Road to "Terminal 4.0" for Brownfield Terminals

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Background

- Technology is now come of age. “Industry 4.0” is here
  - Artificial intelligence (AI), Automation, Digitization, IoT, data analytics
  - AlphaGo “Master” beat the highest ranked Go player.
  - AphaGo “Zero” after 21 days of self learning was better than AlphaGo “Master”
  - In 2017 machine was better than humans on one of a reading test

1997 Kasparov Vs. Deep blue

2017 Ke Jie Vs. Alpha Go

- Potential & opportunity with technology & AI is undisputed & enormous
- Ports, shipping lines, supply chain participants & tech companies are all actively talking about Artificial intelligence, digitization,, block chain, big data, IoT etc.
- For our industry - Fully automated terminals are increasingly fast & all across the globe
- What about the existing brownfield facilities - What should they do to?

Road to terminal 4.0 – Brownfield Terminal

- ✔ | Waiting to first creating a "state of the art" IT infrastructure is not a prerequisite for launching digital transformation

Key message

- ✔ | The digital journey/transformation for most brownfield sites is best advised via a stepped approach & leveraging the existing infrastructure

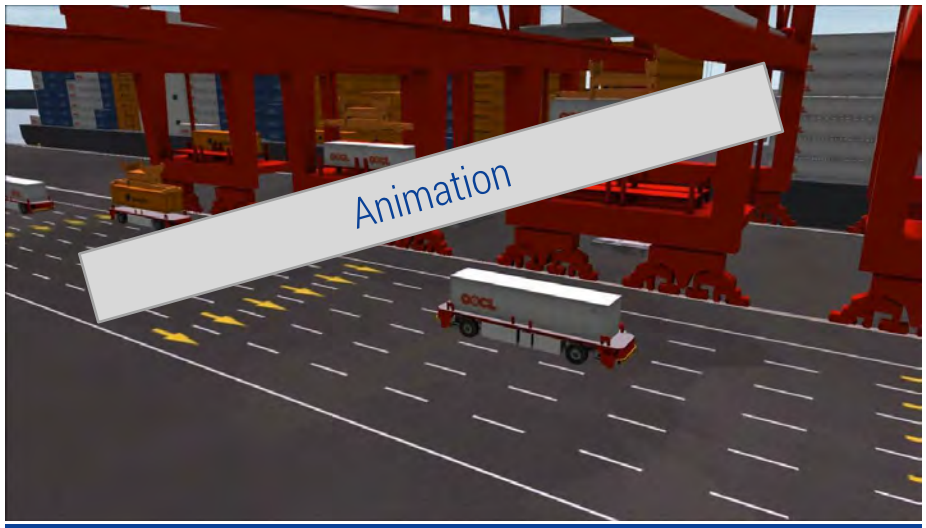
- ✔ | A few examples
  - Using AI to automating RTG dispatching in existing facility
  - Automate Straddle terminal main yard
  - Digital twin – Example Benefits
  - Smarten the operations/Intelligent applications
  - Data Vs Information ; managing data Vs exception management

- ✔ | Conclusion – What is needed for success ?

Introduction
TBA Group

TBA Group Highlights - Design, Operations & Software

- TBA – Globally a recognized leader in terminal design, simulation, optimization & terminal automation.
- Over 600 terminal projects around the world. 9 of top 10 largest global operators use TBA services including, DP World, AP Moller terminals, PSA, Hutchison etc..
- Been involved in many of the cutting edge & most innovative terminals.APMT Maasvlakte II, Rotterdam World Gateway, Long Beach Container Terminal, Euromax, London Gateway, Khorgos Rail (OBOR-Rail terminal Asia-Europe) Etc.
- TBA Equipment Control System (ECS) is controlling majority of the AGVs operating in fully automated container terminals. TBA has been providing this software for +18 years, linking to TOS & handling equipment

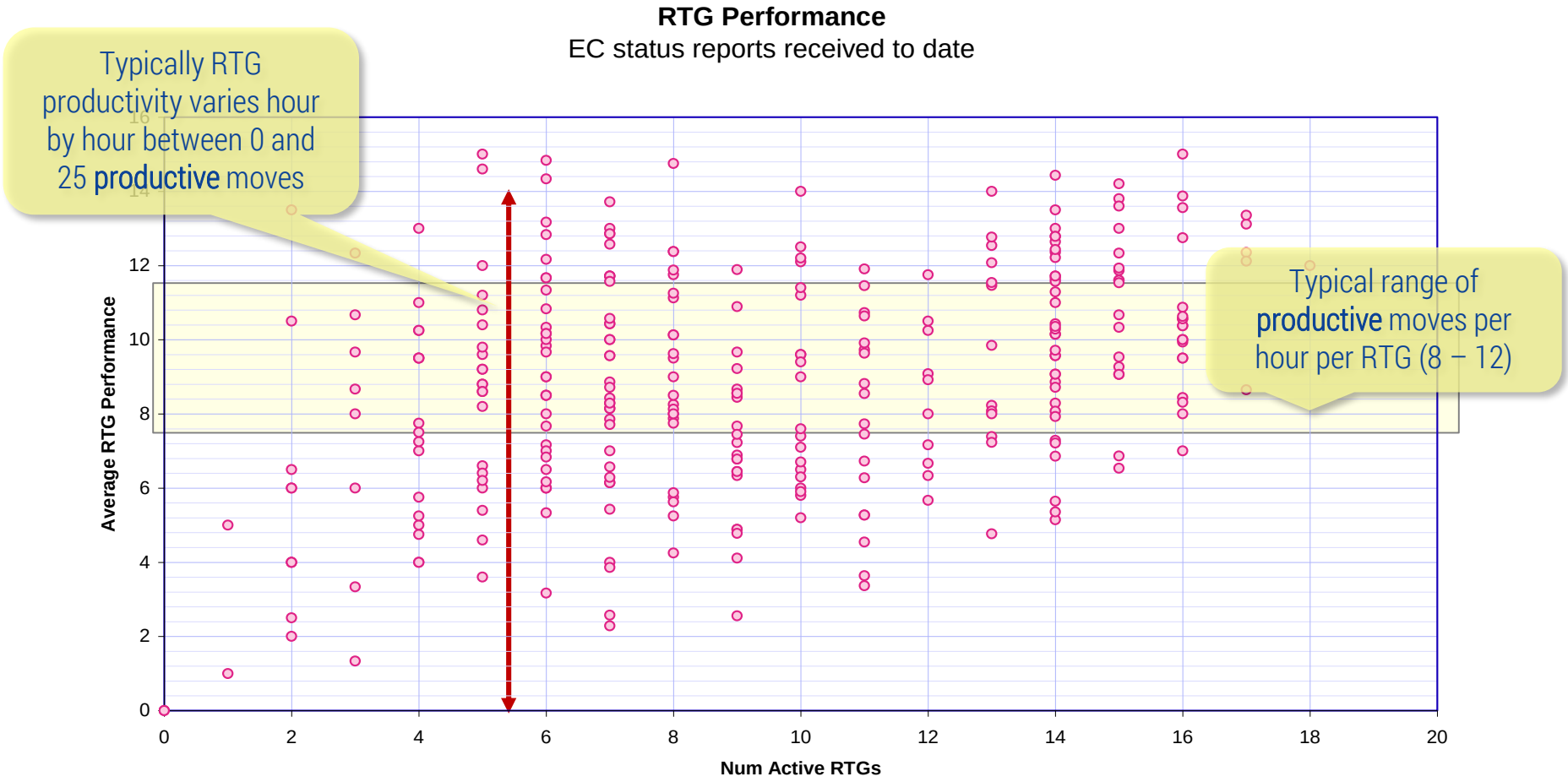


Long Beach Container Terminal – controlled by TBA TEAMS

Yanghan Phase IV- TBA worked on design

The digital journey for brownfield facilities
Example 1
Automating RTG dispatch

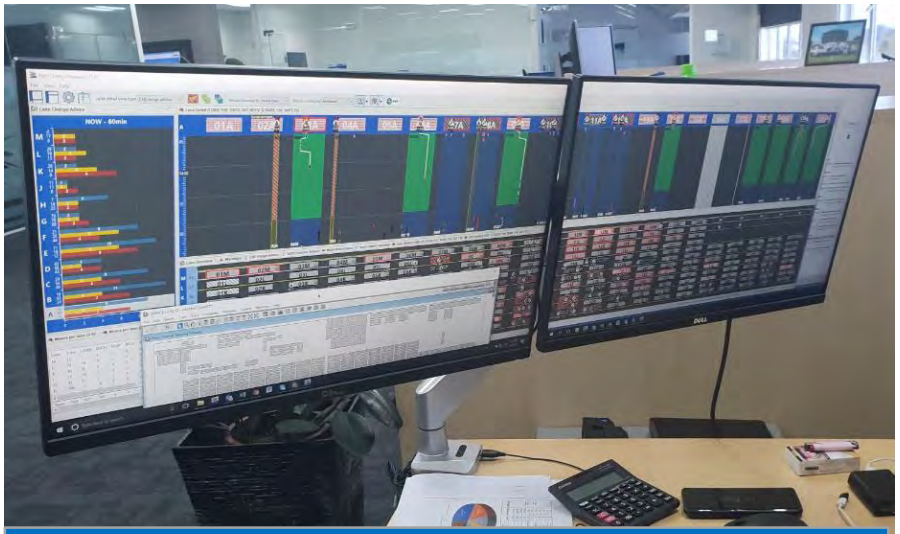
RTG productivity is highly variable on an hourly basis
Observations at current RTG operations



