Container Terminal and Intermodal Planning

Tehran, January 24, 2017

Content

HPC Hamburg Port Consulting GmbH

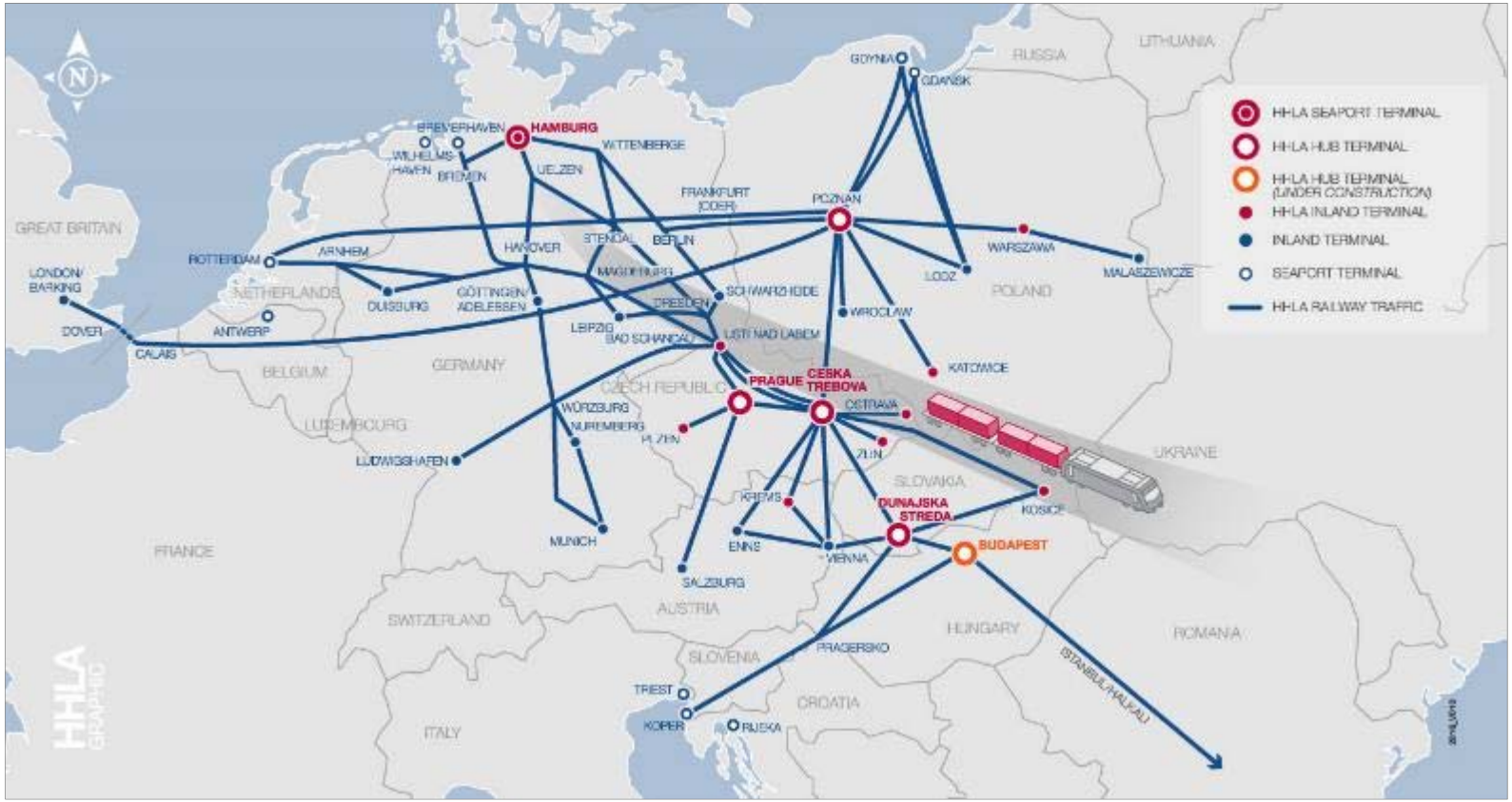
- Founded in 1976 as subsidiary of HHLA Hamburger Hafen und Logistik AG
- Around 100 experts (incl. subsidiaries), annual turnover in 2015: approx. EUR 15 million
- Since 1976 port and transport-related projects in more than 100 countries, both in the private and public sector
- Approx. 1,400 projects world-wide with extensive experience in container terminal planning

Mother-Company HHLA:

- 3 Container Terminals in Hamburg, capacity +10 mill TEU p.a.
- Multipurpose and bulk terminals
- Intermodal transport
- Logistics services

HHLA Intermodal Network

- More than 350 train connections per week
- 13 terminals, more than 50 locomotives, approximately 2,500 rail cars



HPC Hamburg Port Consulting

Our Focus

- Ports
  - Container terminals
  - Bulk terminals
  - Cruise ship terminals
- Logistics facilities
  - Rail terminals
  - Inland ports
- Intermodal facilities

Our Clients

- Private terminal operators, port authorities & public institutions
- Governments
- Logistics service providers
- Banks and private investors
- International organisations, such as World Bank, UN

Content

Port Terminal Planning – Approach

Preliminary Assessment

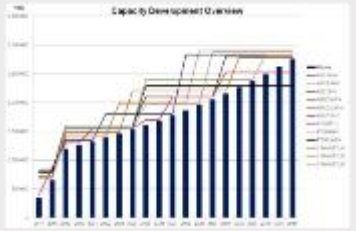
Automation Decision | Prelim. Layouts | Prelim. Capacity | Traffic Impact

