"Simulating LNG inventory management at the Gate terminal"

Feikje Wittermans

Contents

1. The Gate terminal
2. Managing LNG inventory and throughput
3. Simulation model(s) over time
4. SIMA functionality
5. Benefits of simulation
6. Next steps

1. Gate terminal provides an alternative for pipeline gas

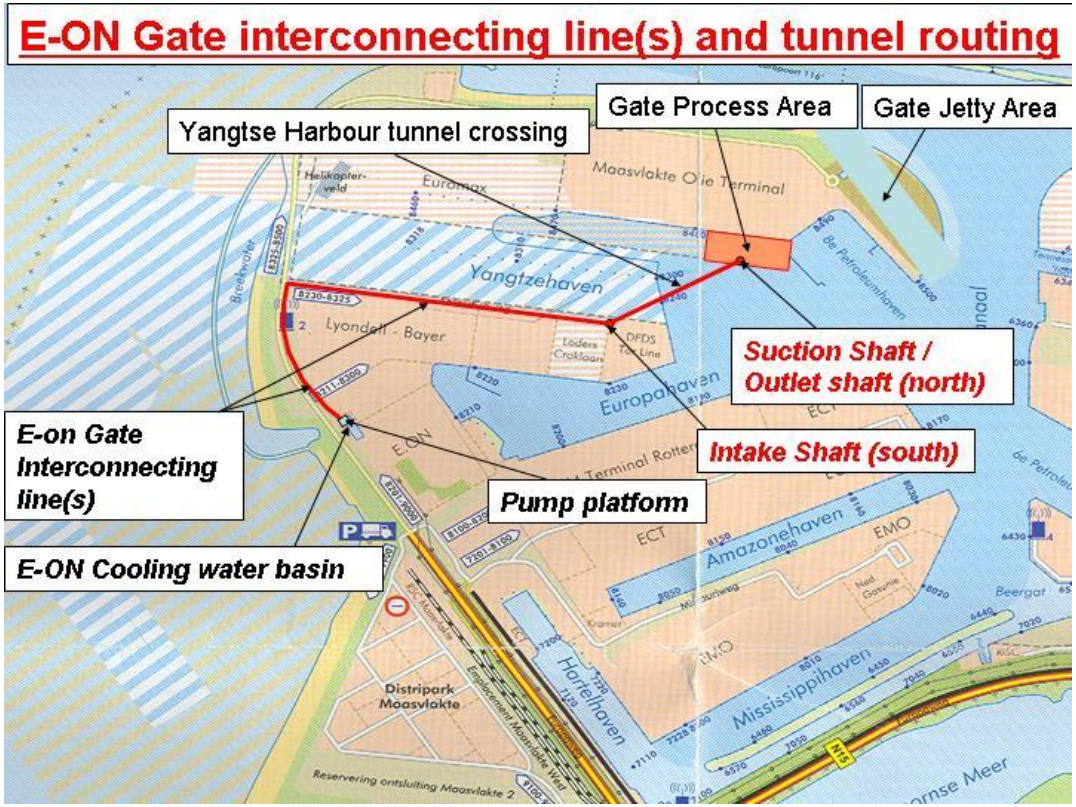
- The Gate terminal is considered as a major component of the Dutch strategy of becoming the ***Gas Roundabout of Europe***

- Gate terminal is an LNG regasification terminal where we
  - Receive LNG by unloading LNG carriers (2 jetties)
  - Store LNG temporary (3 storage tanks) and
  - Deliver Gas in the National Grid (GTS) by regasifying the LNG using cooling water from the Eon power plant

