Container Terminal Robotization

Next Challenge: Brown-field?!

Coeveld

Outline Presentation

- ✔ | About TBA
- ✔ | Trends in Automation
- ✔ | Case Study: Maasvlakte 2
- ✔ | Next Challenge: Brown-field
- ✔ | Q&A

About TBA

Company Profile

TBA in Numbers: Engineered Success

- Headquartered in Delft, The Netherlands, founded in 1996, with subsidiaries in Germany and Romania, TBA is the largest simulation consultant worldwide.
- We have a highly skilled workforce of 135 engineers, consultants and software developers.
- 9 out of top 10 Global Terminal Operators are customers (HPH, PSA, APMT, DPWorld, TIL, Cosco, Hanjin, HHLA, Eurogate).
- Active in more than 75 countries across the globe.
- Completed over 800 terminal projects with varied scope; from planning review to complete master planning.
- TBA supports terminal operators during all stages from concept to realization and thereafter in operations.
- TBA is specialized in ensuring that the planning is realized and targeted performance levels are achieved.

About TBA – Scope of Services / Products

✔ | SERVICES

- **Consultancy** to container terminals with our **simulation** and **emulation** tools

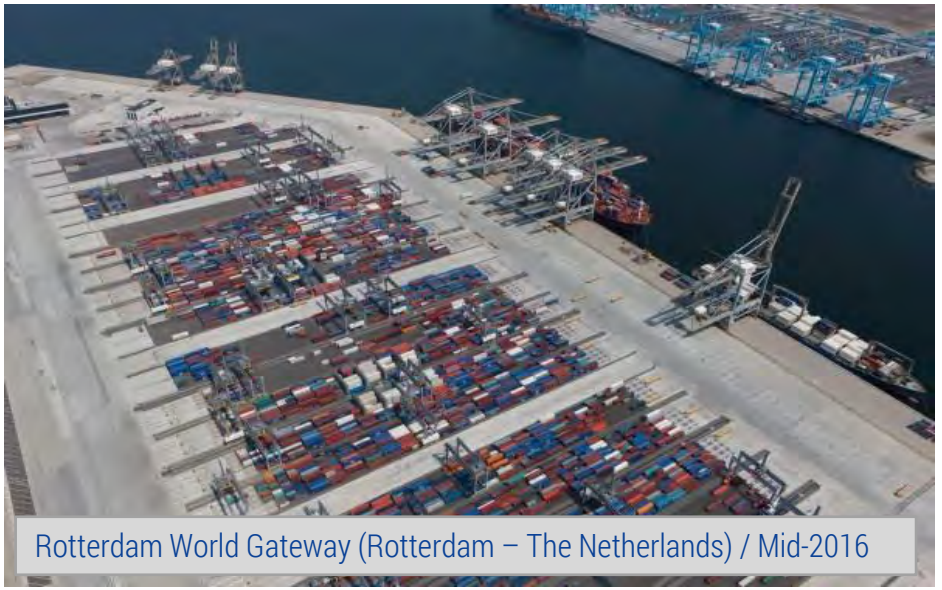
✔ | PRODUCTS

- **Software** for control of automated / robotized equipment at container terminals

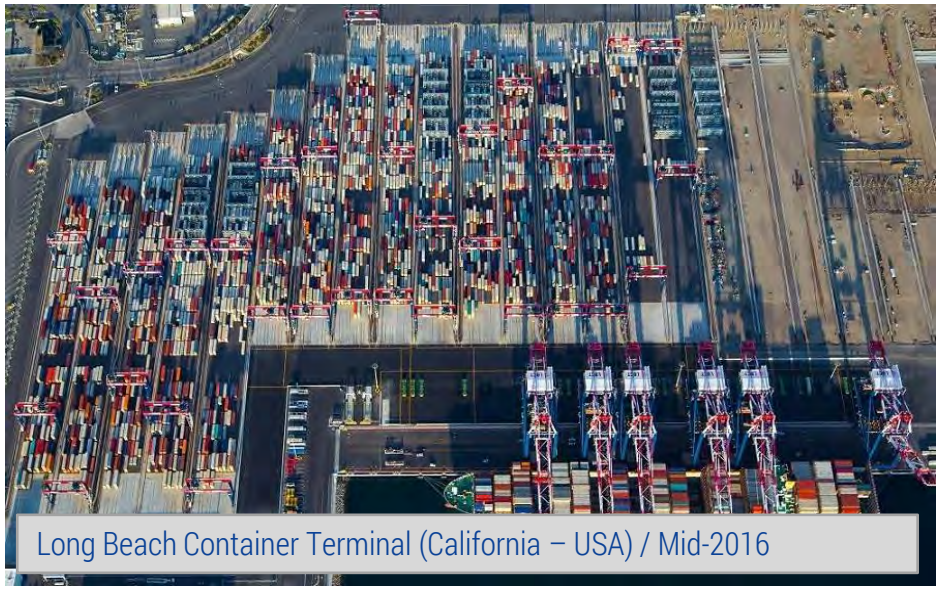
TBA	What	Stage	Purpose
Simulation 	Virtual terminal plus virtual TOS	Conceptual terminal design	Create a design that works and performs
Emulation 	Virtual terminal plus real TOS	Terminal construction / implementation	Make sure TOS works and performs
Software 	Equipment control software for real equipment	During operation	Run the operation efficiently

