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## FROM THE EDITOR

Achieving full automation or a truly smart port is not as simple as flicking a switch and turning everything on. For a port it is a journey that will evolve over time and must take into consideration a multitude of variables and challenges.

The journey many are exploring today is one of retrofitting existing equipment in order to enhance operations and drive efficiencies.

ZPMC, the world's largest crane manufacturer, has said that the growth rate of automation retrofit projects is now exceeding the rate of new automation terminal projects.

Speaking to PTI for this edition of the Journal, the company said that more users have a desire to retrofit brownfield terminals. This of course requires less investment than the construction of a fully automated greenfield site, making it an attractive solution.

For many, it will come down to the return on investment: will the terminal be able to achieve the efficiencies necessary with semi-automation, rather than going all out on full automation.

There is an argument that for some terminal operators it may be more useful to automate only parts of the terminal operations.

Dr Rafiq Swash, Founder, AIDrivers points out in his article that for the automation providers they must ensure that their solutions

are "easy to slot into existing brownfield terminals to render semi-automation viable and attractive".

### EFFICIENCY-DRIVING TECHNOLOGIES

Automation is not the only efficiency-driving technology our contributors have highlighted in this edition of the Journal. We also discuss the use of drones, how to reduce container handling downtime and container visibility across the supply chain.

Each solution strives to make the supply chain as seamless as possible and remove the problems that cause major inefficiencies.

Regarding drones, Lorenz Technology highlights how a drone solution specifically designed for the port industry can help in the transition to the fully automated terminal.

Hyster discusses how to overcome container handling downtime, a costly event, by mitigating the threat of downtime before it happens.

Finally, Navis examines the supply chain from the ship to the intermodal terminal and how data exchange between the two could benefit the cargo owner in the future.

**Beth Maundrill**

Head of Editorial

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aerodynamic design



reduced operational costs



less maintenance



lower energy consumption



process optimization using IoT  
(KIS – Kuenz Information System)



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# A NEW ERA FOR TERMINAL AUTOMATION AS CRANE MARKET BECOMES SATURATED

An increasing number of terminals are opting for brownfield over greenfield automation and the market for port cranes has become saturated after years of rapidly increasing demand, according to Shanghai Zhenhua Heavy Industries Co., Ltd. (ZPMC).

Speaking to PTI, ZPMC said it had observed an increasing recent trend of clients looking to upgrade existing equipment, and that is often a better model for most terminals dealing with an uncertain trade outlook.

“Our analysis believes that the current number of terminals and cranes has approached saturation, and the growth rate of new terminals and procurement of new equipment has slowed down,” the China-based port equipment supplier said.

“The growth rate of automation retrofit projects even exceeds the rate of new automation terminal projects. ZPMC have a deep feeling recently that more and more users and terminals want to retrofit of brownfield terminals and cranes to automation.”

Port and terminal automation has been one of maritime industry’s biggest trends over the past several years, with many hubs looking to the technology to help them process an ever-increasing amount of containerised goods.

## HEAVY INVESTMENT

Some ports, particularly in the world’s biggest economies, have invested heavily in automation equipment and are now looking at next-level smart technologies, such as artificial intelligence, blockchain and machine learning to fully optimise their operations.

Instead of building new terminals to meet growing demand, ports now generally prefer to upgrade existing technologies, the company explained. According to ZPMC, this is because doing so requires “less time and less capital investment” than building a new terminal.

Retrofitting, the company said, “can help the terminal obtain a higher return on investment and a shorter payback period”.

**“THE GROWTH RATE OF AUTOMATION RETROFIT PROJECTS EVEN EXCEEDS THE RATE OF NEW AUTOMATION TERMINAL PROJECTS.”**

– ZPMC



Despite the uncertainty brought about by the COVID-19 pandemic, ZPMC said automation projects in China have not ceased but are actually accelerating and increasing in number, with brownfield projects being particularly popular.

“The number of domestic automation projects in China is still growing,” according to ZPMC. “In particular, the growth rate of brownfield automation retrofit projects is more obvious.”

The company also said ports in China are “accelerating their transformation” from traditional operations to “automation and even further intelligence”.

“ZPMC believes that this is an important and effective means to adapt to similar uncertainties,” it said.

Prior to the Container Terminal Automation Conference (CTAC) event in November 2020, ZPMC told PTI its prospective international projects had declined. However, they have since begun to “slowly recover” and that numerous contracts are currently “under negotiation”.

ZPMC also claimed the pandemic had made the industry better understand the importance of automation and the value of new technologies as a changing market requires greater flexibility.

Since then, and in response to the pandemic, ZPMC said it has made “some adjustments

in market development” as well as “some innovations in technology research and development”. The company hinted that it would soon be releasing details of new strategies but would not be drawn any further.

Despite its international orderbook declining during the pandemic, ZPMC delivered on its previous commitments, even while border restrictions and social distancing measures created new challenges. It was even able to enter new markets, such as Cambodia, where it supplied a fleet of four empty container reach stackers to the Port of Sihanoukville.

In addition, at the start of 2021 it provided the final five of 22 automatic rail-mounted gantry cranes to the SIPG Haifa Terminal, Israel, adding to the eight quay cranes it previously supplied. In doing so, it helped Shanghai International Port Group, the operator of the terminal, launch its overseas investment.

#### SEEKING OPPORTUNITIES

In January 2021 ZPMC also unveiled a new range of super reach stackers that it said can provide the high-efficiency transfer requirements of various terminals and yards, suggesting it is looking to enter more markets and work with a variety of different terminals.

However, it does not believe ports in some other emerging markets, such as Africa or South America, hold much potential for automation investment. ZPMC said it currently has

only one automation project in both continents, in Morocco and Colombia respectively, and that demand for automated terminals in these regions is “relatively small”.

This assessment is consistent with other stakeholders in the industry, such as the International Association of Ports and Harbours (IAPH), which have claimed some regions are being left behind in the race to digitalise operations.

In January 2021, the IAPH and the World Bank released a report which said developed nations, largely in the northern hemisphere, have moved ahead of those in the southern hemisphere in this regard, and that this is especially evident in ports.

The COVID-19 pandemic, the report concluded, has made this division even greater and those already slow to take up automation and digitalisation could be left behind for good.

ZPMC explained that automated terminal projects are “more suitable for scenarios where labour costs are high, the population is ageing and the declining birth rate is serious”. Furthermore, ZPMC claimed automation projects are best suited to areas where “young people prefer to work in the office more than on the crane”.

The COVID-19 pandemic has had a substantial effect on the maritime industry and ports around the world. It is currently unclear how the pandemic will affect projects to automate and upgrade terminals, with experts seemingly split.