Prelim. Equipment | Prelim. Staffing | Energy & Emissions

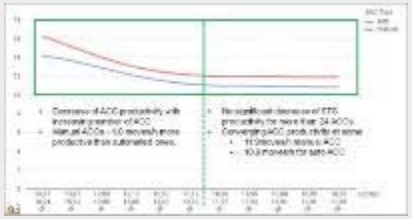
Automation Level | 30 year Horizon

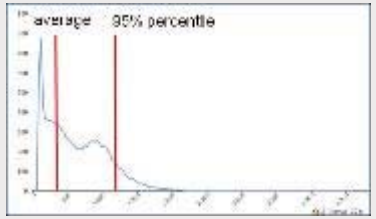
Narrow Options

	Weighting	Option 1a Single QC perp. RMG ShC	Option 1b Tandem QC perp. RMG ShC	Option 2a Single QC RTG TTU	Option 2b Tandem QC RTG TTU	Option 3a Single QC par. RMG TTU	Option 3b Tandem QC par. RMG TTU	Option 3c Single QC perp. RMG TTU	Option 3d Tandem QC perp. RMG TTU	Options 4a Single QC perp. RMG AGV	Option 4b Tandem QC perp. RMG AGV
Quantitative Criteria											
Total handling volumes	15%	0.150	0.150	0.135	0.135	0.142	0.142	0.150	0.150	0.151	0.151
Average QC productivity	10%	0.100	0.120	0.100	0.120	0.100	0.120	0.100	0.120	0.095	0.114
Staffing	5%	0.050	0.051	0.027	0.028	0.040	0.042	0.045	0.047	0.096	0.096
Truck turn time	5%	0.050	0.050	0.042	0.042	0.043	0.043	0.050	0.050	0.050	0.050
Emissions / TEU	10%	0.100	0.096	0.035	0.037	0.110	0.104	0.095	0.097	0.110	0.110
Operating cost / TEU	15%	0.150	0.140	0.114	0.118	0.137	0.131	0.152	0.151	0.162	0.160
Total cost / TEU	20%	0.200	0.188	0.180	0.178	0.193	0.187	0.206	0.203	0.169	0.163
Qualitative Criteria											
Work safety	5%	0.050	0.048	0.040	0.038	0.053	0.052	0.055	0.053	0.060	0.060
Operational flexibility	10%	0.100	0.110	0.150	0.155	0.105	0.115	0.100	0.110	0.043	0.045
Ease of maintenance	5%	0.050	0.048	0.060	0.057	0.059	0.056	0.050	0.048	0.040	0.039
Sum	**1**	**1**	**0.9995**	**0.8825**	**0.908**	**0.982**	**0.992**	**1.003**	**1.029**	**0.976**	**0.988**



