How to increase performance of the Steel Service Center

anylogic

AnyLogic Conference 2021

TBS Consulting

CONTENTS

INTRODUCING TBS CONSULTING

TBS = THE BEST SOLUTION

TBS Consulting Ltd. was founded in 2010 by a group of consultants with a substantial practice in some of biggest Russian IT & Consulting companies

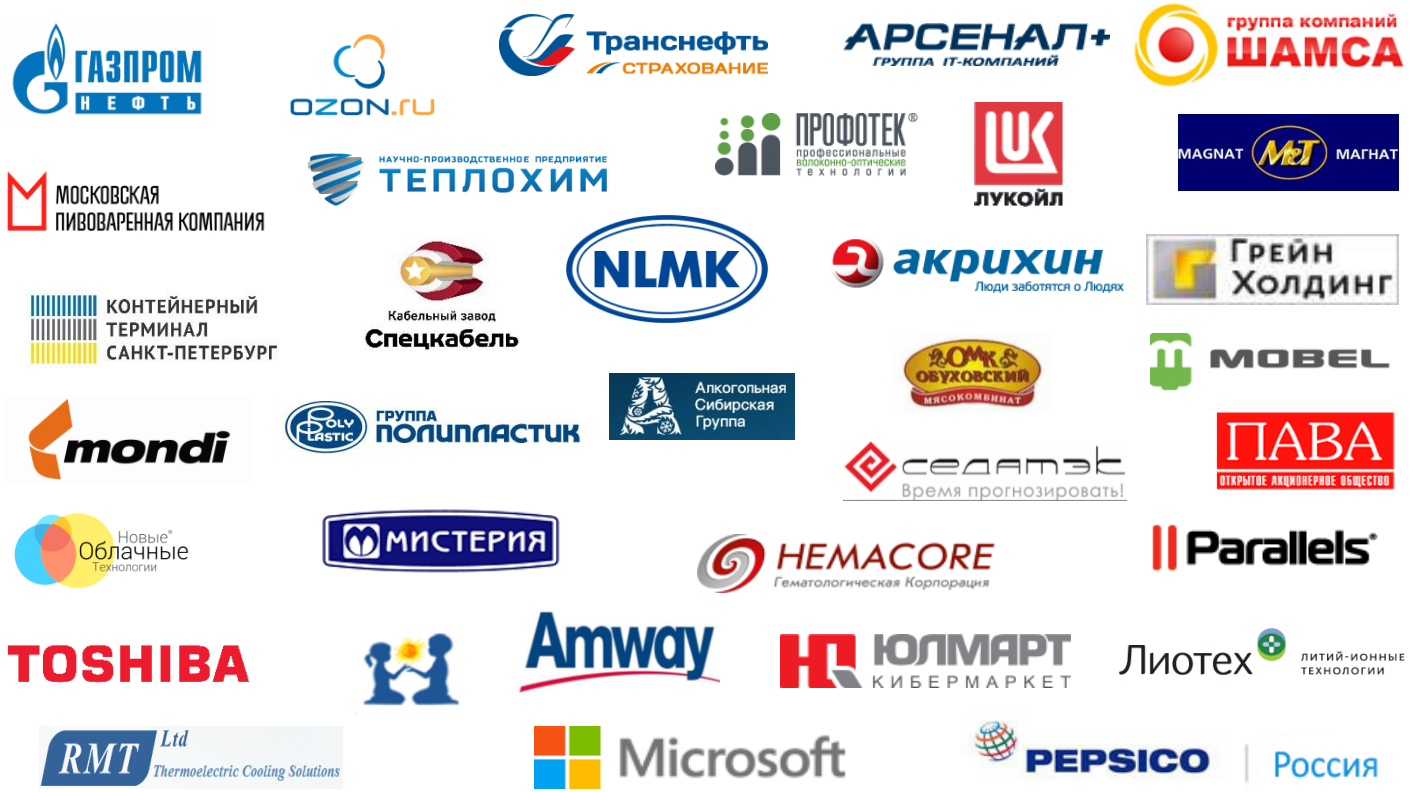
Experience for the following industries:

- Wholesale and Retail, FMCG
- Discreet manufacturing
- Steel and Pipe industries
- Agro and Mill products
- Oil, Gas and Utilities

Services:

- Management consulting
- Logistics consulting
- IT consulting

The company is focused on providing high-quality consulting services for middle-ranged companies



