

**Railway simulation:
from single asset up to trunk line**

TBS DEVELOPMENT HAS BEEN ANYLOGIC'S PARTNER IN THE REPUBLIC OF KAZAKHSTAN SINCE 2022

Services:

- management consulting, business processes, KPIs and personnel motivation systems
- logistics consulting, simulation modeling
- IT consulting and implementation of IT systems

Geography:

- Kazakhstan
- Turkmenistan
- Belgium
- some other countries



Our company deals with AnyLogic and anyLogistix models.
Railway transport is one of the most important areas of our activities and expertise.

KITNG LLP - KAZAKH INSTITUTE OF OIL AND GAS TRANSPORT LIMITED LIABILITY PARTNERSHIP



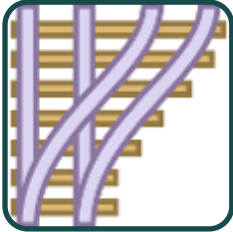
- Private (without the state participation)
- Engineering works and services (design & design management)
- More than 140 persons
- Location - Republic of Kazakhstan, Almaty and Atyrau (branch)
- Integrated Management System containing ST RK ISO 9001 - 2009, Quality Management System ST RK ISO 14001 - 2006, Environmental Management System ST RK ISO 18001 - 2008
- KITNG LLP started ITS activities since 1973 from the foundation KazGiproGaz state enterprise founded to provide the unified approach while designing the systems of gas supply to settlements, cities and regions of Kazakhstan. Since early 2000-s the institute was on the leading positions in the design of main oil and gas pipelines in Kazakhstan. It was included such projects as Asian Pipeline (Kazakhstan-China), Caspian Pipeline Consortium and many other.

Since 2003, more than 300 projects have been performed in total. In 2015 the company set the goal to transfer to BIM technologies and introduced major changes to have the most advanced technologies, equipment and highly professional engineers.

Since 2022 the company uses simulation in its design projects.

The institute is now confident in its future tries its best to keep the pace

MAIN GOALS OF RAILWAY SIMULATION



Track Layout Optimization:

Comparing development scenarios for new/modernized stations and industrial sidings (non-public tracks)



Rolling Stock Workflow:

Selecting the most efficient processing strategy, including shunting



Capacity Stress Testing:

Validating growth targets for future cargo volumes



Digital Twin:

Real-time decision support for dispatchers



Integrated planning:

Aligning production schedules with rail logistics



AnyLogic comes with a sufficiently broad set of capabilities to enable the creation of various models covering railway infrastructure, non-public tracks (sidings), stations, and related operations

EFFICIENCY DRIVERS FOR RAILWAY SIMULATION



Higher throughput – increase freight turnover



Faster cycles – reduce railcars turnaround & locomotive idle time



More resilience – lower risk of schedule deviations



Better service – cut costs and order fulfillment time



Efficient rolling stock – reduce locomotive mileage, speed up processing



Lean staffing – save on payroll costs



Simulation results validate broad opportunities to achieve real cost savings and operational gains

