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Building Information Modelling (BIM) in Railways

For Design, Construction, Operation and Asset Management

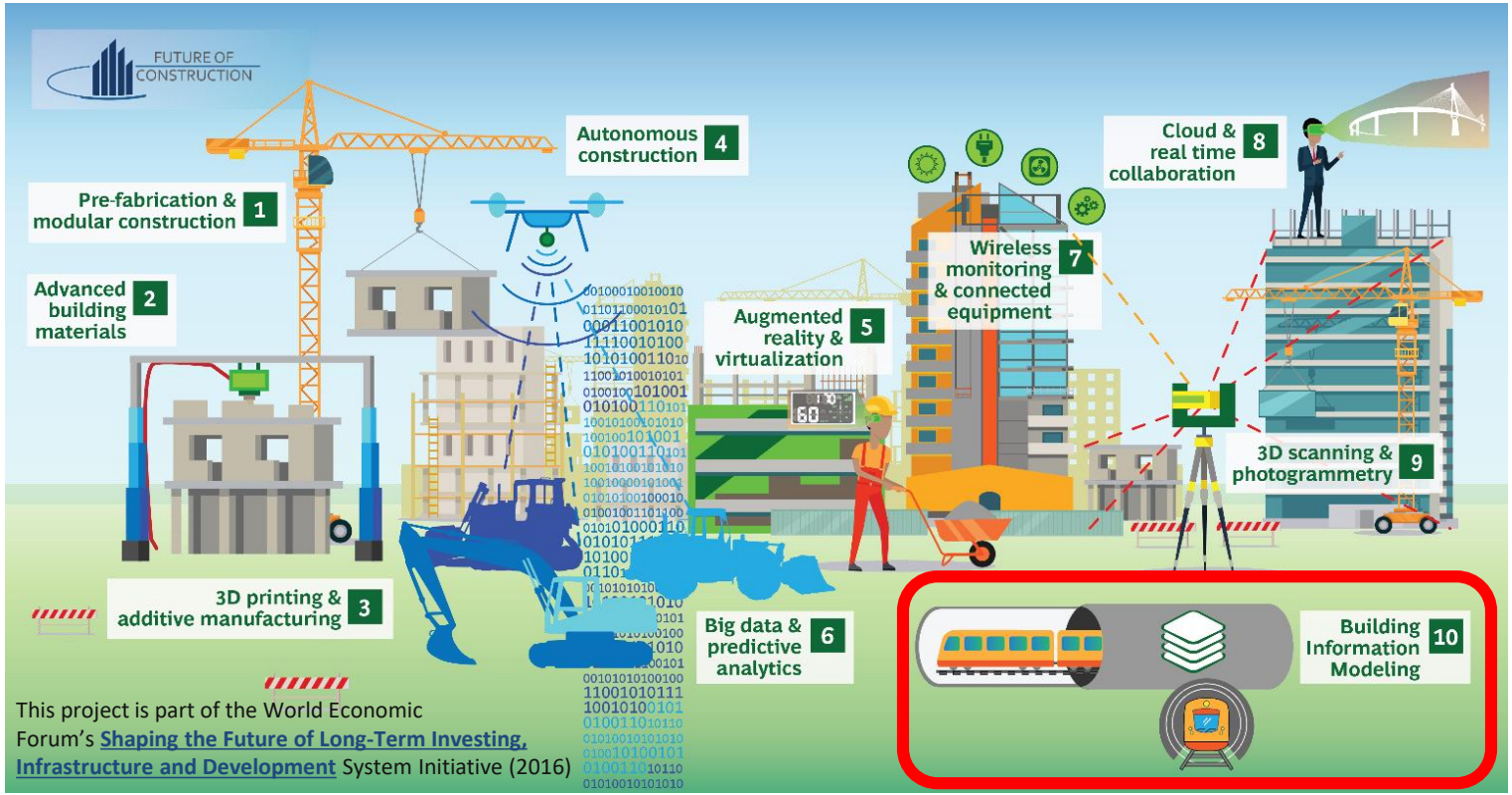
21 May 2019
Asia-Pacific Rail Innovation Forum

Jugal Makwana
Consultant – ADB (TA9420)
Global Director – BIM/Digital Engineering

