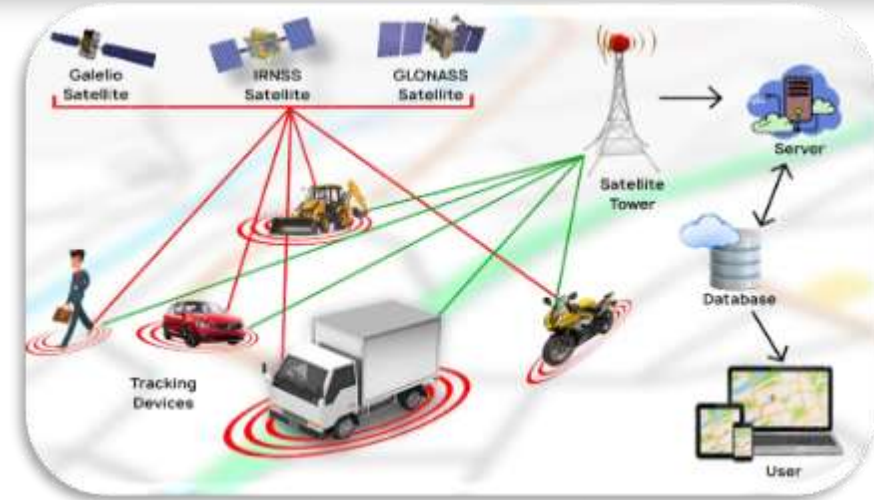


EO & GEOSPATIAL AN ENABLER FOR DIGITAL TWINS

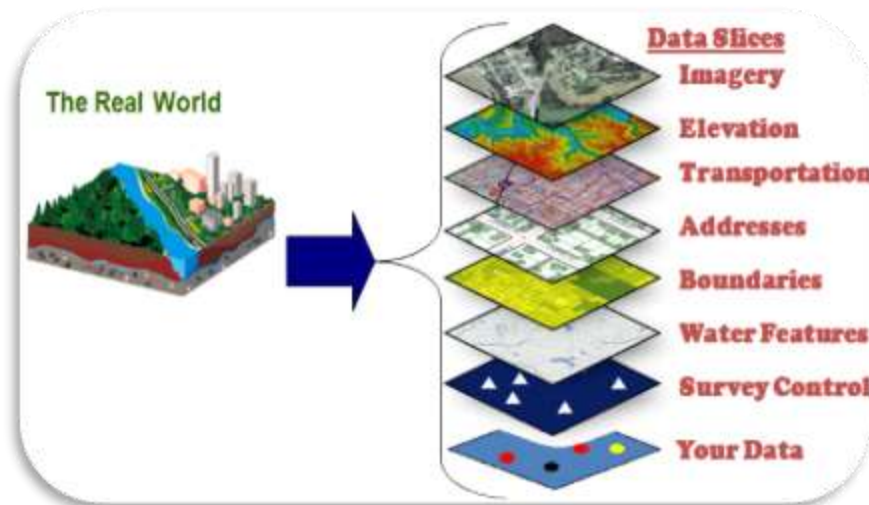
ADVANTAGES OF EO & GEO SPL DATA (LOC)



Locational Awareness



Accuracy



Geo Spatial Integration



Enhanced Decision Making

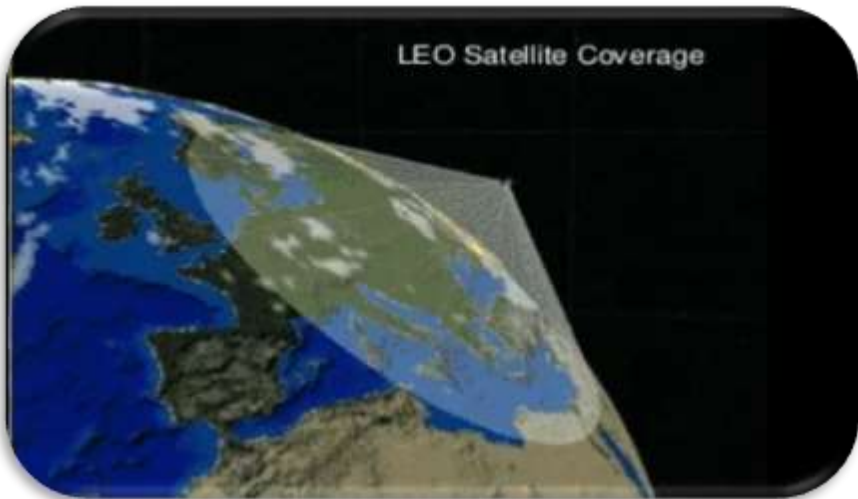
ADVANTAGES OF EO & GEO SPL DATA(COMN)



Data Security



Real Time Data Synchronization



Increased Area of Coverage



**Cost Saving Measures
Optimise CapEx & Reduce OpEx**

FORCE MULTIPLIER EFFECT

Geospatial & EO Data

- Accurate Spatial Data
- High Bandwidth
- Geometric & Topological Representation
- Diverse Dataset (Hyper Spectral, Multi Spectral)
- Real Time
- Security
- Large Area of Coverage

Integration

Data Modelling

Data Fusion

Simulations

Data Analysis

AI & ML Algorithms

Standardisation

Digital Twin Requirements

- High bandwidth
- Data Visualisation
- Real Time Data Feed
- Accurate Data
- Security of Data
- Interoperability
- Homogenization of Data
- Large Data Storage

INTEGRATION WITH DIGITAL TWIN

Emergency Planning



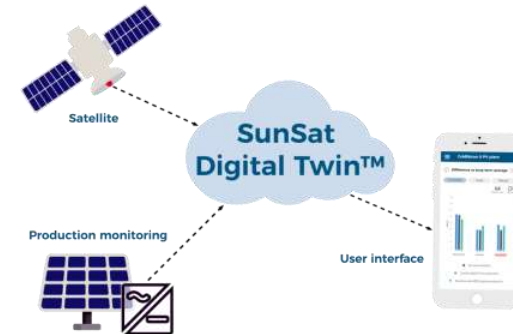
Inform interoffice emergency planning in the event of an external threat/ inclement weather

Risk Management



Understanding the variables of your building and its surroundings, it becomes easier to plan for avoidable situations or unwanted eventualities