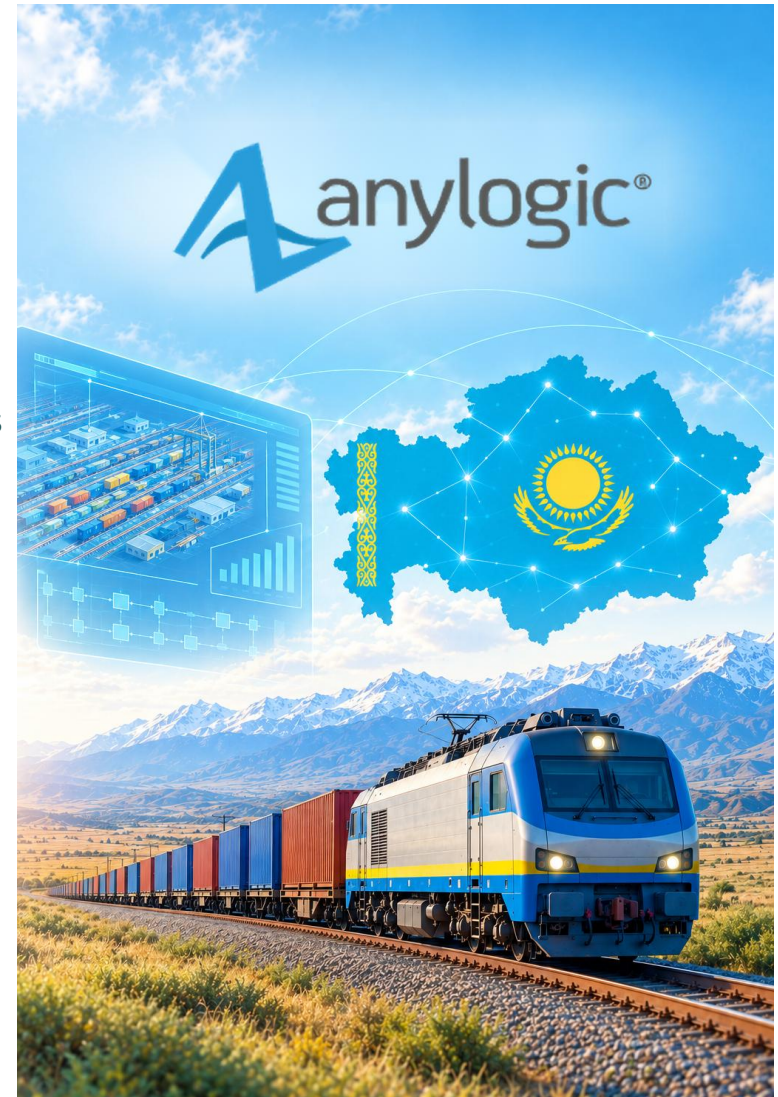
KEY ANYLOGIC ADVANTAGES FOR RAILWAY SIMULATION

AnyLogic is a universal simulation modeling platform offering:

- **Advanced visualization** – 2D- and 3D- graphics with GIS map integration
- **Dedicated Rail Library** – including tracks, switches, train sets, wagons, and base movements
- **The ability to combine** rail operations with other processes in a single model, with unlimited detail, such as:
 - Loading/unloading of general, liquid, and bulk cargo, containers
 - Maintenance and repair of rolling stock
 - Passenger boarding, alighting, and movement
 - Road traffic and level crossings
 - Staff operations and movements
- **System integration** – connectivity with dispatching systems, transportation planning tools, and accounting systems
- **Built-in optimization** capabilities – to fine-tune performance / costs



Combining ready-to-use libraries enables creation of comprehensive models. AnyLogic is well-suited for multi-level abstraction — from entire rail networks down to individual stations and industrial sidings



KAZAKHSTAN. NEW RAILWAY LINE CONSTRUCTION PROJECTS (1/2)



ҚАЗАҚСТАН
ТЕМІР
ЖОЛЫ



OBJECTIVES:

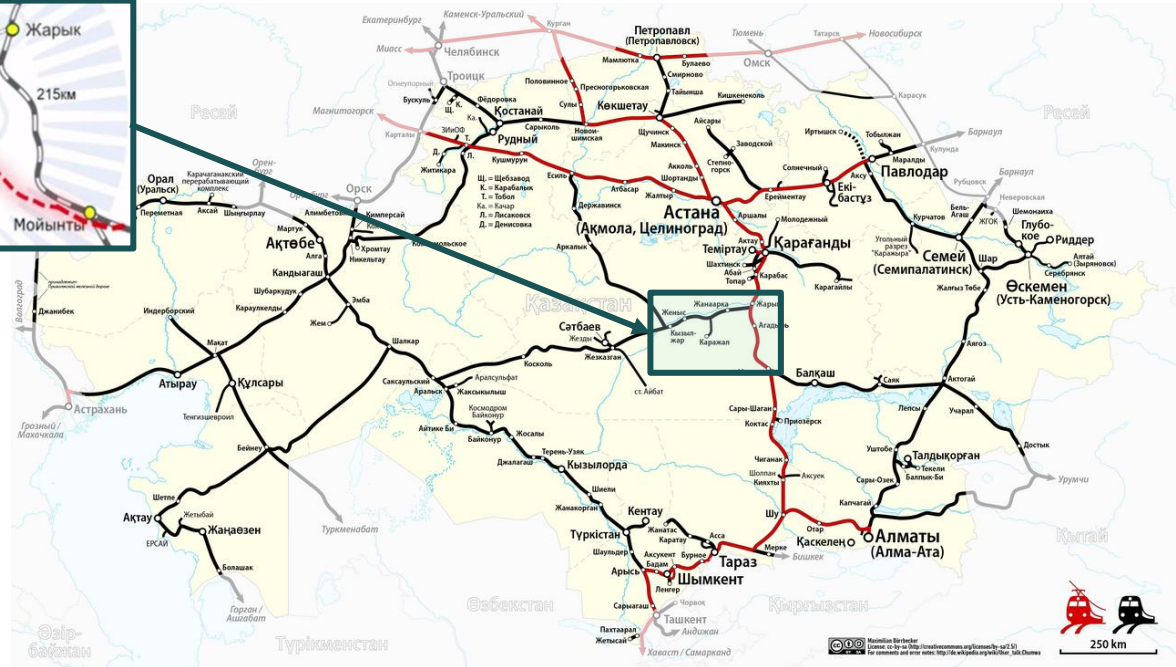
- Determine optimal location of sidings (passing loops)
- Calculate maximum line capacity
- Advantage over formula-based calculations: ability to model random events and traffic variations

PROJECT GOAL:

- Development of a simulation model to evaluate the capacity of new railway lines under construction in Kazakhstan

MODELED PROCESSES:

- Movement of loaded, empty, mixed, container, and passenger trains on single-track sections
- Scheduled station operations
- Locomotive changing at stations
- Track maintenance operations on railway line sections



KAZAKHSTAN. NEW RAILWAY LINE CONSTRUCTION PROJECTS (2/2)

PROJECT GOAL:

- Development of a simulation model to evaluate the capacity of new railway under construction lines in Kazakhstan.

TECHNOLOGY:

- "Classical" discrete-event simulation model
- Industry-standard specialized reports (train schedules / traffic graphs)

RESULTS:

Simulation model for two railway lines, enabling:

- Capacity assessment under varying traffic intensities
- Load calculation for individual sections under changing speed regimes
- Evaluation of weather impact and snow-clearing operations
- Determination of optimal number of stations and passing sidings

Both trunk lines will play an important role for TransAsia railway corridor



ANYLOGIC RAIL LIBRARY – CAPABILITIES & LIMITATIONS

Advantages

- Gives out-of-the-box features for full-scale modelling (tracks, switches, trains, wagons, movements)
- Supports core railway infrastructure elements
- Enables rapid development of clear, illustrative models
- Two abstraction levels – individual railcar and train consists
- Programmatic (code-based) generation of rail yard / junction layouts
- Multi-approach modeling in one model:
 - for a multi-station network: each station = agent with detailed Rail Network => Train = agent
 - for specific elements (e.g., hump yard): lowest level => Railcar = agent
 - inter-station movement: standard agents moving along paths in GIS space