There have been suggestions that the pandemic will lead to greater investment in new technologies across the supply chain, especially in ports, thanks largely to fluctuations in containerised trade.

Some industry experts have voiced concerns that automation projects will be hamstrung by the ensuing economic uncertainty, with some ports, especially those with prominent private sector-influence, being anxious about how their investments will be affected.

*Written by Max Schwerdtfeger*





# TERMINAL MODERNISATION AND INNOVATION WITH SEMI-AUTOMATION

Dr Oscar Pernia, Director of Engineering (Automation), and Alex Jansen, Director of Engineering (Terminal Development), Terminal Investment Limited (part of MSC group)

Automation, whether greenfield or retrofit, is typically considered from an efficiency, sustainability and, to some extent, safety and stability perspective. During development we tend to build on conventional terminal principles, replace yard equipment with automated equipment, put facilities in place to control the ship-to-shore (STS) crane remotely and to modernise the control room with more real-time and data-driven tools.

For terminal operators, automation, whether semi or full, requires a fundamentally different approach, which is integrated, built on a single process and data platform, and a cultural change. It demands silos to be broken down between functions during design, implementation and operations stages.

Successful application of automation still requires changes to our industry, which need to be incorporated into terminal operator's business models and can only be properly implemented on a platform of operational excellence, instilling discipline on core processes.

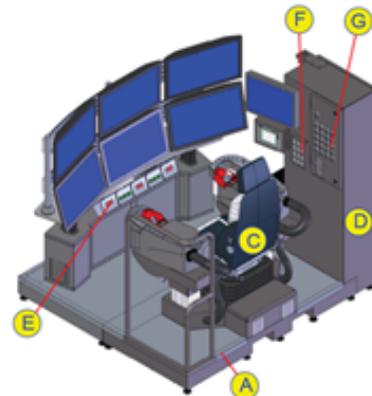
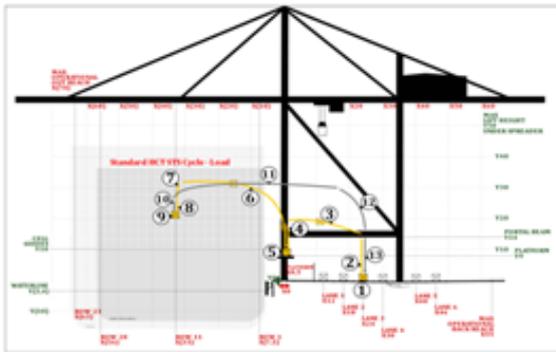
## SEMI-AUTOMATION

Defining semi-automation, we traditionally distinguish from full-automated terminal types based on the choice to automate the horizontal transport at waterside, although that definition is not completely accurate: there is no full-automated terminal as the quay cranes will continue to depend on (remote) operators and many important functions still

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'INCREMENTAL  
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A SIGNIFICANT  
EVOLUTION IN THE  
WAY THE TERMINALS  
ARE DEVELOPED AND  
MANAGED.”**

# REMOTE QUAY CRANE OPERATIONS

SAFER, MORE EFFICIENT AND SUSTAINABLE



- System driven crane move and interactions.
- Data-driven cycle assessment & learning.
- Structured process for testing and fine-tuning.
- Important impact on energy efficiency.

- Human and machine are de-coupled.
- Safer and ergonomic work environment.
- Driver integrated optimization component.
- Better workflow with other relevant roles.

require manual work as with lashing or twist-lock handling.

- Full-automated terminals do demand a more advanced system integration and synchronisation of different components to ensure a performing balance between quay, horizontal transport and yard, but sacrificing a bit of flexibility in the ability to deal with changes.
- Targeting enhanced efficiency, especially relevant at transshipment hubs, full automation can provide better operational control, consistency and resiliency: being able to manage balance even better.

In this article we describe few different areas where we feel even an 'incremental automation innovation' approach can still produce a significant evolution in the way the terminals are developed and managed, paving the way towards digitalisation and bringing the fundamental benefits not only on efficiency, but on safety, sustainability and stability as well.

## DIGITISING QUAY OPERATIONS WITH REMOTE CONTROLLED STS CRANES

Remote quay crane operations are gaining popularity, (being) implemented at many terminals globally – it involves the de-coupling of humans from machines and systematising the crane cycle, bringing many benefits:

- Remote equipment handling is process-driven and continuous improvement oriented, as the operator is assisted during 60-70% of the crane movement and the systems controls every single portion of it, recording all the relevant efficiency, safety and sustainability execution aspects and improving ergonomics and working environment significantly.
- Kinematic parameters and physical constraints, as with vessel geometry and crane movement itself, are monitored in real-time during each part of the execution, and continuous learning in each cycle is achieved with sensors and software applications matching models with actual performance.
- The operator is becoming an integrated optimisation component of the overall system, and the terminal can effectively bridge the gap between the technical specification of the crane and the actual operational performance – also analysing the aspects that have an impact on vessel planning.
- Finally, the communication with the crane team and the control room becomes truly digital, improving the workflow and coordination and management of exceptions, also helping to minimise idle times and shift transitions.

With these potential benefits in mind, there is significant work to be done at system level, enabling potential realisation as well as a consistent learning curve:

- The digitalisation of physical models for vessels and cranes itself is very important, as the system is learning in every single cycle, calibrating itself and helping the continuous improvement opportunities to be diagnosed and applied in a systematic manner.
- There are many systems involved, so the interfaces and interactions between those become fundamental and suppliers need to continue supporting standardisation for simplifying procurement and empowering adoption.
- Training and qualification programmes are essential, as with remote operations there are many traditional 'human-behaviour' specifics that need to be challenged, with operators becoming adapted to a gaming kind of practice, at the same time facilitating social inclusion/enhanced collaboration.

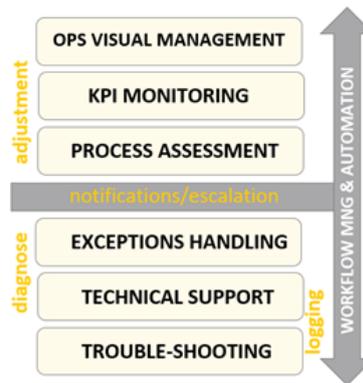
## SIMPLIFYING CONTROL ROOM EXPERIENCE AND CONTINUOUS IMPROVEMENTS

With semi-automation, the evolution created at user experience level can be significant, with overall operational management

## NEXT GENERATION CONTROL CENTERS

PROCESS ORIENTED, DATA DRIVEN AND PRESCRIPTIVE

- Production Control and KPI Monitoring.
- Sequence adjustment & re-planning.
- Process Control & Incident Analysis.
- Proactive congestion amendment.
- Technical diagnose and assessment.
- Escalation and System troubleshooting.
- Logging and escalation to Suppliers.