More than 100 projects in 10 years, over 30 Simulation Models

AnyLogic partner since 2013

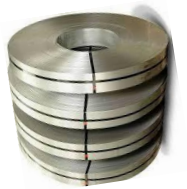
AnyLogic & anyLogistix expertise

THE CUSTOMER - MANAGE STEEL SERVICE CENTER (MSC)

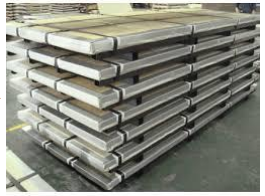
Input coils, 20-25 tons,
up to 2 m diameter
~10000/year

SLITTING

Cut-To-Length



Slits with different
width & orientation



Packs of sheets
1,25 - 6 m length

The Steel Service Center is located at Manage, Belgium.

It provides a wide range of transformation services for Strip business of NLMK Europe.

It focuses on hot rolled, pickled steels, cold rolled steels, galvanized steels for furniture, heavy & light metallic frames, automotive industries.

Production capacity is over 200,000 tons per year

PROJECT TASKS AND DELIVERABLES

Pre-Project Status

MSC planned to implement a set of modernization activities to increase the plant throughput by ~1,5 times

There were several options to consider with different layouts, combining :

- installation or relocation of production lines
- adding new cranes
- relocation of scales
- introducing conveyors, opening additional gates …

There are many interrelated factors affecting performance

Project Goals

Help the management to select the (technically) best option

Evaluate the maximum possible plant performance in KTons per year

Project Deliverables

- Detailed Technical Specification
- Simulation model built with AnyLogic for the AS IS layout for model verification
- 5 Simulation models built with AnyLogic for alternative layouts
- Model documentation in English/French
- Online workshop for users
- Comparative report

PROJECT CHALLENGES

The new production line must fit into existing facilities

Territory is limited by railway, canal & private property

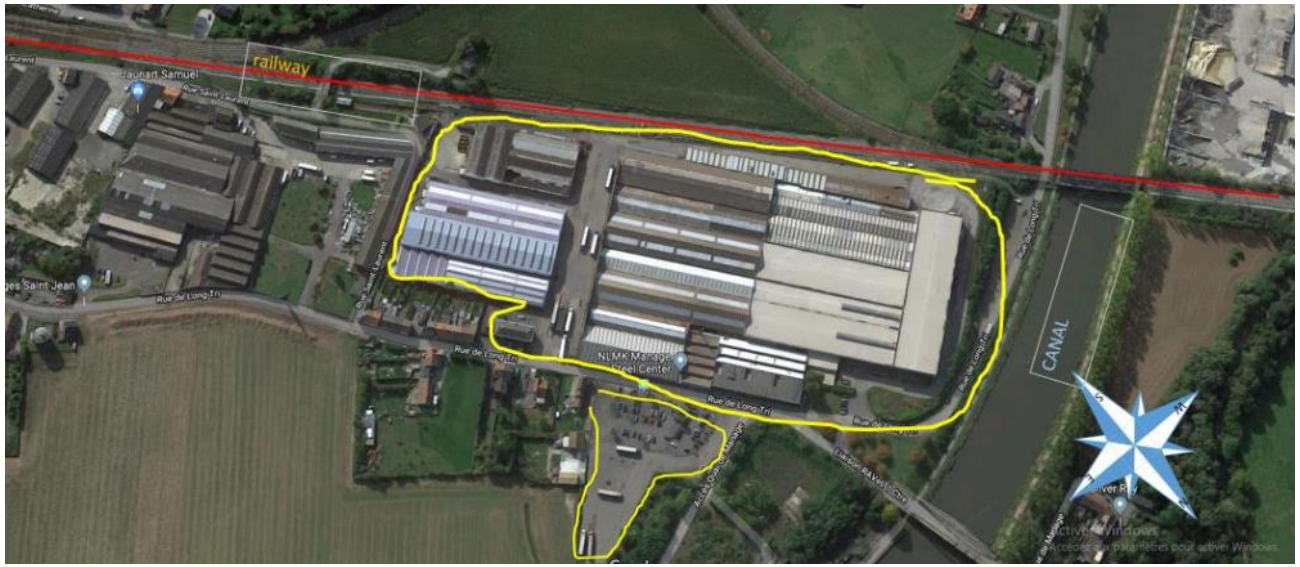
Limited space especially for client trucks arriving for finished goods, must take special precaution to avoid collisions

Unloading of incoming coils is possible by existing cranes that are also used to upload the coils for processing

The additional production line will require extra space thus decreasing storage capacity

There are seasonal variations in client’s demand and supply of coils

There are significant intraday variations of incoming & client truck arrivals



The Best Solution should fit all such constraints and provide desired throughput

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WHY ANYLOGIC ?