Agenda

- **Building Information Modeling (BIM)**
  - Growth
  - Adoption
  - Standard
  - Uses
- **Information Federation for Railways**
- **BIM Solutions/Technology for Rail Lifecycle**
- **Rail BIM Projects**
- **Challenges**
- **Future of BIM for Railways**
- **Recommendations and Guidelines**

World Economic Forum
Future of Construction and Infrastructure



This project is part of the World Economic Forum's **Shaping the Future of Long-Term Investing, Infrastructure and Development** System Initiative (2016)

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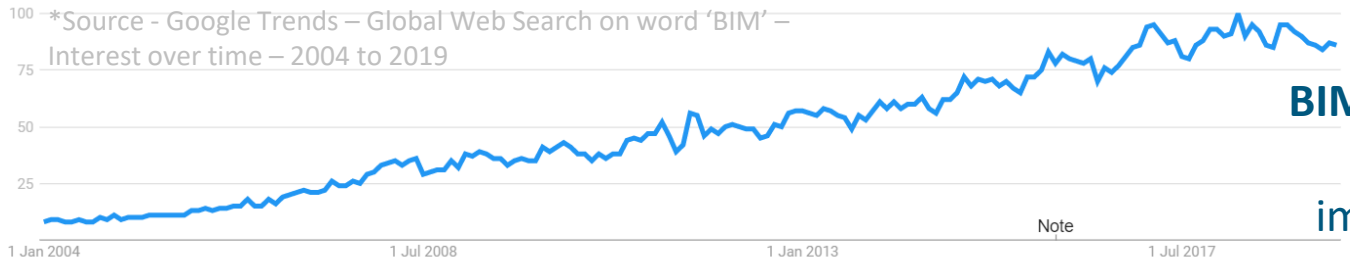
Interest in ‘BIM’ over time



BIM – Is not a technology

BIM – is a **Process** enabled by **Technology** implemented by **People**

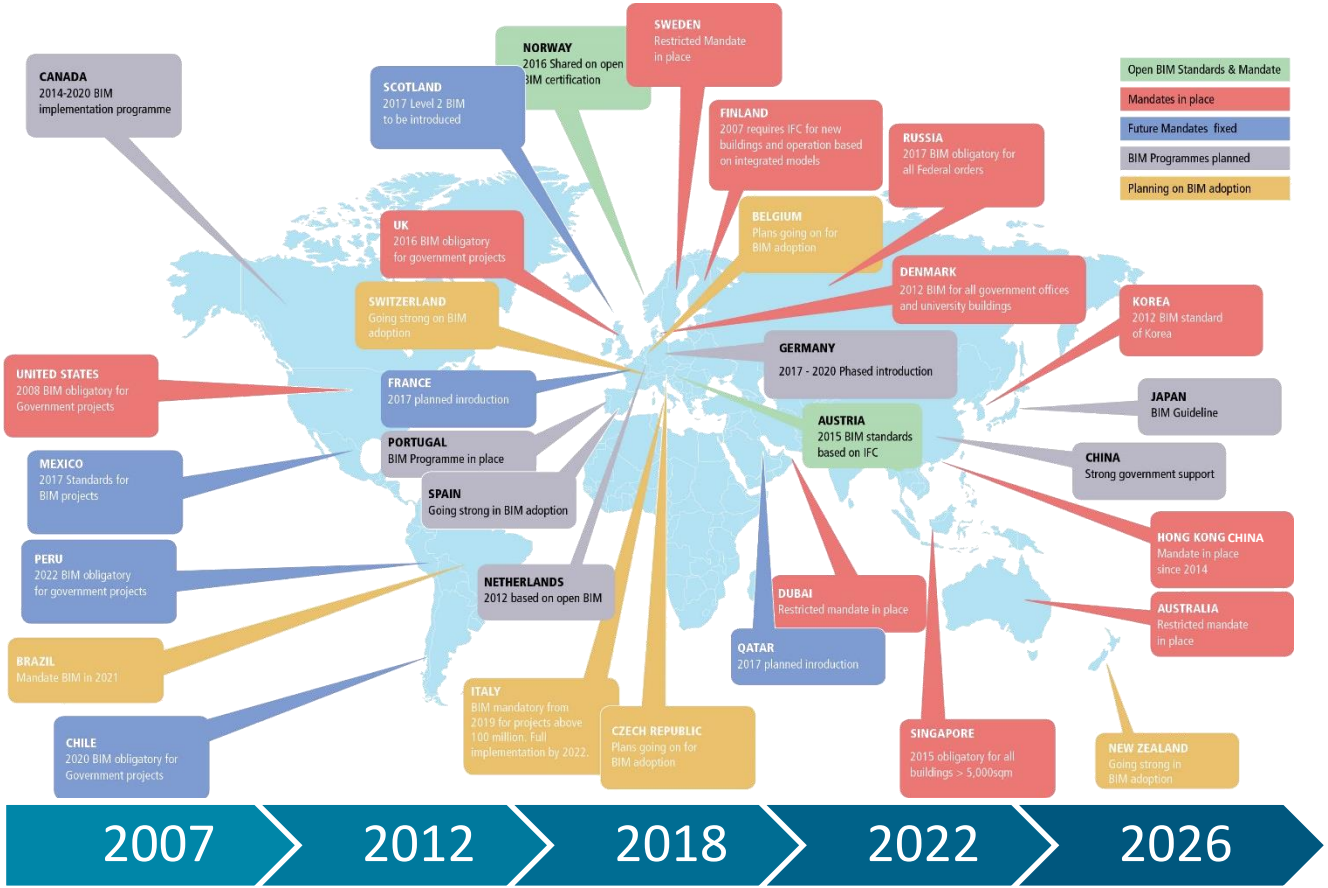
CAD → 3D → Coordination → Collaboration → Integrated BIM → Digital Twin