Recent Automation Projects

APMT MV2 (Rotterdam – The Netherlands) / End-2014



Rotterdam World Gateway (Rotterdam – The Netherlands) / Mid-2016

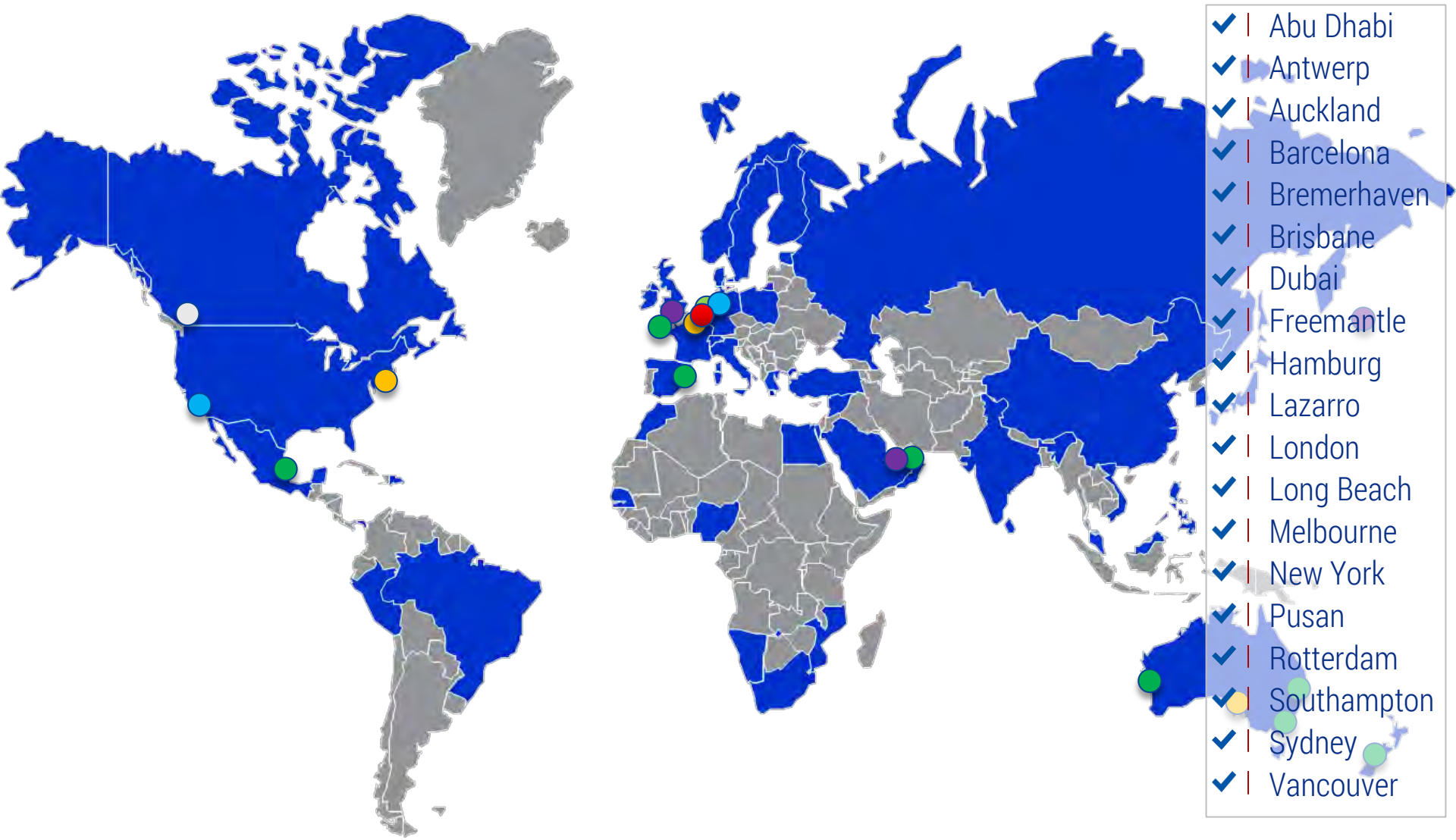


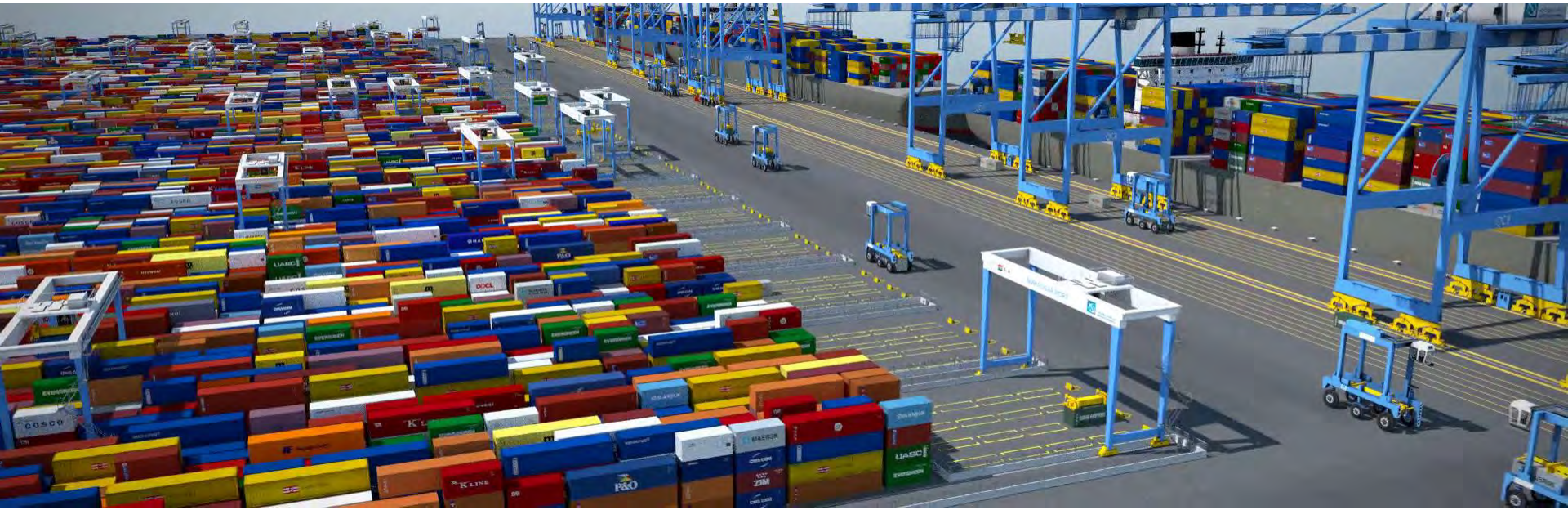
Long Beach Container Terminal (California – USA) / Mid-2016

Automated equipment

- ✔ | Quay cranes (semi): QC / STS
- ✔ | Yard cranes: ASC
- ✔ | Transport: AGV / L-AGV
- ✔ | Rail cranes (semi): RC