Simulation

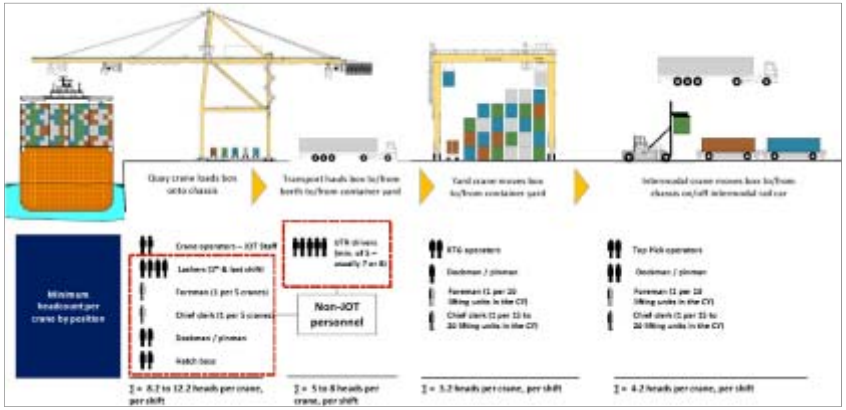


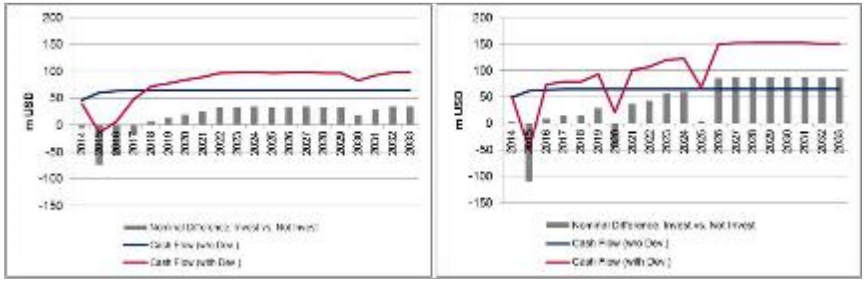


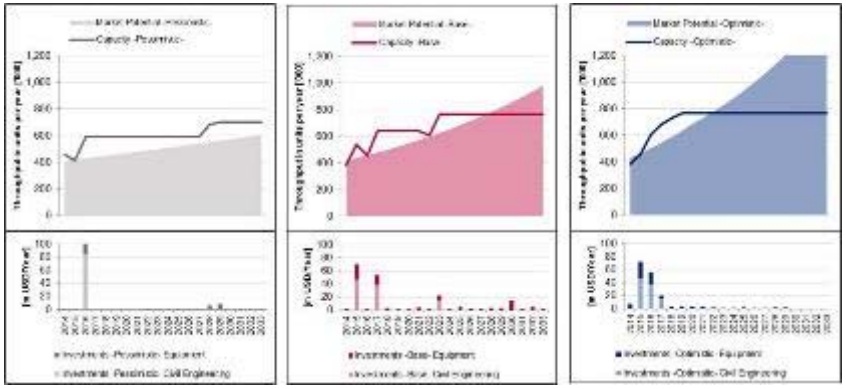
Visualisation

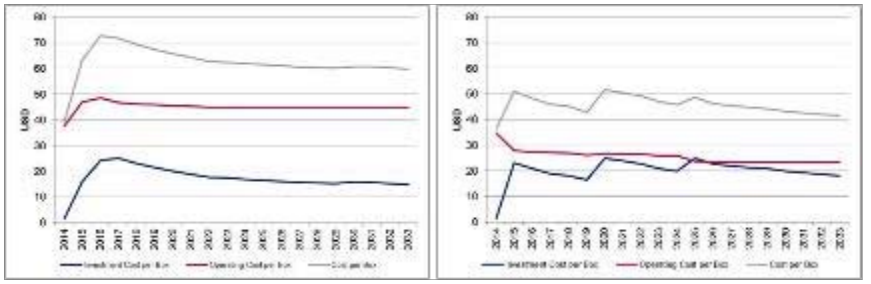
Preliminary Assessment

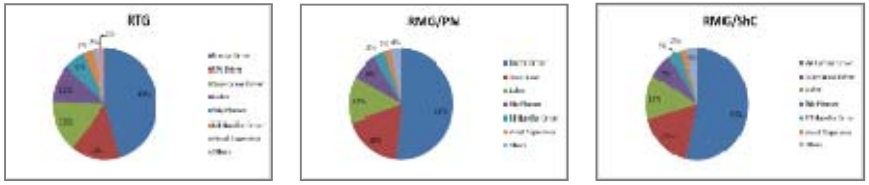
Initial planning contributes to reference design and assists in informing the stakeholders











Valuable insights in options will be available from static planning task, which can already be turned into rendered preliminary results.

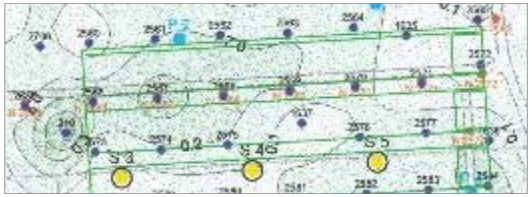
Preliminary Assessment

Across all areas various options and alternatives are to be discussed and tested

Ship-to-shore	Transportation	Yard	Rail	Gate
				
Single/double trolley	Automated guided vehicles	Automated stacking cranes	Reach Stacker	Truck distribution, combination
Twin 20’	Shuttle carrier	Rubber tyred gantry	Rubber tyred gantry	Automated
Double 40’	Manned transport	Width/length	Wide span crane	Vehicle booking system
Portal / Backreach handover	Rail supply	Emissions	Schedules	Container info exchange
Automated twistlock handling	Emissions	Specials handling	Network concept & location	Working hours

Each year financial modelling informs decision making

Equipment – Understanding Limitations



Coordinate site specifics with desired operation

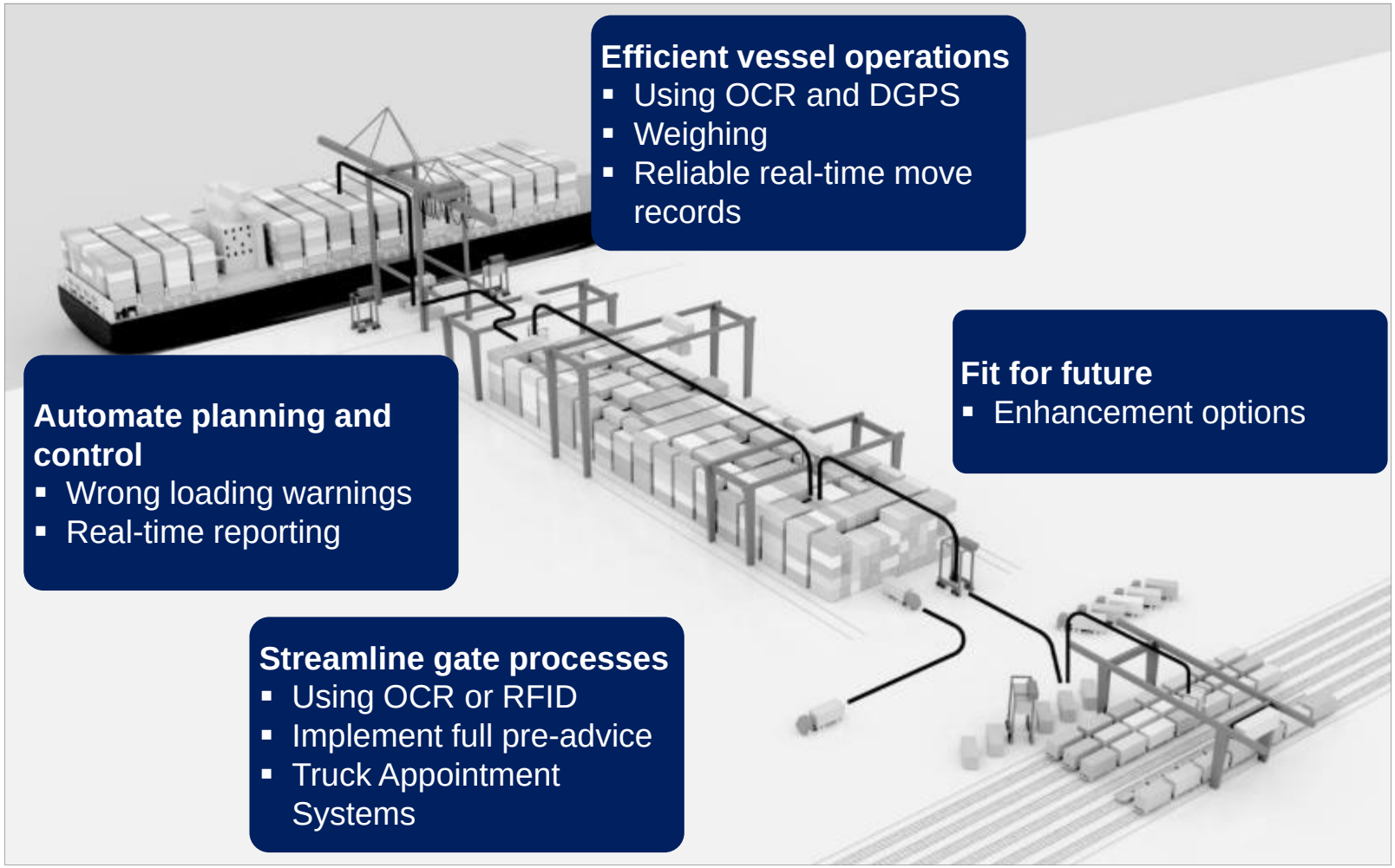
Risk of settlements depends on compacting level of terminal land