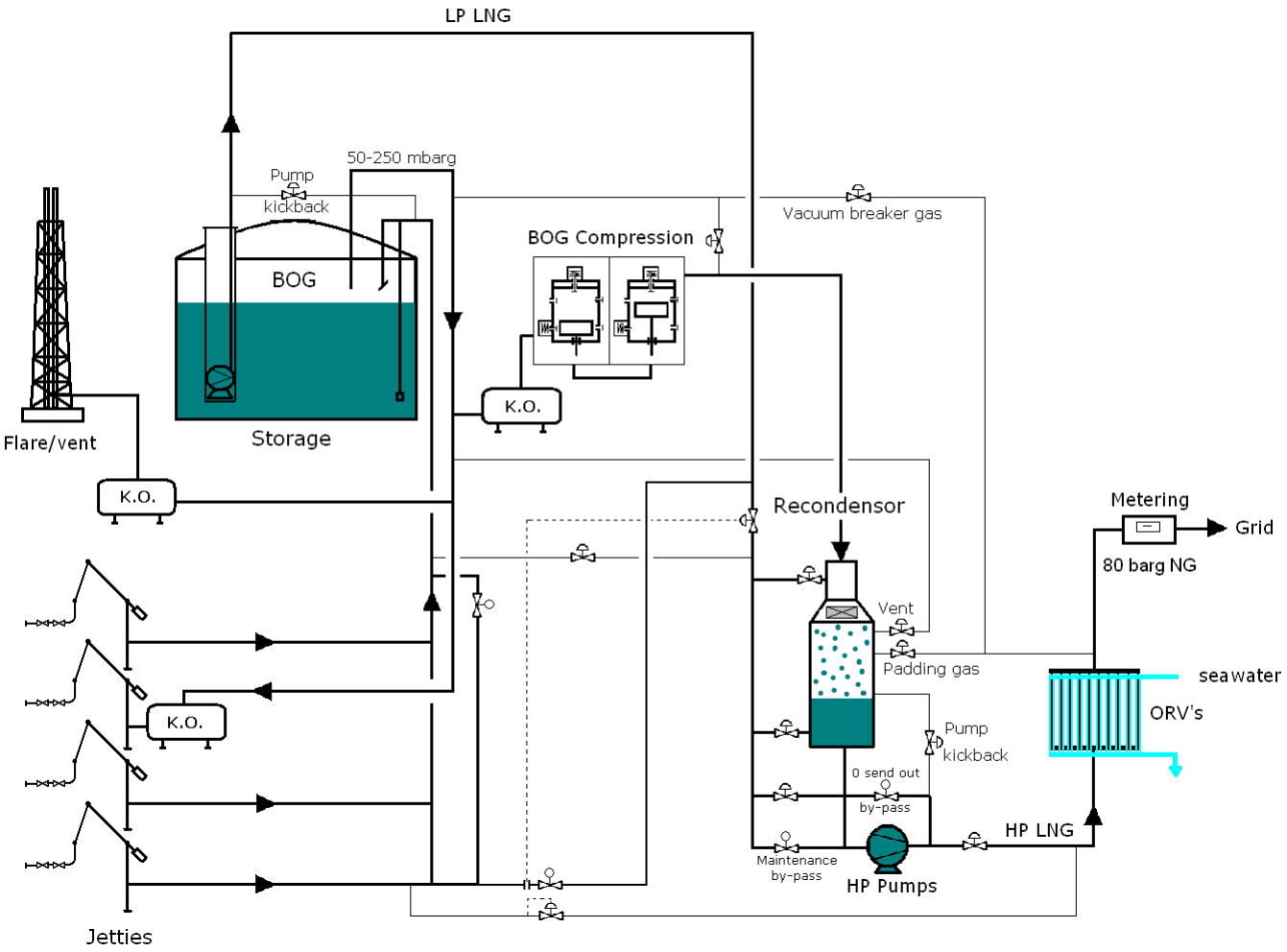
- Yearly output (in natural gas) of the terminal in Gas is 12 billion m^3 (n) per year

1. Cooling water is used to regasify the LNG

- Cooling water used to regasify the LNG is transported via a pipeline and tunnel from the Eon Power station to the Gate terminal
- The terminal is Considered a zero emission terminal