Utility Optimization

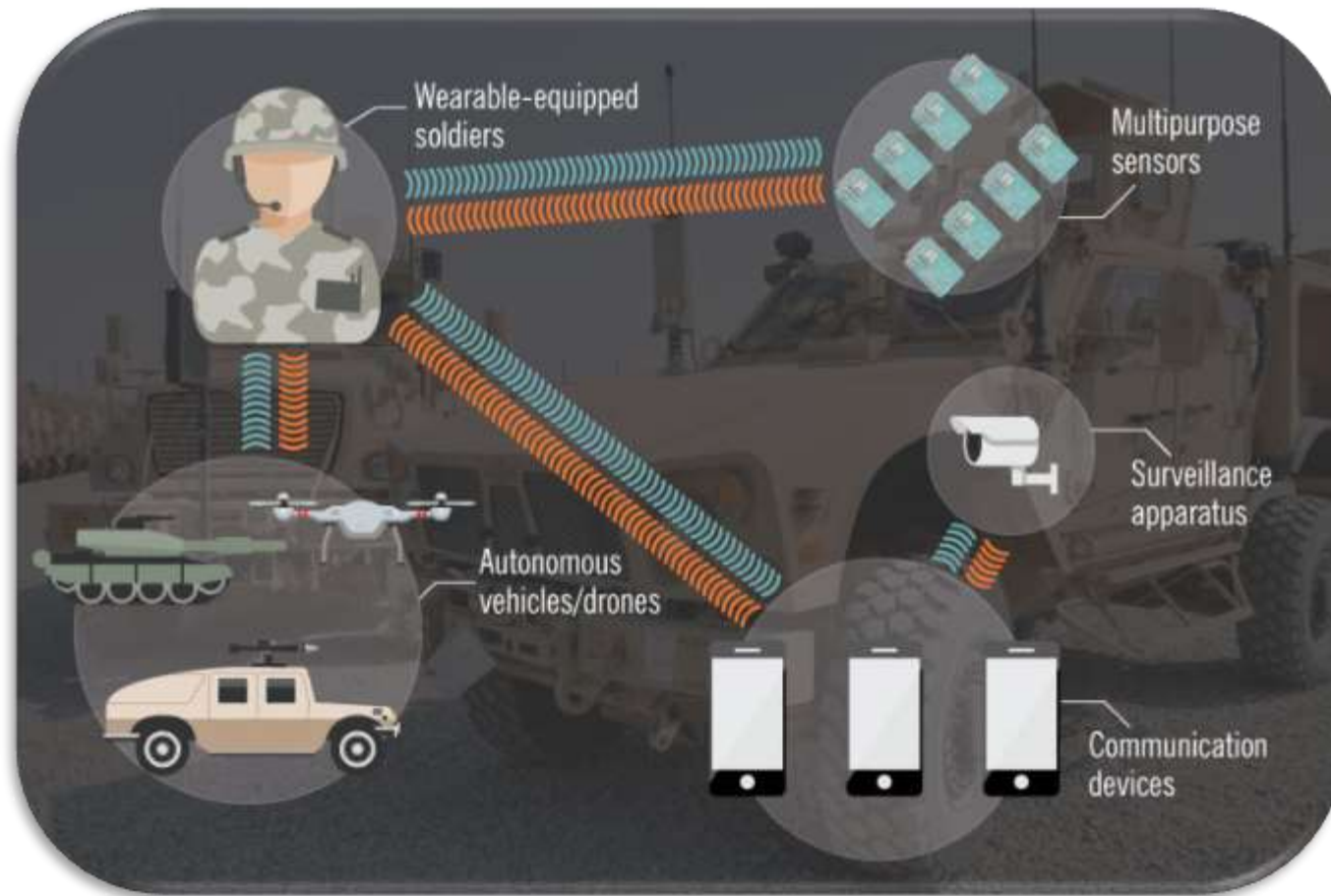


Correlate variables to build a clear picture of solar panel and check, How much is inclement weather affecting your solar systems

Health and Wellness



Create new workplace & hospitals and other medical setups in digital domain that improve health of people.



USE CASES

DESTINATION EARTH INITIATIVE

A graphic for the Destination Earth Initiative. At the top left, it says 'DESTINATION EARTH' in teal. Below that, 'A DIGITAL REPLICA OF OUR PLANET' in white. A paragraph describes the goal: 'Destination Earth (DestinE) aims to develop a highly accurate digital model of Earth to monitor the effects of natural and human activity on our planet, anticipate extreme events and adapt policies to climate-related challenges.' The central image shows a glowing blue digital globe with a network of lines and nodes. Below the globe is a circular interface with four segments labeled 'MONITOR', 'UNDERSTAND', 'SIMULATE', and 'ANTICIPATE'. The ESA logo is in the top right. At the bottom left are logos for the European Union, ECMWF, ESA, and EUMETSAT.

DESTINATION EARTH

A DIGITAL REPLICA OF OUR PLANET

Destination Earth (DestinE) aims to develop a highly accurate digital model of Earth to monitor the effects of natural and human activity on our planet, anticipate extreme events and adapt policies to climate-related challenges.

MONITOR **UNDERSTAND** **SIMULATE** **ANTICIPATE**

ESA

European Union ECMWF ESA EUMETSAT

Inaugurated on 30 Mar 2022

European Space Agency & European Commission

Develop a Highly Accurate Digital Twin of Earth

Objective

- **Risk Planning**
- **Mitigation Measures**
- **Adaption Actions**

Improve Realism of Digital Representation through AI & ML

Vital tool for solving Earth's Pressing Challenges

Enabling Tech

Cloud Computing
Big Data Analytics

Artificial Intelligence
Machine Learning

DESTINATION EARTH INITIATIVE

HOW EARTH'S DIGITAL TWIN CAN CREATE A BETTER WORLD

This 'living' digital replica of Earth gives us new knowledge to transform our planet's future

PHYSICAL WORLD

OBSERVATIONS AND SIMULATIONS

Real-world data from across Earth



REVISIT THE PAST, REVEAL OUR FUTURE

Insights into how our planet works



MAKING AN IMPACT

Innovating for a better world



DIGITAL TWIN

Destination Earth key dates

2022

Launch of Destination Earth (DestinE) initiative.