‘shifting’ to being more process driven and the data from the different systems creating a digital core foundation for decision making at planning and execution levels.

- The specific technical characteristics, when the level of automation and robotisation is high, makes an integrated approach for technical functions recommended; normally based on a dynamic pool of resources, which might or might not rely on specialised outsourcing partners, to ensure a high level of service and to minimise response time to technical incidents.

The combined OPS-IT-MNR responsibility, will effectively support operations in real-time and will establish a seamless process for asset management covering the entire terminal eco-system – being the overall goals for the terminal operator:

1. Reduce downtime
2. Fast response to exceptions
3. Precise root-cause troubleshooting
4. Extension of hardware lifecycle
5. Enable proactive operation and maintenance
6. Adaptive and resilient terminal efficiency
7. Lower overall maintenance costs
8. Leverage deep learning maintenance capability

The evolution of the organisation at terminal side needs to be supported by the graphical user interfaces (GUI) and data visualisation that systems should provide –with the overall user experience (UX) typically still being too complex:

- At the control room, GUIs need to be simplified with operational visual management, so users are only exposed to the relevant information for each role and the system is suggesting the specific action to take, based on its own analysis and empowering user empathy with system decisions.

- Process assessment and technical monitoring tools produce alarms and notifications with actionable assignments, enabling the escalation across the different roles and departments driven by the systems and their interactions, allowing for proactive assessment and technical support.
- The interaction between the different functions and roles are supported by workflow tools that are including multidimensional data analysis and robotic process automation to define, assess, confirm processes in an integrated way limiting the interventions to specific edge cases where system demands human manual intervention.

Therefore, the control rooms are becoming intelligence centres where operations management, production control and technical support functions are performing seamlessly. They will foster more autonomous terminal system solutions which, however, do continue to rely on the human brain but demand new functions and competencies as related to data science and artificial intelligence.

- Following that approach, it is essential that automation introduction follows an inclusive approach (of data, processes and systems) with people, building future generation of control room operators learning from existing knowledge and workforce and catalysing evolution of workforce frameworks.



### ABOUT THE AUTHOR

Dr Oscar Pernia is Director of Engineering (Automation) for TIL. Based in Geneva HQ, his responsibility covers Automation and Digitalisation, with core focus on Process Engineering, System Integration and Data Analytics.

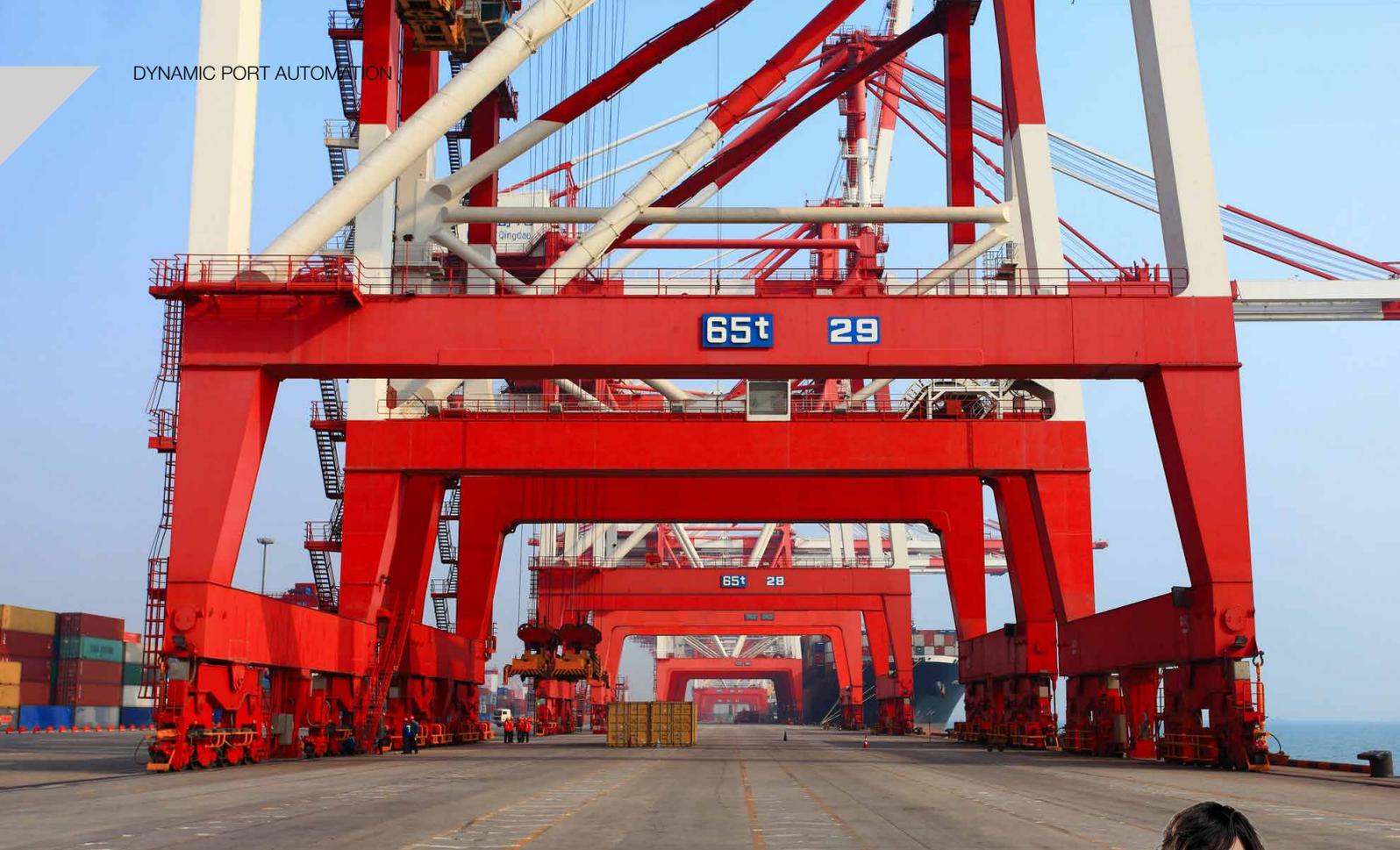
His education was in Telecommunications Engineering, and he holds an Industrial Engineering PhD, where he focused on algorithms design and simulations applied to marine operations optimisation - during last 20 years he has accumulated extensive experience in container shipping, covering technology solutions across all processes in the ocean supply chain, with specific focus on ports and terminals.