- RTGs have individual performances from 1 to 25 productive moves, but the average is typically ~ 8 to 12 up to 16.
- Typically one RTG is very productive one hour and not so productive the next due to work load distribution
- RTG dispatching is done manually - With high numbers of RTG it becomes more challenging to distribute workload !
- Solution – Yard crane Scheduler – Use AI to Automate RTG dispatching?

Large RTG terminal
Increasing a challenge to manage RTG workflow

Solution.....
Use AI to dispatch RTGs

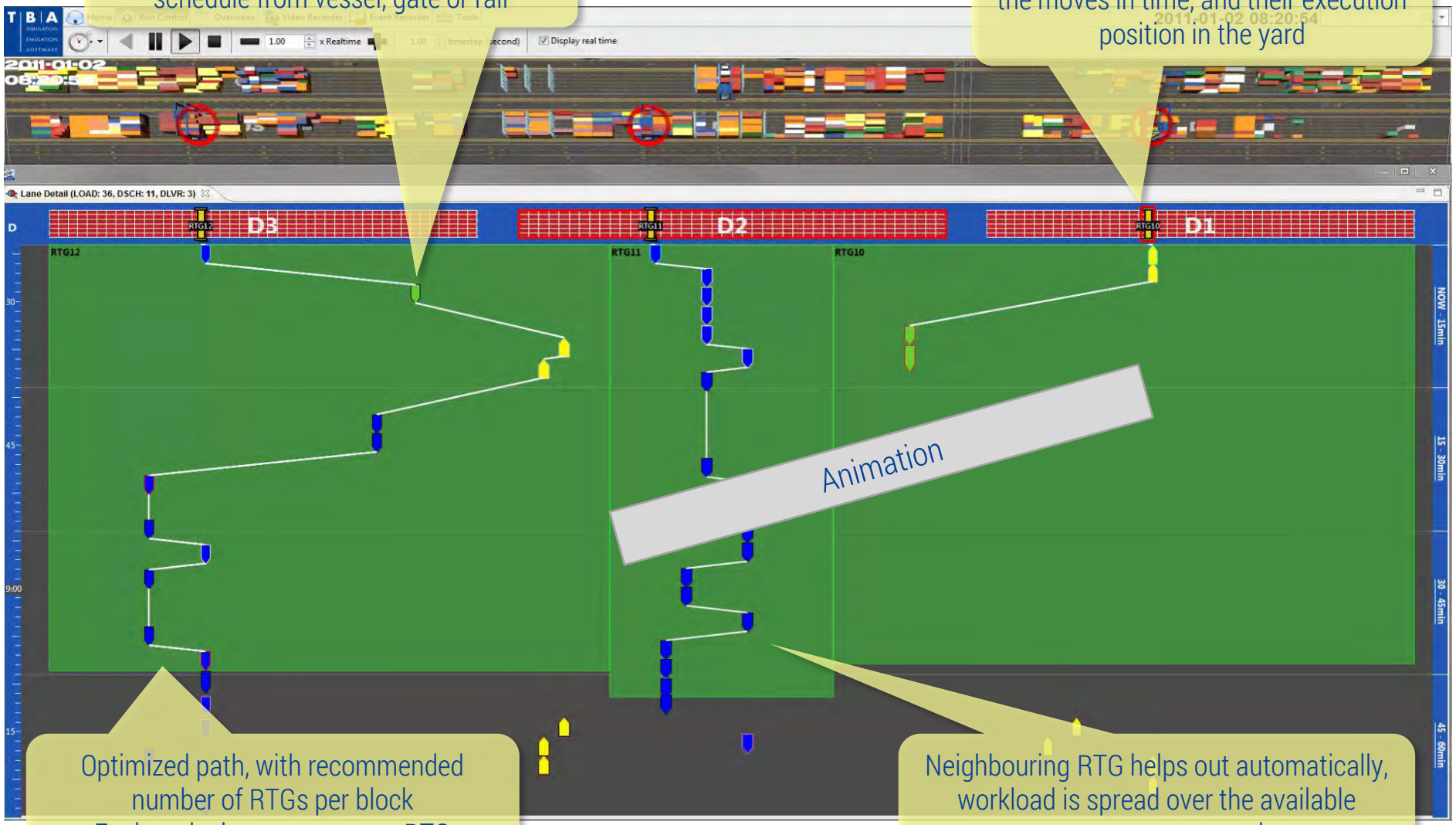


Yard Crane Scheduler -PTP

Automated dispatching of RTGs- Using AI
TBA Yard Crane Scheduler (YCS)

Moves are added in real-time to the schedule from vessel, gate or rail

Zone assigned to 1 yard crane, with all the moves in time, and their execution position in the yard



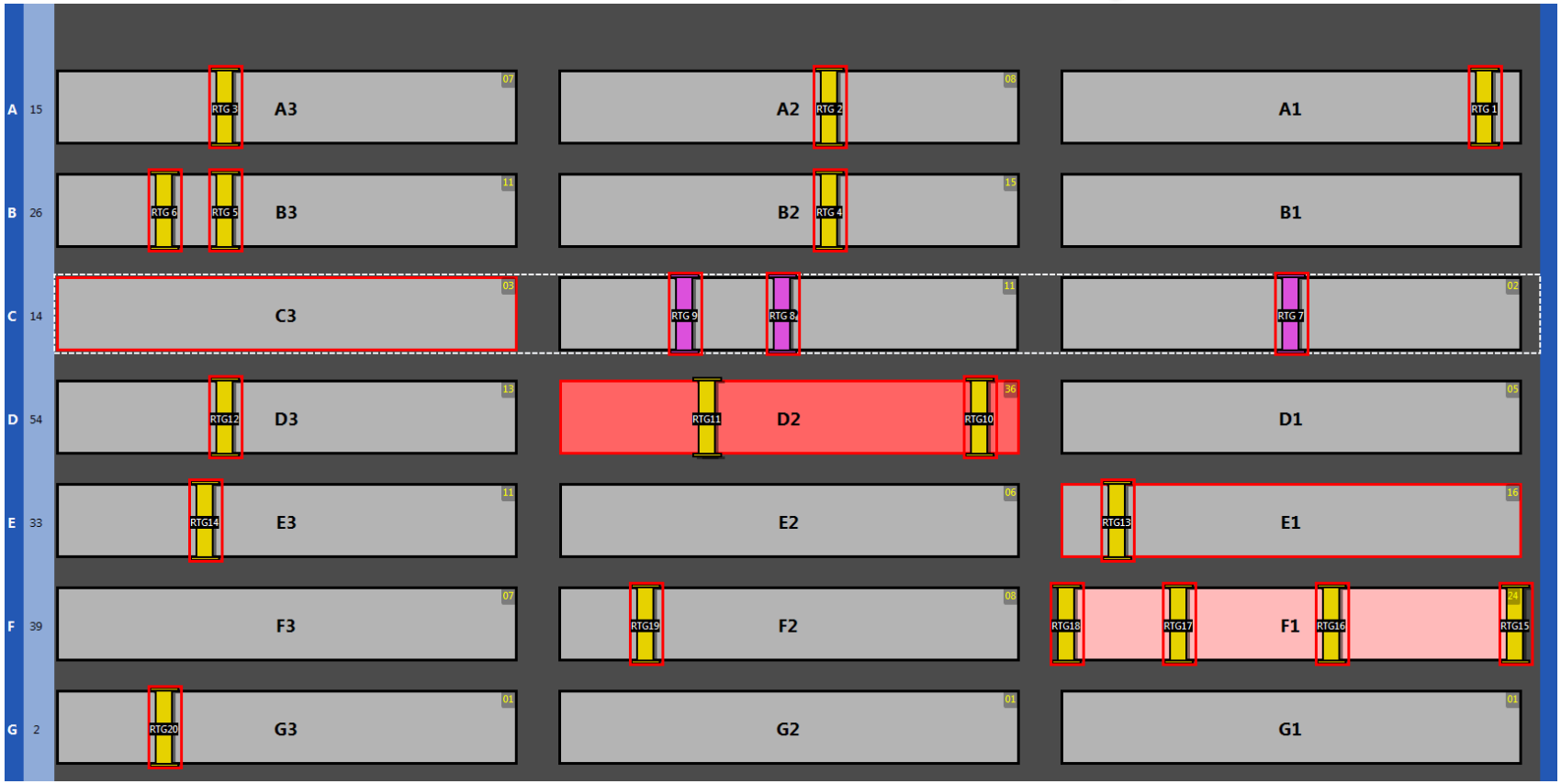
Optimized path, with recommended number of RTGs per block
Each path shows a separate RTG