Level 0 → Level 1 → Level 2 → Level 3

ISO 19650 (Jan 2019)

*“Use of a **shared digital representation** of a **built asset** to facilitate design, construction and operation processes to form a **reliable basis for decisions**”*

Global Adoption of BIM



Drivers:

- Increase productivity
- Improve reliability
- Time Savings
  - Design
  - Construction
  - Handover
- Cost Savings
  - Maintenance
  - Upgrade
- Reduction in cost variance – from Design to Construction

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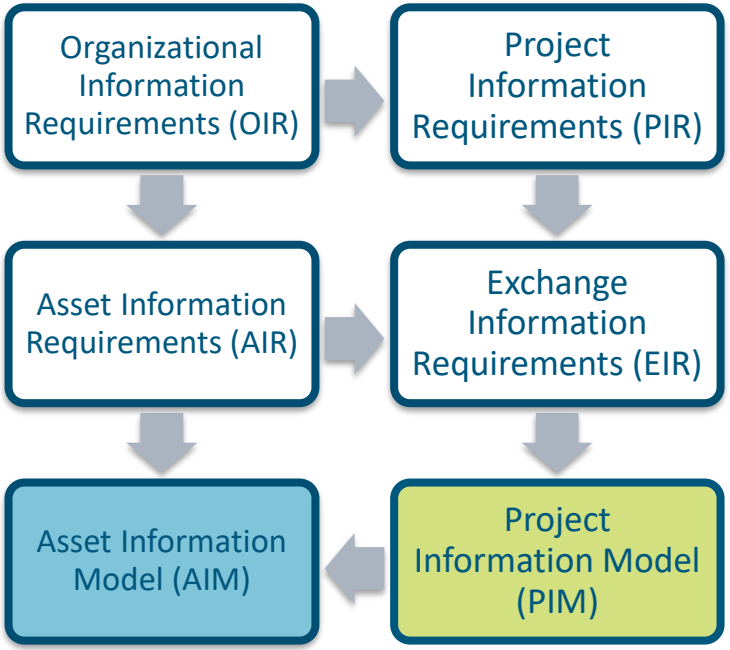
BIM – Information Management



ISO19650
Figure 2 — Hierarchy of information requirements

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Rail BIM Uses

Common Uses

- Drawings & Documentation production
- Interference Management
- Analysis & Simulation
- Quantity take-off
- Code & Functional compliance
- Visualization
- Tendering
- Procurement
- Functional & RAMS demonstration

