



# Railway Digital Twin for Innovation and Efficient Operations

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# Rail Freight Challenges and Opportunities

## 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



# 3DEXPERIENCE® Railway Digital Twin

Collective imagination

**Collaborate**  
Collective intelligence

Collective efficiency

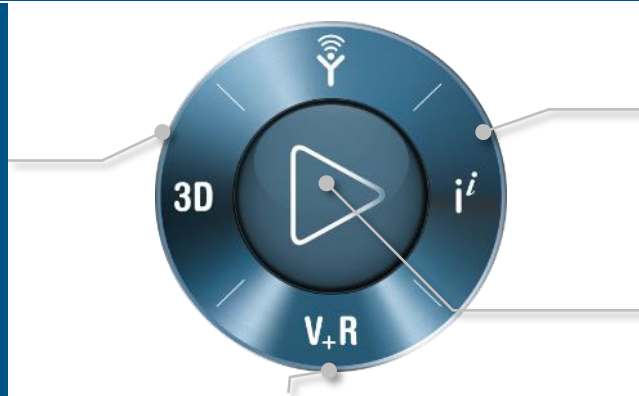
**Imagine, Design and Model**

System of systems modeling  
3D modeling

Territories

Infrastructure

Fleet



**Plan and Optimize**

**Real-time Simulation**

Real-time data available (IoT)

**Operate**

Build

Deploy

Maintain



Common and unique reference





# 3DEXPERIENCE® Imagine the future of mobility



# 3DEXPERIENCE® Railway System Digital Twin



Safety



Designers



Maintenance

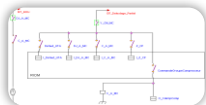


Operators

## Virtual



Lines



Signaling & Interlocks



Driver behavior



Virtual Control room  
ATS & ATO



Rolling stock  
physical dynamics



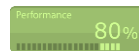
Virtual controllers  
ATC



Headway  
Robustness



Real time Multi-system  
Simulation



Punctuality  
Availability

## Real



Customers



Physical objects



Physical controllers

## BENEFITS

### Faster innovation

- Early test during design
- Test future equipment off site

### Capacity / Timetable optimization

### Better service

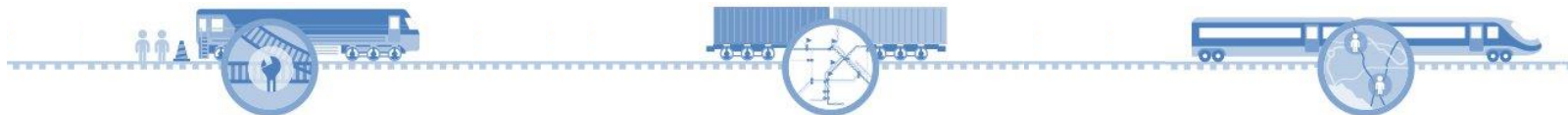
- Operators Training
- Incidents investigation off line

Streamlined collaboration  
Single source of truth



# 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



**Traffic Planning and Management**

Optimize timetable compatible with Infrastructure constraints (Network, station, Platforms)



