Railway Digital Twin for Innovation and Efficient Operations

Henri BERINGER
Transport and Mobility Consulting Director
Dassault Systèmes
Rail Freight Challenges and Opportunities

Multiple stakeholders across borders
- Infrastructures
- Authorities
- Operators
- Manufacturers
- Customers
- Logistics providers

Constrained infrastructure
- Complex multi-level system
- Heterogeneous
- Major innovations (ERTMS)
- Densification – urbanization

On-going digitization of the assets

Dynamic business environment
- +60% total freight by 2050 (EU)
- Growing international rail freight (50% in EU)
- New long corridors (ERTMS)
- Decarbonization → Multimodal opportunities

Real-time data available (IoT)

Attractiveness
- Reliability and punctuality
  - Transit time: Remove or optimize bottlenecks
  - Cost: Longer and heavier trains
Multiple stakeholders across borders

- Infrastructures
- Operators
- Customers
- Authorities
- Manufacturers
- Logistics providers

Constrained infrastructure

- Complex multi-level system
- Heterogeneous
- Major innovations (ERTMS)
- Densification – urbanization

On-going digitization of the assets

Dynamic business environment

- +60% total freight by 2050 (EU)
- Growing international rail freight (50% in EU)
- New long corridors (ERTMS)
- Decarbonization → Multimodal opportunities

Real-time data available (IoT)

Attractiveness

- Reliability and punctuality
- Transit time: Remove or optimize bottlenecks
- Cost: Longer and heavier trains

Imagine, Design and Model

- System of systems modeling
- 3D modeling

Territories

Collective imagination

Imaginative

Collective intelligence

Collective efficiency

Plan and Optimize

Real-time Simulation

Real-time data available (IoT)

Operate

Build

Deploy

Maintain

Common and unique reference

Collective imagination

Imagine, Design and Model

System of systems modeling

3D modeling

Collaborate

Collective intelligence

Plan and Optimize

Real-time Simulation

Operate

Build Deploy Maintain

Common and unique reference
Imagine the future of mobility
3DEXPERIENCE® Railway System Digital Twin

**Virtual**
- Lines
- Signaling & Interlocks
- Driver behavior
- Rolling stock physical dynamics
- Virtual Control room
- Virtual controllers
- ATC
- ATS & ATO

**Real**
- Customers
- Physical objects
- Physical controllers

**BENEFITS**

**Faster innovation**
- Early test during design
- Test future equipment off site

**Capacity / Timetable optimization**

**Better service**
- Operators Training
- Incidents investigation off line

**Streamlined collaboration**
- Single source of truth

**Safety**
- Designers
- Maintenance
- Operators

**Real time Multi-system Simulation**
- Headway
- Robustness
- Punctuality
- Availability

**Designers**

**Rolling stock physical dynamics**

**Customers**

**Physical objects**

**Physical controllers**

**Virtual controllers**

**ATC**

**ATS & ATO**

**Virtual Control room**

**Signaling & Interlocks**

**Driver behavior**

**Lines**

**3D EXPERIENCE**

**Robustness**

**Punctuality**

**Availability**

**Railway System Digital Twin**

**Maintenance**

**Operators**
3DEXPERIENCE® Rail Operations Planning & Optimization

Solve rail and public transport planning puzzles ranging from

**Strategic**
- Infrastructure Maintenance Planning and Scheduling
  - Schedule accesses, skills and equipment to perform maintenance tasks

**Tactical**
- Traffic Planning and Management
  - Optimize timetable compatible with infrastructure constraints (Network, station, Platforms)

**Operational**
- Fleet planning
  - Minimize vehicle usage and empty kilometers
  - Optimize fleet maintenance

- Crew diagraming and rostering
  - Minimize idle time
  - Real time working rules management

Software capabilities

- Predictive analytics
- Real-time rule propagator
- Configurable kpis
- Optimization
- What-if
- Interactive user interface
- Mobility
3DEXPERIENCE® Transport bottleneck optimization

1 train every 3 minutes at peak
Maintenance Planning and Scheduling
Reduce possession from 2 nights to 1 night
3DEXPERIENCE® Transport bottleneck optimization

Integrated rail freight operations planning and scheduling

Ground operators

Drivers, Qualifications

Locomotives
3DEXPERIENCE® Transport bottleneck optimization

- On-time loading/unloading
- Storage capacity
- Resources Availability
- Demurrage

PSA Antwerp
Sequence vessels in line with lock capacities
Schedule Pilots, Tugboats, Linehandlers....
14,000 vessels per Year
400 million tons (+22.2% Y/Y)
Last-mile delivery

1.8 billion pick-ups and deliveries per year

Real-time optimization of the dispatch
Digital twin for collective improvement of rail freight?

Collective imagination

Imagine, Design and Model
System of systems modeling
3D modeling

Territories
Infrastructure
Fleet

Collaborate
Collective intelligence

Plan and Optimize
Real-time Simulation
Real-time data available (IoT)

Operate
Build
Deploy
Maintain

Common and unique reference

Collective efficiency

Imagine, Design and Model
System of systems modeling
3D modeling

Collaborate
Collective intelligence

Plan and Optimize
Real-time Simulation
Real-time data available (IoT)

Operate
Build
Deploy
Maintain

Common and unique reference

Collective efficiency
Thank you

Henri BERINGER
Transport and Mobility Consulting Director
Dassault Systèmes
Henri.Beringer@3ds.com
3ds.com