Neighbouring RTG helps out automatically, workload is spread over the available cranes, no more uncovered moves

Visibility about RTG workload & manages ranges
Moving RTGs with Blocks & Lanes

- ✔ Incorrect machine status
  - Breakdowns (unreported)
  - Unmanned machines (driver left, kept logged on)

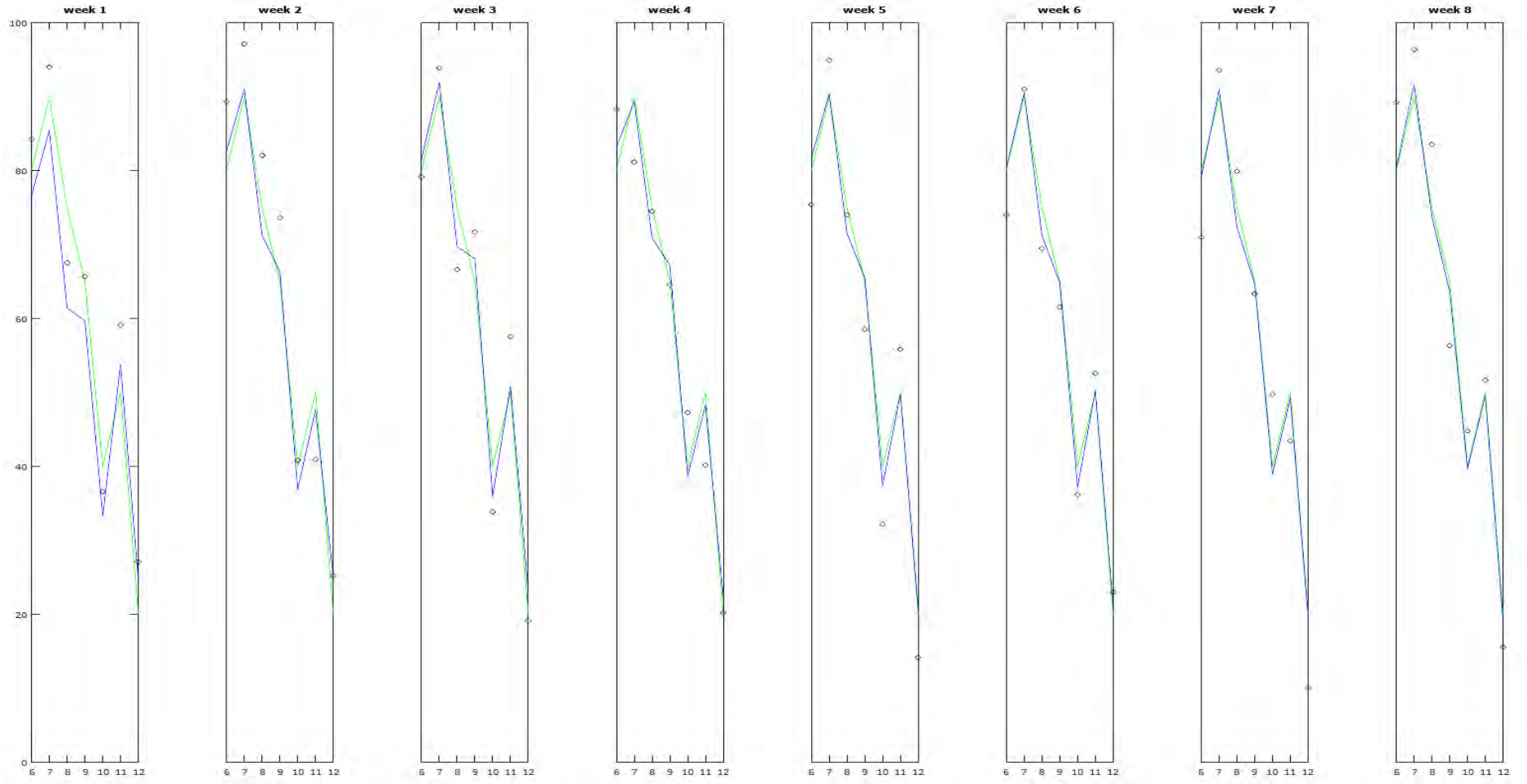
Lack of discipline
→ ADAPT



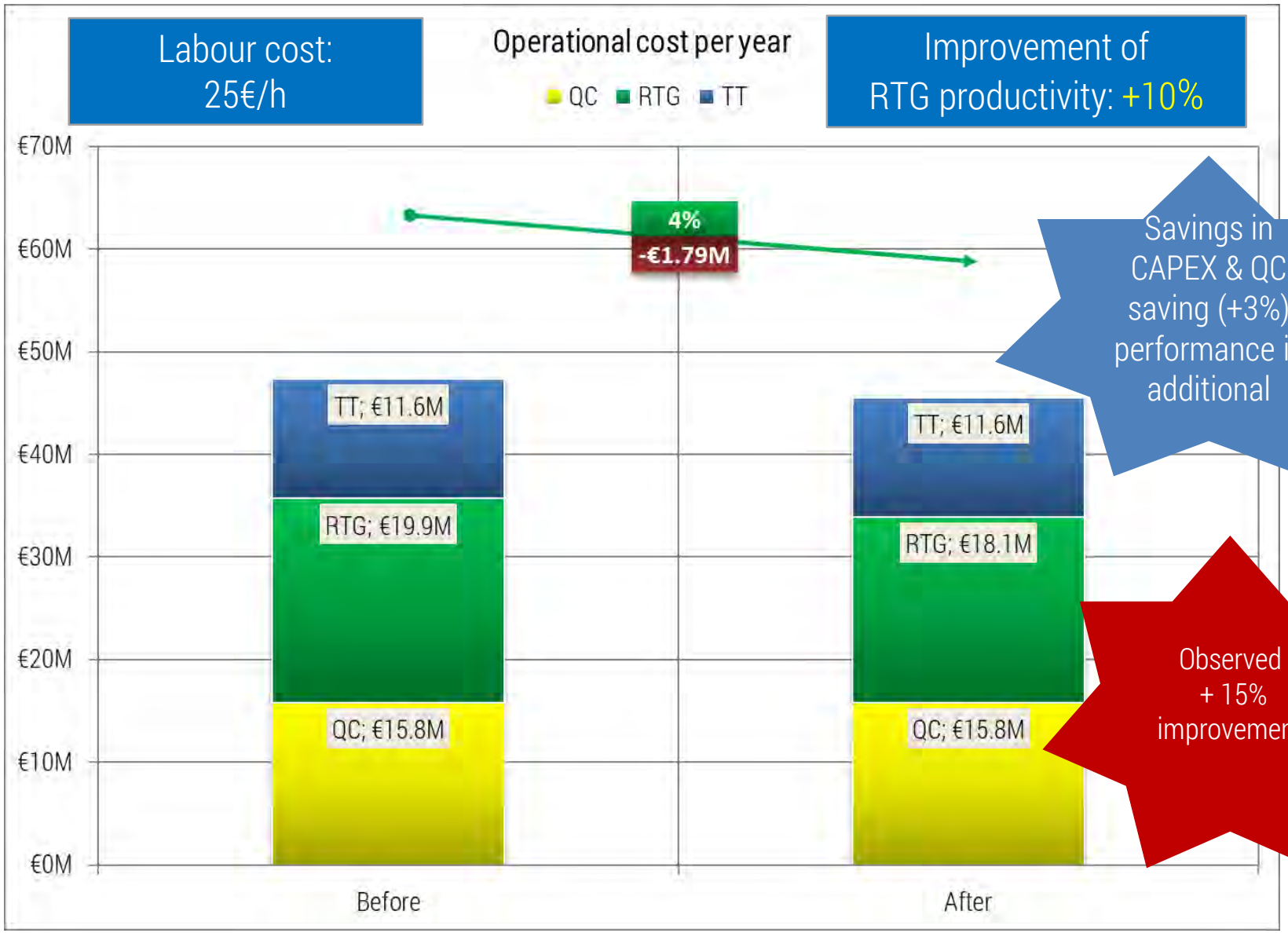
What does AI do ?