Alex Jansen is Director of Engineering (Terminal Development) at TIL. His responsibility covers the implementation of new terminal projects, either green-fields or (major) brownfields. His education was focused on logistics, having entered the container terminal business in operational (management) roles in the late nineties, adding management roles in design and automation of container terminals at a later stage and eventually transitioning into (portfolio) management roles related to the implementation of new terminal projects and major refurbishments.

### ABOUT THE ORGANISATION

Terminal Investment Limited (TIL), the container terminal business unit of MSC, invests in, develops and actively manages container terminals around the world, often in joint ventures with other major terminal operators. Since its founding in 2000 TIL has grown to become one of the largest and most geographically diverse terminal businesses globally, with material ownership interests in 40 operating terminals and one development terminal in 27 countries on five continents.

**“SUCCESSFUL APPLICATION OF AUTOMATION STILL REQUIRES CHANGES TO OUR INDUSTRY.”**



# PORT AUTOMATION: THE ROUTE TO THE FUTURE

Dr Rafiq Swash, Founder, AIDrivers

The first port terminal to introduce automation was Rotterdam in 1993. Terminal operator ECT was a forerunner in its vision to implement automated systems to move containers from quay cranes to the container stack. Today, Rotterdam is fully automated along with a small number of other ports including China's Qingdao (QQCTN), Yangshan, Ningbo Zhoushan and Australia's Port of Melbourne.

QQCTN and Melbourne were the first ports to reach the prestigious milestone of full automation in 2017. However, it is much more common to find partial or semi port automation widely throughout Asia and Europe as operators seek the trade-off between increased cost efficiencies, increased productivity and the reduction of downtime with the overall cost of implementation.

Over the last decade, port operators have shown a clear understanding that automating processes are replete with upsides and in turn the majority are adopting automation where they can. Benefits range from lower longer term operating costs,

greener credentials, less fuel consumption and therefore lower emissions and crucially, improvements in productivity. The quick installation of automation is highly attractive especially with the collateral safety upticks it brings and entices terminal operators to upgrade facilities. The key question port terminal operators must address is the level at which the Return on Investment (ROI) makes sense for their operations. This is directly linked to the improvements in sustainable operating maintenance costs.

## STRIKING A BALANCE

There is a fine balance to be struck when investing in automation. The 2018 McKinsey Report<sup>1</sup> showed from their port operators' survey that in some ports, ROI is not high enough to warrant an upgrade to full automation as TEU volumes are insufficient to justify the capex. It is therefore evident for many port operators that it is more cost effective to automate only some parts of the port terminal process. This means that in turn the conversion of brownfield sites

to incorporate automation must be carefully considered as to which elements are upgraded and to what extent the investment is made.

Today, we have multiple global examples of ports incorporating automation without changing the entire terminal system or needing to upgrade their infrastructure as the semi-automation solutions are sufficiently effective. The providers of the automation must, however, ensure automation is easy to slot into existing brownfield terminals to render semi-automation viable and attractive. Moreover, to start with a greenfield site and build from scratch is a huge financial undertaking and only justifiable in key gateway port locations where TEU volumes warrant such high capex.

Indeed, using brownfield sites more effectively through the densification of terminals, as explained in the 2019 Port Technology International technical paper by Dr Asaf Ashar<sup>ii</sup>, delivers the highest ROI for most ports. Densification entails automating storage, retrieval, TEU handling, cranes

and port transport including trucks. This automation is key to sweating port terminal assets to optimise usage in the space and facilities already present. This reduces infrastructure investment costs and optimises the efficiencies of existing equipment.

One of the biggest challenges in ports today is the inconsistency of service, for example, the differing length of dockside time ships stay to unload and unload. The variability between ships is hard to manage and forecast and leading to inconsistent costs. The shipping industry wants reliable and consistent servicing time to help them provide a dependable quality of service to the end client.

AIDrivers' niche area is artificial intelligence (AI)-enabled autonomous mobility for industrial applications. The focus is providing mobility automation solutions to ports to solve bespoke needs. Efficiencies, quality of service, costs and safety are at the core of AIDrivers' product offering. Retrofitting AI-enabled operating systems produces quick, easy to install conversions of existing equipment rendering trucks and other equipment fully autonomous without requiring infrastructure and environment changes. This makes this option very port operation friendly.

#### **ATTRACTIVE PROPOSITIONS**

Retrofitting is an attractive green proposition for ports who recognise the need to improve the quality of service and efficiencies whilst demanding low cost, yet impactful solutions to deliver lower emissions through zero waste. Currently, port operators experience resource and energy

waste which would be avoidable through automation. For example, idle truck engines waste up to 50% of their fuel load. AIDrivers' current trials and roll outs indicate the readiness of operators to adapt and adopt automation to pursue in-time operations and a more sustainable maintenance programme.

Retrofitting equipment to existing fleets is the most effective approach in achieving efficiencies, service consistency and reducing operating costs to remain competitive in the wider shipping industry. Automating to streamline operations will reduce the bottlenecks as seen in Q4 2020 as TEU volumes increased post Covid-19<sup>iii</sup>.

In addition, retrofitting also carries extra green benefits as existing assets are used for the duration of their lives reducing carbon emissions. AIDrivers' technology seamlessly equips the truck or crane, or indeed any horizontal port transport, to deliver autonomous operations. Furthermore, there is no need for any changes to the port infrastructure which makes the process of automating through retrofitting much simpler, cost effective and speedier. Indeed, the McKinsey report<sup>iv</sup> showed that ports' operating expenses could fall by 25% to 55% through the adoption of automation. Based on AIDrivers' recent trial results, AI-enabled autonomous retrofitting could support port operators to reduce up to 50% of operating costs. This is a huge number and has real impact on port profitability.

The AIDrivers' Autonomous Intelligent Operating System (AIOS) ensures reliability and predictability; both essential to maintain rigorous safety standards and deliver

the productivity required by port operators. AIOS uses 3D LiDAR, radar, cameras and motion sensors with cutting-edge multi-sensor data fusion techniques to deliver precision positioning, situation cognisance enabled perception and self-aware intelligent autonomous navigation.

The vehicle scheduling system optimises journeying with the creation of an environment cost-map. In turn this delivers equipment readiness as vehicles are allocated tasks according to the location of the truck delivering less wasted downtime, less fuel consumption and an increase in the trucks' daily productivity. Intelligent planning for in-time operations with a V2X enabled self-aware connected environment enables trucks, cranes, traffic lights, smart gates and fuel stations to interact and work together to deliver a common goal of job completion.