2024

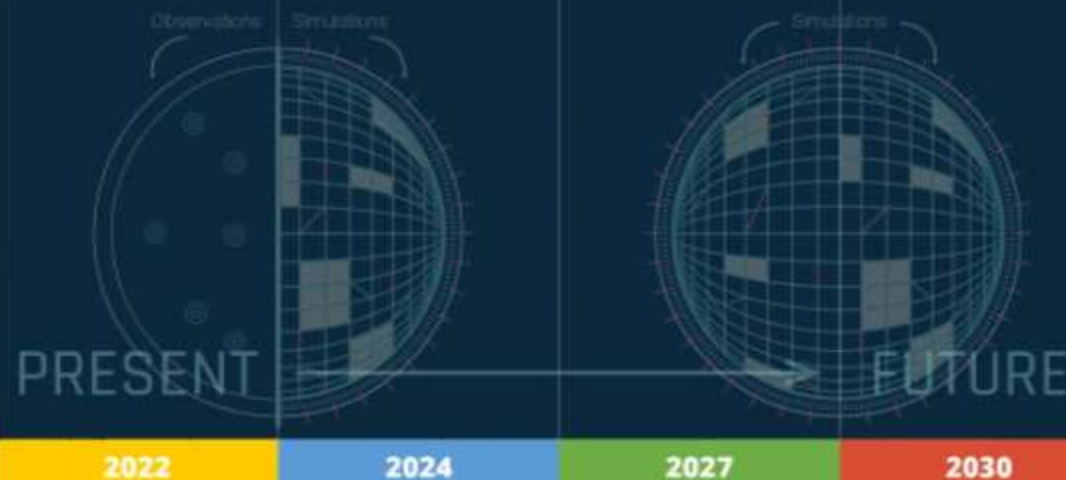
Demonstration of open core digital platform and the first two digital twins: weather-induced extremes and climate change adaptation.

2027

Completion of the core platform, the first two digital twins and integration of additional digital twins.

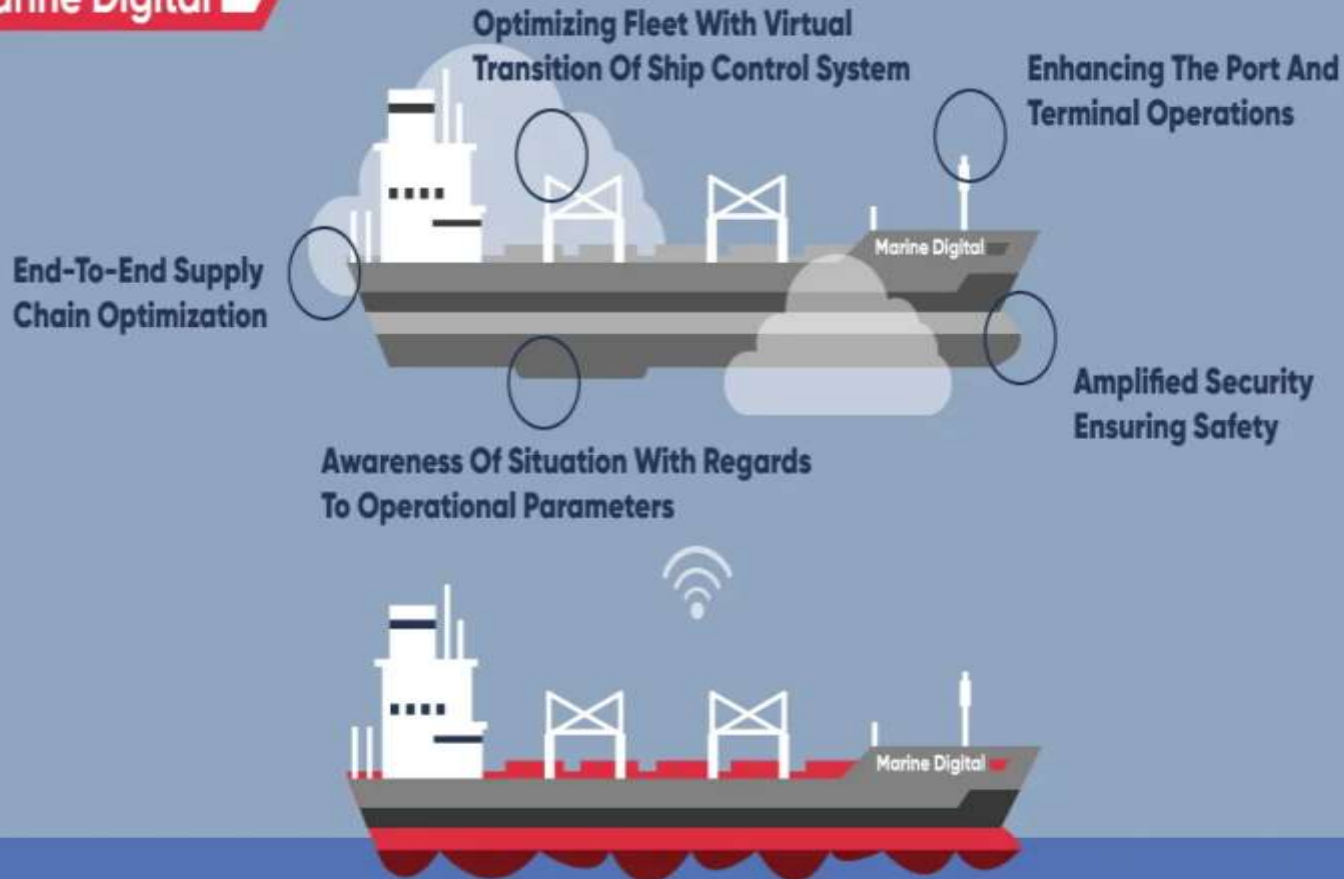
2030

A full digital replica of the Earth through the convergence of the digital twins available.