Planning / Upgrade

Feasibility Studies

Existing condition Modeling

Route selection & optimization

Design

Design Engineering & Modeling

Project investigation & approval

Consultation & Project acceptability

Maintenance / Operation

Railway Handover documentation

Operation acceptance

As-built survey modeling

Railway as maintained modeling

Railway as operated modeling

Virtual training for operation & maintenance

Disaster Planning/Emergency Preparedness

Construction

Railway Handover documentation

Operation acceptance

As-built survey modeling

Railway as maintained modeling

Maintenance & Operation Planning

Virtual training for operation & maintenance

Disaster Planning/Emergency Preparedness

Source: BuildingSmart – IFC Railway Room

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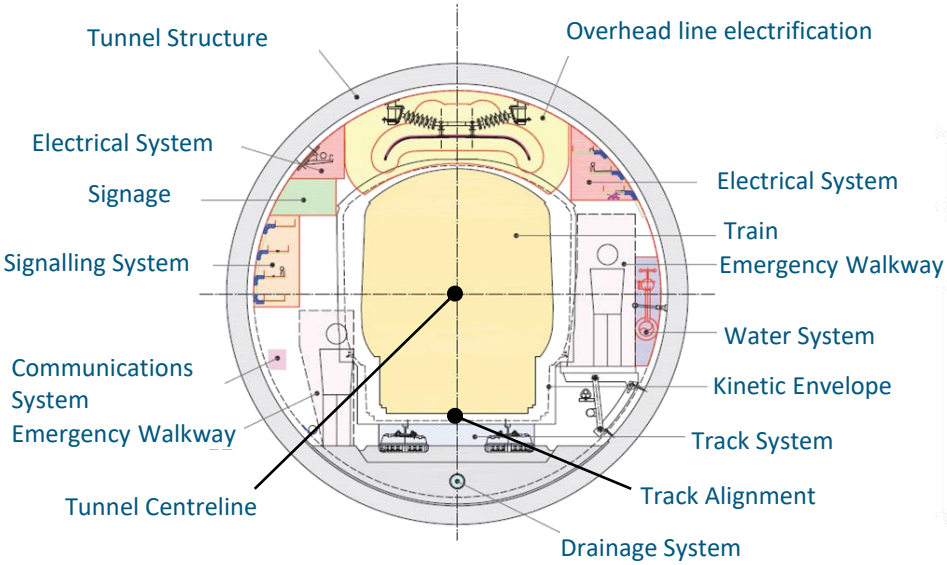
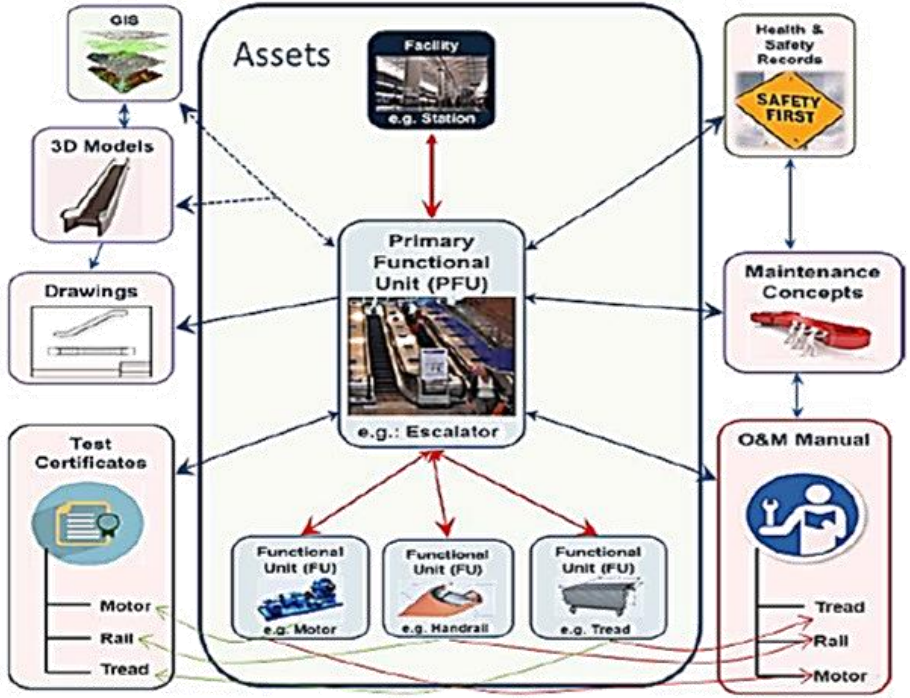
Information Federation Strategy for Rail Projects