1. Process overview of the terminal



2. Modeling LNG inventory and throughput management

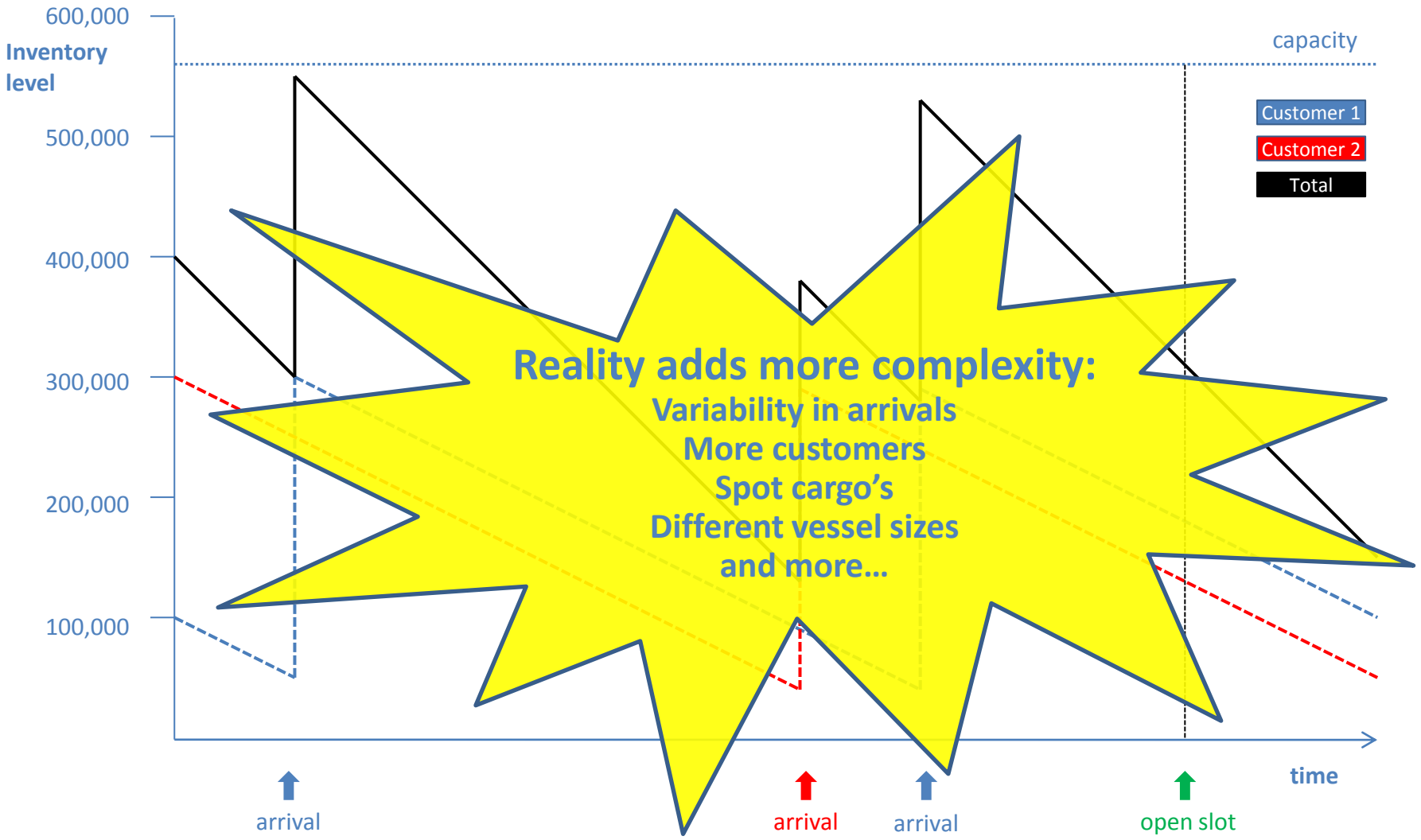
Setting:

- Multiple customers → 12 BCMa
- Terminal capacity = 540,000 m^3 (3 tanks of 180.000 m^3 each)
- Max parcelsize (Q-Max = 266,000 m^3 LNG)
- 2 jetties (unloading capacity of 15.000 m^3 per hour)

Challenges:

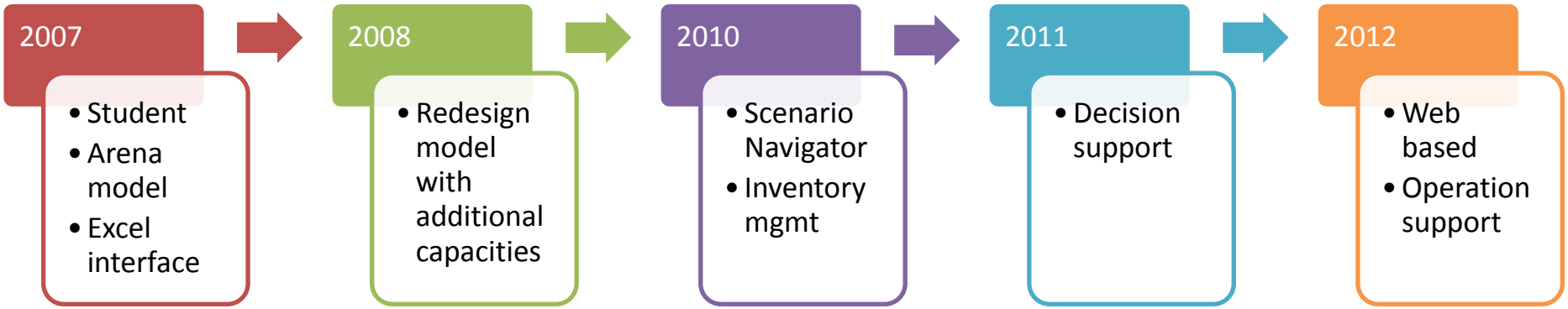
- Guarantee customer throughput
- Minimize demurrage
- Optimize capacity usage
- Manage send out rate for Gas delivery in the Grid

2. Inventory and throughput is ruled by many variables



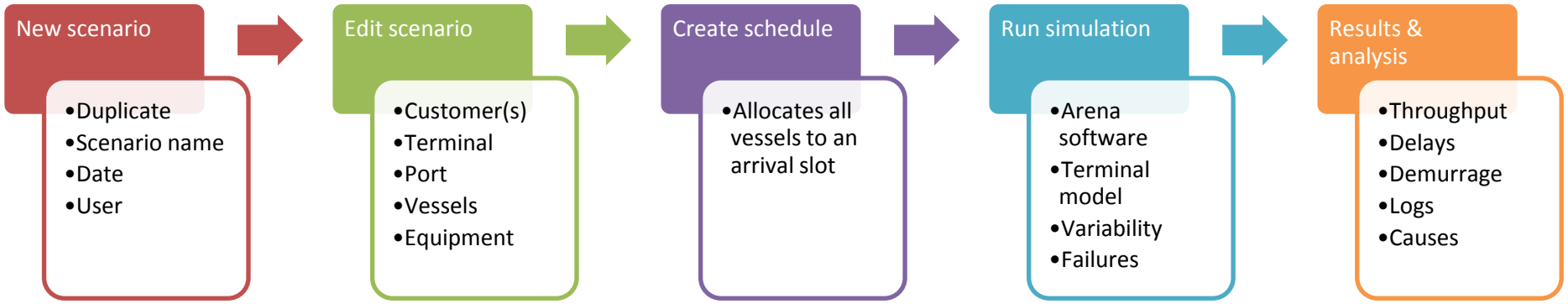
3. SIMA developed over time from a Decision support tool only into a general support tool

- The simulation models used for Decision support have developed from a complex, non-transparant model using huge excel files into a user friendly web based application allowing secured access from anywhere
- Now additional functionality (e.g. back loading) is easily added to the model
- The next version of the model will also support the terminal planning function