CIVIL DOMAIN: DIGITAL TWIN

Marine Digital



Fleet Management

- **Marine Digital - Digital Twin hardware and software accumulates the AWS Managed Services, National Marine Electronics Association and other sources (incl. analog data sources) data**
- **Provide a better Analytics for vessel Performance Monitoring, Maintenance Prediction and Navigation purposes.**

Date Of implementation – 2020

<https://marine-digital.com/>

CIVIL DOMAIN: DIGITAL TWIN



Port Management

- **Port of Rotterdam - undergoing Digital Twin transformation**
- **First digital port by 2030**
- **Smartest port in world**

Upcoming Digital Twin of the Port of Rotterdam

<https://www.ibm.com/blogs/internet-of-things/iot-digital-twin-rotterdam/>

CIVIL DOMAIN: DIGITAL TWIN



Unilever Public Limited Company

IoT sensors feed real-time performance data such as temperature and motor speed into the enterprise cloud.

Using Advanced Analytics and ML algorithms, an what-if scenarios to identify the best operational conditions.

Eight digital twins operational across North America, South America, Europe, and Asia.

MILITARY DOMAIN: DIGITAL TWIN

Fighter Jets

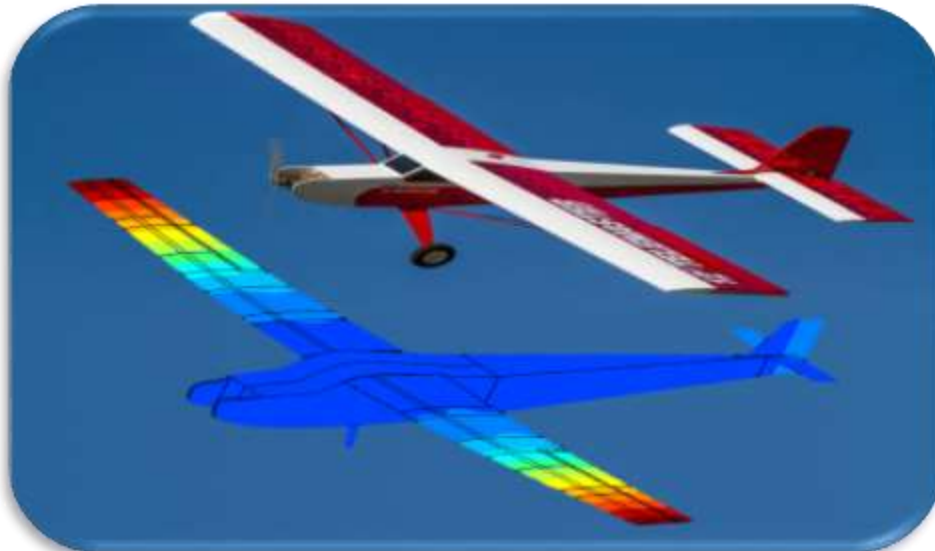
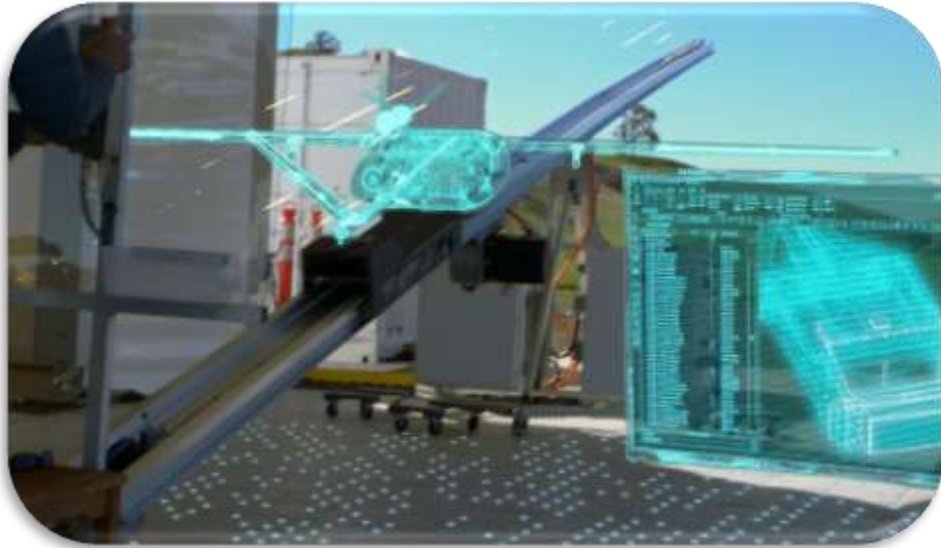


- **F-35 Fighter Jet – Digital Twin (Made)**
- **B-1 Bomber Aircraft – Digital Twin (started in 2020, likely completion by 2026)**
- **Advantages**

- **Early Fault Detection**
- **Performance Enhancement**
- **Saves Maintenance Cost**
- **Predictive Maintenance**

- **Date Of implementation – 2018-19 (F 35 Program)**
- **Place – US AF Research Laboratory**

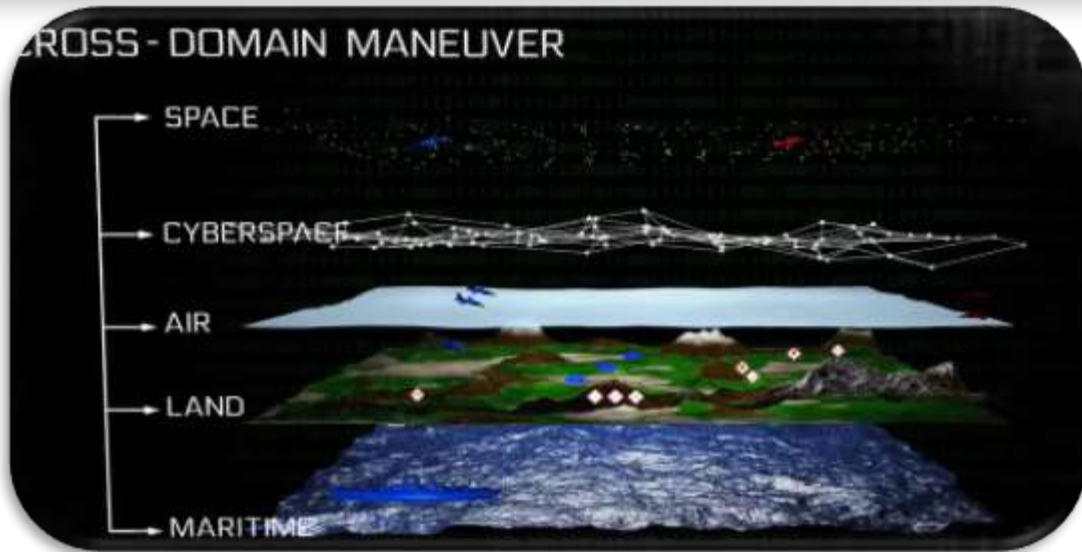
MILITARY DOMAIN: DIGITAL TWIN



Drones and UAV

- Remote Maintenance
 - **Saves cost of R&D**
 - Remote Modification with Real World Changing Scenario
 - **Improves Performance**
- Date Of implementation – June 2021
 - Place – Department of Aeronautics, MIT