A major plus of automating the vehicular aspect of ports is the cost savings attributable to maintenance scheduling reducing waste and increasing efficiency. The self-aware nature of the vehicle means that superfluous scheduling of maintenance downtime is no more. The vehicles will detect and alert when things go wrong saving on unnecessary resource allocation to avoidable and excessive vehicle inspection. The technology delivers a smarter way to maintain vehicles delivering operational cost savings which boost the bottom line.

#### **PROVIDING ROBUST SOLUTIONS**

The use of a digital twin in the development of this technology has enabled AIDrivers to simulate the environment and produce a much more robust product. The digital



**aidrivers**

# PORT AUTOMATION

## The Route to the Future

AIDrivers is delivering automated mobility solutions to global operators and pushing the boundaries of what is possible in the realm of automation.

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## “AIDRIVERS’ CURRENT TRIALS AND ROLL OUTS INDICATE THE READINESS OF OPERATORS TO ADAPT AND ADOPT AUTOMATION TO PURSUE IN-TIME OPERATIONS AND A MORE SUSTAINABLE MAINTENANCE PROGRAMME.”



twin technology not only gives the ability to analyse the environment for safety and manoeuvrability, but for re-processing real port data with AI-enabled autonomous systems to identify the system efficiency without disrupting port operations as well as increasing awareness and training possibilities. This process has highlighted glitches and ironed out problems.

The introduction of 5G and the constant advancements in AI will be key drivers of the fourth industrial revolution and in turn the uptake of automated processes. The interconnectivity of systems is driving this revolution. The Internet of Things (IoT), blockchain, AI-enabled autonomous processes and machine learning are all part of the port terminal landscape with the next few decades. Today, some automated systems such as automatic guided vehicles (AGVs) are adapting to overcome their network limitations by using 5G. However, AIDrivers is working on modifying the use of 5G even further by using it to reduce automation costs and improve efficiencies and system management.

The elephant in the room for automation, however, is data. It is widely acknowledged that the current fragmented standards and holes in collation and processing are hindering progress in AI-enabled automation. The digital age’s dependency on interconnectivity means data is key. At present, systems are sub-optimal due to the poor quality of information. This does, however, offer a huge potential for improvement in automation once these hurdles are overcome. AI will significantly improve with standardisation. This is something that AIDrivers is keen to see ameliorated sooner rather than later as better data will further improve efficiency

gains via seamless automation management tools and reduced retrofitting costs.

On the positive side, with improved and standardised data collection, processing and usage the forecasting and prediction of schedules, maintenance downtime will lead to automated processes delivering even greater efficiencies in accuracy, productivity, fuel consumption, lower emissions, and cost savings. Moreover, the constant battle of handling exceptions is something that can be eliminated with well-planned processes using data to continually improve.

Traditionally, automation is seen as part of the new port terminal landscape. It is an inevitability which is being embraced in some geographies with ease. Simple retrofitting of existing equipment with AI-enabled autonomous mobility as a starting point makes financial, environmental and safety standard sense. Investing in retrofitting mobility equipment launches ports into a more robust and sensible financial operating model which is not to be scoffed at. AIDrivers is already delivering automated mobility solutions to global operators and pushing the boundaries of what is possible in the realm of automation. It is an exciting place to be.

Enabling ports to remain competitive and service the supply chain is the key goal of AIDrivers. Innovative AI-enabled solutions through retrofitting existing equipment provides the efficiency and resiliency for port operators to deliver a reliable quality of service to their customers. Combine this holy grail with zero waste and sustainability then the answer is clear. Automating must be at the heart of the future of the port industry.

AIDrivers. Only do better.

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### ABOUT THE AUTHOR

AIDrivers’ founder Dr Rafiq Swash of Brunel University London contributes to international research in AI, visual information search and retrieval, computer vision, 3D sensors, predictive data analytics and automation. Professionally this has expanded into further international leading collaborations in connected robotics, AI enabled automation, sensor intelligence and fusion, digitisation and behaviour and pattern modelling.

### ABOUT THE ORGANISATION

AIDrivers provide specialised AI enabled autonomous mobility solutions for port terminal automation that meet the needs of port operators. The company is working passionately to address industrial mobility challenges by optimising industrial operations and improving the quality of service towards a sustainable future.

# THERE IS ~~NO~~ IT IN **INFRASTRUCTURE!**



The world is changing. The rule of thumb that Investments in concrete and steel will deliver a strong ROI are no longer certain. It is time to challenge the age old adage that IT and infrastructure projects are separate. When planning infrastructure projects, you need to be considering the impact AI and optimization software will have on your overall requirements. Afterall, INFORM's software based solutions deliver huge ROI on their own and when factored into infrastructure projects at the planning stage strengthen the ROI proposition of your traditional concrete and steel assets as well. **#challengeyourself**  
**<https://infrm.co/nolt>**



Lorenz  
TECHNOLOGY 

# WHY DO PORT DIGITALISATION BY DRONE OR MOBILE ROBOT?

Kristian Skaarup, CEO, Lorenz Technology

Implementing innovative technology and advancing the use of data is no longer a question of being first movers or trendsetters. It is simply a demand and requirement to survive and stay in business for larger industrial ports accommodating to the EU regulations and becoming a more effective operation by smart automation of work processes improving safety conditions and turnovers.

Lorenz Technology has identified the need for rapid advancements in technology providing the solution to perform organisational changes of work processes and digitise port operations based on the request from valuable collaborations with the Danish maritime industry.

Lorenz Technology provides both the hardware and software to manage enterprise workflows. Since 2017, the company has developed the intelligent drone solution which provides the missing link between existing enterprise drones and

the platform for smart data management. Having manufactured an edge-computing device capable of performing autonomous missions and on-board data processing, the solution is built for the future and the further implementation of artificial intelligence and automation.

“Before we had the drone technology, inspecting quays was done physically in a car or boat, obviously making it more difficult, time consuming, and more expensive. Now, with drone flights we are doing a two-day job in 20 minutes.” The quote is by Jesper Bank, CCO, Port Esbjerg (DK) where Lorenz Technology has developed the solution to fit the needs of a modern industrial port. Performing area mapping and management, doing quay inspections, and many other digitised tasks to provide updated visual data in real-time.