Impact on M&R costs for equipment and infrastructure

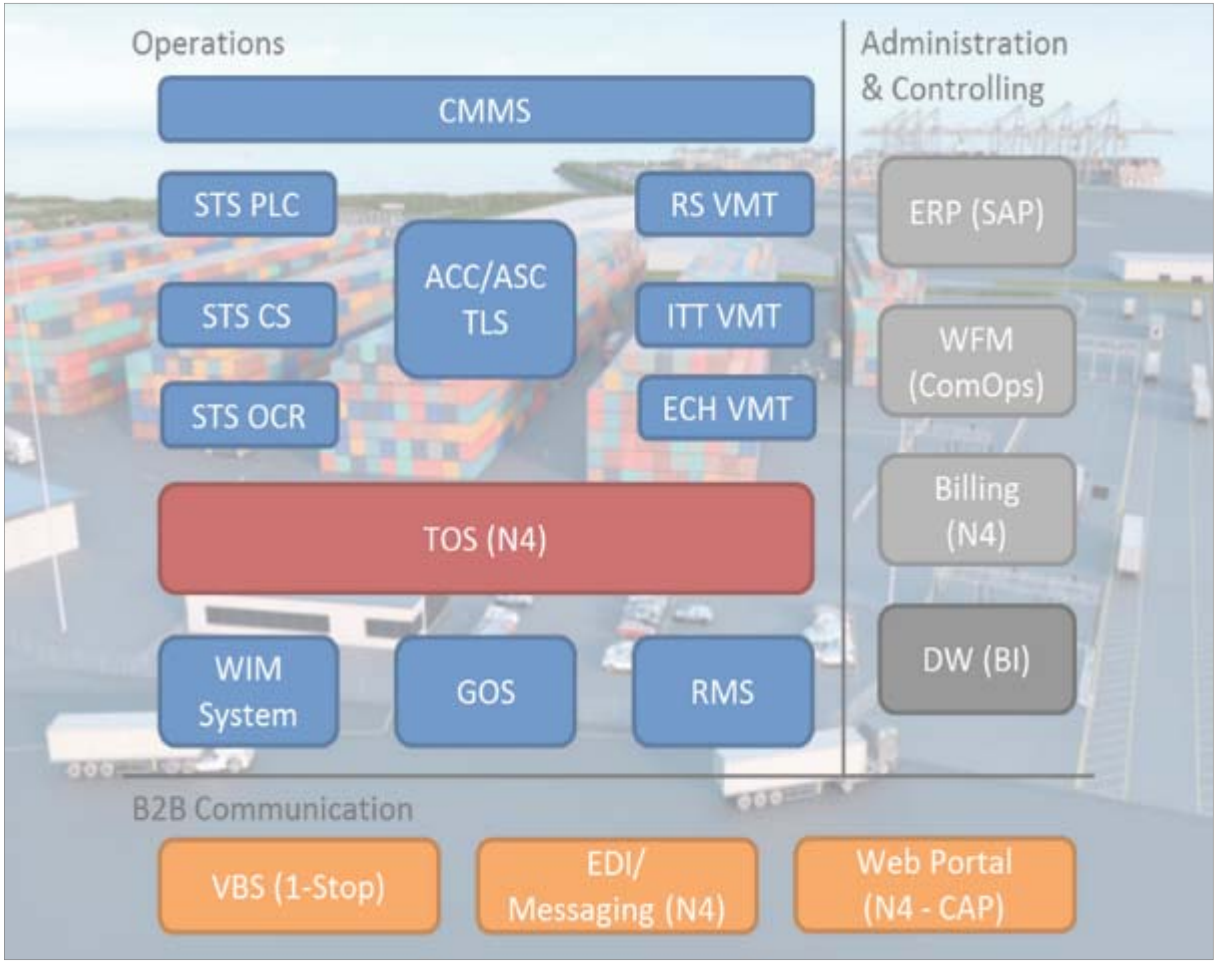
Determine workable, cost effective solution – avoidance of gold-plated solution

Integrated strategic and informed decisions required

Systems – Determination of Requirements



Systems – Assess IT System Requirements



Understand suitability of existing IT systems for future needs

Development path of system architecture to meet future requirements and all interim stages

Cost estimates and IT development strategy

Terminal Automation

CT Burchardkai is the most significant conversion project underway globally.