MILITARY USE CASES: US ARMY



US Army Soldier Center Program

- Rapid Expansion of Synthetic Environment & Simulation Capabilities.
- **Multi-Domain operations.**
- Multiple wide threat Scenarios

Technology being Used

- 3-D Modelling and Reconstruction
- **Machine Learning & AI**

Status

Under Development and R & D being conducted at US Army Simulation & Training Technology Center, Orlando Florida since 2021.

"Simulation-Based Engineering Science: Revolutionizing Engineering Science through Simulation,"
National Science Foundation, May 2006.

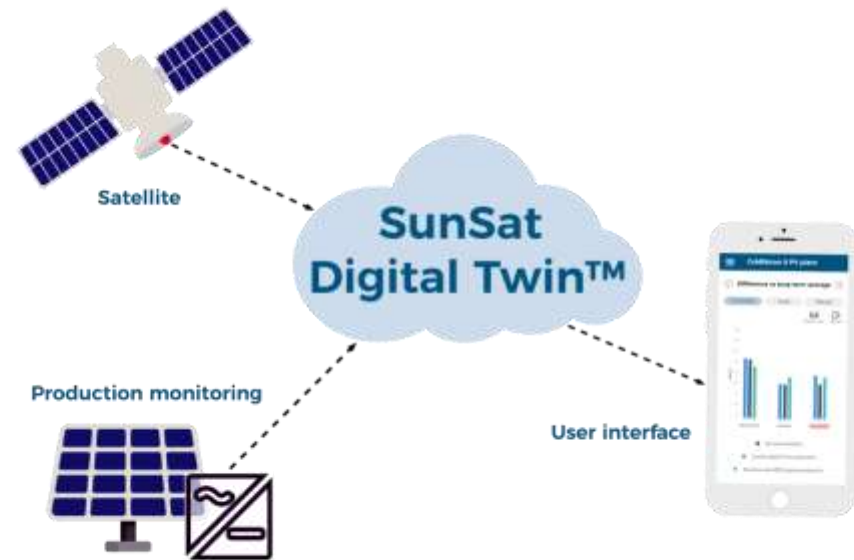


**INDIAN FORAY IN INTEGRATED GEO
SPATIAL & DIGITAL TWIN TECHNOLOGY**

INDIA: GEOSPATIAL & DIGITAL TWIN TECHNOLOGY

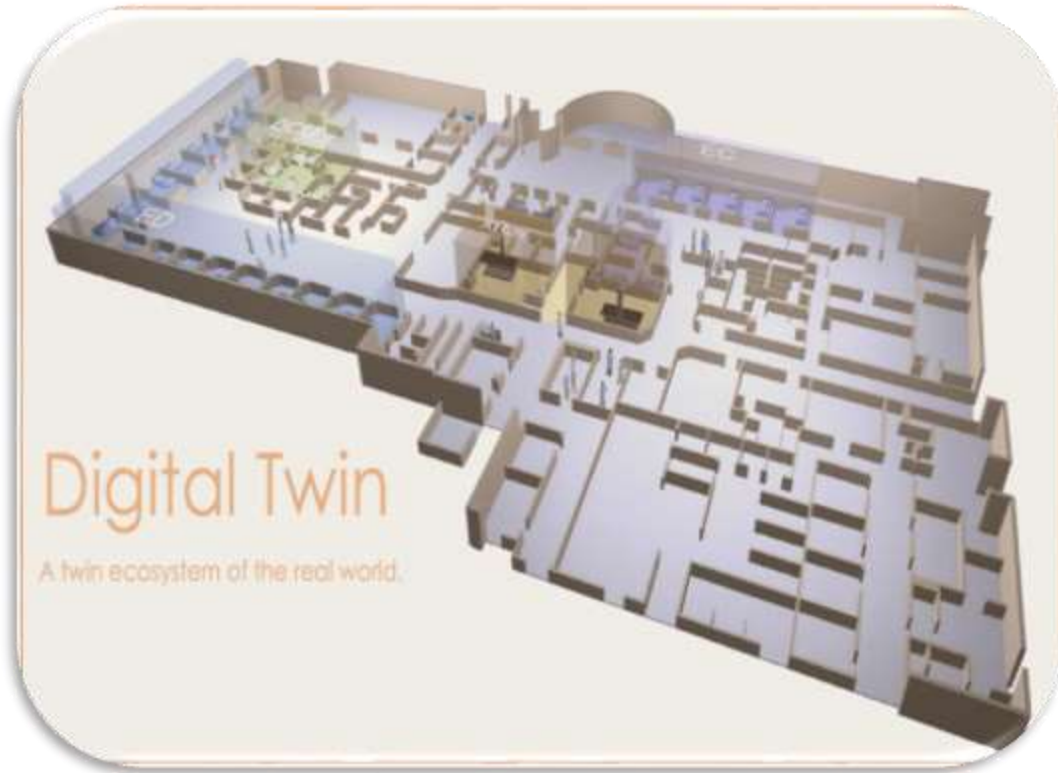


Genesys International Corp



Pratiti Technologies

INDIA: GEOSPATIAL & DIGITAL TWIN TECHNOLOGY



Switchon



Twin Health

INDIA: DIGITAL SMART CITY

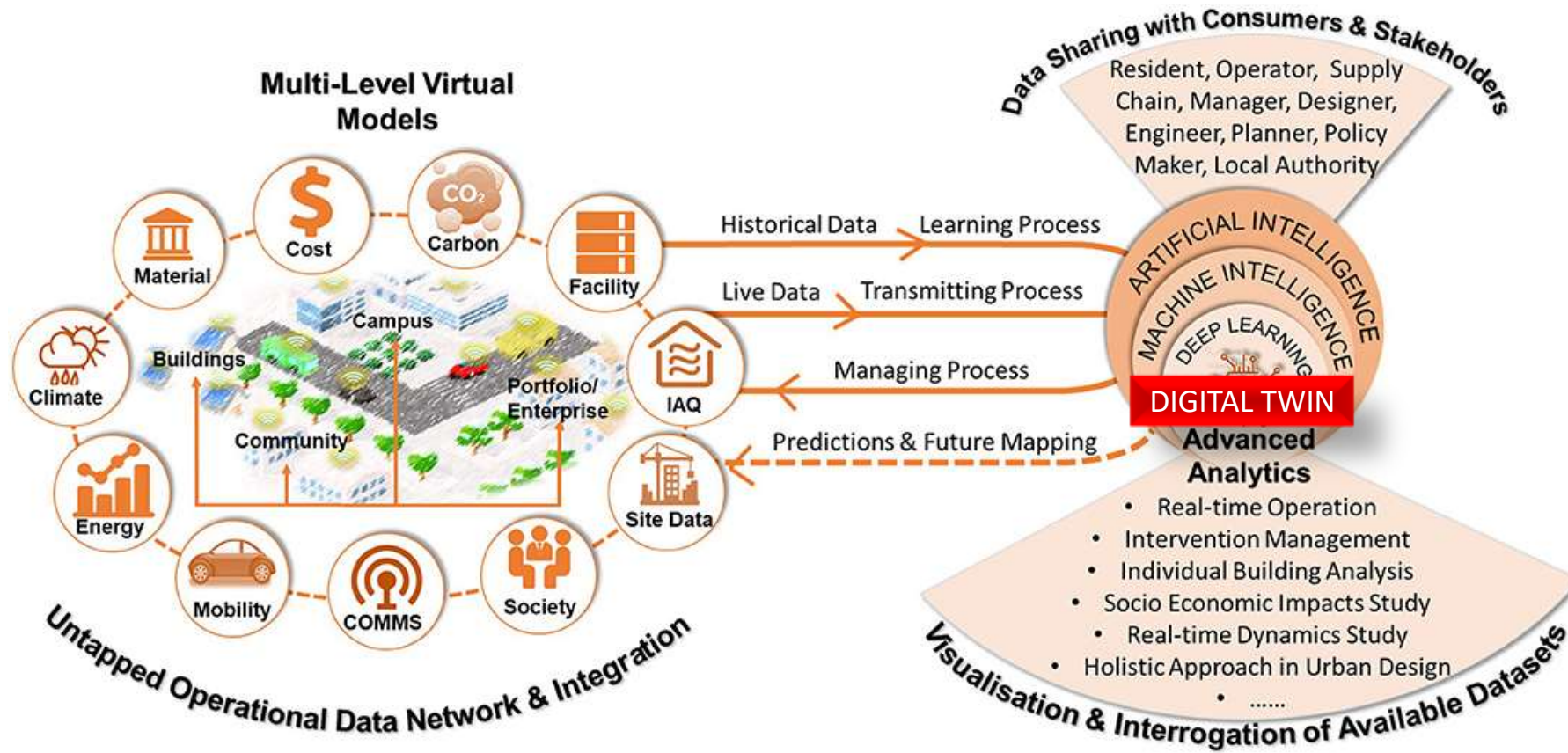


Key Features

- **Real-time construction progress monitoring,**
- **Environmental and wellness monitoring**
- **Advanced mobility and traffic monitoring and simulations**
- **Advanced microclimate and climate change monitoring and simulations**
- **Digital “drag and drop” building permit submissions**
- **Digital zoning, setback, environmental, traffic, and other statutory compliance-related preliminary analysis**
- **A proposed digital twin user ID scheme for every Amaravati citizen that will serve as a single citizen portal for all government information, notifications, forms, and applications.**

<https://www.ft.com/content/15851b06-1b6f-11ea-81f0-0c253907d3e0>

<https://www.smartcitiesworld.net/news/news/digital-twin-created-for-new-indian-smart-city-3674>



CHALLENGES & OPPORTUNITIES

CHALLENGES

Digital Twin Technology

- **In nascent Stage and will require more R&D and time to be realized in a big way.**

Maturity of Integration

- **Integration of Geo Spatial data with Digital Twin technology needs to developed further.**