The visual data collected from drone flights are shared with the Lorenz Hive cloud platform, where they are to be ana-

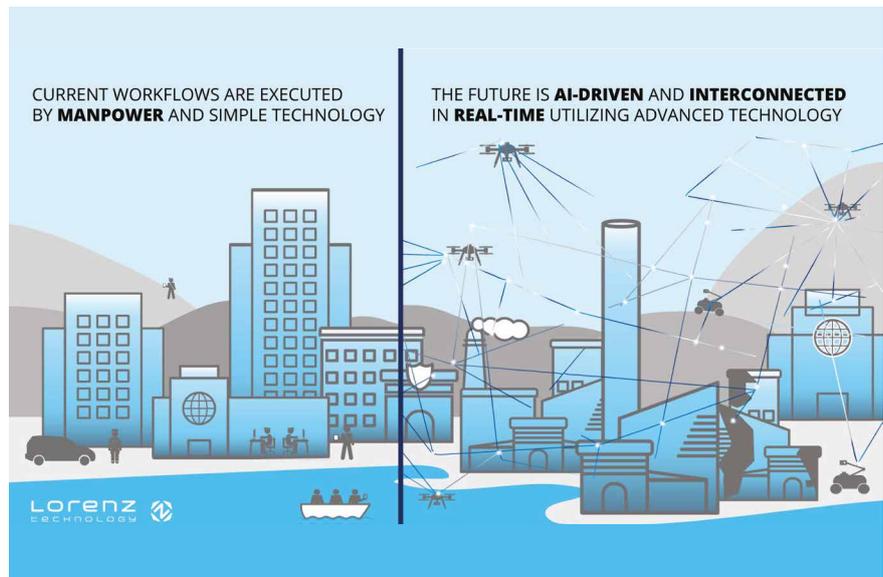
lysed and shared when compiled in insightful reports for actionable efforts.

**VIDEO:  
AUTONOMOUS QUAY INSPECTIONS**

## PORT DIGITALISATION WITH AUTONOMOUS VEHICLES AND AI-DRIVEN SOFTWARE

The Lorenz Technology intelligent drone solution has been designed especially for the port industry with features on doing quay inspections identifying fenders, safety ladders and the condition of waterfronts. Furthermore, special plugins have been developed for example, managing outdoor rental areas by supporting updated maps in real-time and letting the administration access the updated maps working with measuring tools to work out and calculate how many acres that are used, and which are

## “THERE IS NO DOUBT THAT AUTOMATED DRONE FLIGHTS WILL BE A PART OF THE FUTURE.”



vacant for storage of various objects (wind turbine parts, trailers, or other goods).

Together with the international shipping and logistics company DFDS, Lorenz Technology has been part of the EU funded OPTIPORT project to develop a solution capable of detecting trailers at port terminals, saving time when loading and unloading docked vessels. The proof of concept has led to the conclusion that drone flights are able to gather the ID of the trailers parked at the terminal which means truck drivers can locate them faster and thereby load vessels faster which allows the vessels to slow down their speed to the next destination, save fuel and thereby cut CO2 emissions.

The intelligent drone solution from Lorenz Technology offers several possibilities of digitising port operations and provides crucial visual data for actionable insights and efficiency improvements. By utilising existing drone and robot hardware, the Lorenz Technology solution offers the missing link between the advanced technologies and easy implementation for the maritime industry. The intelligent solution is built on Microsoft Azure and provides a military standard level of data encryption which saves your infrastructure safely whether in the cloud or at a local installation.

The operations that autonomous vehicles will be able to perform in the future is not difficult to imagine, but developing the brilliant solutions requires a collaboration on each case to define the exact areas of business development. With a growing agile team of robotics engineers and software developers located in Denmark, Lorenz Technology has established a company integrating with the latest technologies in order to provide the best solution for their clients.

Integrating to existing hardware – drones and outdoor driving robots – Lorenz Tech-

nology focus on the control systems and the digital data management processes to secure a sustainable business model and offer the port industry something really unique when it comes to artificial intelligence and edge computing.

### FROM MANUAL WORK PROCESSES TO FULLY AUTONOMOUS OPERATIONS: WHY GET STARTED TODAY?

There is no doubt that automated drone flights will be a part of the future. Lorenz Technology is already capable of performing autonomous flights based on pre-programmed routes within given geofences. The biggest obstacle of the implementation of fully autonomous drones is currently the legislation. Many nations across Europe prohibit flights beyond visual line of sight which means we need an operator on ground able to take over manually even though the drone mounted with Lorenz AI-Link is able to perform operations on its own.

### WHY START TODAY?

Implementing a fully automated solution requires a process of moving from manual workflows to digital workflows to train the AI-driven technology to full automation. The three-step process is required no matter how well the technology you implement is designed. The transitional phase is necessary and essential for a tailor-made solution fitted for exactly the needs of your port.

Waiting for the perfectly designed off-the-shelf solution could be an endless waiting game. Lorenz Technology is able to produce tailor made solutions for your industry.

Working with the maritime industry for almost four years now have made the Lorenz platform perform digitalisation of various tasks on Danish ports. The next step for the technology is implementation abroad and with a great network of resellers across

Europe this accelerating company is ready to implement the tools to greater automation and sustainability based on edge computing, AI, and interconnection between drones and mobile robots hooked up to the smart data management system Lorenz Hive.

### ABOUT THE AUTHOR

Kristian Skaarup has been CEO at Lorenz Technology since 2017 and has 10 years' experience managing companies and advising executive teams. He is versed and knowledgeable on IOT, cloud platforms, edge-computing, artificial intelligence, real-time streaming with sub-second latency, autonomous drones and mobile robots, Kristian Skaarup embodies the strategies on utilising advanced technologies to design strategic and sustainable solutions.

### ABOUT THE ORGANISATION

Lorenz Technology utilise drone technologies to provide the intelligent solution designed for ports to digitalise their operations and automate work processes. With the edge-computing device Lorenz AI-Link® and the web interface of Lorenz Hive® drones and mobile robots can be utilised as autonomous data collectors providing insights for actionable improvements in real-time.

Data gathering and management becomes easier with the intelligent solution built to operate on ports and serve the maritime industry with data gathered by drones.



# GUARDING AGAINST CONTAINER HANDLING DOWNTIME

Barry Larrain, Big Trucks Industry Manager, Hyster Company

When cargo handling equipment suddenly fails, the consequences can be cataclysmic.

Terminals depend on mission-critical equipment like container handlers to power through the unloading process as soon as cargo vessels arrive, freeing space for more shipments and getting vessels back on the water generating revenue. Delays unloading can thwart on-time delivery to beneficial cargo owners, racking up financial penalties and straining relationships as downstream consequences come to a head and backlogs disrupt other incoming vessels.

Terminals simply cannot afford tight margins to be threatened by the productivity and profit impacts that result from equipment outages. This paper addresses the practical steps port terminals can take to minimise downtime risk in their cargo handling equipment.

## DOWNTIME CAUSES

Although some amount of downtime is expected for regular maintenance, service tasks are carefully scheduled to avoid disrupting regular business. When there are only a few surplus pieces of equipment, precisely planned service tasks to make the most of the little redundancy on hand can keep daily operations on track.