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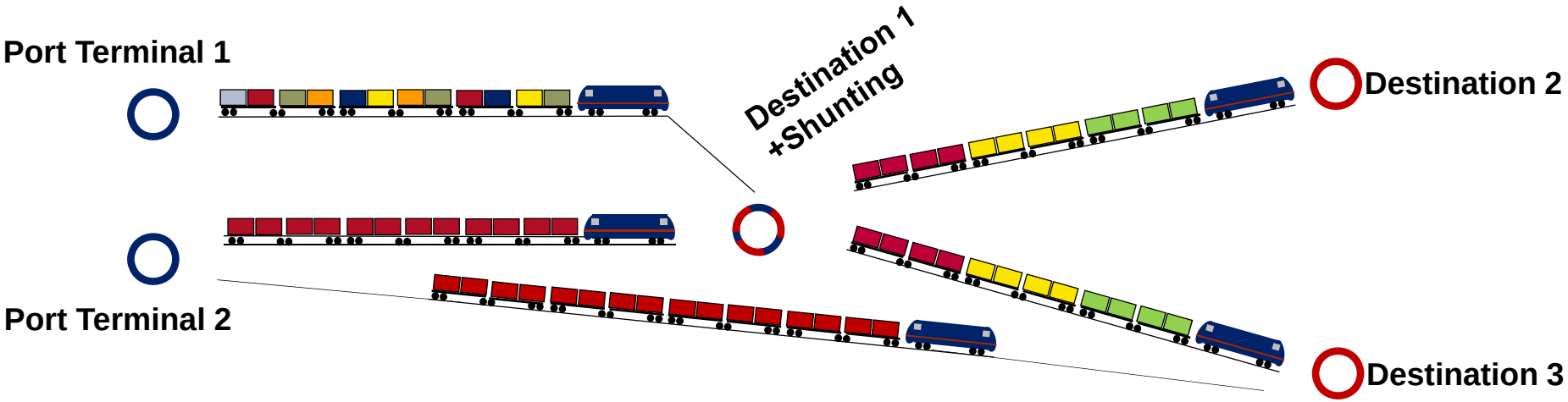
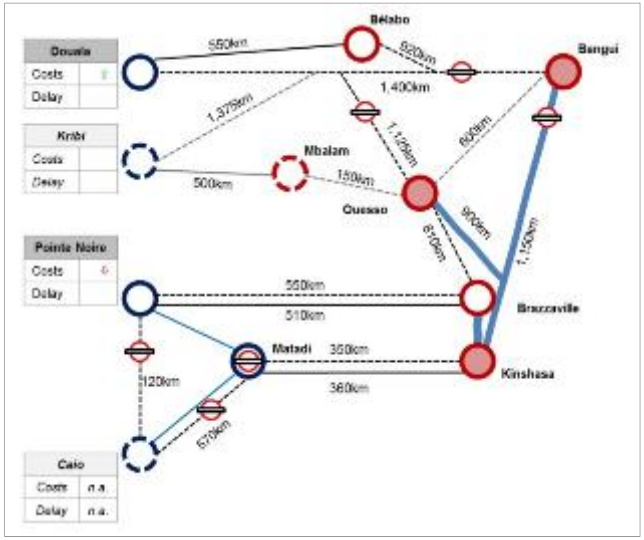
Network Character



Challenges

- Inland terminal capacities and operations / processes to match sea port rail interface
- Network capacities to cater for required train frequencies

→ Reliability at a certain frequency determines rail competitiveness
  - Between ports
  - Towards trucks



Intermodal Planning – Planning Approach

Train Schedule and Consist Analyses

Track Utilisation Planning

Crane Performance Demand Analysis

Storage Demand Analysis

Crane System Selection

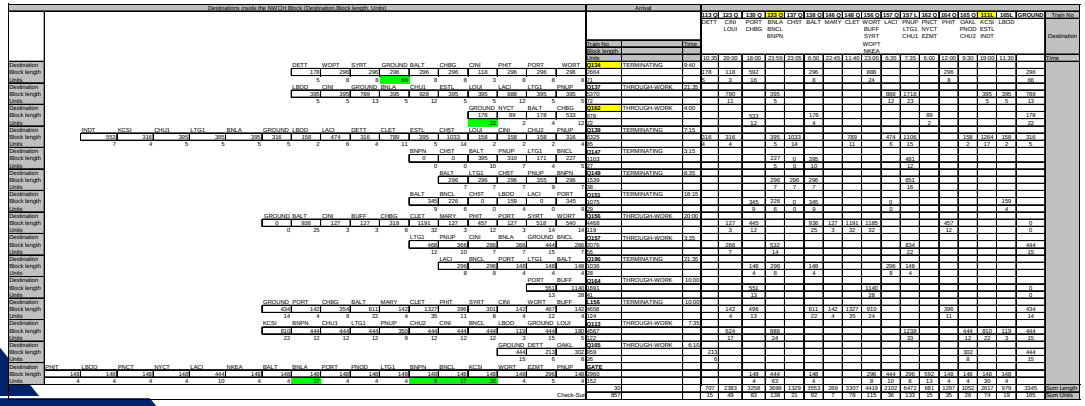
Selection of Horizontal Transport Alterna-tives

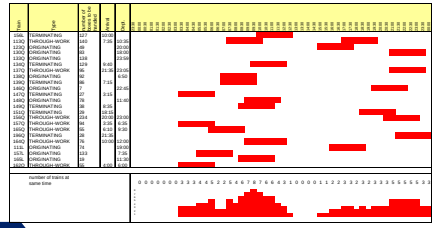
Simulation incl. Scheduling and Equipmen Deployme Optimisati