- ✔ Learning gate patterns
  - Real-time and over time

PREDICT



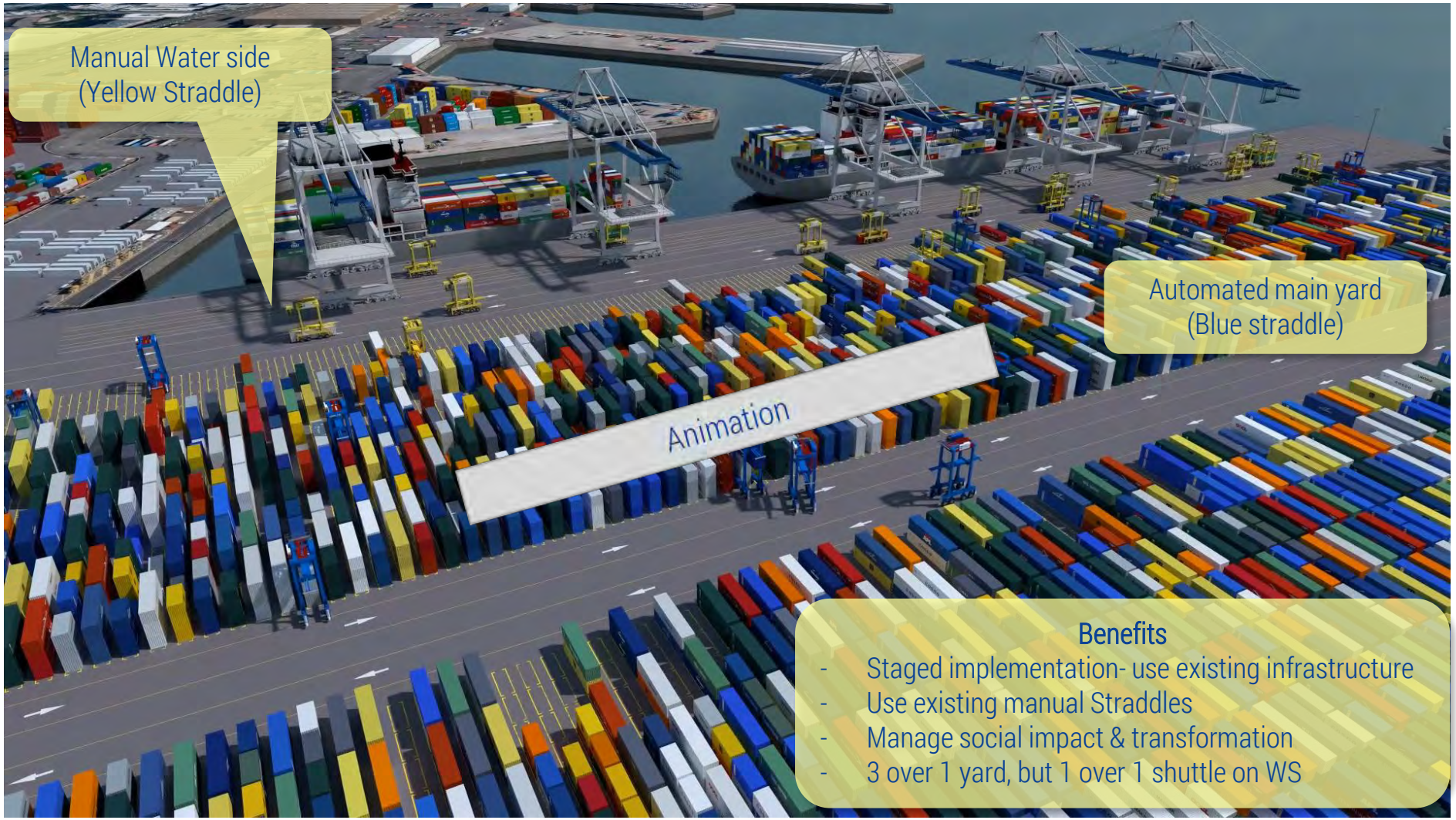
What is the benefit ?
Euro 1.8 M a year



1M TEU operation

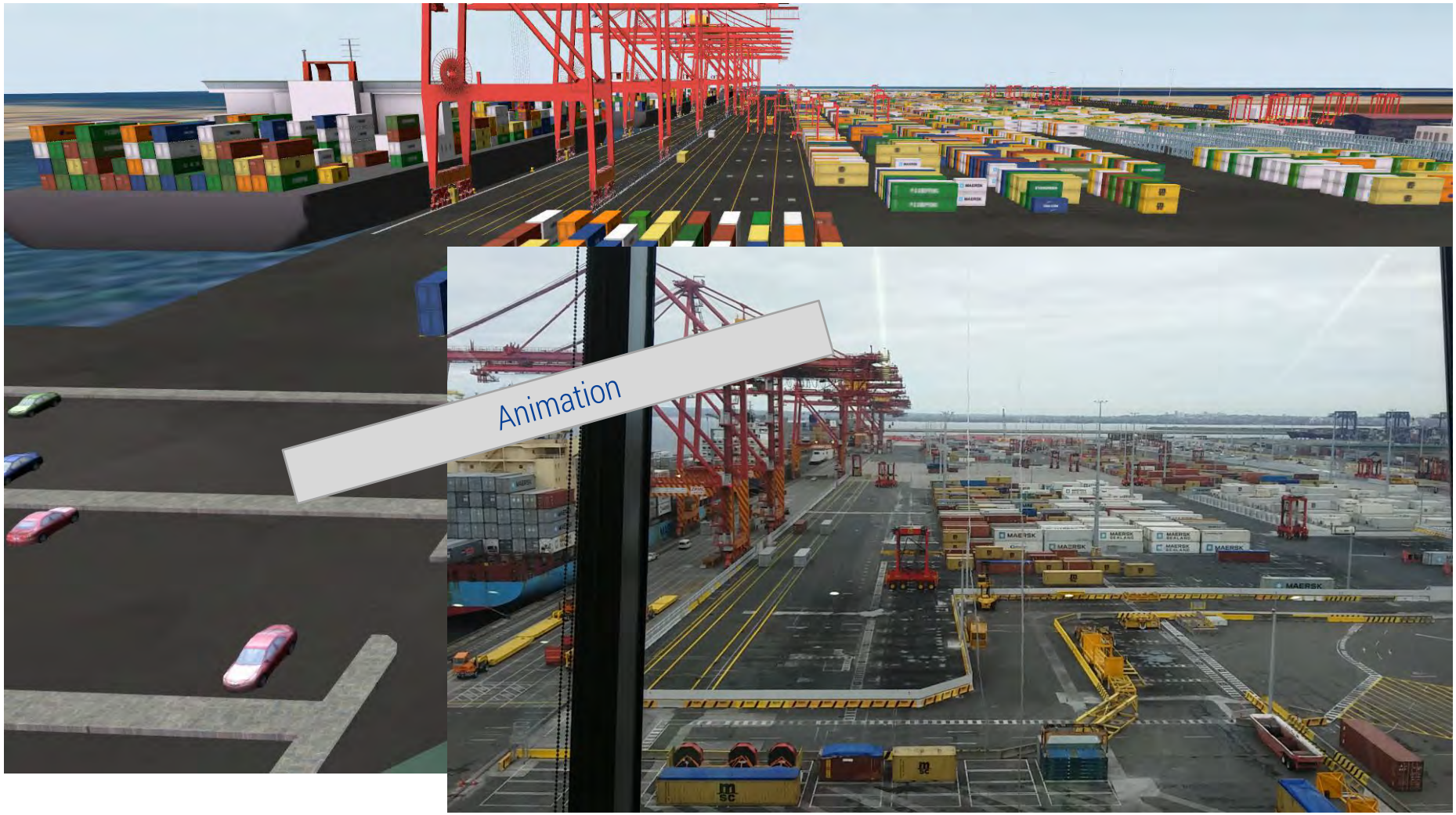
Example 2
Straddle Automation

Example 2 for brownfield sites: Auto Straddle Carrier – decoupled roll out



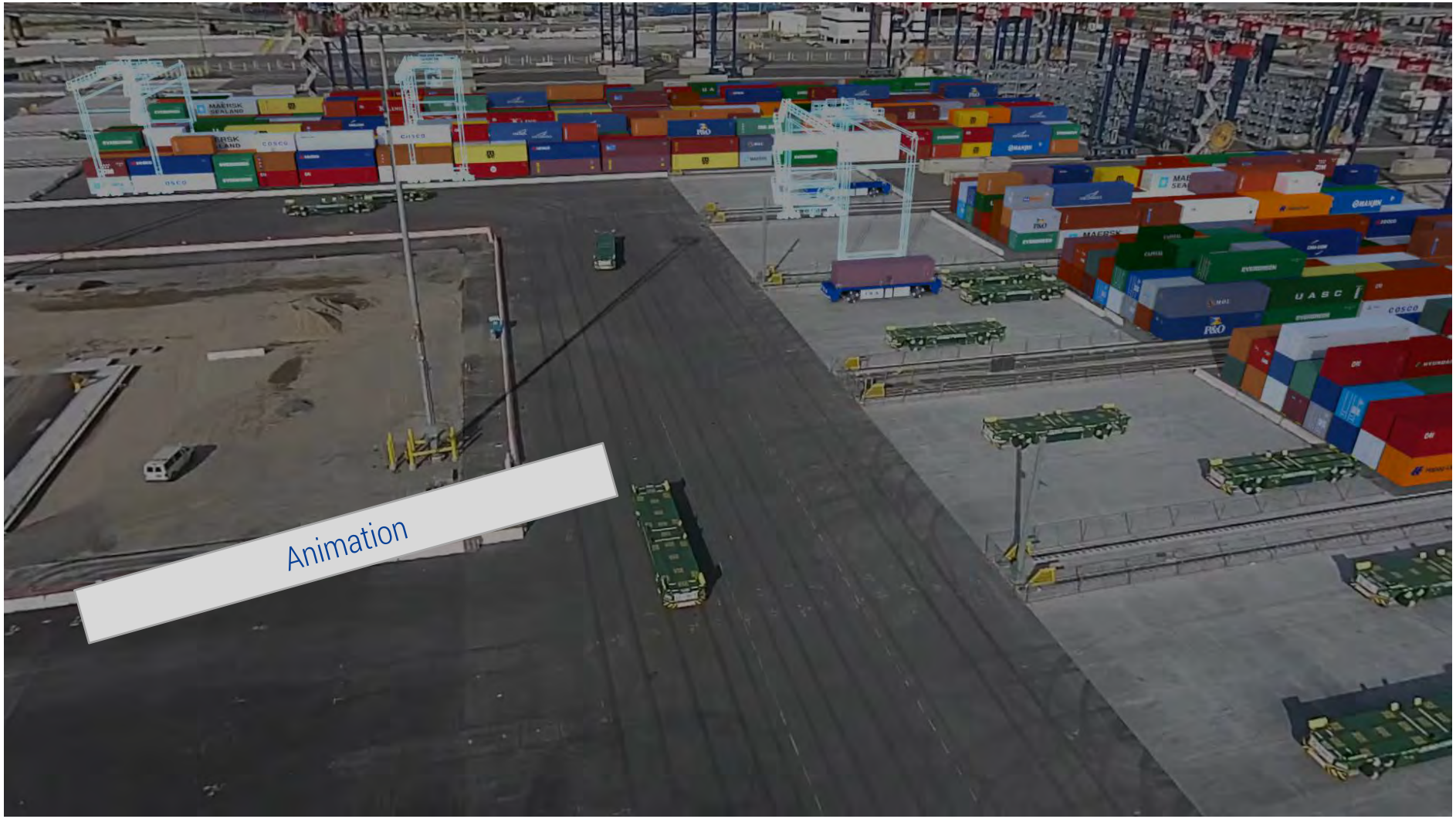
Example 3 – Digital Twin

The role of technology