Privacy , Data Security & Authenticity

- **Security of Sensitive Data : Military Significance**

Trust in the Technology

- **User Confidence in the tech : Verify performance**

Data Integrity

- **Quality Data : Noise Free**

Standardization

- **Uniform methodology for development for all stages**

Increased Requirement of Data Storage

- **With Real time continuous feed of high Volume of data**

OPPORTUNITIES



Manufacturing : Not Fully Realised in Industry



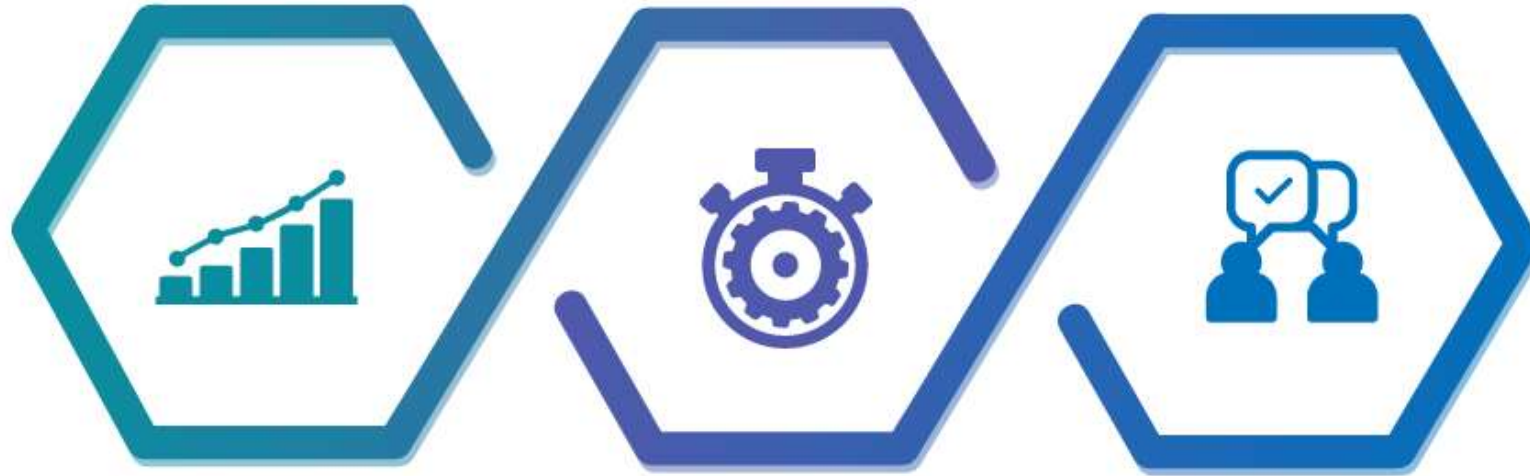
Healthcare : Digital Twin of a Person