- Discipline based Information Containers
- Geocoordination and Georeferencing
- Secured collaboration and sharing



Source/ISO19650 Part 1-2(figure 1a)



Source/Crossrail- A case study in BIM

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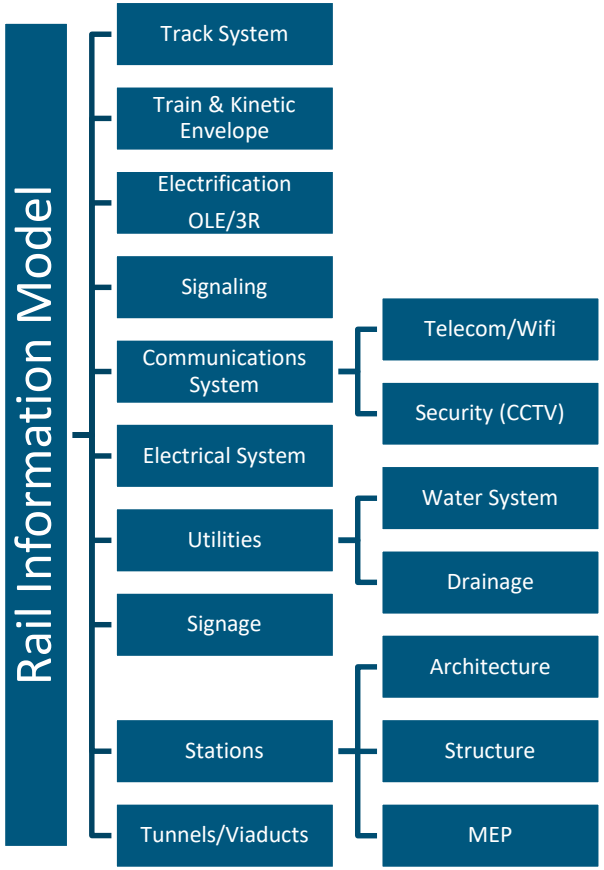
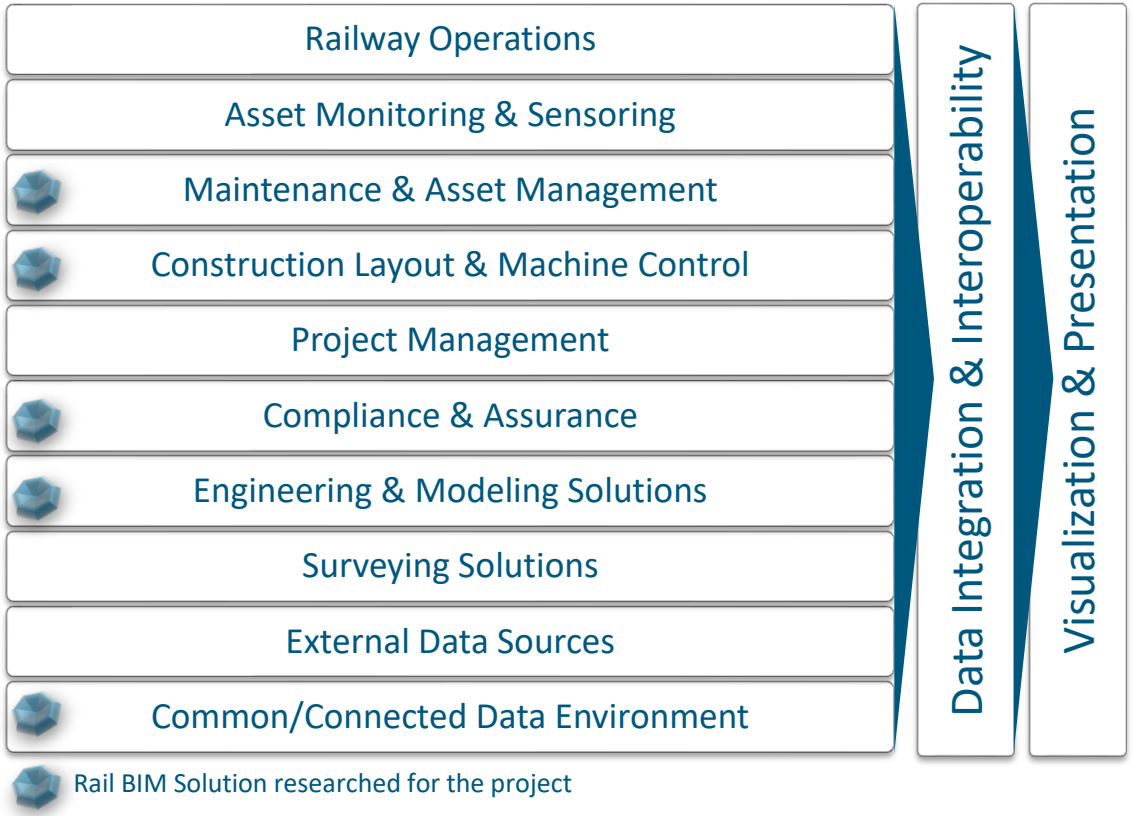
Rail Technology Solutions