TBA's History with Container Terminal Automation Projects



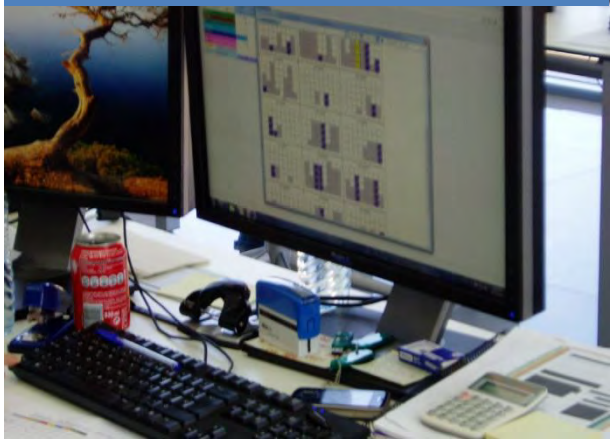


Trends in Automation

Illustrated in a Port Context

Gate Automation
Process Automation

1. Truck appointment, including container number



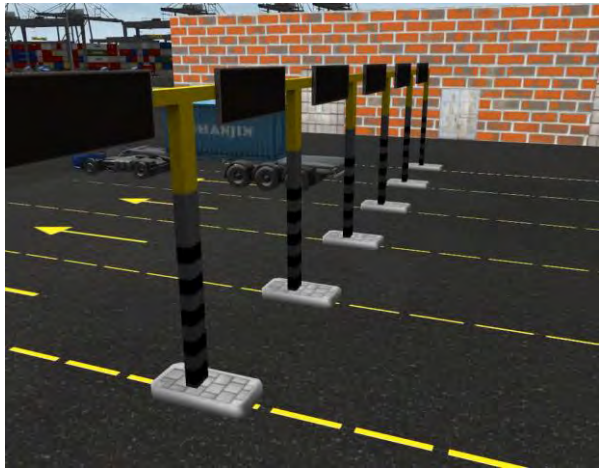
2. LPR + OCR