Simulation 2010 Vs. Live operation 2015



- ✔ Videos are from Control tower. (quality of simulation video is much improved now as compared to 2010)
- ✔ Simulation is with 6 QC, but live operation is 2 QC only

Digital twins: not one but multiple levels



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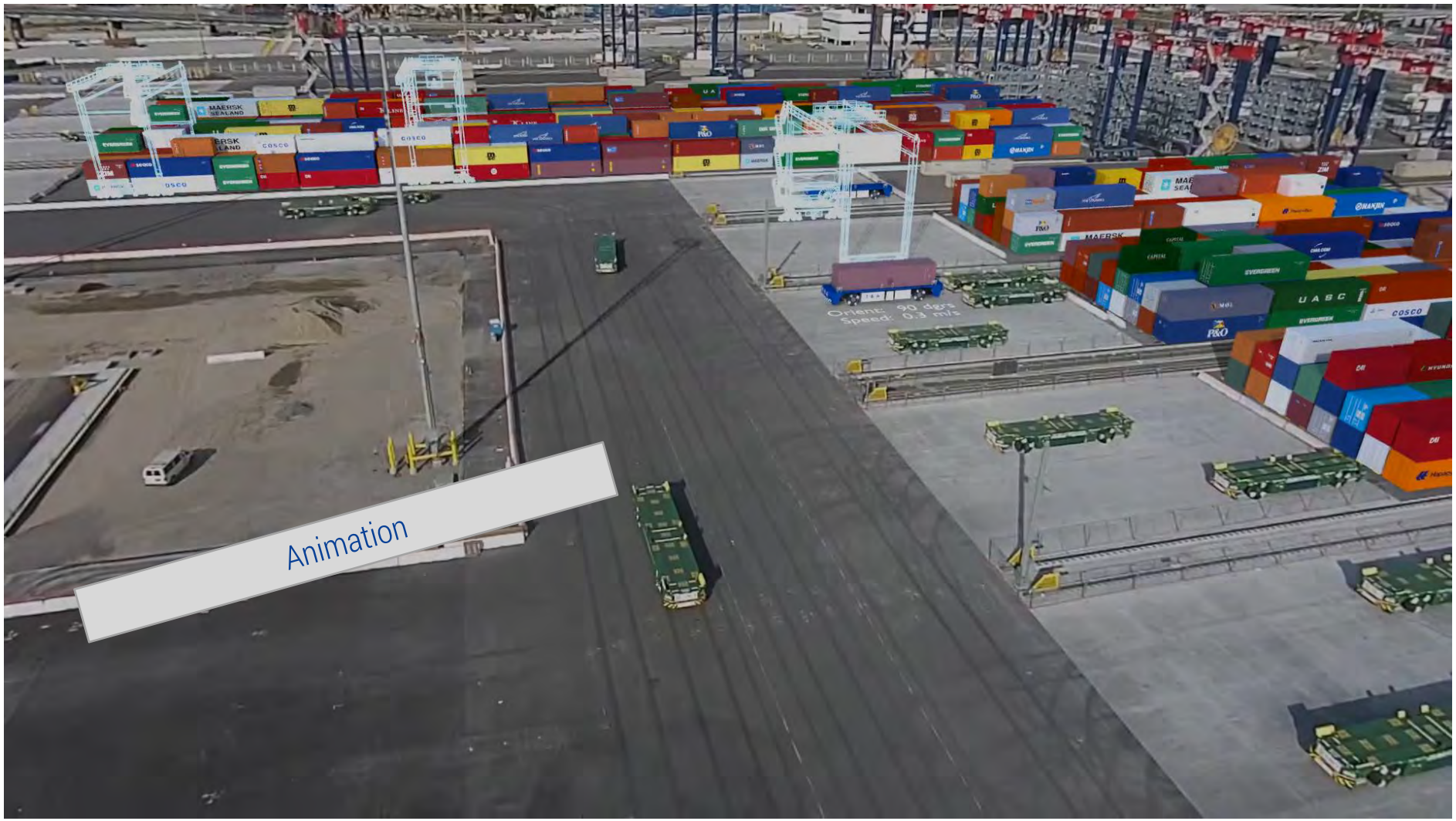
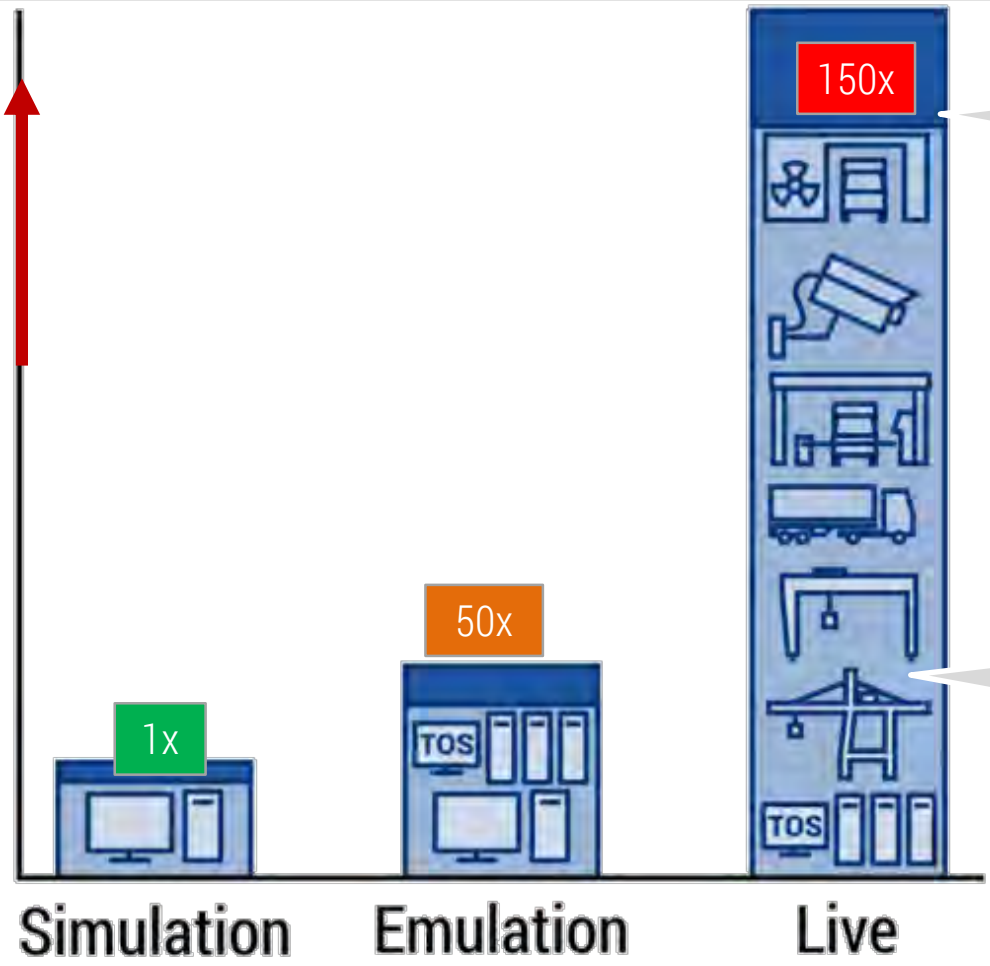