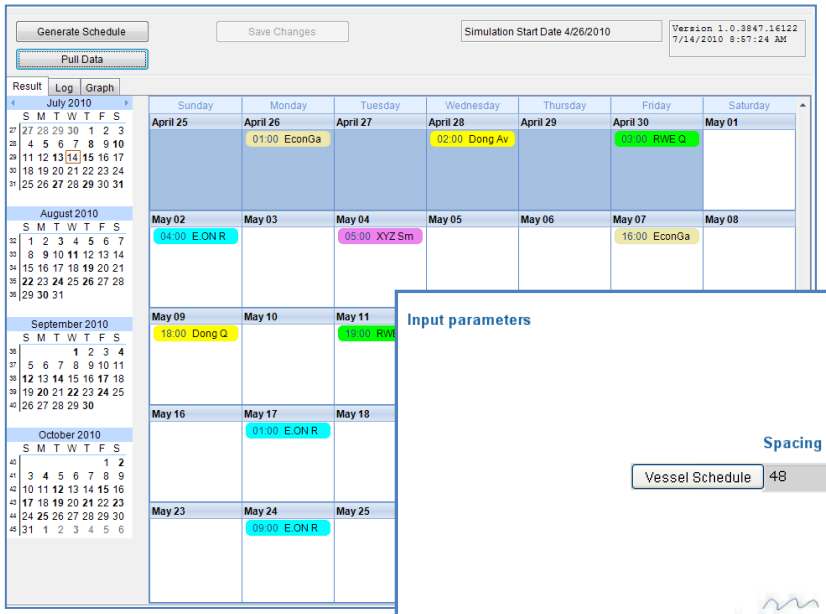
4. SIMA gives insight in the terminal's boundaries of the "hard- and software"

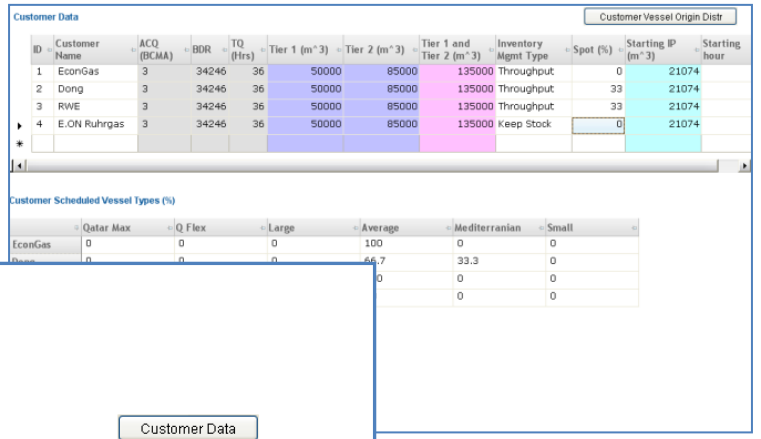
- Over several dimensions we are able to change inputs and parameters in order to analyse the impact of these changes on the performance of the terminal