3. OCR read + known appointments → >99.9% quality

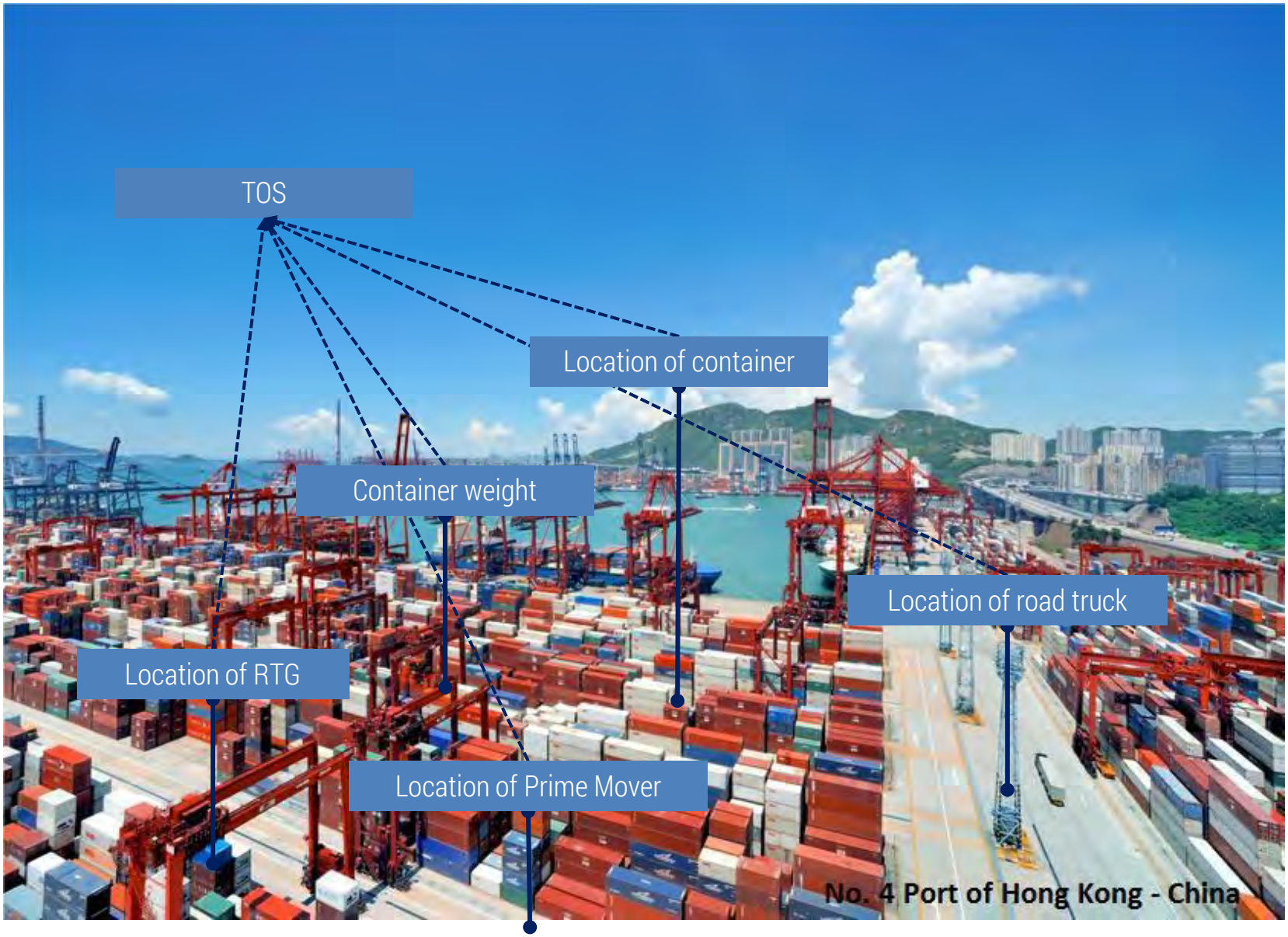
4. X-ray / radiation scan

5. Pedestal for driver ID + ticket

6. Routing advise

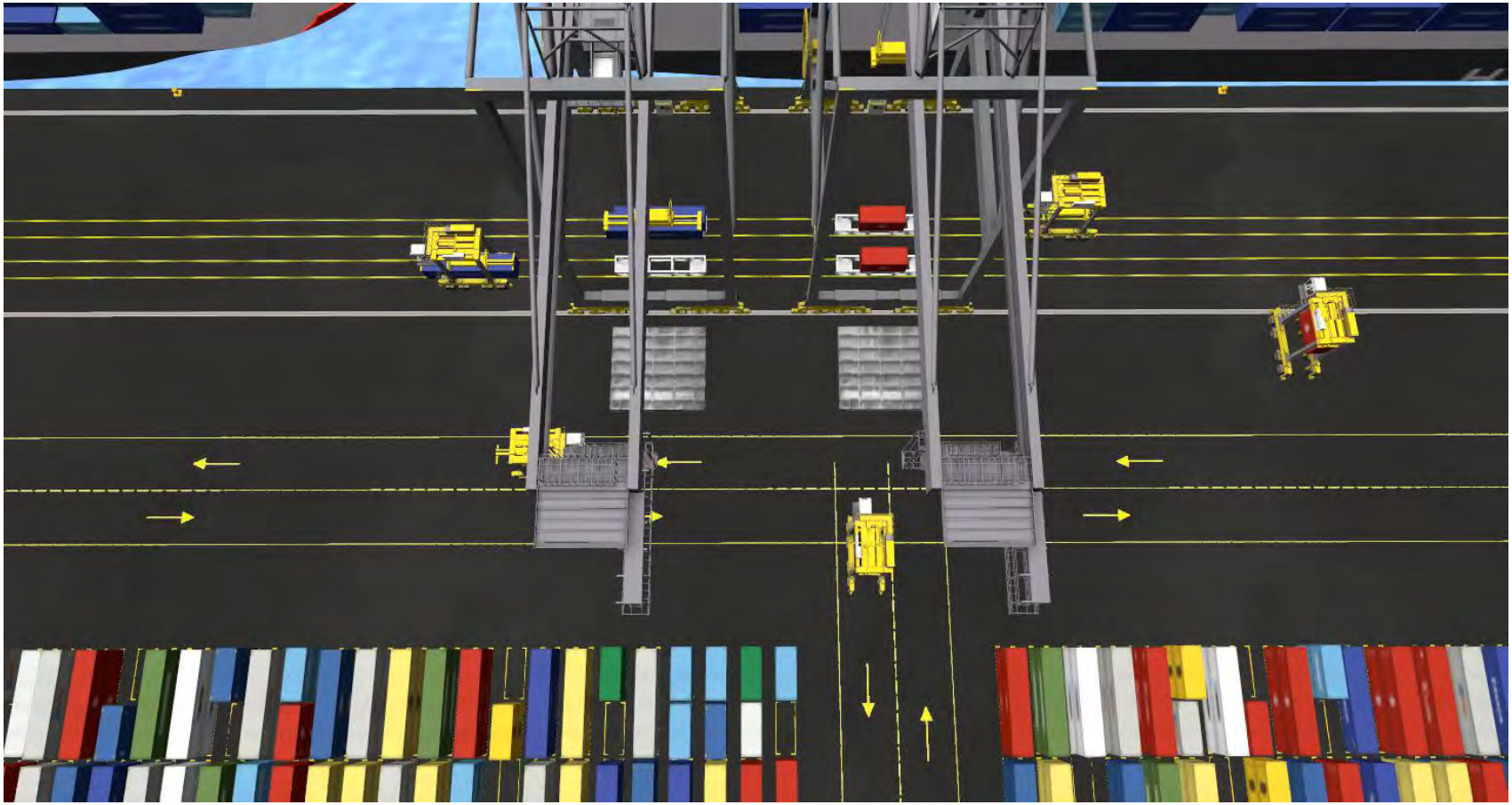


Systems
Process Automation



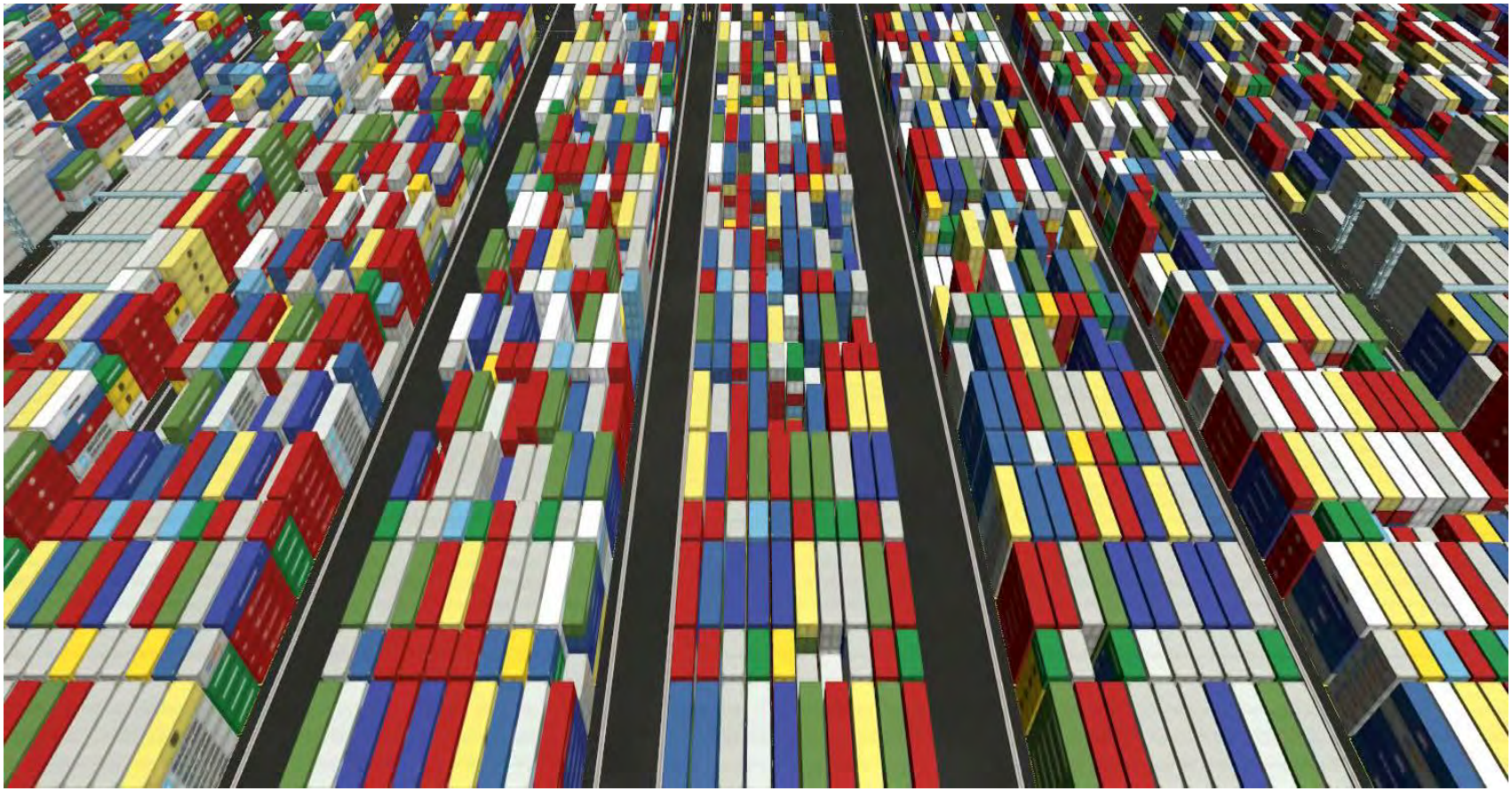
Vehicle Dispatching
Automated Decision Making

