HCLTech | Supercharging Progress™

Cognitive Digital Twin for Rail Infrastructure Management and Operations

Girish Sohoni and L Sreenath

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HCLTech overview

Partner to over 50% of the Global 500

300+ leadership recognitions by analysts

Top Employer in 26 countries; ranked #1 in 18 countries
as per the Top Employers Institute

Rated as ESG 'Leader' by MSCI

National Water Award by the Government of India

HCLTech Chairperson Roshni Nadar Malhotra named among the "The World's Most Powerful Women" by Forbes and Fortune; won Business Today Most Powerful Women in Business Award 2023

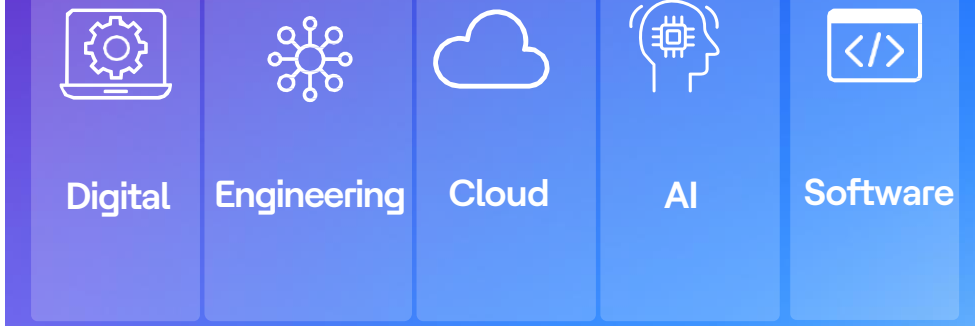
219K.
Ideapreneurs

$13.27B
Revenue

159
Nationalities

60
Countries

Focus areas



Revenue as of 12 months ending March 2024

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Engineering and R&D Services

Accelerating time-to market and time-to-monetize products and platforms of global enterprises through innovations in traditional and digital engineering

#1 in Engineering Services

Everest Group's PEAK Matrix Provider of the Year™ Awards 2024

We work with

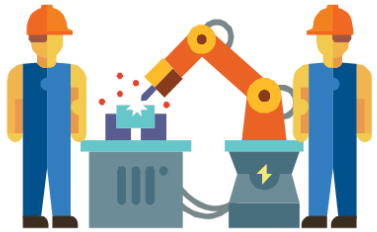
101 of the world's top 250 R&D spenders

100+ Engineering Labs for accelerated time-to-market and end-to-end services

CONNECTED DESIGN

- Digital Platforms
- Product Lifecycle Management
- MBSE
- Digital Thread
- Digital Twins
- Digital Productivity Tools
- Industrial Design
- Visual Communication

CONNECTED FACTORY



- Manufacturing Operations Management
- Manufacturing Automation
- Manufacturing Intelligence
- Industrial Cybersecurity
- Worker Safety Tools
- Smart wearables
- Asset Maintenance Management
- Track & Trace
- Predictive Supply Chains

CONNECTED PRODUCTS

- Service Life cycle Management
- Connected Services (Devices / Product in Field)
- Digital Retrofits
- Digital Engagement Technologies
- New Service Enablement & Monetization

Enabling Technologies

IoT · AI/ML · AR/VR/XR · 5G · Cloud · Blockchain · Computer Vision · Additive MFG · Digital Twin · Robotics

Outcomes Delivered

- Accelerated time-to-market
- Innovation at scale
- Ecosystem growth
- Sustainability
- Regulatory compliance

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Outline

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Rail Industry Trends and Drivers

Digital Transformation

Business Trends

- Increasing rail system complexity & supporting rail infrastructure, assets
- Smart, Connected & Autonomous mobility solutions – Autonomous train
- Sustainable mobility systems (Carbon footprint, energy consumption)

Technological Advances

- Increased electronics, software content & reliance on digital signaling
- Increased adoption of IoT & Cloud based solution
- Advances in computing (e.g. real time simulation & analytics)

More focus on continuous monitoring, analyses, and predicting the performances & problems in Rail Asset Infrastructure !