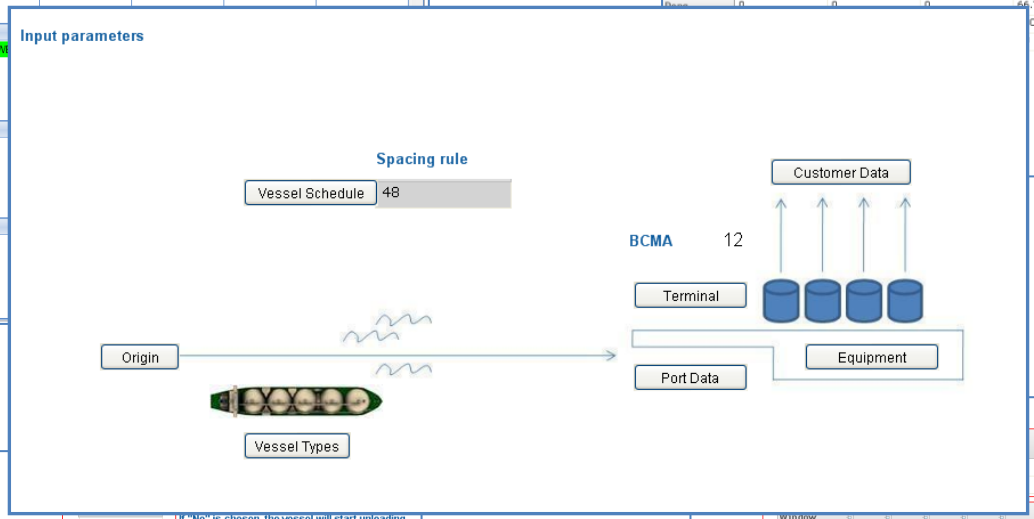


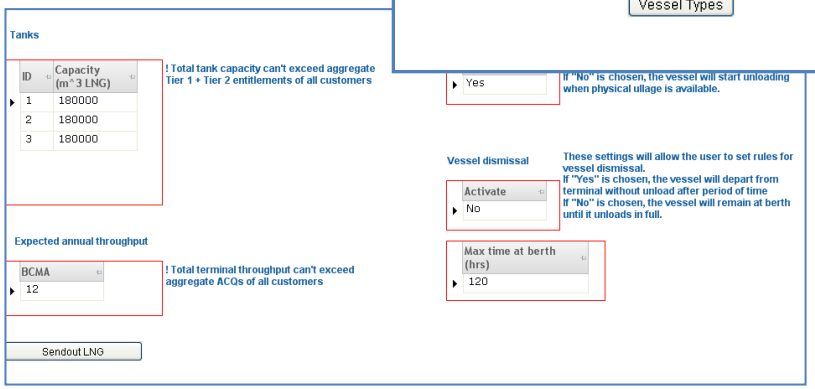
4. The User interface for creating scenario's and running the model only needs 4 buttons:

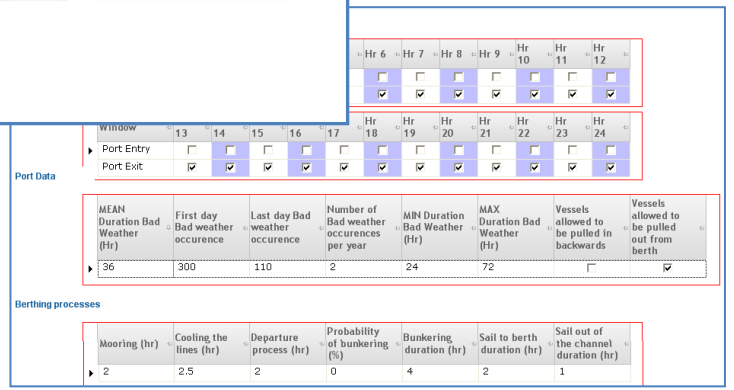
4. SIMA's parameters are "easy" built up over several dimensions