But unplanned downtime is an entirely different story. Such little redundancy means reliability is a non-negotiable for container handlers, along with the resources and processes to address unexpected issues. If a unit must be taken out of service to replace a critical part or sensor, operations need to have confidence that they can source and install the part quickly so the truck can return to service in hours – not days or weeks.

So, what causes unexpected downtime? Container handlers have long duty cycles, typically operating about 3,000 hours per

year, for 10 years before being taken offline and replaced. As with most aging equipment, parts can wear out over time. While many terminals take a more proactive approach to recordkeeping and preventive maintenance, it can be difficult to predict when a part might fail.

## DOWNTIME NIGHTMARES: WHAT MAKES A COSTLY DOWNTIME EVENT?

Not every downtime event spells disaster. But the parts support and service capabilities of the local dealer and the equipment manufacturer can cause resolution timelines to vary widely, from a swift fix to weeks or even months-long lapses in equipment operation.

The kind of part that is in need of repair or replacement can dramatically shape the significance of a downtime event. A part receives mission-critical designation if its failure can take equipment out of service.

Some examples are the joystick, onboard sensors and hydraulic components like pumps and cylinders.

Parts availability and transit time also influence the ultimate extent of downtime. Due to the size of some container handler parts, fast shipping methods like air freight are not always a viable option. If a terminal on the West Coast of the US needs a part that is stocked at a distant location, transit time and customs inspection periods can stall repairs for days or weeks. In the real world, when a terminal has an 8,000 TEU vessel to unload in four days, it needs that replacement part yesterday.

### MINIMISING DOWNTIME RISK

How can terminals mitigate the threat of downtime before it happens?

Reliability and durability are important factors to consider for equipment as a whole and critical parts. Parts like hoist cylinders for instance, which are essential to the operation of a container handler, are the kind of components that must be built to last – and have a track record of doing so. Purchasing managers can consult with industry peers to help evaluate equipment suppliers and assess maintenance data to understand their records for reliability.

But reliability is only part of the issue. It is also critical to evaluate if vendors are well-equipped to support and respond in the event of a service issue by securing parts and making timely repairs.

Consider the location and resources of your equipment dealer and manufacturer. Is your dealer able to rapidly deploy parts or service technicians in the event of an issue? Does your local dealer have the financial bandwidth and willingness to stock not only parts necessary for regular maintenance, but mission-critical parts that might sit on their shelf for a year, maybe more, simply to ensure that those parts are readily available when you need them?

A terminal's operations department should not rely on a singular pathway to secure essential parts. Layers of inventory availability help prevent extended downtime. For example, some equipment providers may maintain an inventory of essential parts stocked at the terminal's local dealer, other dealers in the network and a central warehouse in the same state and time zone, with a regular procurement framework in place. For the most urgently needed but less commonly replaced components, some manufacturers may even source parts directly from their production line to help customers get them as quickly as possible.

The financial resources your dealer has at their disposal can also play a role in whether they have skilled and trained service personnel, available in adequate numbers



for fast response to diagnose and resolve issues. One of the greatest challenges for supply chains as a whole and dealers specifically is a lack of trained, experienced service technicians. A well-capitalised dealer may be better equipped to competitively compensate technicians, retaining the steady supply of skilled labour to respond on a moment's notice.

### SUPPORT IN ACTION

Some terminals with a history of struggling to source parts may take additional precautions to protect supply. In one such case, the dealer and manufacturer worked with the terminal to first identify a list of priority parts, based on criticality and expected need for regular replacement. Then, they forward deployed that inventory to the customer site. The local dealer also stocked critical parts, even during the equipment warranty period, so the terminal could rest assured that parts availability would not keep their equipment out of service.

Another special case involves going above and beyond to provide parts access for a port in a very remote location. The terminal location was so remote that the nearest urban centre and dealer location was thousands of miles away, accessible by a several-hour-long flight. The only way to transport large parts was by barge, a process that required two weeks. To prevent such long wait times for replacements, the customer received an entire shipping container filled with parts to keep on-site. The dealer periodically ran inventory, using data on parts usage for billing and replenishment, helping keep the terminal stocked with parts ready to go.

### REALISTIC EXPECTATIONS

No equipment is perfect but examining reliability records for container handlers can provide a reference point to evaluate how equipment compares in practice.

For instance, the failure of structural components in multiple container handlers led one international terminal operator to question their decision to pay a premium based on a perceived reputation

for reliability. But over time, the container handlers developed a track record plagued with unexpected repairs and the terminal found that the high sticker price was not necessarily correlated with quality. In a search for the optimal balance of quality, support capability and price, they explored other equipment brands, getting references from other terminals and re-evaluating expectations for cost and support. Ultimately, the terminal placed orders for several Hyster container handlers for robust construction and reliability, backed by the factory and dealer support to keep operations moving.

### A LASTING IMPACT

Effectively managing downtime risk is a team effort. It requires a joint effort between purchasing and operations when evaluating cargo handling equipment to begin with, and long-term ownership tests the capability of factory and dealer support.

Keeping container handling equipment running is a high-stakes game, as delays have cascading effects throughout supply chains, eroding customer trust and damaging relationships. Success means equipment running anonymously in the background, as a critical but low-profile cog in tightly planned terminal operations. But in the event of an unplanned outage, the bright lights come on to the source of the problem. As one terminal operator said, "they don't remember if things go smoothly, but they never forget if you screw up".

#### ABOUT THE AUTHOR

As Big Trucks Industry Manager, Barry is responsible for providing cargo handling solutions to the ocean and inland port and intermodal industries. Such solutions from Hyster include high-capacity lift trucks, a range of dedicated container handlers and ReachStackers and the service, parts and rental support of Hyster's nationwide dealer network.

#### ABOUT THE ORGANISATION

Hyster Company is a leading lift truck designer and manufacturer offering 130 models with one of the widest capacity ranges in the industry. Supported by one of the industry's largest and most experienced dealer networks, Hyster trucks offer high productivity, low cost of ownership and easy serviceability to customers globally.



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# REAL-TIME CONTAINER VISIBILITY: FROM THE SHIP TO THE RAIL INTERMODAL YARD

Tom Forbes, Head of Rail, Navis Rail

International container traffic has recently reached record volumes as traffic ramped up through much of the pandemic and container movements continue to grow. In North American ports, there are huge delays in working the ships arriving from Asia and the inbound/outbound container imbalance is creating container shortages for export shipments.