Key Challenges in Rail Industry

- Monitor the condition of **rail assets & infrastructure**
- Lack of data driven **decisions**

Monitoring & Control

Operational

- Combating **operational, safety** risks
- Bridging the gap between **process planning, commissioning & operations**

Predictive Maintenance
- Limit Downtime
- Identify **anomalies**
- **Maintenance planning**
- Extend **asset life**

Maintenance

Network Optimization

- Optimize process & overall **network efficiency**
- Maximize **Track capacity & Fleet utilization**

Safety, Security and **Environmental Standards & Regulation, Sustainability**

Environmental

Scalability

- Rail system scalability to handle more capacity & diverse fleet of trains
- Adapt & extend for **new configurations & variants**

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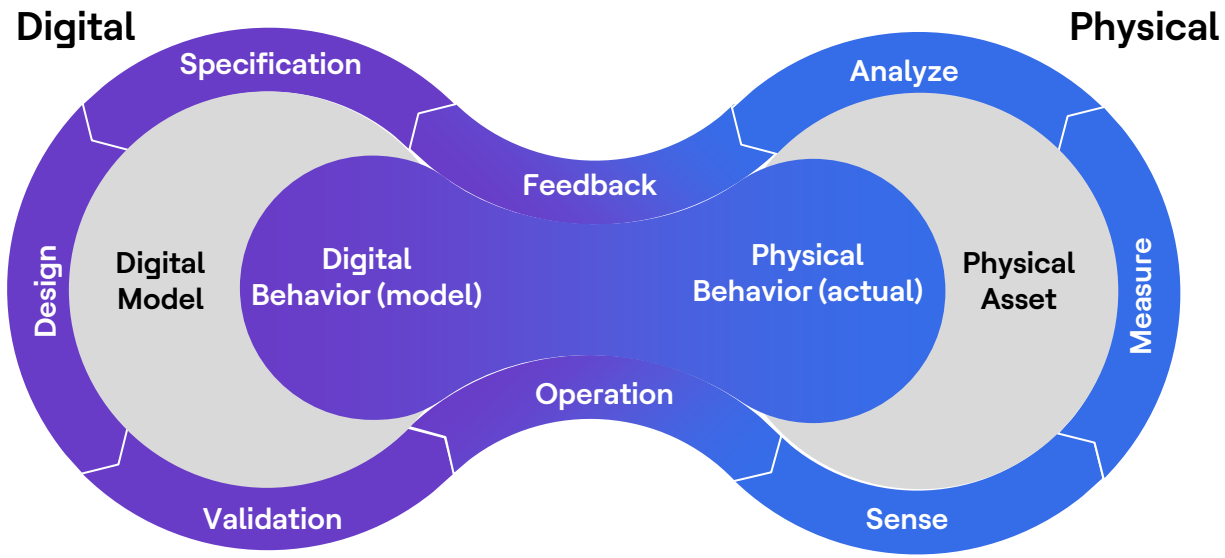
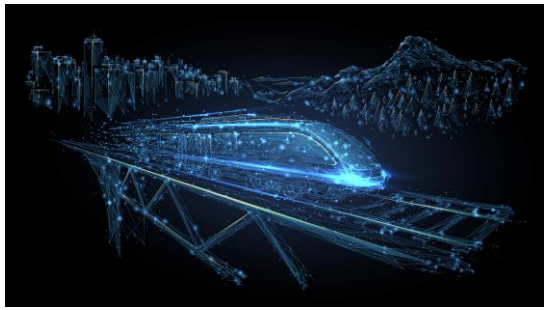
Digital Twin Concept



"A Digital Twin is a connected virtual replica of a physical product, person, place or process"