Limitations

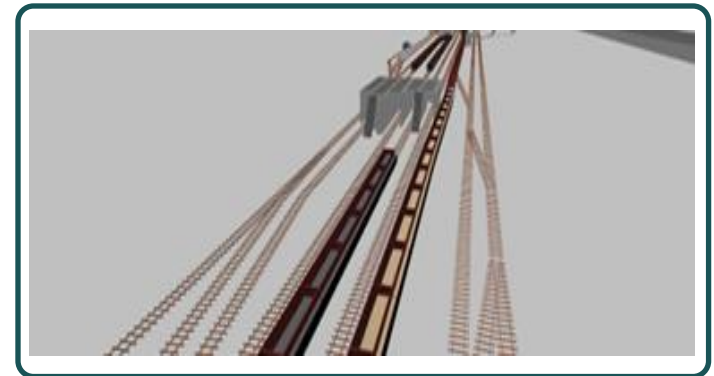
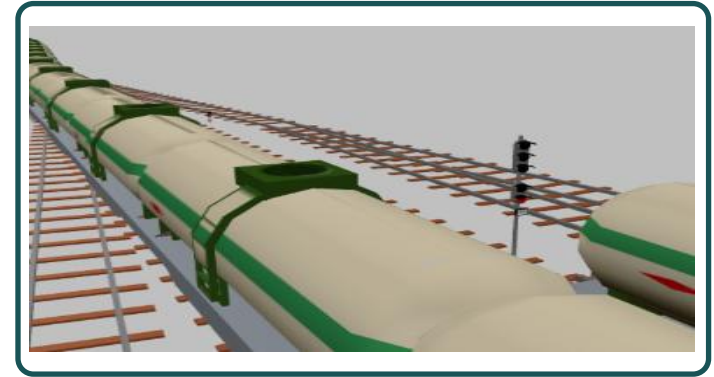
- Only basic single-direction shunting moves (semi-runs)
=> **need to build custom top-level logic**
- Modeling all processes even for a small station at the flowchart block level leads to overly complex schematics and loss of flexibility
=> **control logic is encapsulated in code, not in library flowchart blocks mosaic**
- Lacks specialized railway functions (interlocking, signaling, block control)
=> **develop custom libraries**
- Limited physics for locomotive and train dynamics
=> **select optimal level of abstraction for each project**



For many projects, AnyLogic strikes the right balance — its flexibility and openness for extension more than compensate for the absence of narrow, domain-specific functionality

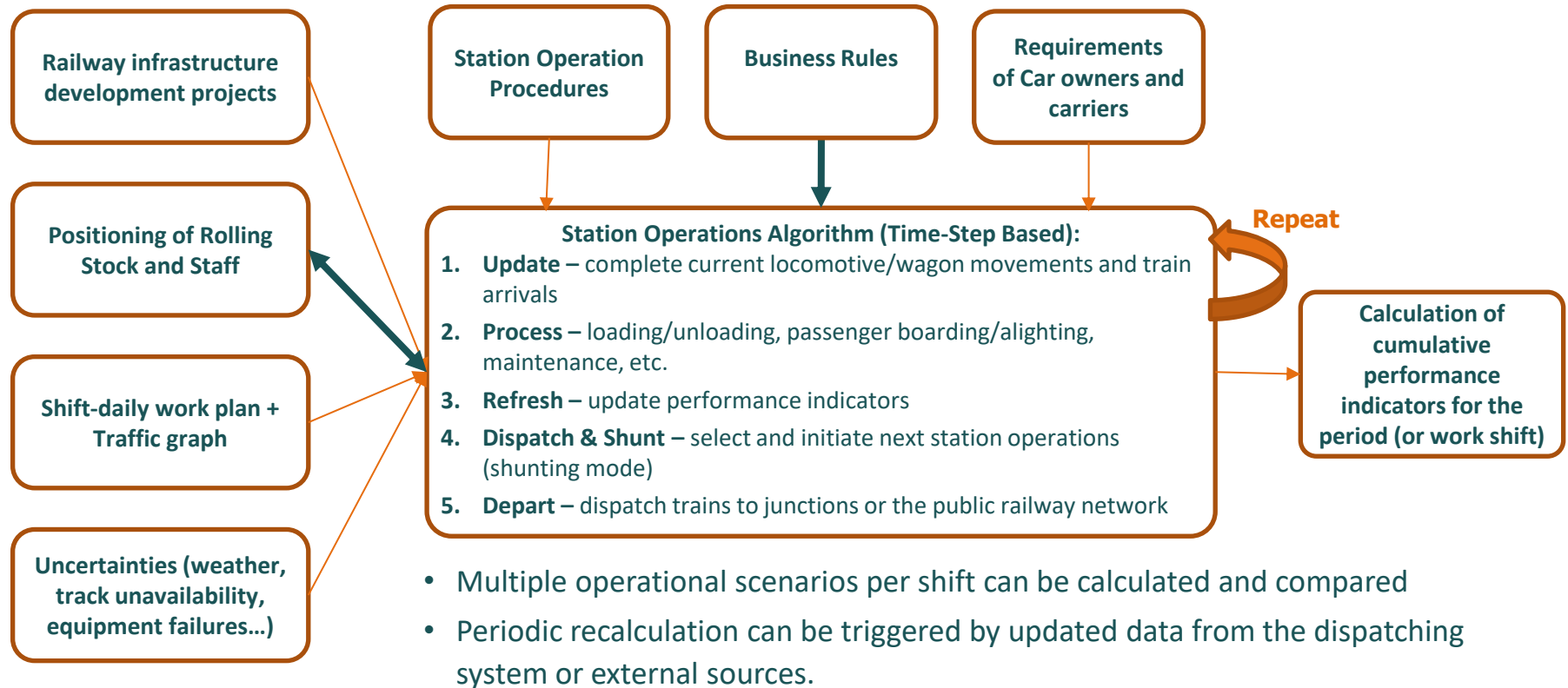
OUR SOLUTIONS – SIMULATION MODELS FOR RAILWAY