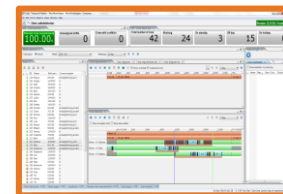
**Fleet planning**

Minimize vehicle usage and empty kilometers  
Optimize fleet maintenance



**Crew diagraming and rostering**

Minimize idle time  
Real time working rules management



Tactical

Operational

Software capabilities



Predictive analytics



Real-time rule propagator



Configurable kpis



Optimization



What-if



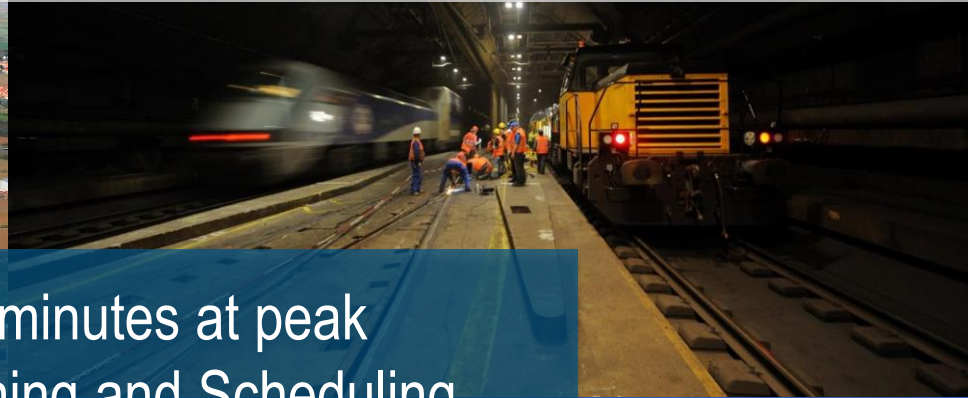
Interactive user interface



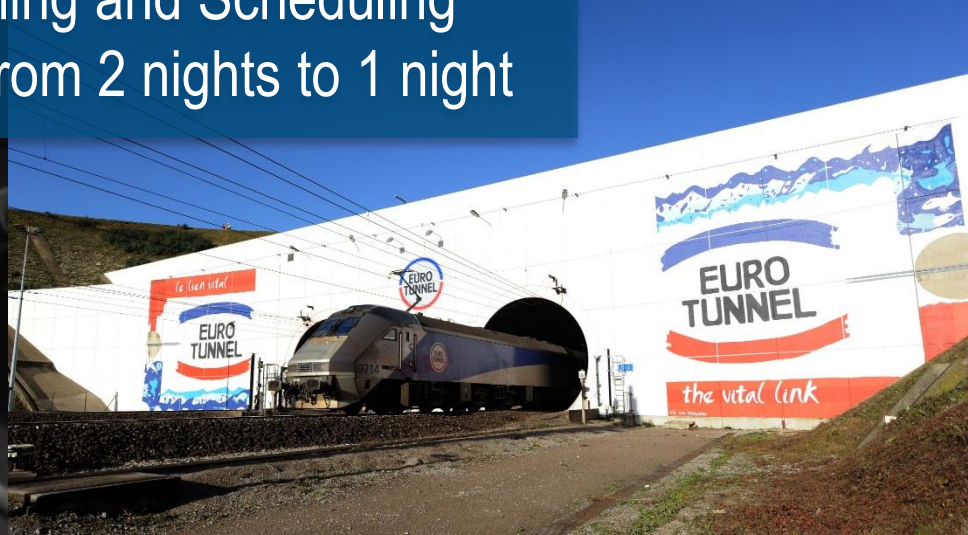
Mobility



# 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

Resources Availability

Storage capacity

Demurrage



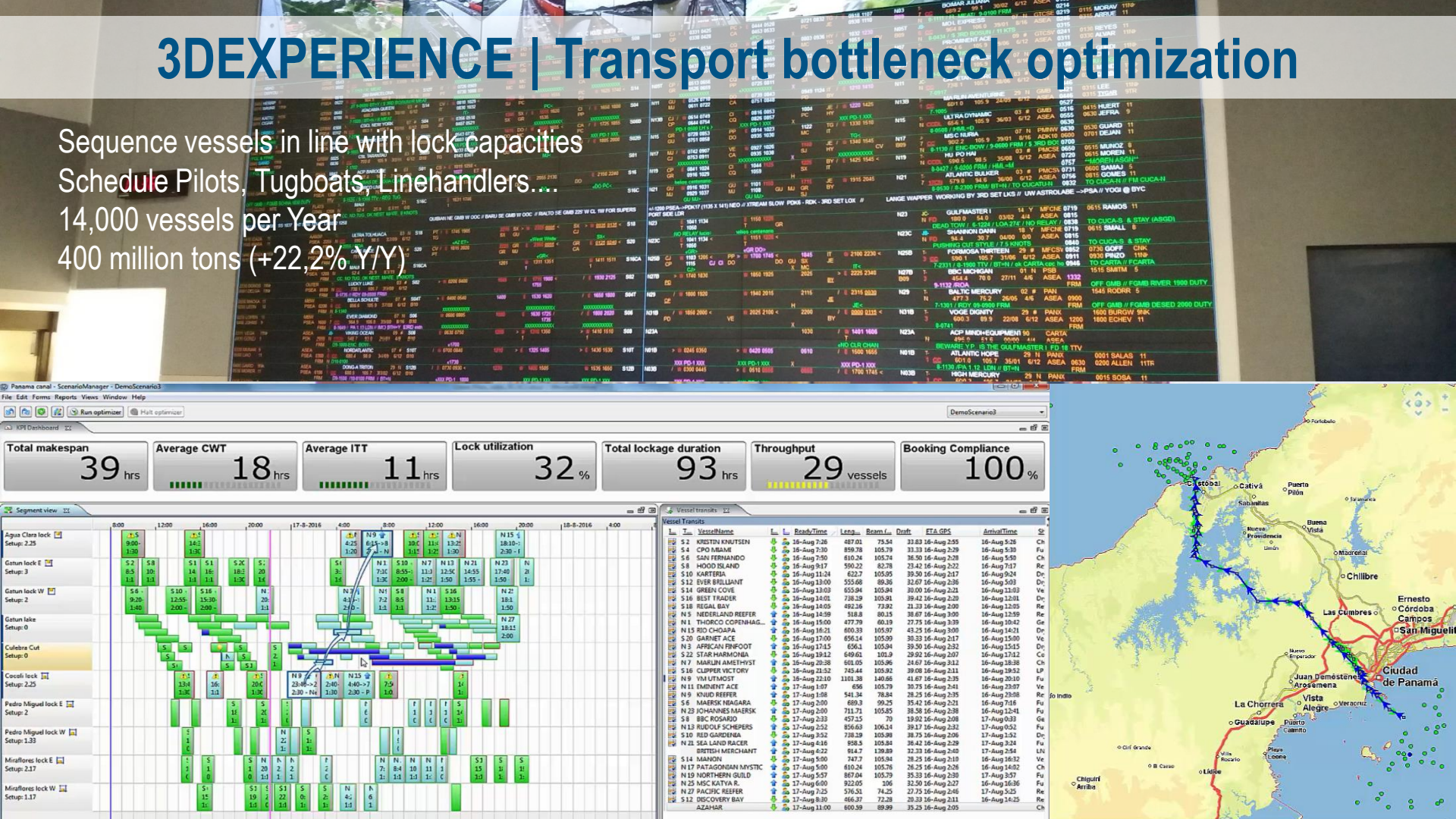
# 3DEXPERIENCE | Transport bottleneck optimization

Sequence vessels in line with lock capacities

Schedule Pilots, Tugboats, Linehandlers...

14,000 vessels per Year

400 million tons (+22.2% Y/Y)



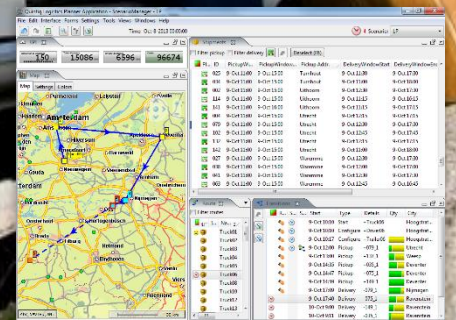


# 3DEXPERIENCE® Transport bottleneck optimization

## 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?

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# Thank you

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