The benefit of modelling



Cost,
Complexity &
People involved

$30,000 at design
simulation stage
can save $4.5 M

**The National Institute of Standard Technology (NIST)*

Terminal life cycle

Design → Implement → Operate → Optimize

Example 4 – Smarten the operations Intelligent Applications/Plugs in

Smarten the operations – Using intelligent applications
Plan Verification Tool

- ✔ I Situation – Vessel & terminal operation depends a lot on the quality of individual vessel plan. (planning experience & how busy the planner is)

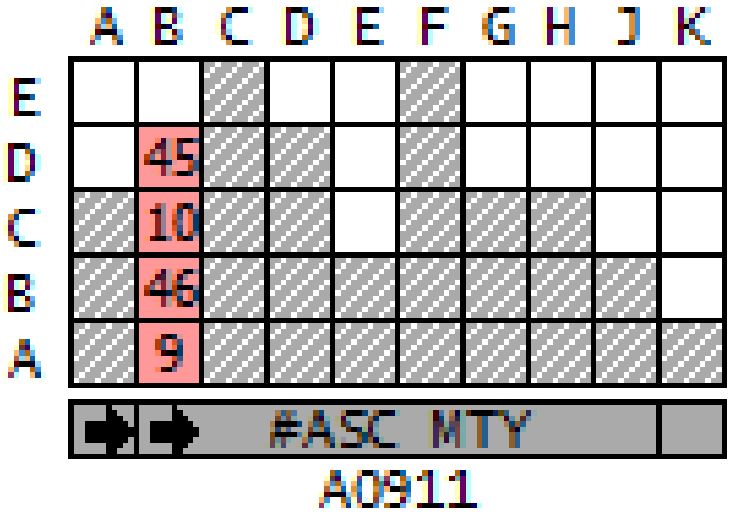
- ✔ I What –A tool designed to check the vessel plan for optimization opportunities & any planning errors

- ✔ I The Plan Verification tool contains configurable checks in several categories of the planning
  - Efficiency (e.g. sequences, no shifters, distances)
  - Vessel planning (no shifters, use of PWP)
  - Vessel positions (floaters, blocked containers)
  - Vessel structure (e.g. port-waterside vs. water-portside)

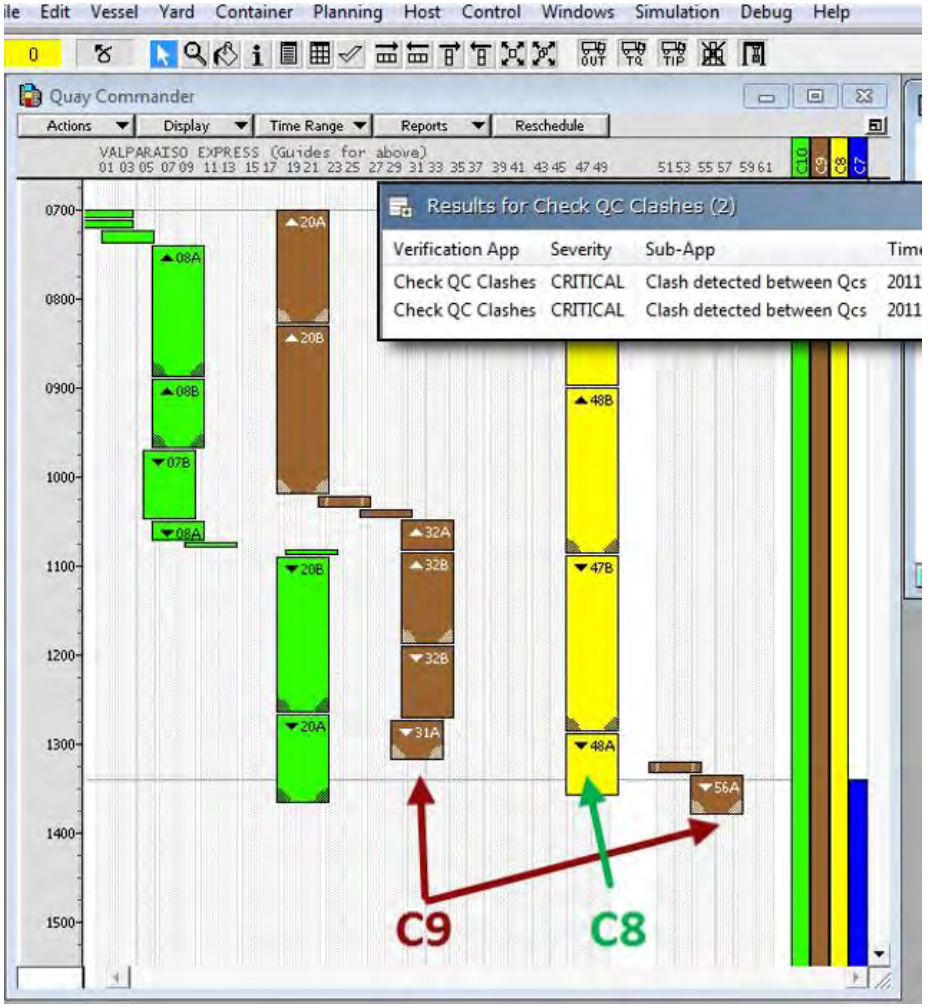
- ✔ I Streamlines the planning process & assists the planners