Automated vehicle dispatching (using Prime Route)

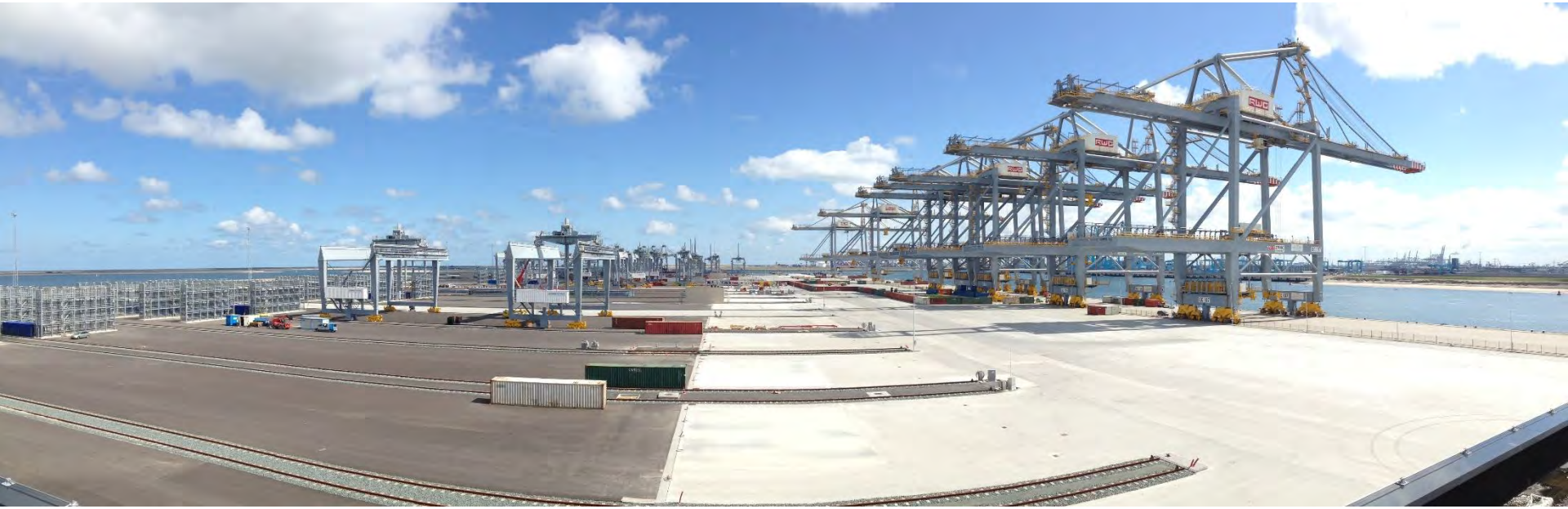


Container Decking
Automated Decision Making

Automated container decking (position assignment) based on algorithms & parameters



Container Terminal in Rotterdam – The Netherlands
Robotization



Case Study: Maasvlakte 2

Ambitions > Results

Ambitions

- ✔ | Handling the largest ships
- ✔ | In the shortest possible time
- ✔ | Minimized safety risks
- ✔ | Minimized environmental impact

