DYNAMIC SIMULATOR FOR THE RAILWAY COMPLEX OF THE PORT OF PARANAGUA

Rail Logistics

September 2025

About Us

... brief introduction about the presenters

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Civil engineer with over 12 years of experience in transport planning

Working since 2021 at Rumo conducting capacity analysis for long term strategic assessments

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Industrial Engineer with 4 years of experience in modeling and simulation working at Paragon

Worked on several projects in the fields of railway logistics, mining, and steel industries

RUMO SOUTH OPERATION

... overview of our operations and link with the Port of Paranagua

RUMO SOUTH OPERATION

NETWORK
Distributed along
4 states of Brazil

AGRIBUSINESS EXPORTS
Most of the goods
moved by rail are
related to grains and sugar

DIRECT CONNECTION TO PORTS
Paranaguá
São Francisco do Sul
Rio Grande

PORT OF PARANAGUA

GRAIN AND SUGAR EXPORTS *DRY BULK*
2nd major Brazilian Port
regarding exports of
grains and sugar

19 *million tons - 2021*
21 *million tons - 2024*

PIPELINE OF INVESTMENTS
Long term growth
based on investments in
terminals and new quays

MODAL DISTRIBUTION
Plan to increase the
amount of goods received
and dispatched by rail
30% Current rail share as of 2Q25
~50% Expected rail share

Dynamic Simulator for the Railway Complex of the Port of Paranagua

PORT OF PARANAGUA

... the railway within the port complex

Dynamic Simulator for the Railway Complex of the Port of Paranagua

Image obtained with Google Earth

Shortly, how does the operations are done?

*Trains are received from the **Rumo network** and stored on the **Railyard tracks***

Then, divided in smaller blocks of wagons according to terminals capacity

*A route in the **Internal network** is then defined and reserved*

*The shunting locomotives move the wagons to the terminal for loading or unloading; Afterwards move them back to the **Railyard tracks***

At the yard the train formation begins by sequencing wagons, coupling locomotives and safety procedures tests

*At last, the assembled train waits to be licensed to enter the **Rumo network***

THE PROBLEM

... why does a simulation model is needed?

Simulation models ...

Randomness effects

...
are optimized for
handle a range
of inputs

Robust combinations
from distributions on
representative
variables

different patterns
of trains arrivals

different mix
of wagons blocks
on trains

System performance

...
provide better results
when compared to
analytical models

Complex interactions
between resources
can be assessed
whether its benefits
for the system

which resource route or locomotive
has been used the most

how does an increase
in terminal productivity
affects the others

Scenarios comparison

...
ease to run different
scenarios and to create
experiments when needed

Scenario #1
modify yard procedures

Scenario #2
build a new line on the yard

Enhanced decision making

...
can create virtual environments
where risk free decisions can be made
to assess its behavior

What's the best
path to consider
Scenario #1 or Scenario #2?

Pros and Cons

Dynamic Simulator for the Railway Complex of the Port of Paranagua

EXPECTED OUTCOMES

... gathering data to make better decisions

Cargo throughput

The number of wagons unloaded and loaded in all terminals

Dwell time

The amount of time spent by wagons in the Port of Paranagua

Time between arrival and departure

Tracks utilization

The amount of time Railyard tracks and Internal network segments were occupied

Shunting locomotives utilization

The amount of time spent by locomotives moving goods between railyard and terminals and back

Trains dispatched

The number of trains dispatched from the railyard to Rumo network and its length and amount of wagons