- **Custom Libraries – Extending the Standard Rail Library**
 - Railway signaling – logic, 2D/3D visualization
 - Level crossings – with road occupation control
- **Standardized high-level operational logic**
 - Processes (e.g., receiving loaded tank cars with oil products)
 - Shunting move sequences
 - Track selection with priorities
 - Inclusion of staff operations (e.g., inspection)
- **Dispatcher Module**
 - Triggered by time (schedule) or upon completion of a process step
 - Determines next priority step and initiates locomotive movement, or train dispatch, considering track and switch availability
- **Planner Module**
 - Solves railcar shunting problems according to Operator's requirements
 - Typically uses fast heuristics - efficient for our purposes



Our Rail Library extensions enable modeling of the full control cycle — from infrastructure logic to dispatching and planning

HOW THE STATION / HUB SIMULATION MODEL WORKS



Business rules are a set of heuristics designed by model developers and consultants to boost productivity and reduce risks (e.g., priority rules, wagon group sizing & selection, track selection from available options etc)

AUTOMATIC BATCH LOADING UNIT (AUTN) – SIMULATION PROJECT

PROJECT GOAL:

Validate track development design solutions for implementation of Automatic Batch Loading Unit (AUTN) at the oil refinery plant in Kazakhstan

MODELED PROCESSES:

- Station shunting operations
- Step movement for loading by railway robots
- Independent loading of petroleum products at two tank cars at a time
- Train dispatch after loading at AUTN
- Traffic control via signaling (traffic lights)

SPECIFIC FEATURES:

- Use of conventional locomotives and robo-locomotives
- Site-specific constraints (e.g., no movement on adjacent track while loading)
- Integration with Fluid Library

RESULT:

- The AnyLogic simulation model helped to develop the Decision Support System (DSS) , enabling:
 - Validation of design solutions
 - Testing of station section operations
 - Verification of planned product shipment volumes under given constraints and assumptions



ANYLOGIC: THE UNIVERSAL PLATFORM FOR RAILWAY SIMULATION

- A single platform for challenges of any scale – from full-network modeling down to detailed station operations
- Versatility and extensibility in many cases outweigh the lack of specific railway industry features
- Library customization and system integration make AnyLogic a future-ready platform for evolving business needs



Anylogic is the one tool for hundreds of scenarios to get measurable outcomes