The Best business solution should fit all above constraints and provide desired throughput, but:

- The impact of most factors is significantly non-linear, while most of them are interdependent
- The requirements are controversial, and the best solution is usually a compromise
- We can't interrupt running business to test new equipment or procedures

- AnyLogic allows to combine discrete-event (space & time separation) and agent (internal logic) simulation
- AnyLogic includes powerful libraries to re-use "ready-from-the-box" logic, e.g. multibridge cranes or conveyors
- AnyLogic open architecture allows to customize the behavior of standard objects and develop own extensions
- AnyLogic offers the possibility of (almost unlimited) model detailing in the iterative way
- Customer can use the runtime version on its own without additional costs

Simulation modelling is an optimal tool since it considers all time-space interactions of real-world objects and details that are far beyond Excel calculations based on average values only

PROJECT SCHEDULE

2020				2021		
September	October	November	December	January	February	March

Step 1. Detailed Technical Specification

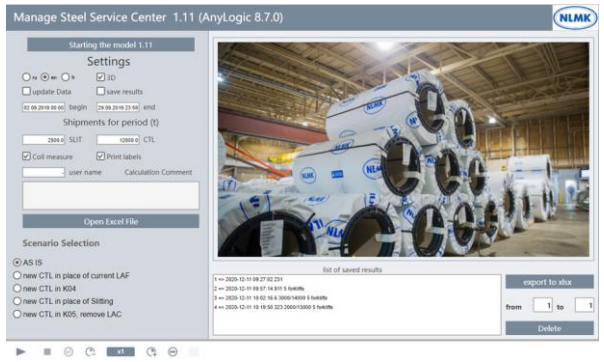
Technical specification
NLMK Manage Steel Center
Simulation Model

1. Introduction
2. MSC "AS IS" operations description
3. Business alternatives & planned changes
4. Simulation model requirements
5. Requirements for participants

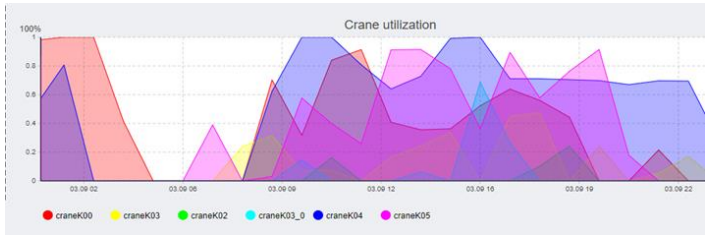
Appendix

MSC selected TBS to develop the specification

Step 2.1
AS IS Simulation



MSC selected TBS to implement the model



Experiments and analysis

Step 2.2
TO BE Simulation
(1-st Option)

Step 2.3
TO BE Simulation
(Roll-Out)

Demo and training

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MODEL KEY ELEMENTS

- The model covers the whole production cycle from arriving coils to production, storage and shipping of end products.
- The model provides the overall plant view as well as diving into details of operation for each operator, crane and production line
- Model setup is based on input data from MS Excel:
  - static parameters for cranes (dimensions, speed, etc…),
  - parameters for Production lines (performance, buffer size, 1st value etc
  - historical statistics for incoming & outgoing trucks, coils and sheets
  - Initial stock
- The user can select the duration of run in any time of the year and desired values for slits and sheets weight shipped
- The model will generate the flows and production plans according to historical statistics normalized to desired weight of shipping products.

Major agents:

- Steel coils (raw & slit, 2 types of orientation)
- Stacks of steel sheets (Packs)
- Trucks (input & output)
- Cranes / Forklifts / Conveyors
- Production lines (modeled as backboxes)
- Scales
- Workers (Operators)
- Traffic lights / barriers

AnyLogic libraries:

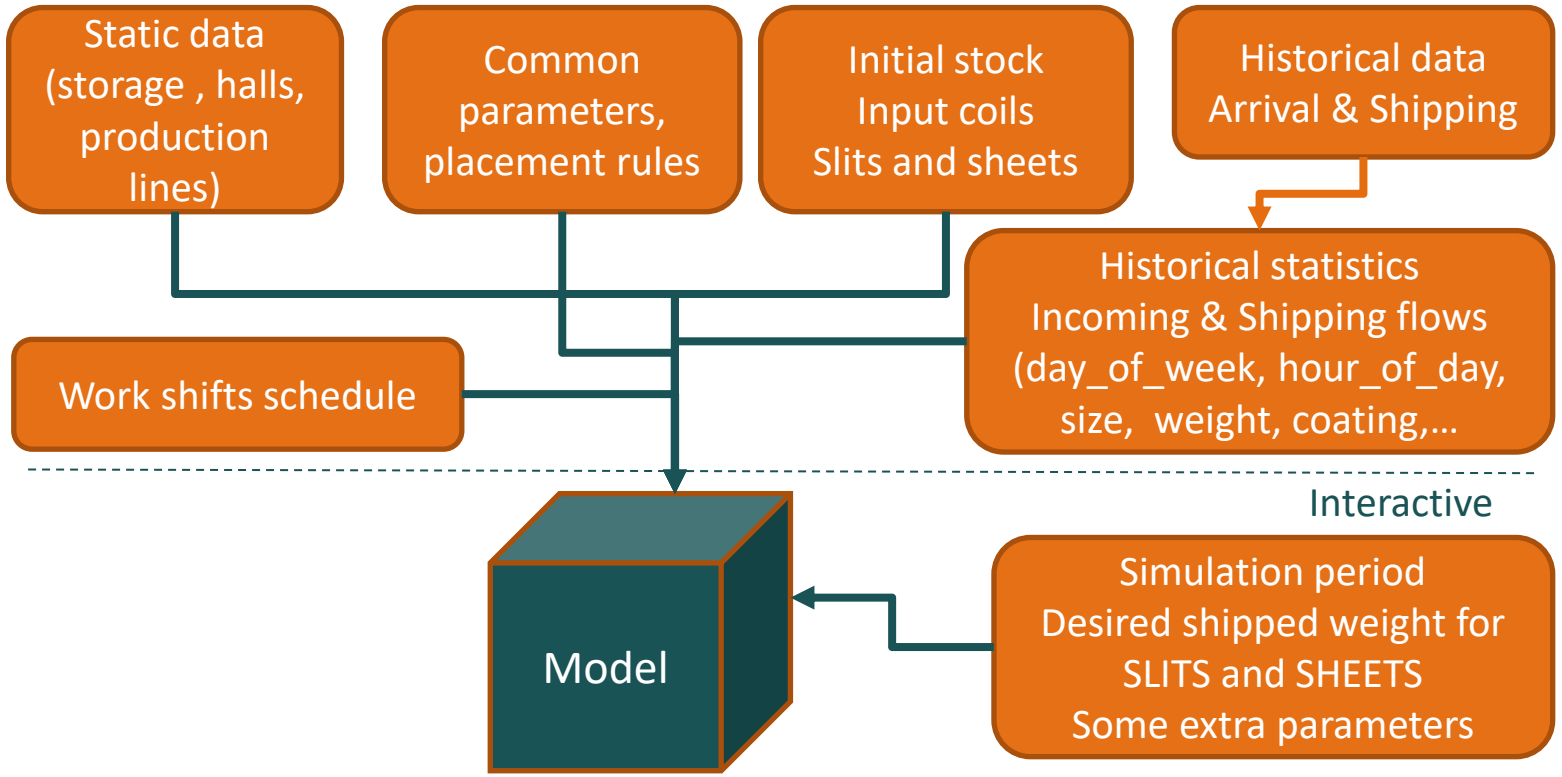
- Process Library
- Material Handling Library

Simulation modes:

combination of Agent and Discrete-Event

MODEL INPUTS & OUTPUTS

Model Inputs



Model Outputs

Detailed data on each and every operation

- coils / sheets movement by crane / forklift
- truck arrival & departure, coils processing
- operator actions

For each operation the model records

- Start & finish date-time
- What object
- Where from/to…

During simulation the user can observe:

- Detailed statistics & plots for individual objects
- Aggregated indicators such as utilization of storage space, gates, cranes
- Gross production and shipping values for coils and sheets

DEMONSTRATION

… a picture is worth a thousand words

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SIMULATION STUDY

Simulation goals

- model verification on ASIS
- check/confirm business initiatives for maximizing plant throughput
- evaluate sensitivity of throughput on different variable options