Twin Types

Product Twin



Asset Twin

Process Twin

Infrastructure Twin

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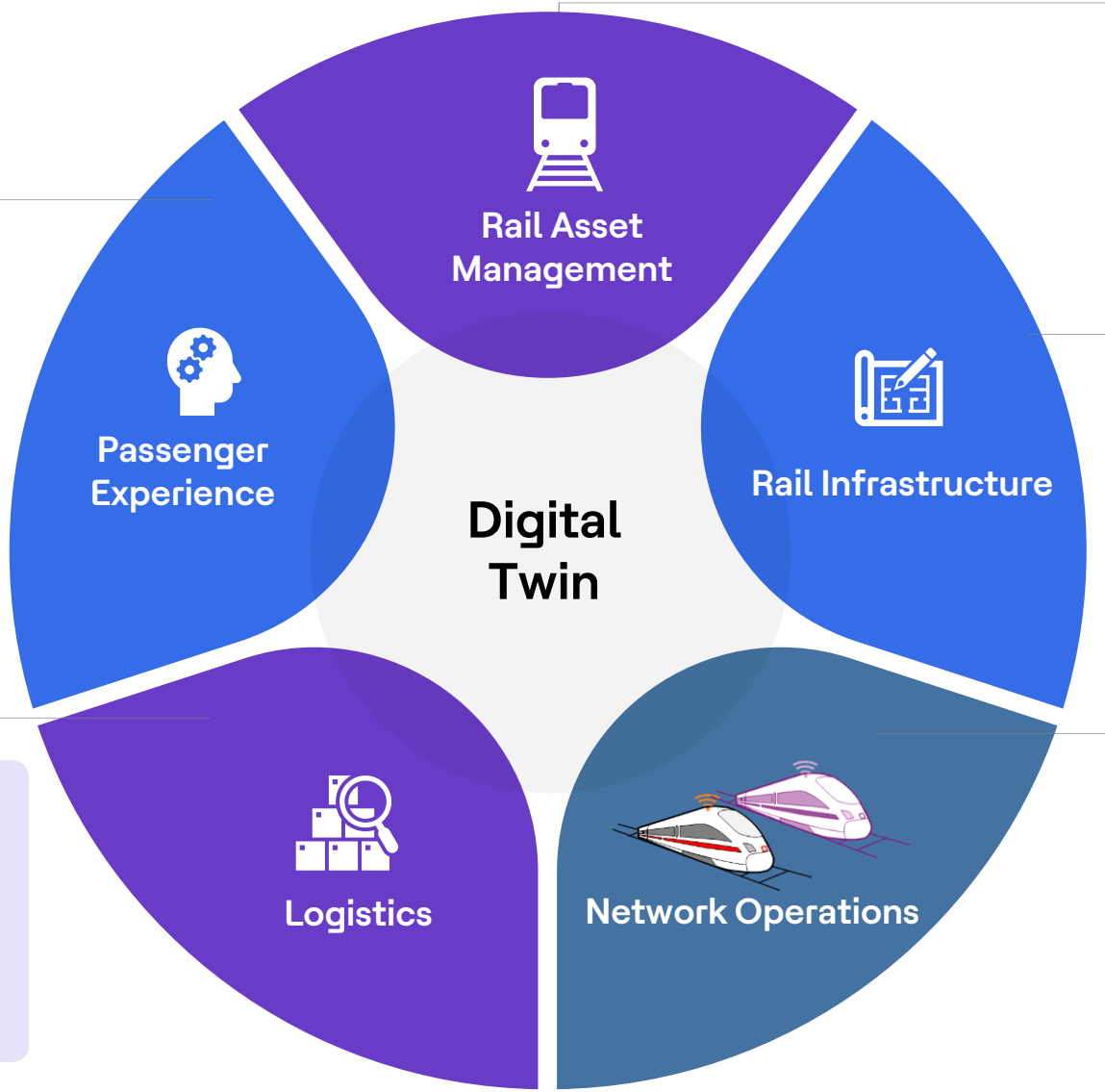
Digital Twin Use Cases in Rail Industry



- Rail Asset monitoring & Control
- Rolling stock Safety & Security
- Predictive Maintenance, RUL Prediction
- Asset Planning Commissioning

- Rail Yard Design & Simulation
- Platform Simulation – Capacity, utilization
- Health monitoring – Track bed, signals, switches, yards, electric wires

- Real time network visibility
- Scheduling & optimization
- Dwell time reduction
- Traffic & disruption management

- Intermodal Simulation
- Material Logistics Management – Inbound, Outbound, Inhouse
- Shipment Management
- Material flow analysis

- Enhance travel experience
- Ticket management & booking
- Real-time occupancy display – mobile app
- Automatic notifications – cancellation, change in timetable