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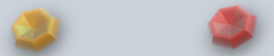
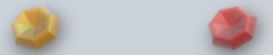
BIM Solutions for Railways – Technology Solutions

Phase	Track Systems	Electrification	Signalling	Communications
Planning				
Design				
Construction				
Asset Management				
Operation				
Upgrade				

Comparison of top global BIM solution providers in railways.

** these organisations participated in the survey and provided information*

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BIM Solutions – Rail Track Systems

Rail Route and Alignment planning

- Consider all viable options considering construction cost, time, sustainability
- Improved collaboration by allowing the GIS, geotechnical and design groups to integrate data
- Generating 3D corridors and alignment based on complex criteria's
- Fast response to public comments
- Time-location planning

Concept and Detail Design

- Create track geometry for mainline, yards, stations, and sidings.
- Turnouts, crossovers, and other furniture using engineering design
- Corridor modeling
- Country specific standards
- Documentation – drawings
- Quantification, reporting
- Train kinetic envelope and clearance
- Realtime Visualization

- BIM in Track Asset Management
- Mobile mapping
- Asset documentation
- GPS based PTC data collection
- RFID data collection
- Payload management
- Railway asset lifecycle solutions
- Vision-based wayside detectors

BIM Model to

- Construction Planning & Simulation
- Progress monitoring
- Site Positioning Systems
- Machine Control Systems
- Track measurement
- Capture track 3D track position, gauge and cant

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BuildingSmart – IFCRail

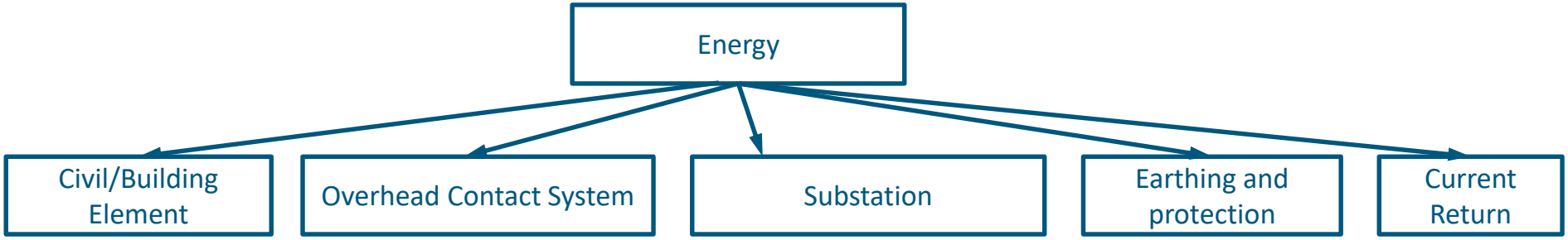
Industry Foundation Class (IFC) Schema

- IFC for Rail Track
- IFC for Energy
- IFC for Telecom
- IFC for Signalling

welcome other members to join

Data Requirement-Object description

For Reference



- **Foundation**
- **Pole**
- **Stay**
- **Portal/Beam**

……

- **Cantilever**
- **head-span**
- **OCL**
- **Tensioning device**
- **Mid-point anchor**
- **Sectioning device**
- **Electrical connector**
- **Clamp and fitting**