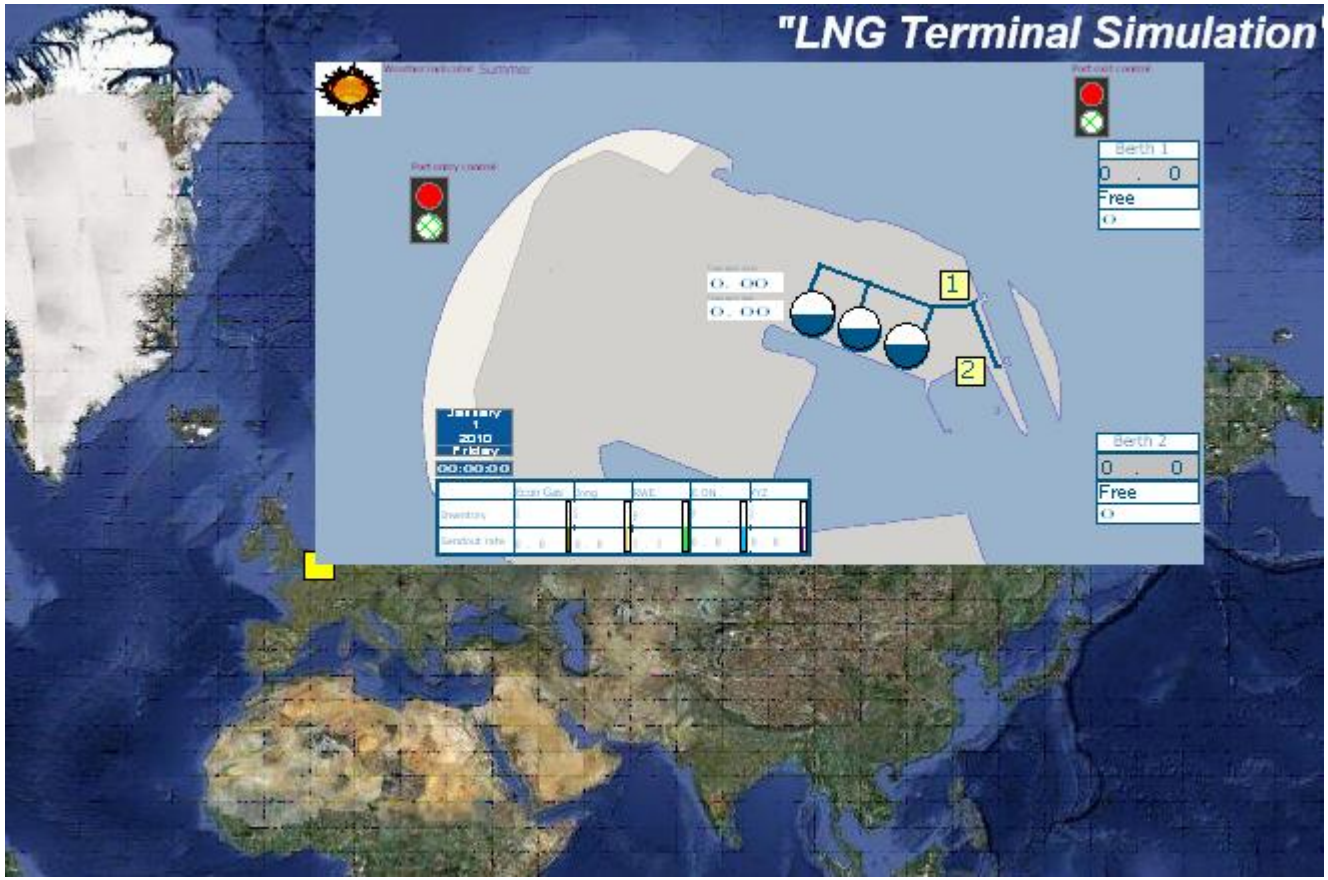






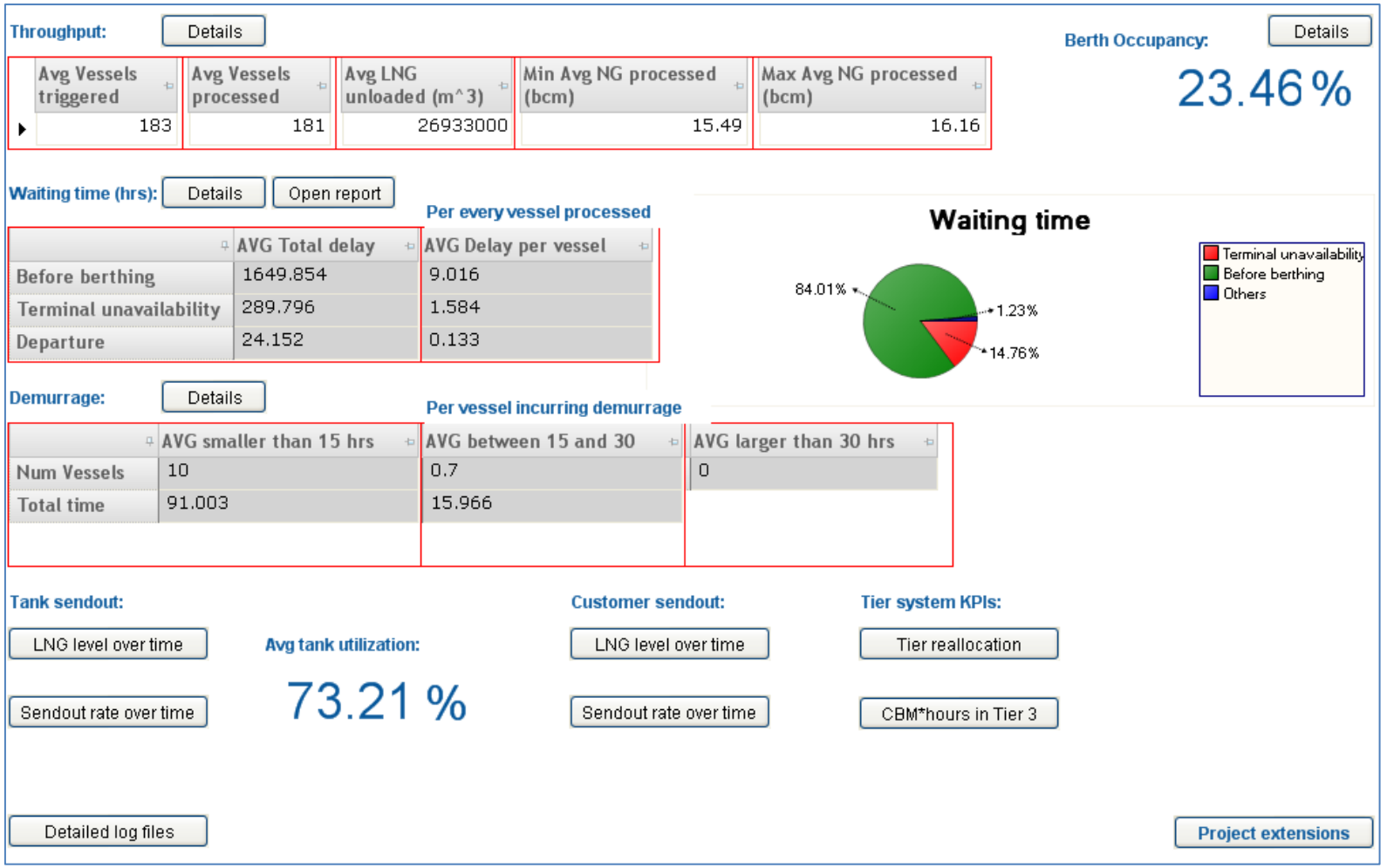
4. SIMA functionality also contains animation

- Arena model animation



4. SIMA 's dashboard shows the bottlenecks in one overview

- SIMA results overview



4. Per issue, we can drill down into more detail to look for the cause

- SIMA results on waiting

Replication report

Wait time distribution chart

Vessels in queue

Waiting for ullage

Waiting time before berthing (hrs):

	AVG Total delay	MAX Total delay	MIN Total delay	AVG Delay per vessel	MAX Delay per vessel	MIN Delay per
Port entry window	1616.256	1687.139	1525.133	8.832	9.219	8.334
Bad weather	33.597	71.578	0	0.184	0.391	0

Waiting time for terminal unavailability (hrs):

	AVG Total delay	MAX Total delay	MIN Total delay	AVG Delay per vessel	MAX Delay per vessel	MIN Delay per
Berth unavailable	50.58	91.63	18.1	0.276	0.501	0.099
Breakdowns	0	0	0	0	0	0
Tank tops	216	312	162	1.18	1.705	0.885
Unloading line	23.216	53.155	0	0.127	0.29	0

Waiting time for departure (hrs):

	AVG Total delay	MAX Total delay	MIN Total delay	AVG Delay per vessel	MAX Delay per vessel	MIN Delay per
Port exit window	0	0	0	0	0	0
Weather on exit	24.152	53.703	0	0.133	0.297	0

5. Benefits of simulation for Gate

- With the **first Arena model** we were able to optimize the dimensions of the terminal and the business model for Gate first and later on other LNG terminals to be planned
- Later on, simulations helped us to learn how the several parameters impacted each other
- We used these insights in defining the optimum parameters for **future expansion in both size and functionality**
- Simulations enable us to show current customers the impact of any expansions

6. Next steps for SIMA

- **Operational planning support**
  - Import annual unloading schedule
  - Cancellation of berth slots
  - Client dedicated dashboards
  - Actual versus scheduled user interface

- **Web deployment**
  - SIMA online
  - Global access by iPad, PC & Notebook