Experiment types

- Simulation standard run – with user 2D & 3D interface on
- Parameter variation – mass run with varying parameters
- Simulation fast run - without user interface,
  allows to speed up by 3-4 times
- Long run – for 1 year period to consider seasonal variations
- Short run (4 weeks) – to examine extra options (e.g. extra gates)

Options considered for TOBE (5 cases)

- different location of production lines
- different topology of storage areas and their capacity
- different number of cranes, incl. multibridge
- choice to use 2 or 3 scales
- number of unloading gates
- different arrival/shipping & production/shipping ratio
- introducing conveyor for sheets transfer
- vary work schedule

SIMULATION SPECIFICS

CRANE CONTROL

Cranes are extensively used for input coils and shipping products

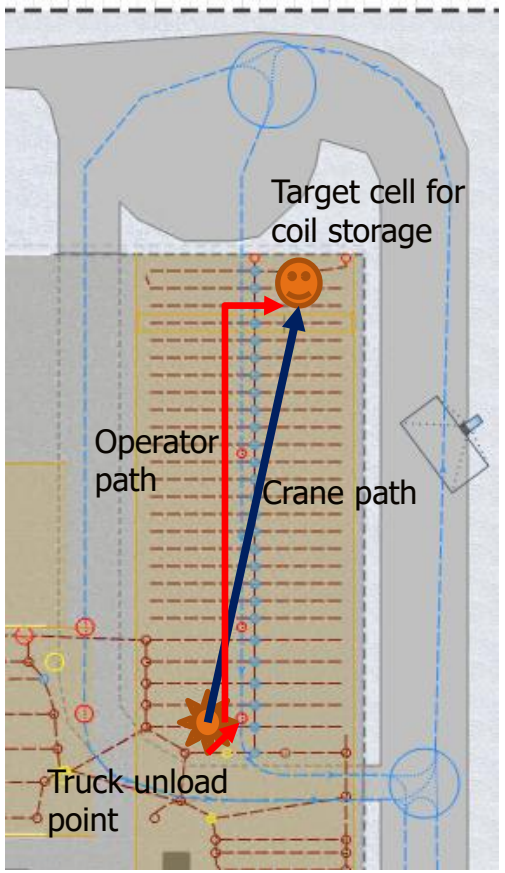
One and the same operator controls the crane via portable device and also performs manual operations such as loading, unstrapping etc…

To control the crane/bridge the operator needs to follow it along the designated paths

The total time (critical factor) is limited both by crane speeds, operator's movement and manual operations duration. We need to simulate both especially for stress test runs.

Solution:

- AnyLogic standard multibridge crane
- State diagram for operator to monitor the bridge position
- During crane movement the operator follows the main road, at target position can go inside the storage row



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SIMULATION SPECIFICS

SELECTING BEST STORAGE LOCATION

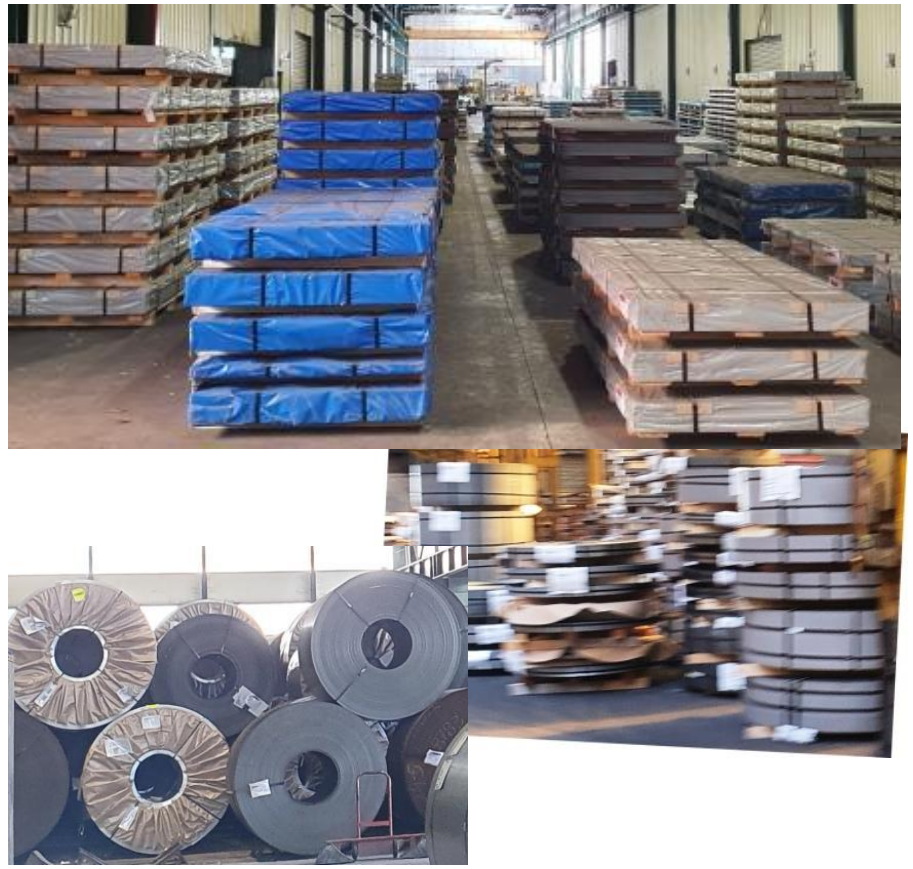
Coils, slits & sheets can be stored in several layers