The Result / 1

Remotely controlled quay cranes

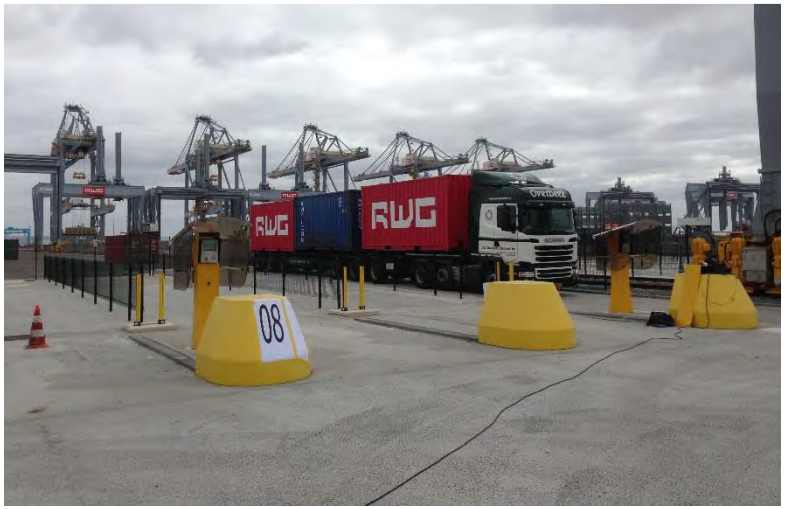
Automated stacking cranes

Remotely controlled quay cranes

Battery powered automated vehicles

The Result / 2

Fully automated truck handling



Automated battery swap

Fully automated truck handling

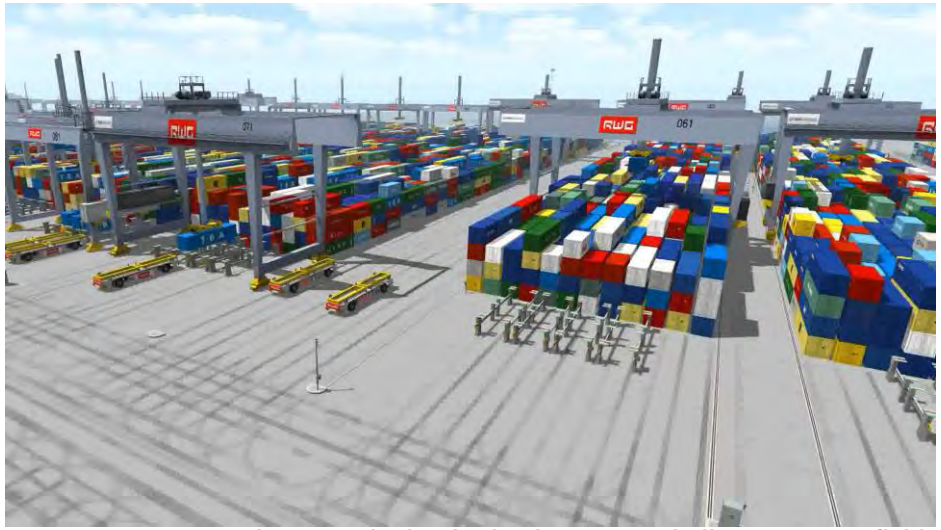
Optical Character Recognition on rail

The Result / 3

Automated routing

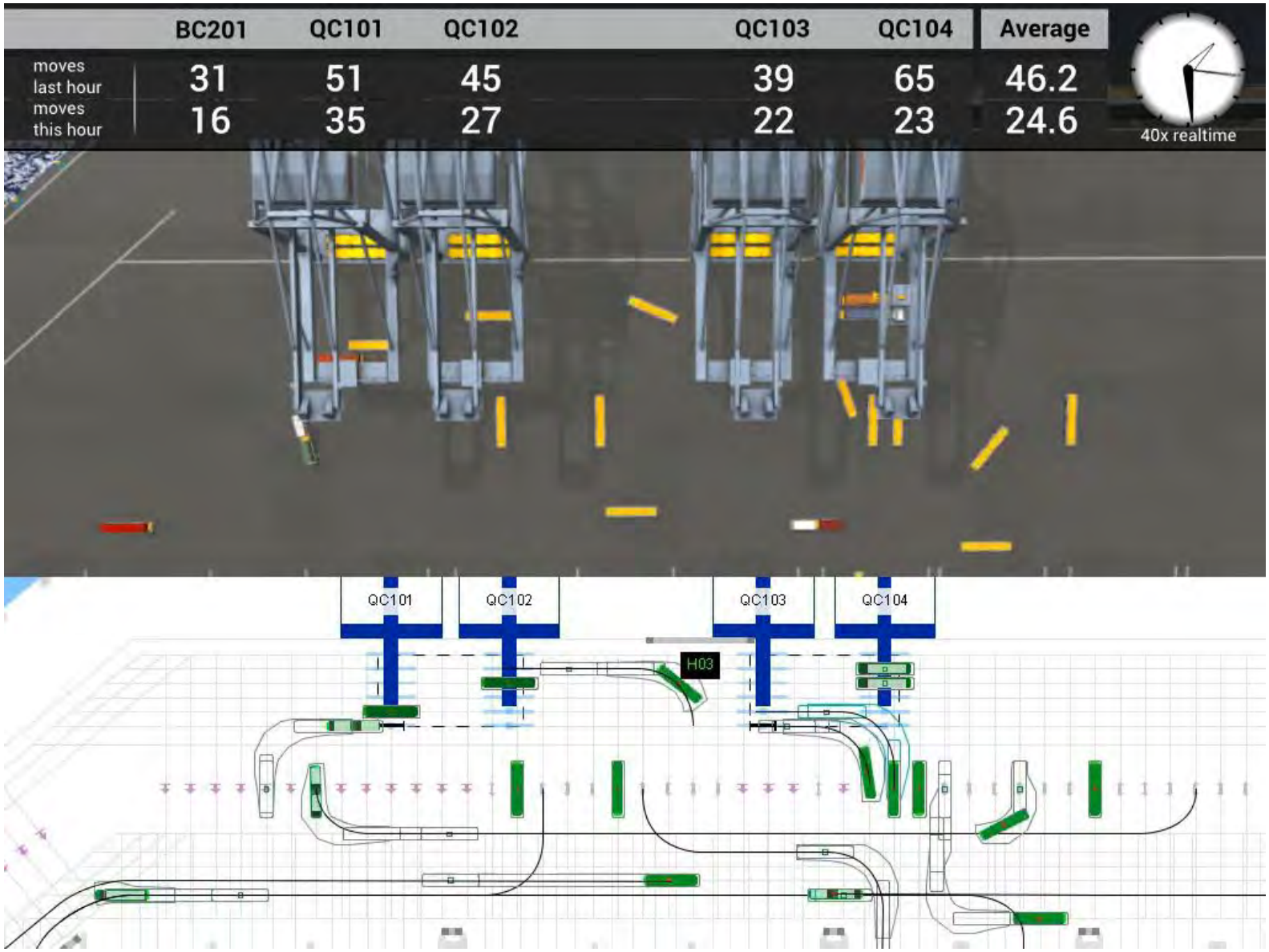
Automated interchange & handshake

Collision avoidance



Automated error diagnosis

The Result / 4


BC201
QC101
QC102
QC103
QC104
Average
moves last hour
31
51
45
39
65
46.2
moves this hour
16
35
27
22
23
24.6
40x realtime
QC101
QC102
QC103
QC104
H03

Lessons Learnt

- ✔ | Requirements need to be crystal clear
- ✔ | Use simulation to ensure that the system can deliver future demands
- ✔ | Automated terminals are still run by humans
- ✔ | Regular operation = disturbed operation
- ✔ | Simulation = Emulation = Live operation
- ✔ | Automation = integration → multiple vendors