……

- **ControlEquipment**
- **Switching Device**
- **EnergyConversionDevice**
- **Instrument Transformer**
- **Power Transformer**
- **ElectricStorageDevice**
- **Filter**
- **BoxTypeSubstation**

……

- **Earthing circuit**
- **Protection Element**
- **Protecting Facility**

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Rail BIM Projects

BIM Uses

- **Drawings & Documentation production**
- **Interference Management**
- Analysis & Simulation
- Quantity take-off
- Code & Functional compliance
- Visualization
- Tendering
- Procurement
- Functional & RAMS demonstration

Common Data Environment based collaboration

BIM Procurement

- **Contractual BIM Requirements and Protocols**
- **Employers Information Requirements**
- **BIM Roles on projects**
- Competency assessment
- Information Security

PIM + AIM

BIM Implementation

- **BIM Manuals**
- **Guidelines**
- **Execution**
- Information management team
- Training Academy

Rail Baltica

hs2

Crossrail

ProRail

SNCF

METRO İSTANBUL

قطار الرياض riyadh metro

RAIL الرياض

Dubai metro

MTR

KORAIL

MRT CORP

SG-KL HSR

MRT/ Rail Depots

MAHA METRO

MRT CORP

Level 2 Certified in Asia

sydney METRO

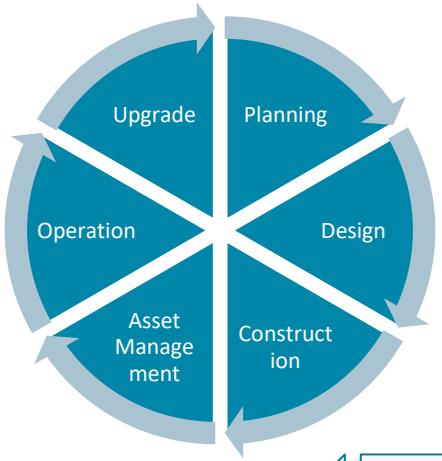
METRO

CityRailLink

BIM Implementation Challenges

- Understanding of BIM
- Procurement stage
  - Defining Project/Asset Information Requirements
  - Competency – Client, Supply chain
  - BIM protocols
  - Contractual framework for information exchange
- Implementation stage
  - BIM implementation guidance is unclear or too limited
  - Lack of skilled project information management team
  - Consumption of BIM information in the decision making process
  - Too much focus on 3D and modeling
  - Lack of integration/interoperability and open data exchange schema
- O&M stage
  - Integration with legacy MMS
  - Lack of organization to maintain and update BIM data

BIM Implementation Recommendation



- Identify BIM Priorities
  - Business/ Project Challenges
- Identify BIM Uses
  - Set BIM Goals
- Create Awareness and Set Common Language
- Define Information requirements
- Create contractual documentation
  - EIR
  - Manuals
  - Guidelines
  - Protocol
- Establish Information Management Team
  - Collaboration Platform
  - Setup Rail Information Exchange
  - Future proof technology stack
- Competency Assessment
  - Upskill internal and external resources
- Execute and Monitor implementation
  - Focus on integrated workflow
- Mandate use of BIM Information for decision making
- Measure Maturity and improve

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Source: www.newcivilengineer.com

Summary

- Implementation of BIM in Railways accelerating globally
- Growth in BIM adoption across rail projects in Asia
- Level 2 BIM mandate soon becoming a norm
- Rail projects can potentially gain significantly from BIM
  - Better coordinated design
  - Deliverables extracted from agreed source of truth
  - Constant monitoring of project risk – cost escalation and time delay
  - Improved project proposal communication for public consultation
- Rail specific BIM solution for Energy, Telecom and Signaling require significant advancements
- Asian organizations need to participate in IFCRail to implement OpenBIM standards
- Educational institutes need to introduce BIM based programs to met future market demand on BIM skilled resources

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