Rumo South Operation expects

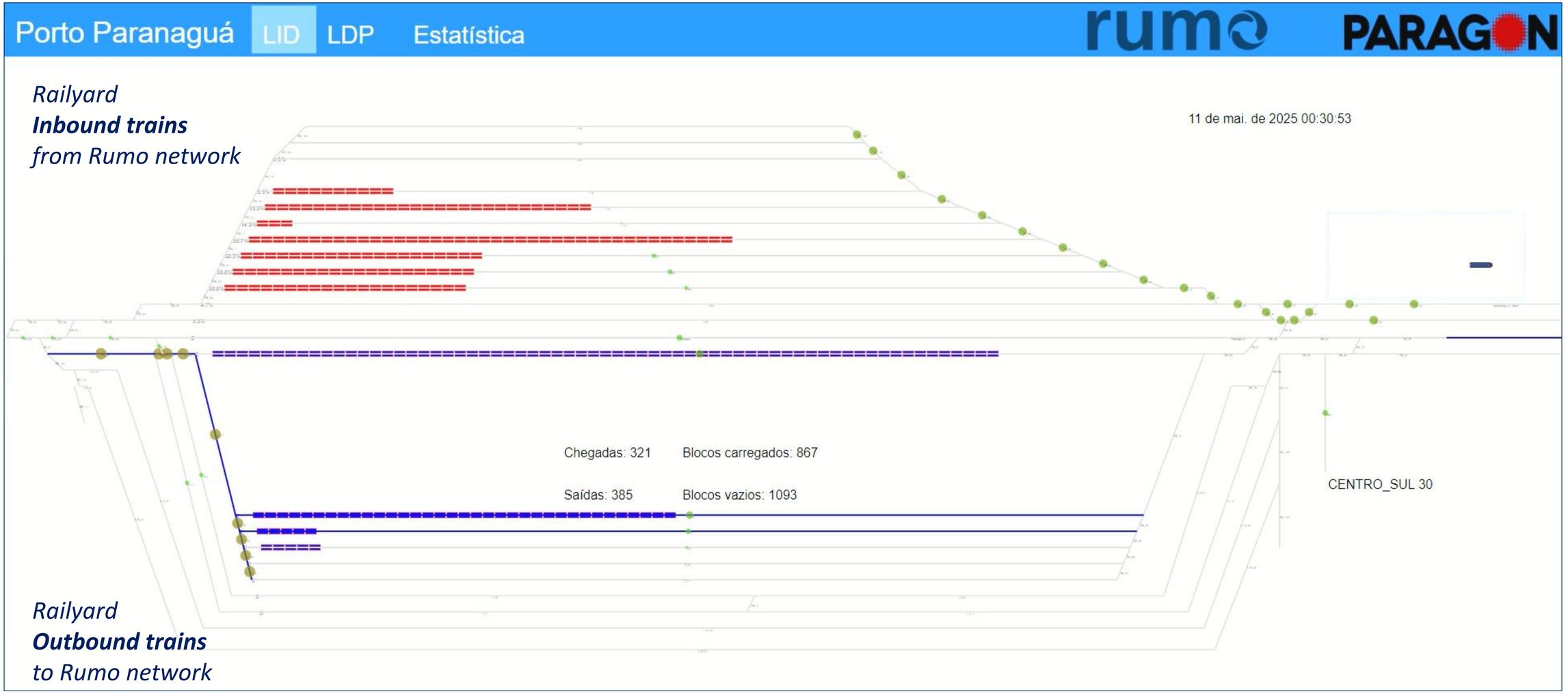
to improve its robustness of decision making

by combining the enlisted outcomes,

across different scenarios

MODEL ANIMATION

...



PROJECT DELIVERIES

... using best practices to achieve the goal

CONCEPTUAL MODEL

Documentation of the approach to the problem

Assumptions, objectives, inputs and outputs

MODELING

Translating the conceptual model into AnyLogic

VALIDATION

Comparison between the model output and real data

SCENARIOS

Set of scenarios of interest and its results

FINAL REPORT

Description of studied scenarios, its outputs and conclusion

VIDEO/ANIMATION

Animation of the model

KNOW-HOW TRANSFER

Training the user on how to use the model

ANYLOGIC TRAINING

Training the team in using AnyLogic

DATA INTEGRATION

... Connecting Input Data, AnyLogic and Output Data

USER INTERFACE

Excel

CSV

- *Arrival of trains*
- *# Locomotives*
- *Processing times*
- *Layout*
- *Routes*
- *Capacity of terminals*
- *Maintenances*