Smart Cities : 3D Model of a Smart City



Military : Aviation, Cyber Security, War Gaming



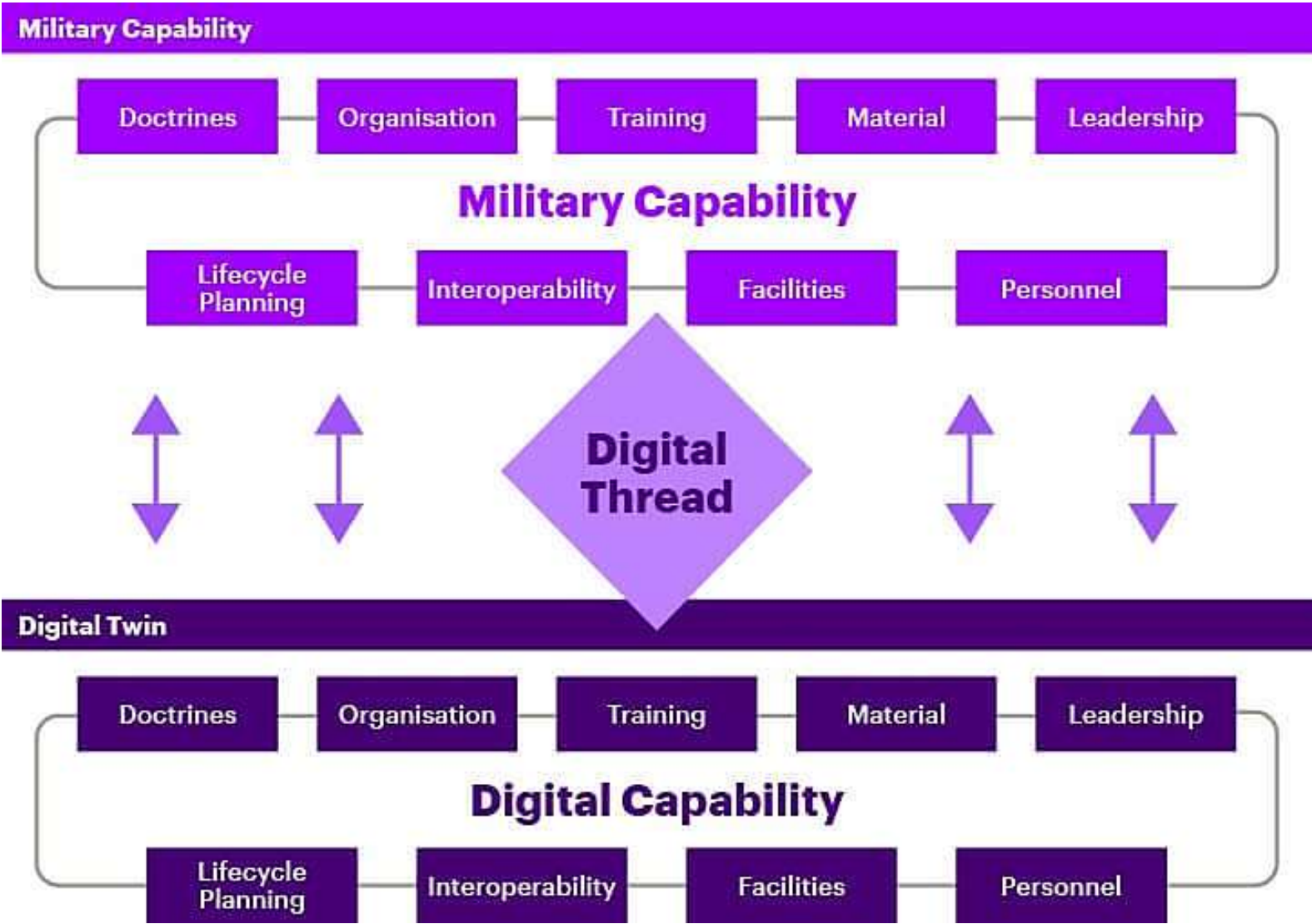
Improvement
of the product

Automation
of the processes

Simplification
of communication

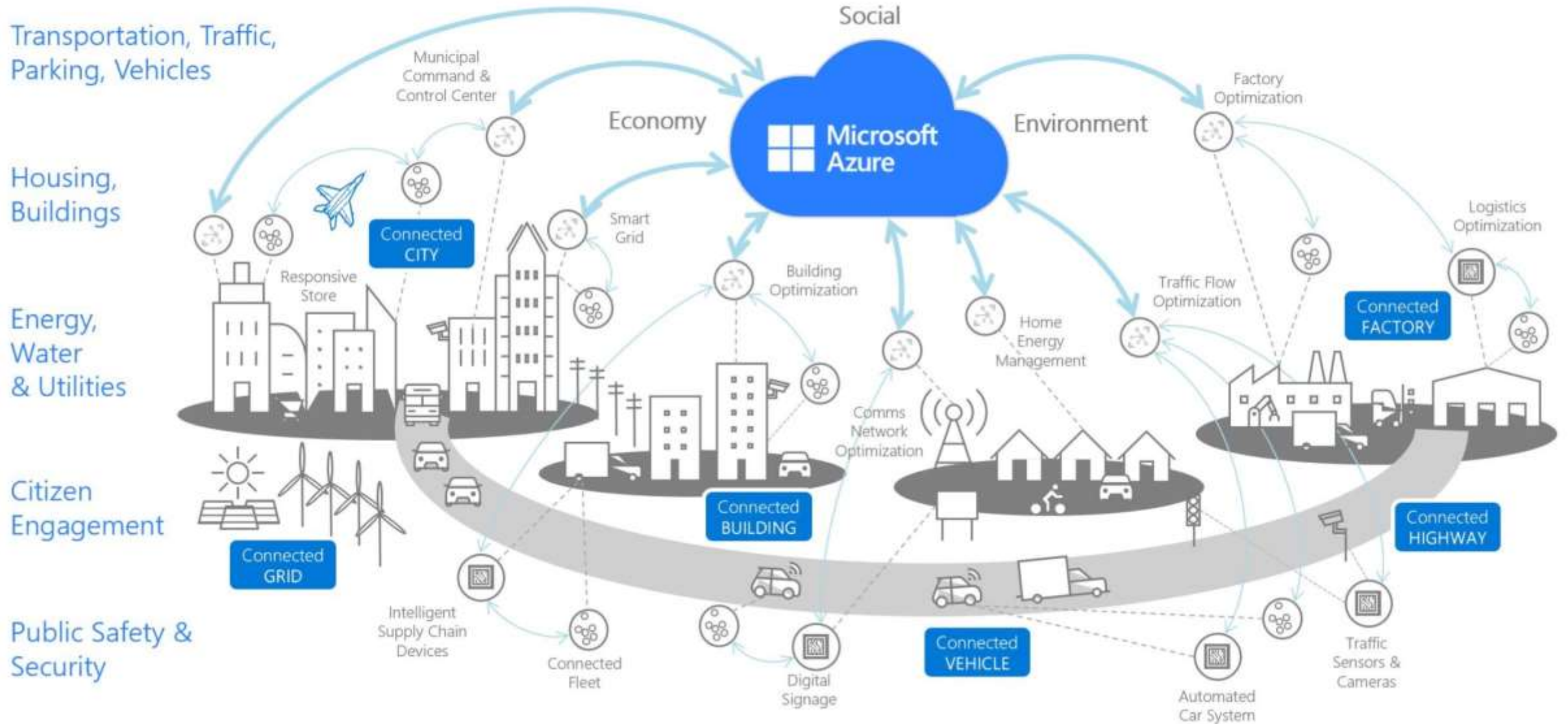
WAY AHEAD

FUTURE: INDIAN MILITARY

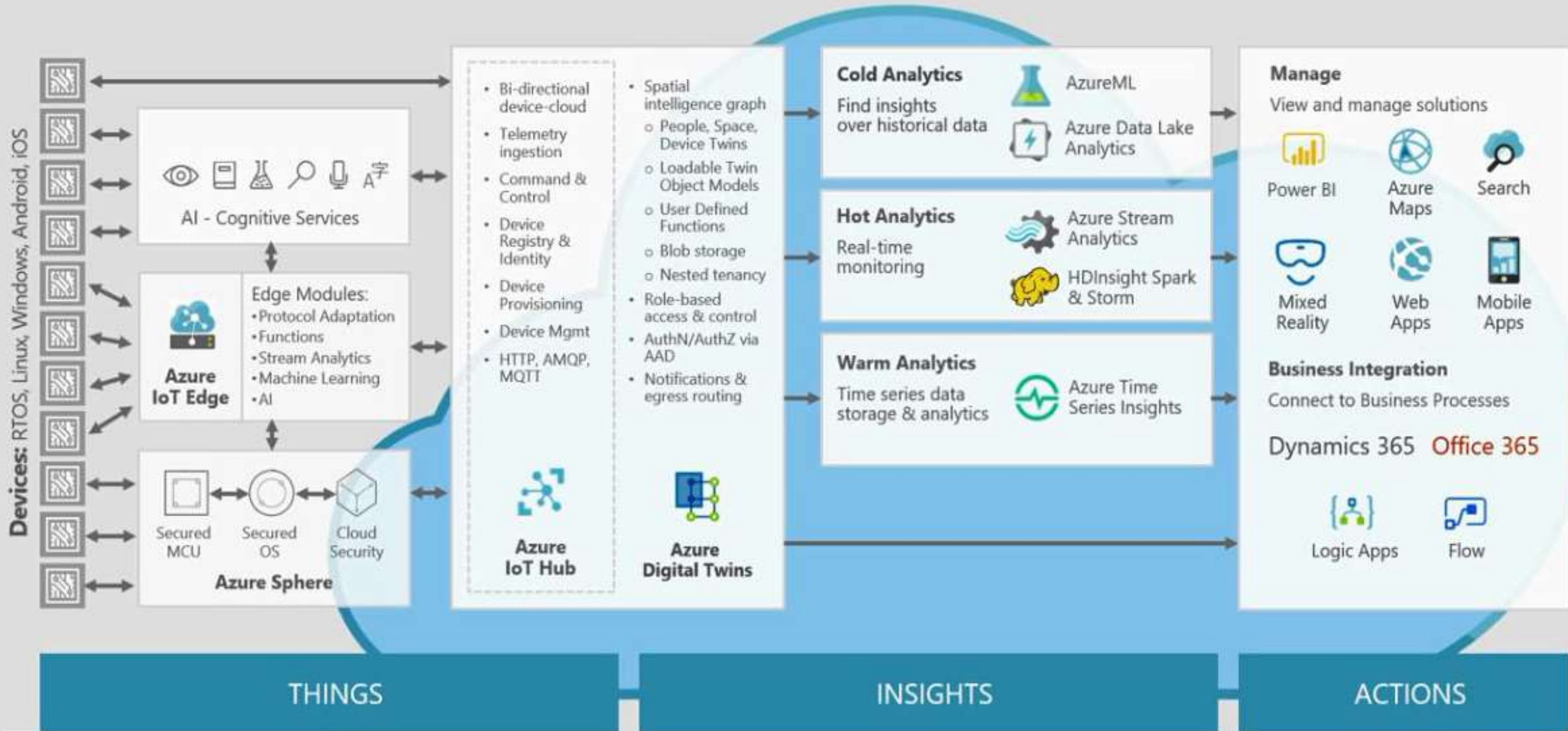


- **5G – High Bandwidth**
- **Increase Satellite for Mil Use**
- **IoT Proliferation**
- **Increase Standardization of Protocols**
- **Democratisation of AI**

Azure Digital Twins



MODEL & INTERACT WITH THE REAL WORLD



JAI HIND