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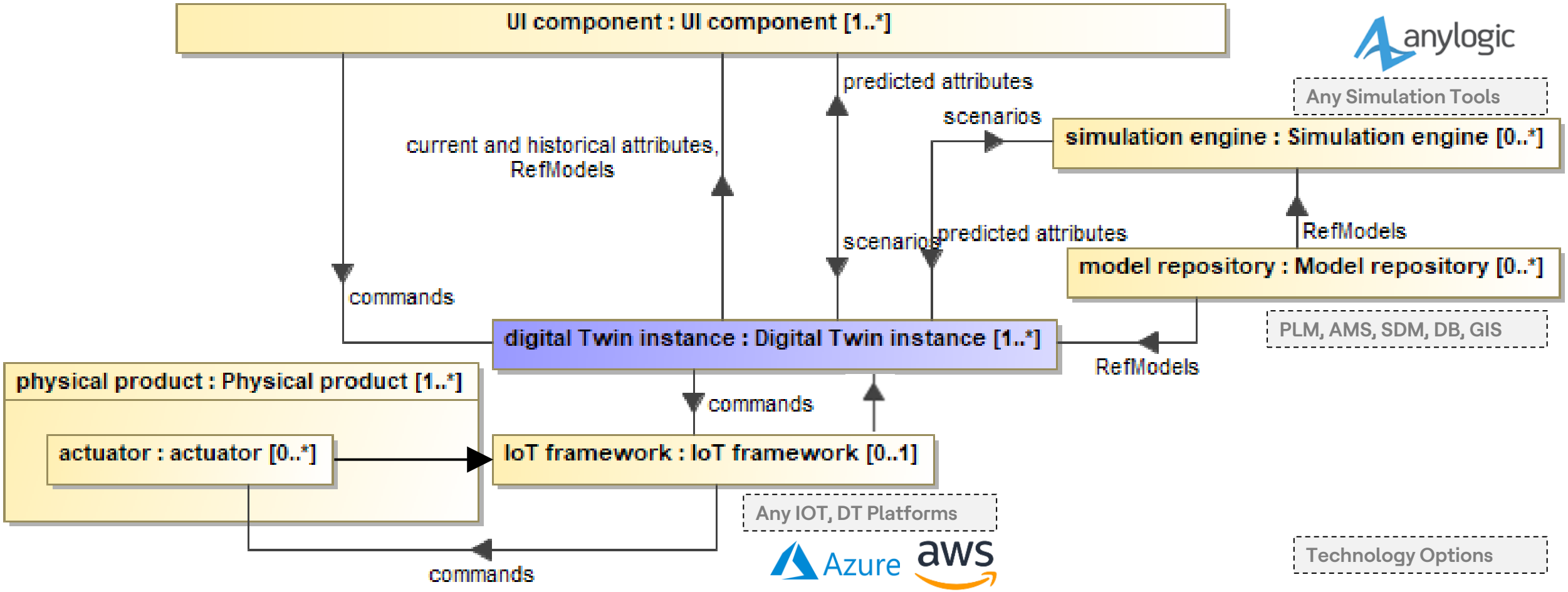
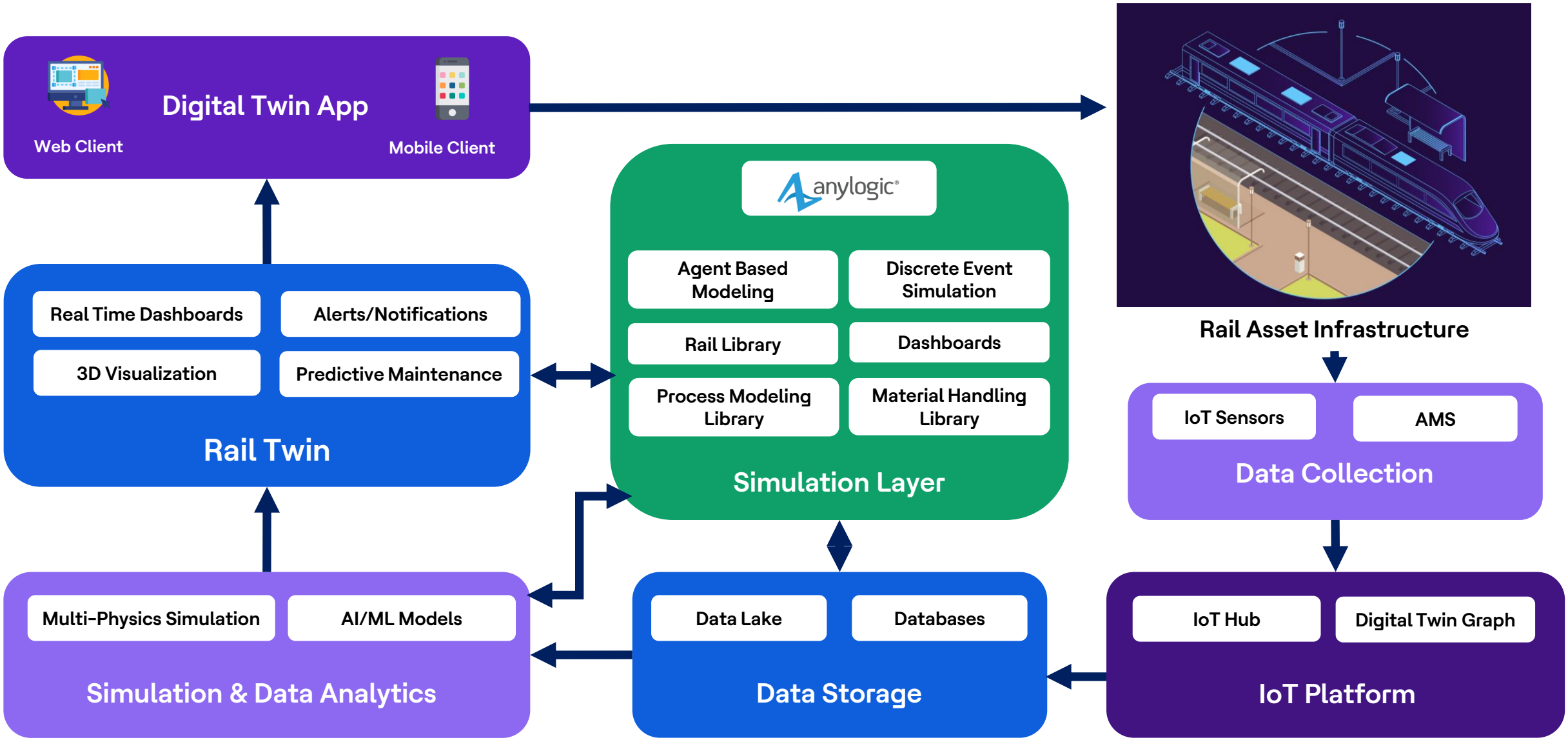
HCLTech Digital Twin Framework