Next Challenge

Brown-field

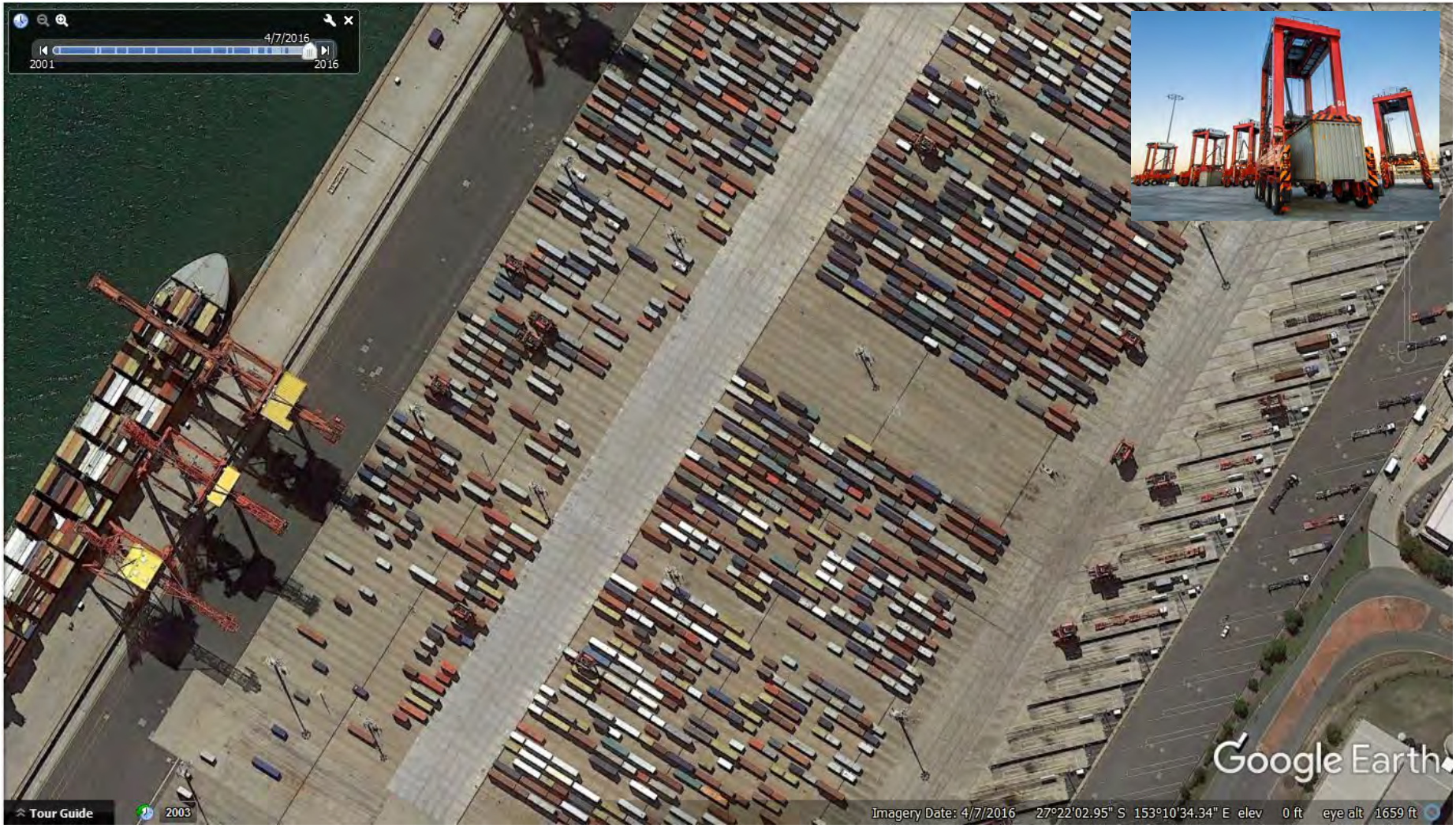
What's Next?

- ✔ | Combined work of human workers and robots
- ✔ | Intelligent everything: from refrigerator to road
- ✔ | Autonomous vehicles
- ✔ | Self-learning devices → new behaviour

What's Next in a Container Terminal Context?

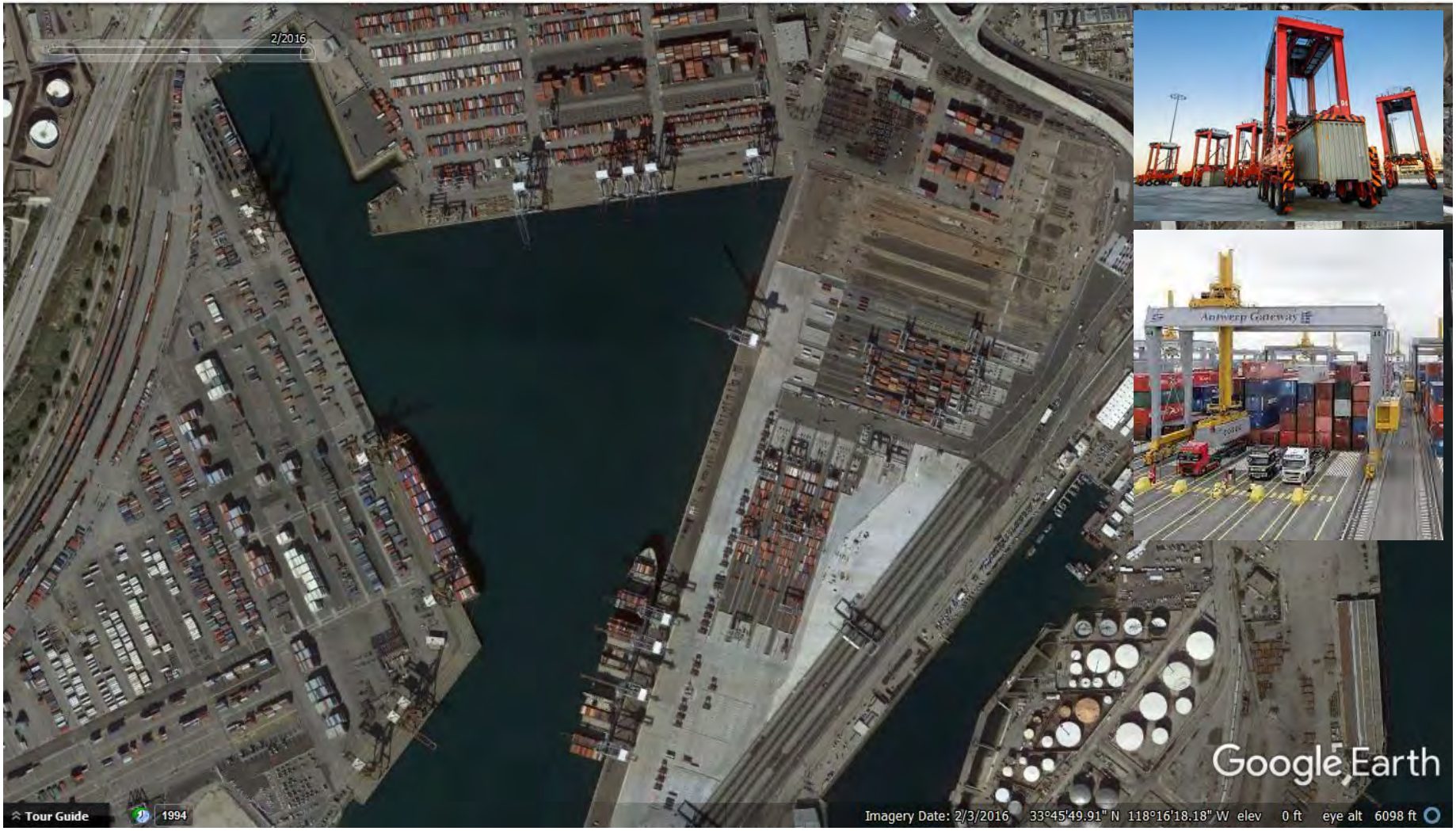
- ✔ | Sufficient capacity => shift of focus from green- to brownfield developments
- ✔ | Main driver for automations – cost-efficiency on the longer run – remains
- ✔ | BUT, how to apply automation in brown-field terminals …
- ✔ | … in space-constrained, manned ops without performance loss?