MODEL

anylogic®

- *Read from CSV*
- *Store into variables*
- *Write to CSV*

OUTPUT

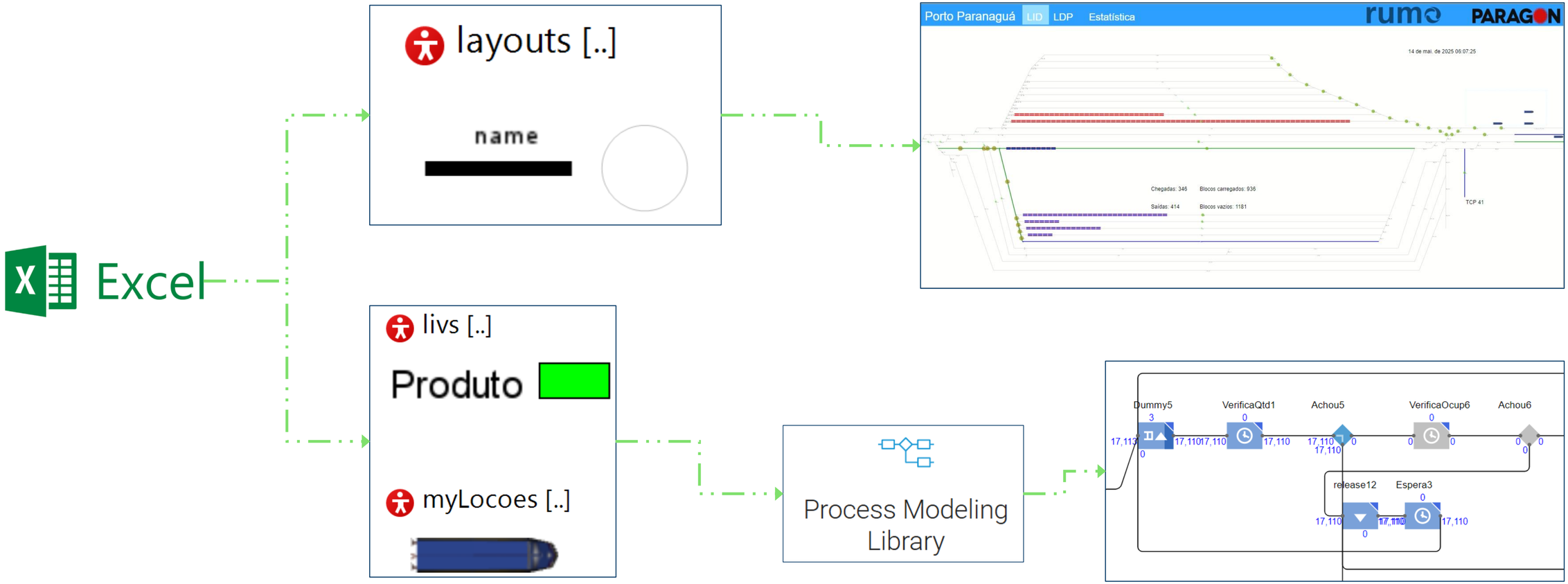
CSV

Power BI

- *Locomotives utilization*
- *Tracks utilization*
- *Dwell times*
- *Cargo throughput*

CHALLENGES

... How to make the model as generic as possible?



CHALLENGES

... Queuing and running parallel scenarios

2 - Cenários exportados e simulados

Cenários	Já Rodou?	Quer Rodar?
P01_54_Diminui_Traf_Rev01	Não	Sim
P01_54_Diminui_Traf_Rev01_T	Sim	
P01_54_Diminui_Traf_Rev01_T2	Não	Sim
P01_54_Diminui_Traf_Rev01_T3	Não	Sim
P01_54_Diminui_Traf_Rev01_T4	Não	
P01_54_Diminui_Traf_Rev01_T5	Não	
P01_54_Diminui_Traf_Rev01_T6	Não	

Excel

Fila de cenários:

Cenario_01
Cenario_02
Cenario_03
Cenario_04
Cenario_05

Replicações:
50

Replicações concluídas:
0

CONCLUSION

... and next steps

Conclusion

Better Decision-making

Providing stakeholders data to enhance decisions making

Model enhancement

Model integration

Integrate the presented model to a new one representing Rumo Network

Inside the Terminals

Improve the terminals process beyond black-boxes

Truck discharge

Include the process of discharging by trucks in the terminals

rumo PARAGON

Thank you!

Also,
we would like to thank
all the other team members
for their support
along the development
of the presented model

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