Digital Twin FW Implementation using AnyLogic



Azure

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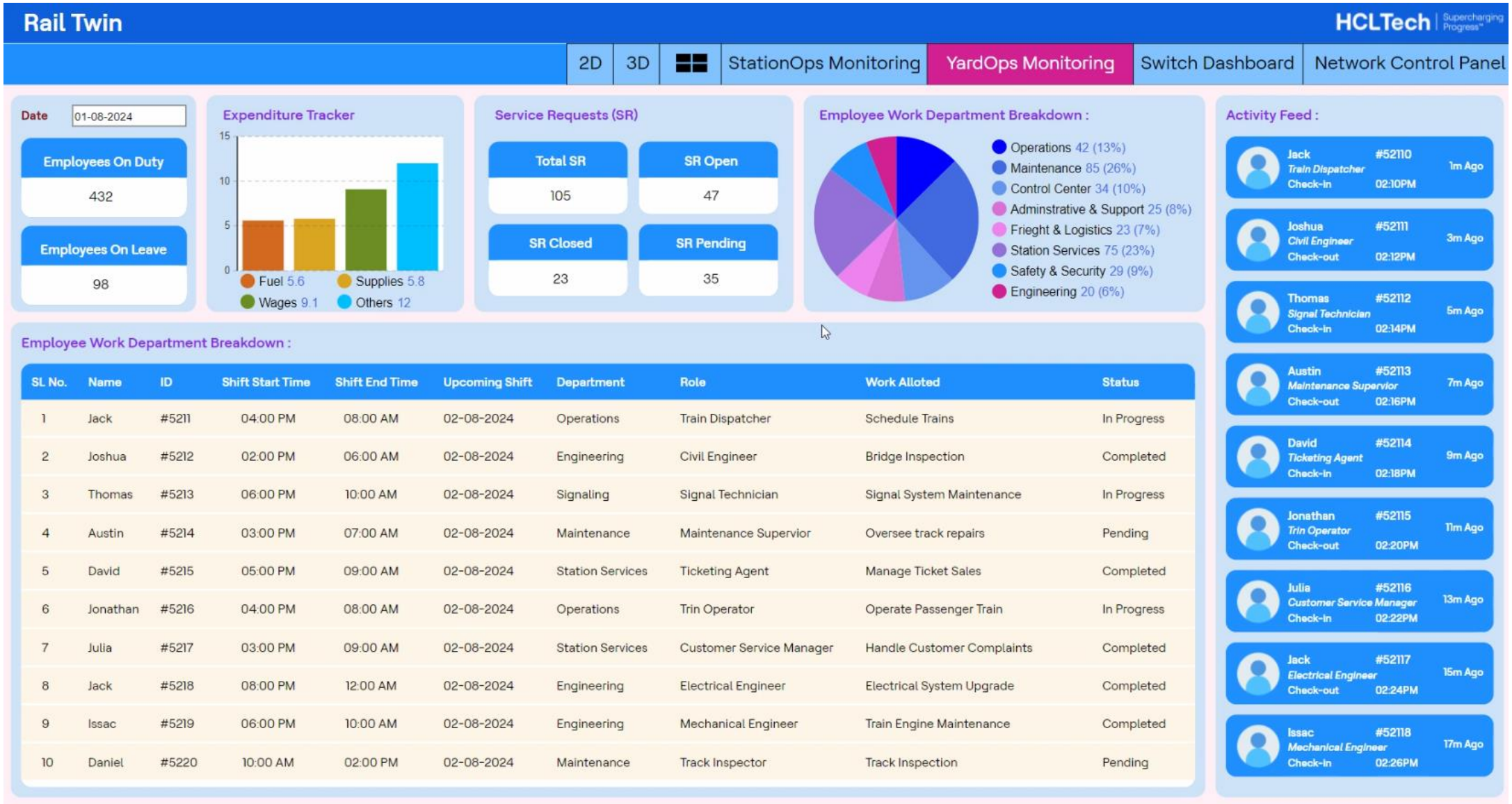
HCLTech Rail Twin Solution for Yard Operation Monitoring