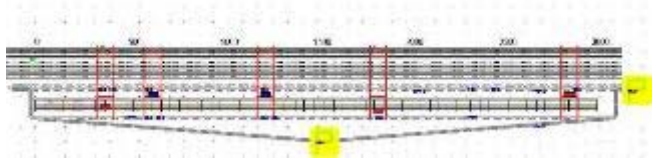
Feasibility Tests

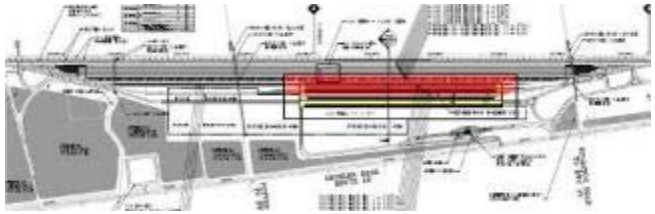
System Validation and Se-lection

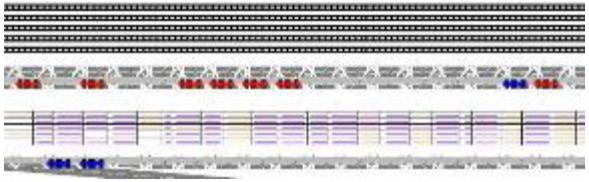
Detailed Process Planning and Requirements Engineering



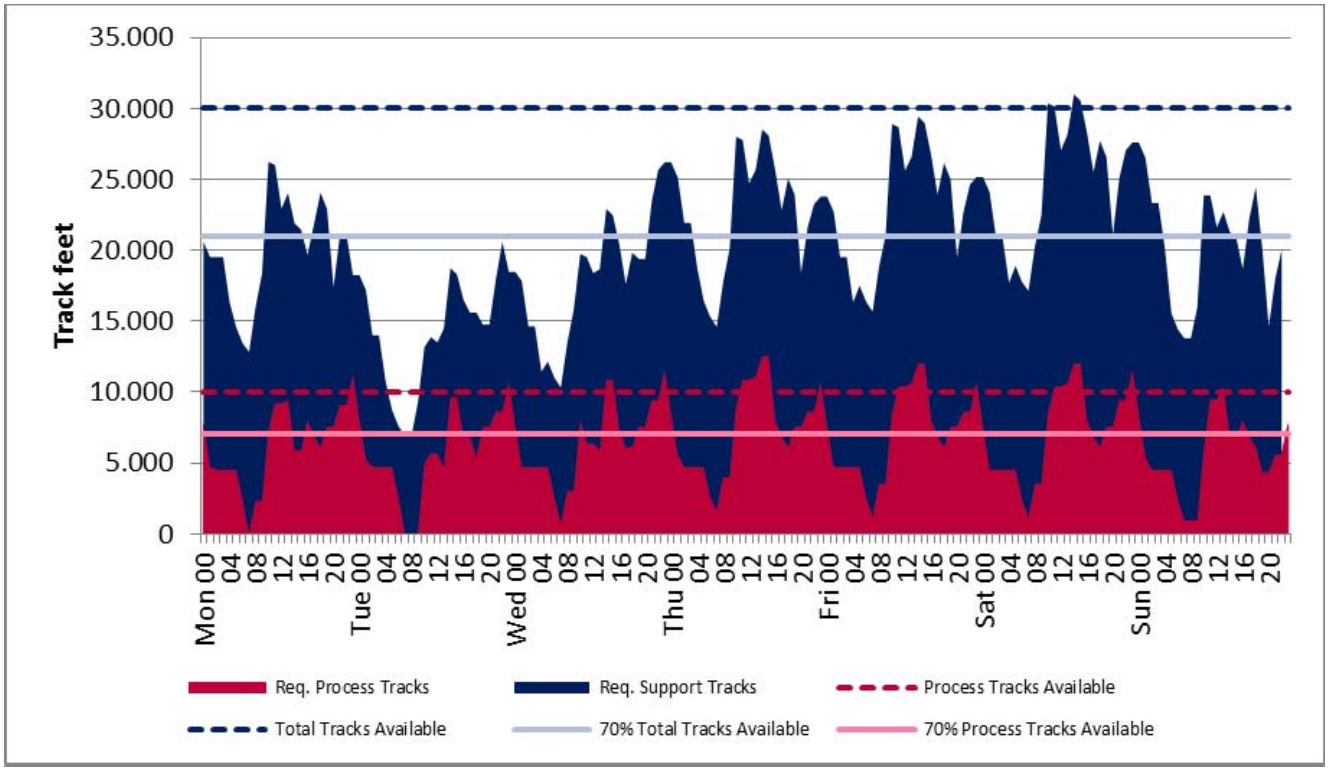








Example: Track Capacity Assessment



→ **Separate assessments of capacities and requirements for process tracks and support tracks**

Methodology and Planned Activities

Example: Net Present Value Assessment

Alternative 1 - RMG					
Terminal XYZ		Capacity ('000 bx)	Investment (mUSD)	Invest per incr. Unit (USD)	NPV (mUSD)
Scenario	Pessimistic	250	80	800	18
	Mid	400	120	480	70
	Optimistic	500	160	457	100

Alternative 4 - RTG					
Terminal XYZ		Capacity ('000 bx)	Investment (mUSD)	Invest per incr. Unit (USD)	NPV (mUSD)
Scenario	Pessimistic	220	75	1.071	19
	Mid	380	120	522	60
	Optimistic	490	165	485	90