Example: Auto Strad
In operation



- ✔ | Automated Straddle Carriers in Australia
- ✔ | Not brown-field but starting from a greenfield operation

Example: Auto Strad plus ARMGs
In progress

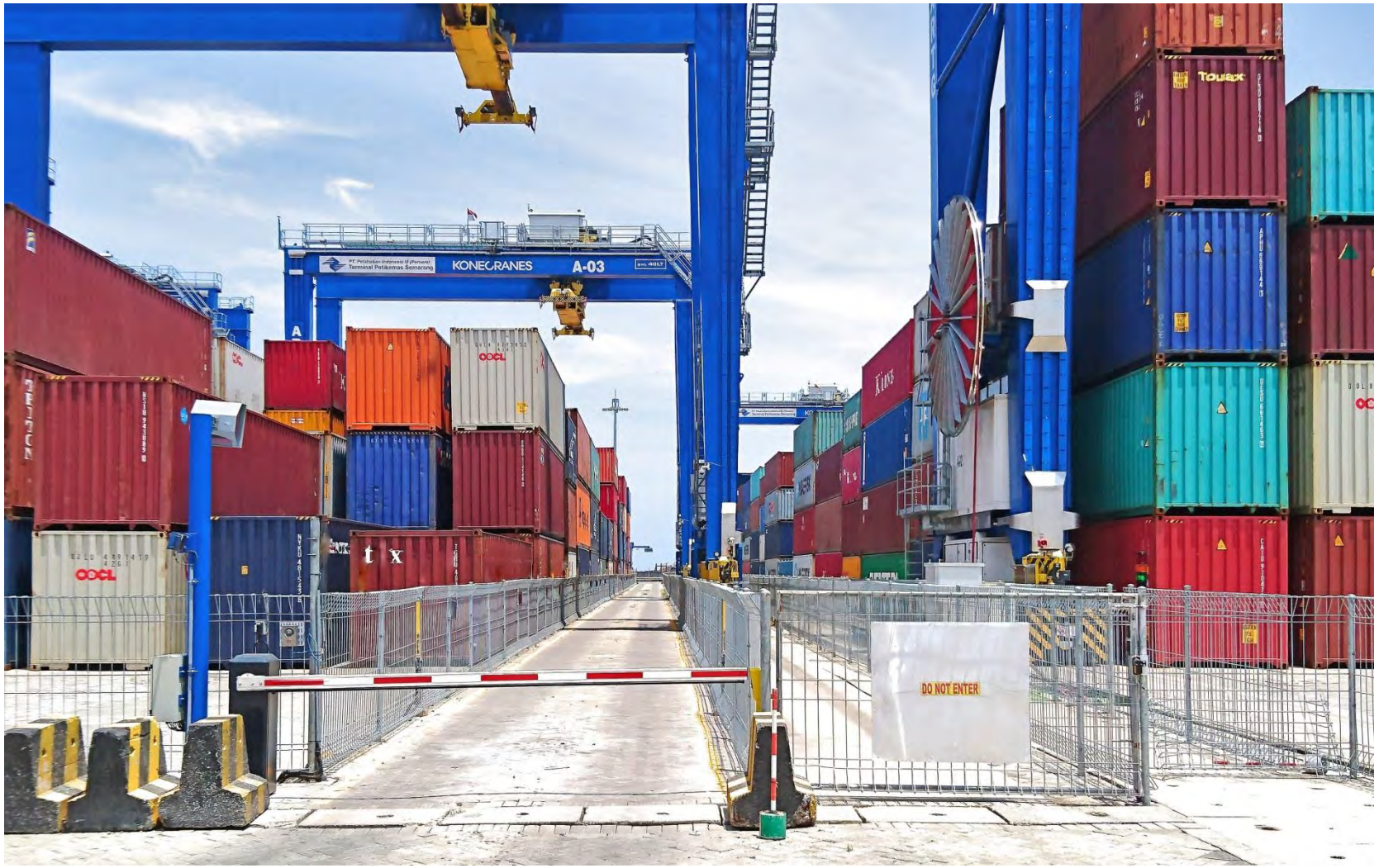


- ✔ | Automated Straddle Carriers in LA / Long Beach in combination with Automated Rail Mounted Gantries
- ✔ | New land in addition to existing terminal provides for a lot of flexibility in transition mode

Example: Auto Strad plus Manned Strad Planned

- ✔ | Auto Straddle Carriers (planned for operations) in New Zealand to serve yard / landside operations and doing a hand-over to manned Strads that serve the waterside operation
- ✔ | Transition is supported by some new land in addition to existing terminal

Example: Auto RTG plus manned terminal trucks
In progress



- ✔ | Automated Rubber Tyred Gantries (RTGs) in Indonesia in combination with manned terminal trucks
- ✔ | Transition is supported by some new land in addition to existing terminal

Some Functional / Technical Considerations

- ✔ | Apply automation in terminal equipment other than (L-)AGV to cover the broader range of existing handling systems

- ✔ | Design clever transition from manned to automated operation overcoming space constraints and supporting performance levels throughout transition

- ✔ | Define new measures to establish safe man-machine interaction in every area where men meet machines