To get the object from the bottom, one must dig down in advance, thus making (excessive) reshuffling movements

Every time – there is a compromise where to put the weight to decrease the total time obeying all constraints

Solution:

- AnyLogic PalletRack is not adequate, thus the **rule & strategy** system is used
- The rule depends on object STATE and defines the logical storage zone where storage is permitted
- A set of strategies is bound to rule, e.g “put to top” or “put matching width”
- For each free cell in a logical zone a score is calculated as weighted average for all strategies, the cell with the best score wins
- The logic is separate from code, the customer can fine-tune the strategies weight with **Parameter Variation experiment** or test new strategies



PERFORMANCE INDICATORS

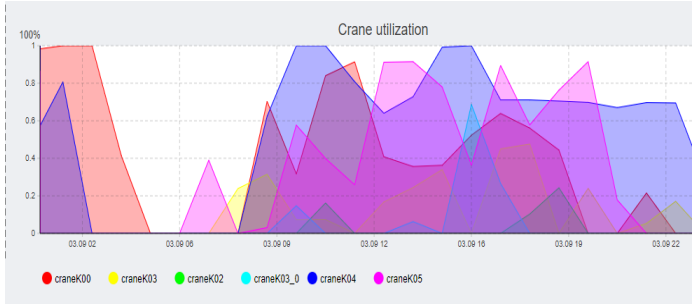
The Model collects detailed data on each and every operation as coils or sheets movement, truck arrival & departure, coils processing, operator actions (start-finish, who, what object, where from/to…)

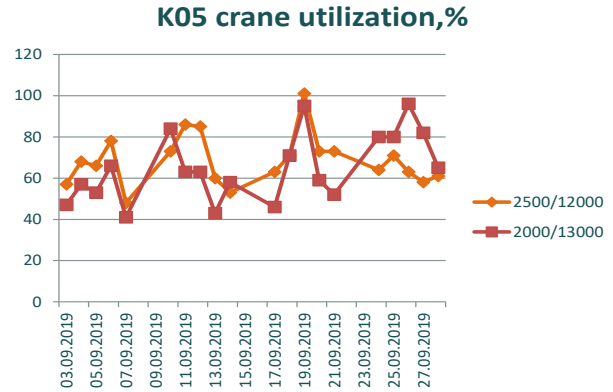
Long-run study (1 year)

- Total weight shipped
- Total weight produced
- Utilization of production lines

Detailed study (~1 month)

- Total weight of products
- Utilization of production lines
- Utilization of cranes/operators
- Utilization of storage space
- Truck processing & waiting times





The results are stored in the database and can be exported to Excel for further analysis