Verification app - Examples
Efficiency

- ✔ | Containers from one yard pile planned in wrong LOAD sequence



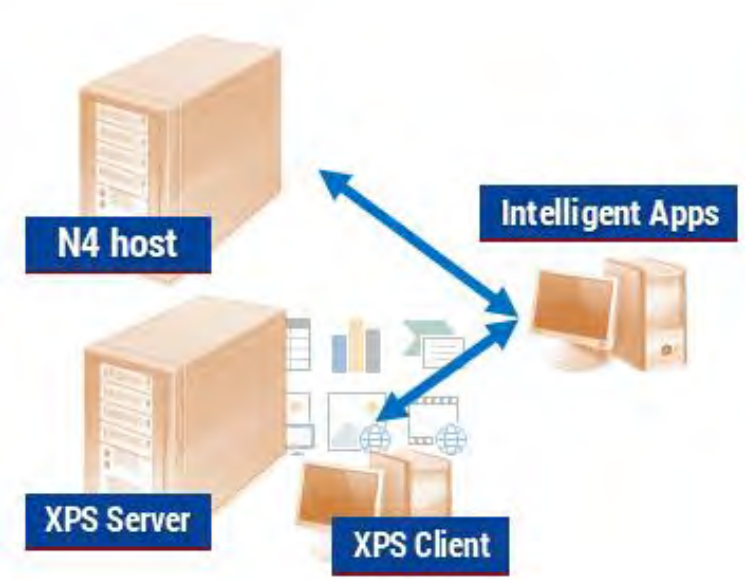
- ✔ | Crane clashes



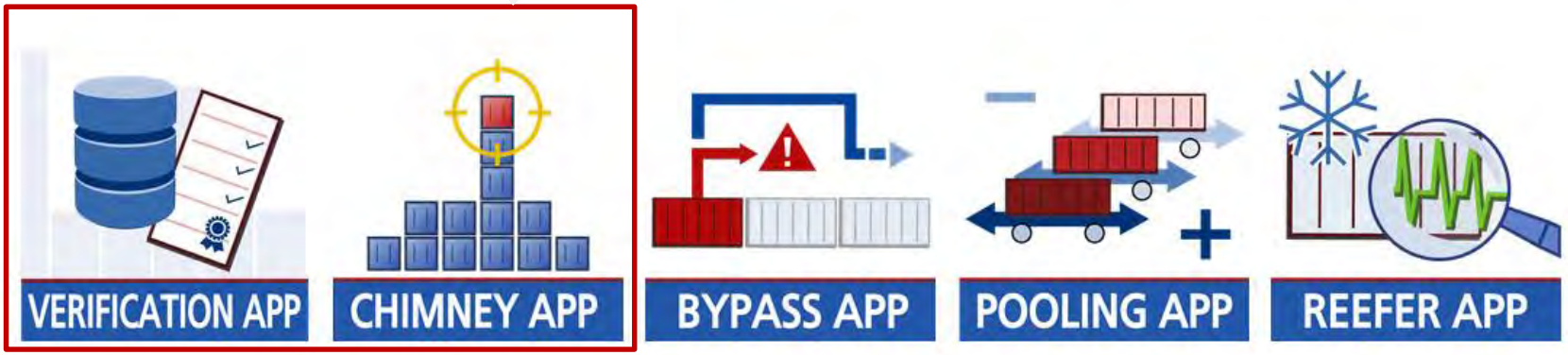
- ✔ | This will lead to rehandles during execution

Intelligent applications

- ✔ I What the users always wanted
  - Smarten the operations
- ✔ I Switch on/off
- ✔ I Configure the tools



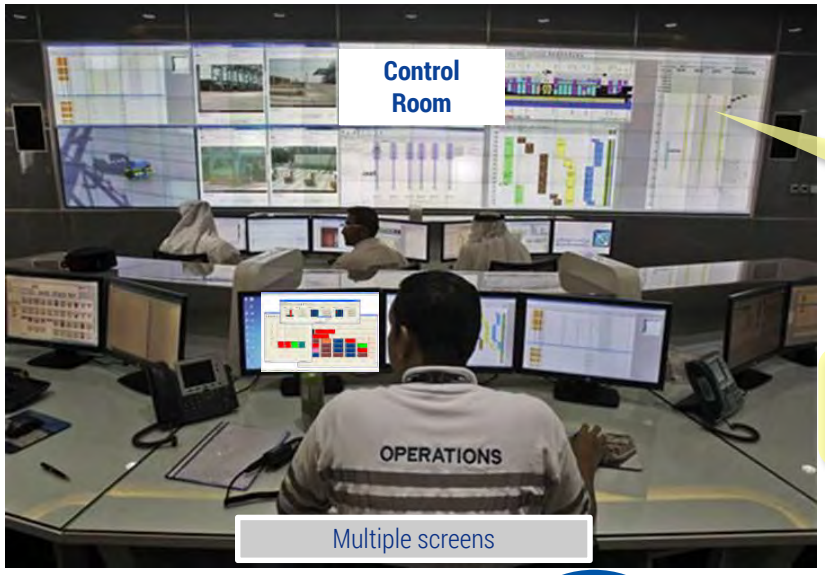
Deployed in PTP



"improving the TOS outcome through collaboration"

Example 5 –
Managing to Exception Management

Current Operation
Managing Vs Exception management



Multiple screens

Current operations set up.
Lots of screen & active operations staff

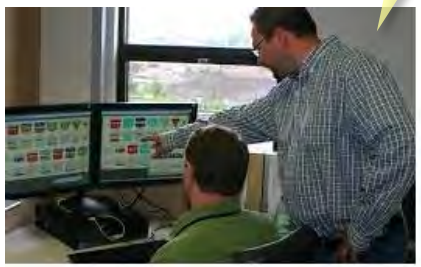
Current operations set up.
Lots of screen & active operations staff