→ Alternative 1, RMG, offers a higher capacity and is financially more viable in the mid and optimistic scenario

→ Alternative 4, RTG, is only advantageous financially in the pessimistic scenario

Content

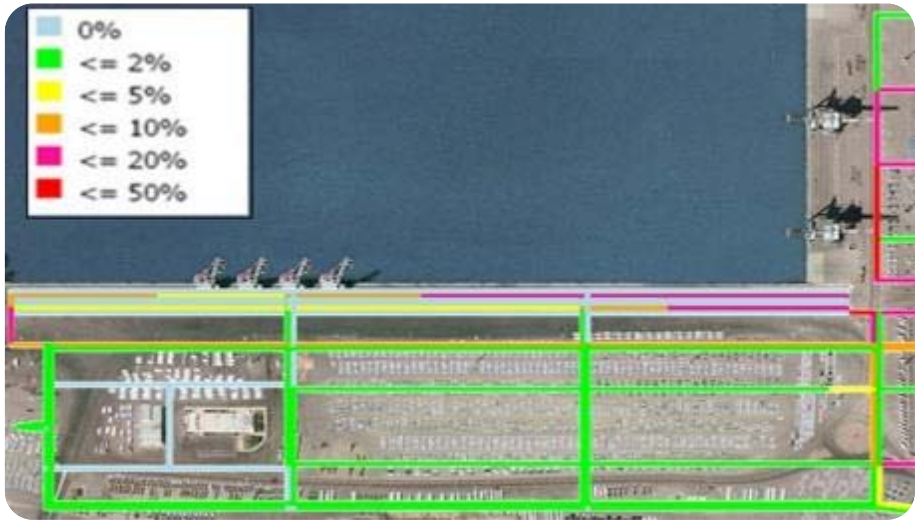
HPCsim – The Operations Expert Tool

Using simulation to design the most efficient terminal

Static Planning | **Proof of Concept** | **Terminal Improvement**

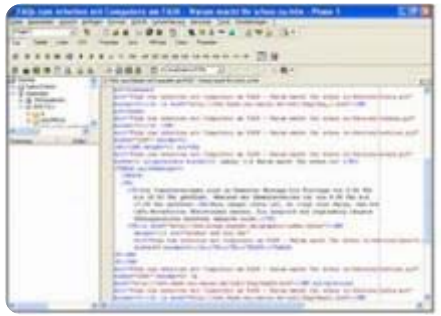
What to answer by simulation?

- Verifying feasibility of terminal design
- Comparing alternative designs/layouts
- Determining equipment requirements, op. hours, energy consumption & emissions
- Identifying bottlenecks



Why HPCsim?

- Realistic simulation of all terminal operations
- Proven, highly accurate results
- Transparent modelling, no black-box



HPCsim – The Operations Expert Tool

Using simulation to improve terminal operations

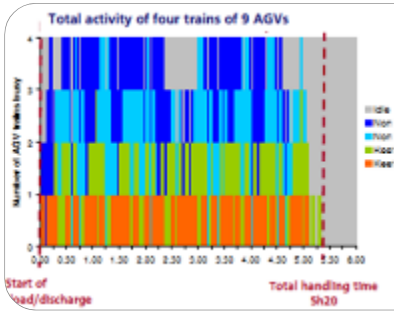
Static Planning → **Proof of Concept** → **Terminal Improvement**

What to improve by simulation?

- Yard layout, street network & block pattern
- Terminal processes and operations
- Container stacking
- Yard crane scheduling
- Vehicle routing and allocation

Why HPCsim?

- Detailed modeling of equipment behavior
- Adaptable to terminal-specific processes
- Onetime modelling – multiple analyses



Intermodal Simulation

Providing the full picture for intermodal rail systems

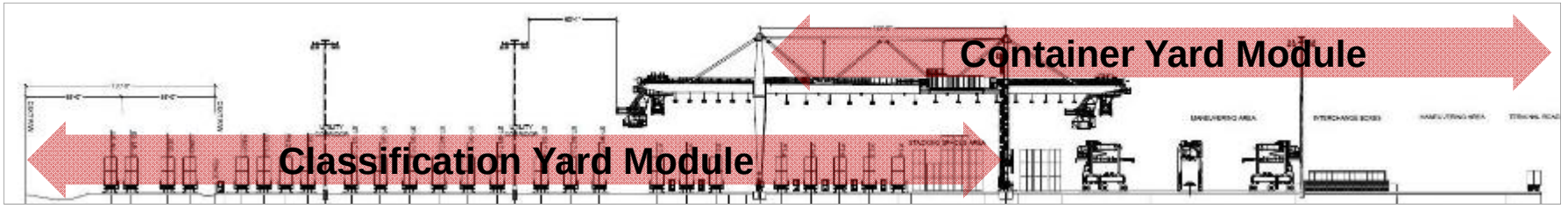
HPCsim Intermodal Rail Simulation

Classification Yard Module

- To scale modelling of track network.
- Detailed modelling of all engine and railcar movements, including track allocation, switch engine allocation, switch paths, load-dependent acceleration/deceleration,…
- Explicitly modelling switch settings.
- Considering empty rail car management.

Container Yard Module

- Modelling of alternative operating systems, such as RMG, RTG, SC, AGV,…
- Detailed modelling of cranes and transport equipment.
- Explicit modelling of individual container storage positions and resulting shuffle moves.