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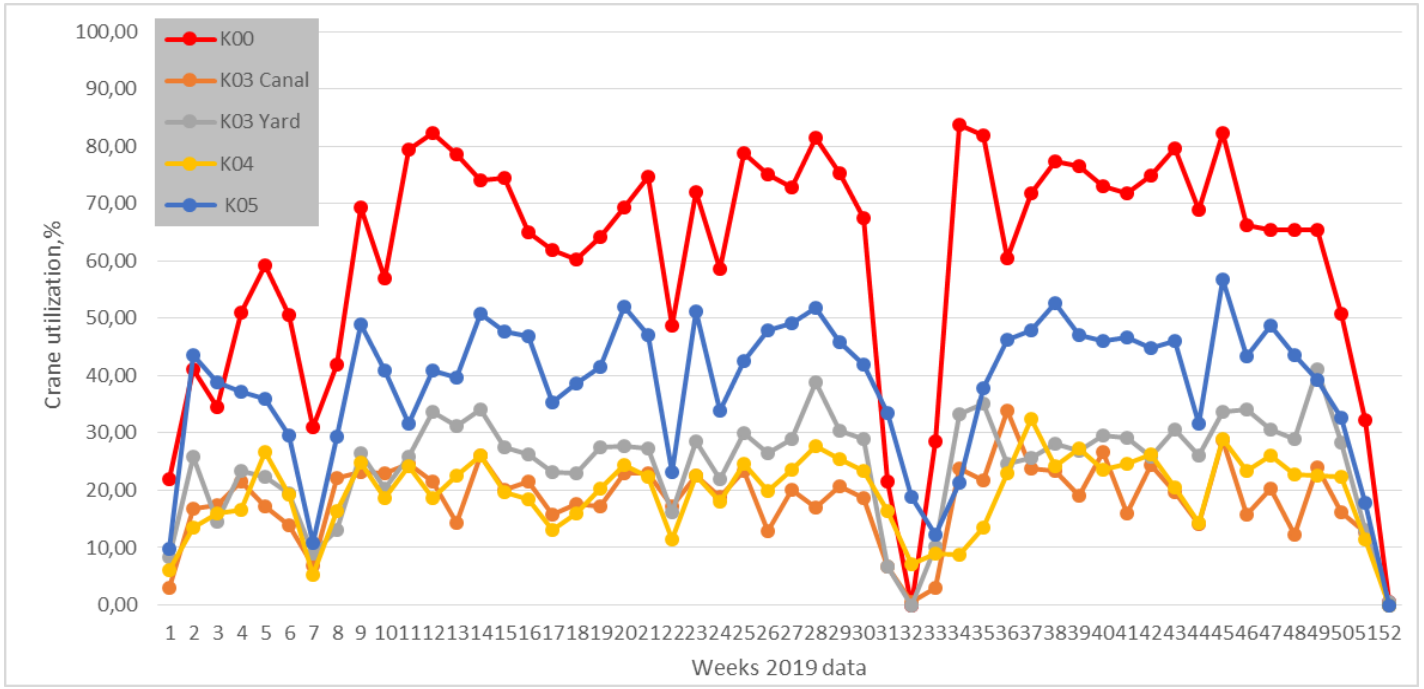
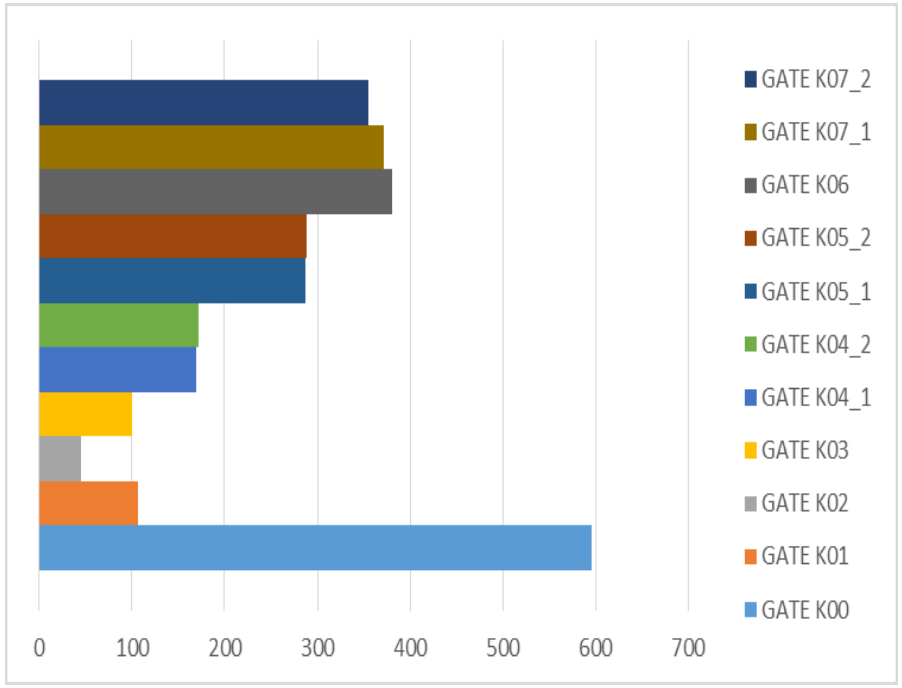
EXAMPLE OF CRANE & GATES EFFICIENCY ANALYSIS



Crane utilization



Average gate usage, minutes per workday

Crane K00 is the most used with average utilization above 70% and is a critical resource. Sometimes the incoming trucks can't unload during the operating hours.