SL No.	Name	ID	Shift Start Time	Shift End Time	Upcoming Shift	Department	Role	Work Alloted	Status
1	Jack	#5211	04:00 PM	08:00 AM	02-08-2024	Operations	Train Dispatcher	Schedule Trains	In Progress
2	Joshua	#5212	02:00 PM	06:00 AM	02-08-2024	Engineering	Civil Engineer	Bridge Inspection	Completed
3	Thomas	#5213	06:00 PM	10:00 AM	02-08-2024	Signaling	Signal Technician	Signal System Maintenance	In Progress
4	Austin	#5214	03:00 PM	07:00 AM	02-08-2024	Maintenance	Maintenance Supervior	Oversee track repairs	Pending
5	David	#5215	05:00 PM	09:00 AM	02-08-2024	Station Services	Ticketing Agent	Manage Ticket Sales	Completed
6	Jonathan	#5216	04:00 PM	08:00 AM	02-08-2024	Operations	Trin Operator	Operate Passenger Train	In Progress
7	Julia	#5217	03:00 PM	09:00 AM	02-08-2024	Station Services	Customer Service Manager	Handle Customer Complaints	Completed
8	Jack	#5218	08:00 PM	12:00 AM	02-08-2024	Engineering	Electrical Engineer	Electrical System Upgrade	Completed
9	Issac	#5219	06:00 PM	10:00 AM	02-08-2024	Engineering	Mechanical Engineer	Train Engine Maintenance	Completed
10	Daniel	#5220	10:00 AM	02:00 PM	02-08-2024	Maintenance	Track Inspector	Track Inspection	Pending

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HCLTech Rail Twin for Asset Maintenance

Business Benefits

10-30%
Reduced time to market

20-30%
Reduced maintenance cost

25-30%
Increased rail asset performance

10-30%
Improved planning efficacy

5-10%
Inventory reduction possible

10-15%
Reduced efforts in development

Conclusion

- AnyLogic can be used in Digital Twin for Rail Infrastructure Management & operations
- AnyLogic plays a key role in any Process Twin & Infrastructure Twin
- Real-time data can be used in AnyLogic process model for predictive maintenance of rail assets

- Digital Twin Framework powered by AnyLogic is scalable for different use cases
- AnyLogic enable to orchestrate different types of simulation & libraries in Digital Twin FW
  - Agent based modelling, discrete event simulation, material handling & rail libraries etc.

HCLTech team

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