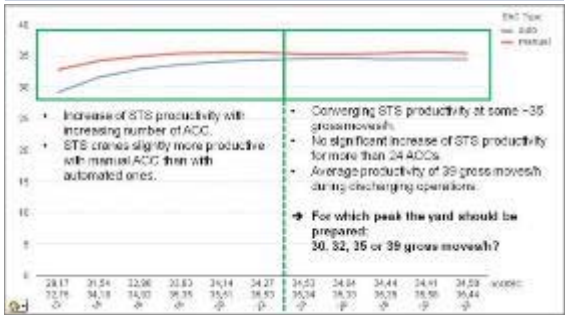


Taking into account dynamic interdependencies between container and classification yards.

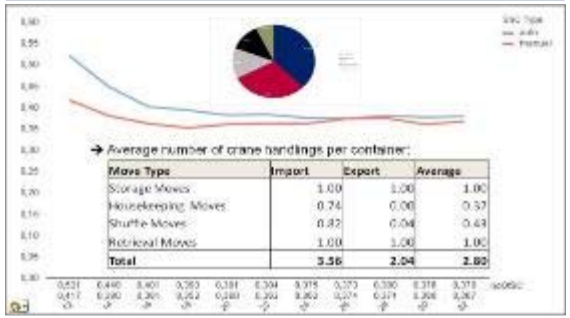
Analyser

Virtually every possible statistic and performance figure can be produced

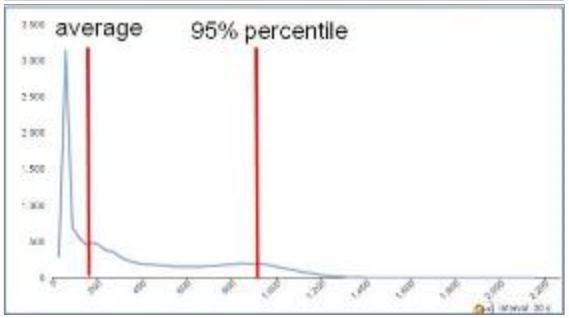
Equipment productivity



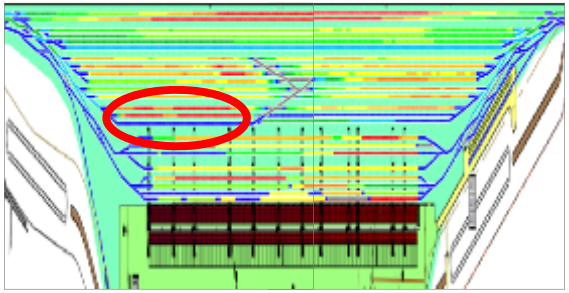
Yard productivity



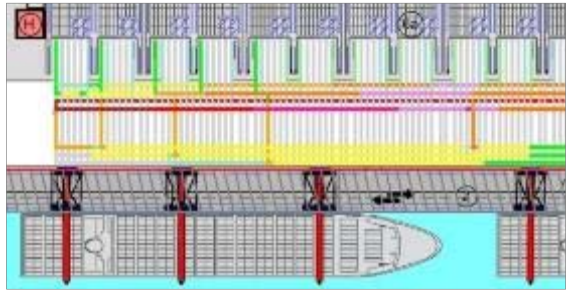
Truck handling productivity



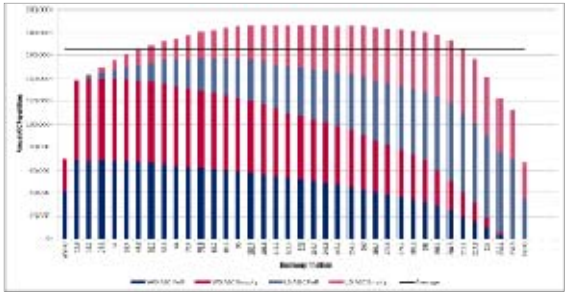
Bottlenecks



Road use input for civil engineering design



Crane load repetitions for civil engineering design

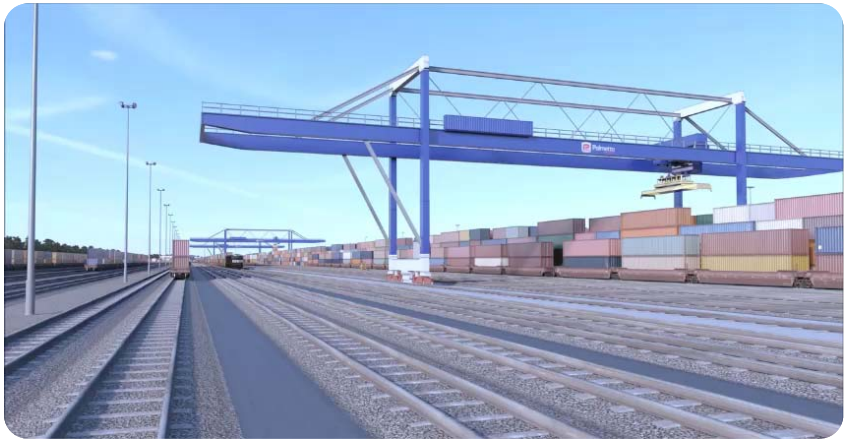


3D Visualiser

Creating state-of-the-art animations of simulated Operations

Why 3D visualisation?

- Optional add-on for each simulation study.
- Selling the project to the community, financial institutions and other stakeholders.
- Facilitating understanding of new operating systems and processes.



Why HPCsim?

- High quality visualisation based on real operations, not on arbitrarily scripted movements.
- Realistic visualisation of terminal and rail operations, including equipment movements and cargo flows.
- Embedding into surrounding environment.

HPC Hamburg Port Consulting GmbH

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