The model helps to identify most critical resources and affiliated risks and can check the effectiveness of decisions (e.g. different placement policy or adding a new crane)

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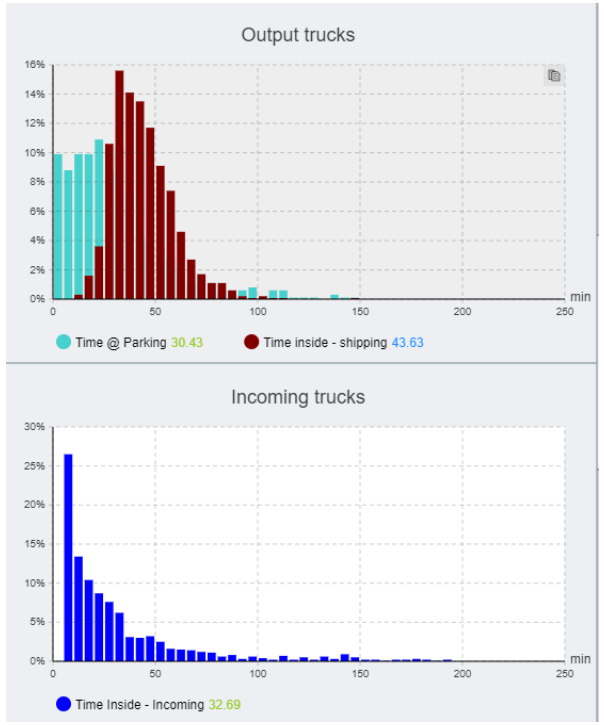
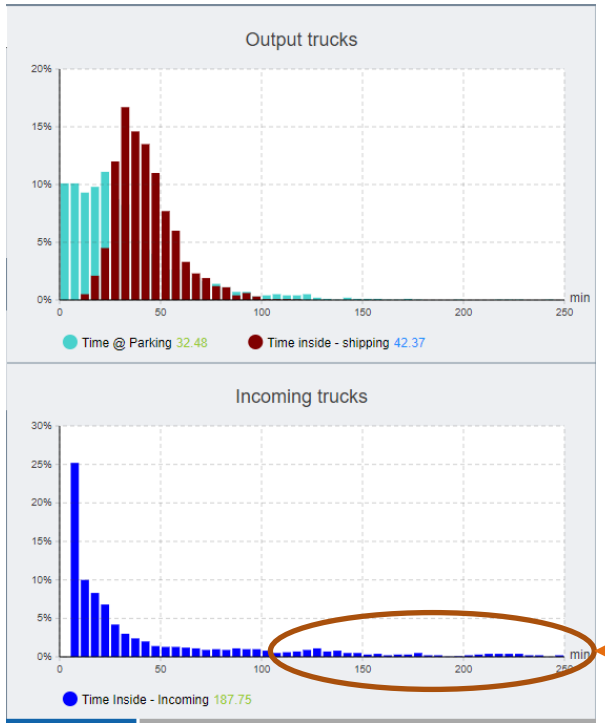
EXAMPLE OF TRUCK DATA ANALYSIS



Test load 150%



Test load 180%

Due to seasonal variations the input flow at some months can be higher than average, a small percentage of incoming trucks spend 3-4 hours in queue and may be late for the day shift. Need to arrange schedule or extend unloading times

The model helps to identify bottlenecks for truck operations

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PROJECT RESULTS

Simulation modeling helps MSC management team to select the best option and confirm its productivity by detailed study taking into account time-space operations of trucks and plant equipment.

The installation of the new CTL production line will significantly improve the ecological factors aligned with general NLMK strategy.

The model may be used in future to fine-tune the storage policies, work schedules and equipment selection. Additional model experiments may be useful for testing in extreme conditions.

MSC also plans to use the model for daily operations planning – including for optimizing coil storage to decrease the number of extra reshuffling operations.

Thanks for your attention!

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