TBA TOS field application
Phone, PC or tablet

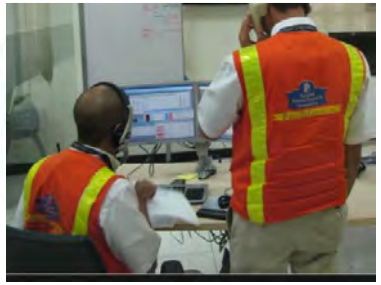
Yard planner

TOS

Vessel & berth planner

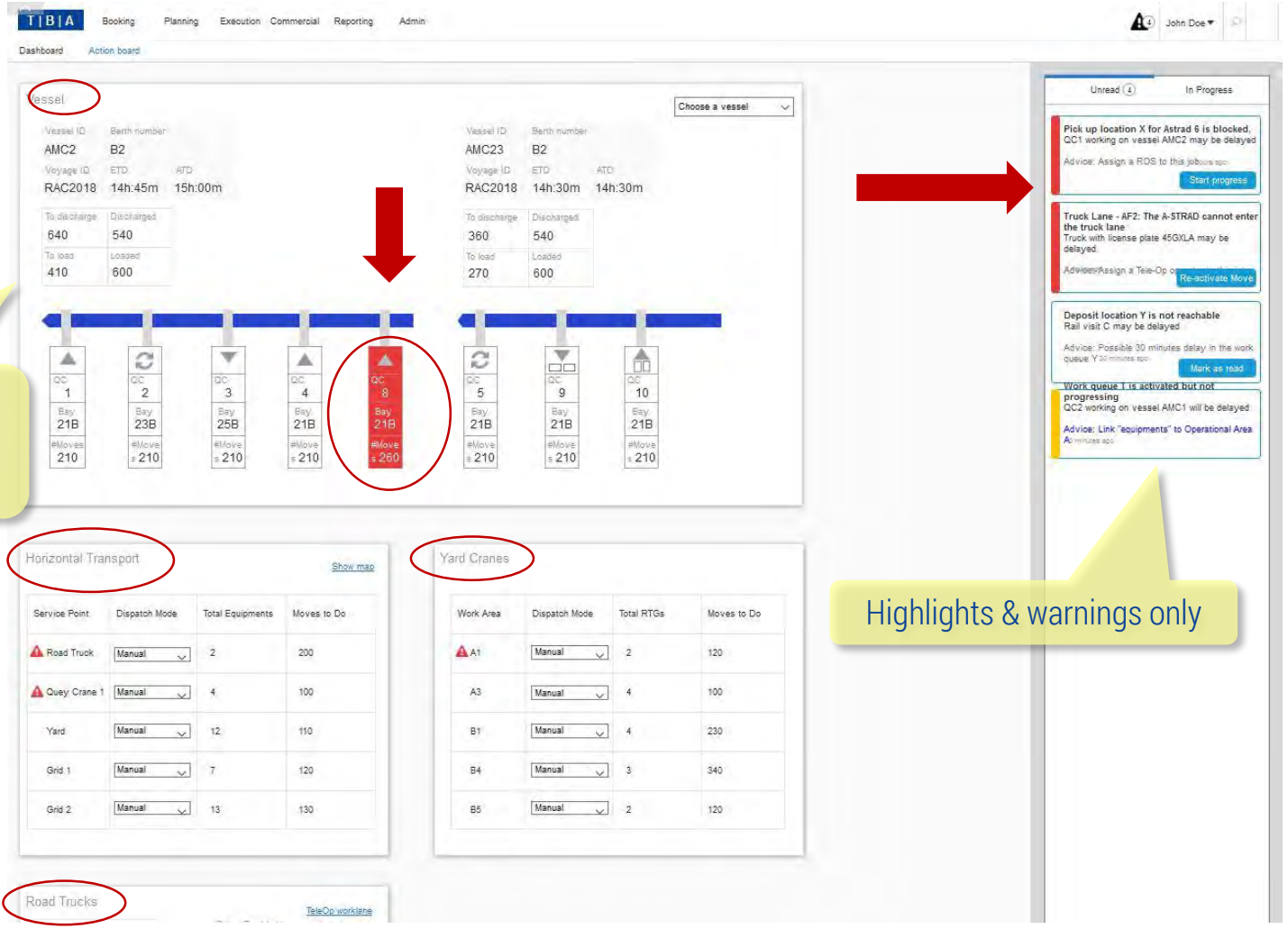


EQU Dispatcher



Managing Vs Exception management

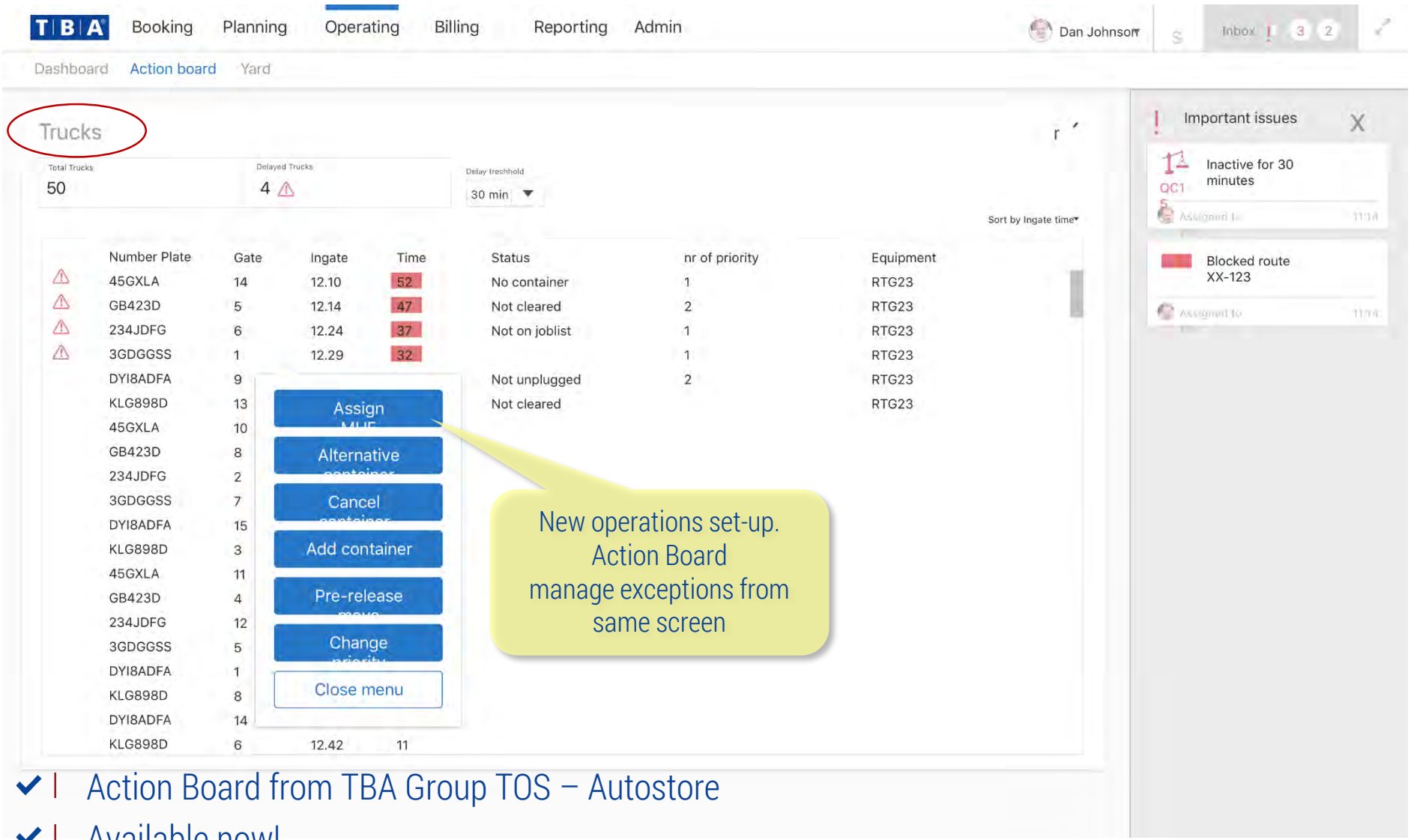
New operations set-up.
Action Board
only manage exceptions



Highlights & warnings only

- Action Board from TBA Group TOS – Autostore
- Available now!

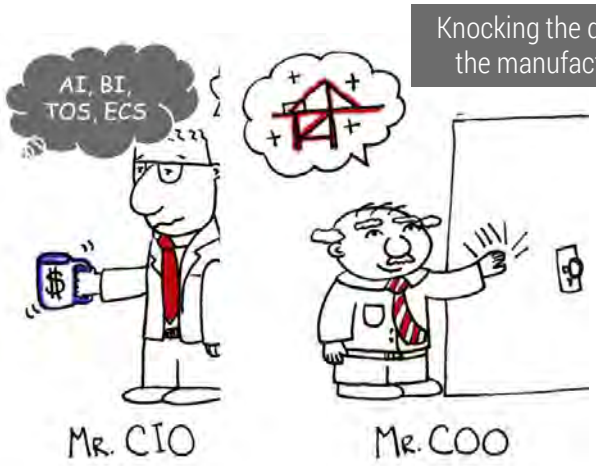
Action Board - Exception management only



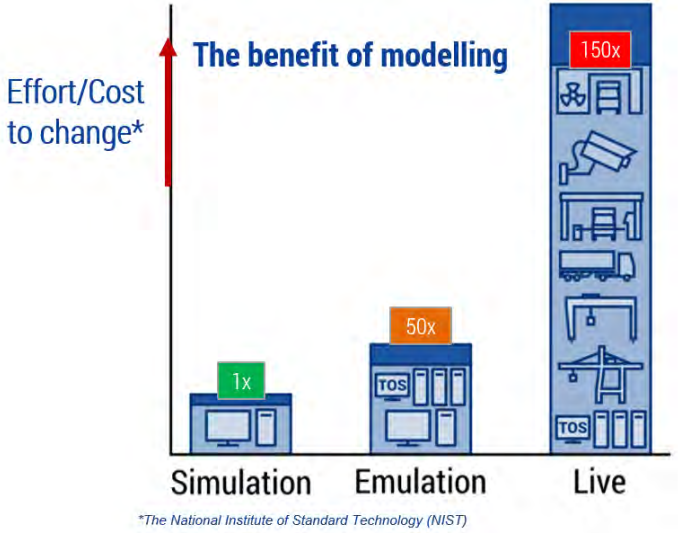
- ✔ | Action Board from TBA Group TOS – Autostore
- ✔ | Available now!

Conclusion : Mind shift change for brownfield sites

- ✔ | Give importance to IT infrastructure & tools
  - Increasing productivity from 20 to 24/28 gmph adds 20%/40% TEUs capacity.
  - It costs far less using IT tool to achieve Vs. CAPEX on hardware, such as QC.
- ✔ | Use IT tool at all stages of operation, development & CAPEX decision
- ✔ | Smarten the Operations



< 2.5% OPEX is spent on software



Conclusion :
Mind shift change for brownfield sites

- ✔ | Building IT from the ground up to ➡ stepped approach – leveraging their existing infrastructure (for brownfield)
- ✔ | Competition to ➡ collaboration in an IT agnostic context (different manufacturers, hardware, software)
- ✔ | Singular system hierarchy to ➡ System networks vs (example GOS/TOS/ECS)
- ✔ | Big data to ➡ Information & data analytics
- ✔ | Management to ➡ exception management
- ✔ | For brownfield terminal doing nothing is not an option, standing still is going backward very rapidly

  Power of technology & rate of change is only escalating

  Distinct or extinct (if operating in a contestable market)

Contact Details

Thank you for your attention

Simplifying your operation

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