Throughout this rapid business expansion, there remains a strong focus on supply chain visibility among ship and port operators, railroads and truckers. Shippers and beneficial cargo owners want better tools to see and track shipments from release to delivery, in the same way consumers track Amazon or FedEx shipments. As consumers become more accustomed to better tracking and service standards, these capabilities are needed at every stage of the transportation and handling process.

## FROM THE SHIP TO THE INTERMODAL YARD

The greatest need for supporting advanced supply chain visibility will take us beyond the domestic tracking of shipments. This would be the full integration of planning and operational systems, and data across multiple transport modes. For example, if a single planning application (and set of data) extended from the ship, to the container terminal, to the on-dock rail, to the rail intermodal yard, the carriers would have more opportunities to optimise and track this extended process.

One critical area of system and data interfaces is in intermodal movements, and the related data. This deserves more examination from logistics specialists. The macro technical environment for improving intermodal planning and management is very good since devices, software and APIs from transport providers and third parties, for tracking cars, containers and individual shipments, are be-

coming available and affordable. Additionally, the integration of data feeds across systems is rapidly evolving and data is more easily shared among multiple transport modes. But is intermodal data available at all transport stages and for all interested parties?

## DATA AND TOOL AVAILABILITY

Based on our observations and discussion with clients, railroads do not always directly exchange data with ocean carriers. Currently, there is sharing between the ocean carrier and the ocean terminal operator, but not necessarily enough for the benefit of the railroad and the beneficial cargo owner. This means that there is an opportunity for more data to be exchanged between vessel operators and rail companies, most likely through the terminal operating system (TOS), which already needs to “understand” what is being offloaded from the vessel and what is being loaded

onto trains. This TOS intersection between the ocean carrier and the railroad could provide the common interface for all downstream transport modes.

Some software tools are being developed that support this data interface among the ocean carriers, terminals and intermodal service providers. Much of this information is currently shared via electronic data interchange (EDI) or phone and email, but more efficient technologies are developing. Navis's RailEye, a part of the N4 software platform, provides real-time visibility of rail network status, accurate train ETA for terminals, and train loading progress for railroads.

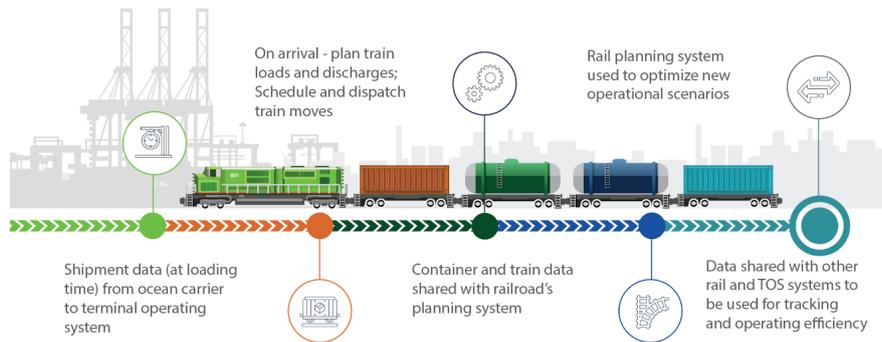
These ocean-terminal oriented systems are a key component in efforts to capture and control information regarding terminal and train interaction. Other key information usually flows with the containers. For example, for containers arriving on a vessel, terminals using N4 will receive container information (weight, customs etc.) from the ocean carrier and as the boxes are loaded and departed on a train, the container detail can be forwarded from the terminal to the railroad. From a planning and data visibility perspective, the container-oriented information should be made available to the railroad as early in the process as possible.

There have been developments among some of the large ports to improve data availability. Late last year, the Port of Los Angeles announced the launch of The Signal, which is designed to provide information on how many shipments will be arriving at the port over the next three weeks. The data is reported to be broken down by container type and includes details on the mode of transportation (rail or truck) that will be used once the containers arrive in LA. This sort of advancement is critical for reducing congestion, but also for handing off data to other systems such as rail planning and operational systems.

Another initiative that could impact multi-modal data availability is Rail Pulse, where the objective is to upgrade all North American rail cars to GPS and other new tracking devices, to give railways the type of visibility seen in trucking and package delivery. Pulse is designed to provide telematics capabilities, which will include data capture to support real-time track-level visibility. The program is focused on the owners of the assets using a GPS transceiver for tracking individual cars in real time, and not just at yards. This project currently includes many influential companies including Norfolk Southern, Genesee & Wyoming, GATX, Watco, TrinityRail and others.

## PLANNING AND ANALYSIS

It's clear that rapid intermodal turnaround in late 2020 and early 2021 has been difficult for railroad planners to manage. If rail planners had been informed two to three weeks before the loaded ships started to arrive at west coast North American ports, the railroads



might have been able to have crew, power and other assets in place. This data would form the basis of tracking the containers at every stage in the movement – international and domestic.

It would be a massive improvement for ports, truckers and the railroads to know the volume and types of containers that they would be receiving when a ship sets sail from Asia. Rail Planners would then be able to have the rolling stock, crews and network capacity in place when the containers hit the pier. Additionally, more complete rail data would be available to share with the customer, earlier in the supply chain.

In the container terminal, the container and storage data will be used to create, view, and manage the intermodal train work. Systems such as Navis's N4 can enter and manage full train visit detail information, including the train identification, location, service, direction of the train, various arrival and departure times and weight limits. This data is stored and made available to other Navis tools and for export to other systems.

At this point, the detailed container/rail information can be shared with railroad planning and operational systems. This will seamlessly provide the shipment status throughout the movement of the intermodal train from the container terminal, through the freight rail network, to the intermodal terminus.

Software, such as the Navis Rail planning platform, can use the data for immediate analysis and optimisation of rapidly changing planning scenarios, such as the impact of the spike in intermodal activity on the west coast. The same data can also be communicated to rail and trucking operational systems through APIs, EDI, and other methods of data transfer, or sharing of business objectives.

## CONCLUSION

Many railroads have tools in place to provide real-time, or near real-time, cargo status to their clients, and more tools are now being developed by the carriers and third parties to take this to a more granular level. The expansion of this view to include detailed information on incoming or outbound international containers would dramatically improve this visibility. But this information is not currently

or readily available to all segments of the transportation process.

Transportation providers and software developers should take the immediate step of making sure that international shipment information is made available to the complete supply chain. This could start at the time of the cargo booking, but should be validated as the containers are tendered to the ocean carrier for loading. The availability of this data would close one of the largest remaining gaps in shipment visibility for all stakeholders.

## ABOUT THE AUTHOR

Tom Forbes is head of rail for Navis and brings decades of experience working with rail operators to improve efficiencies through the use of advanced software solutions and algorithms. He has lived in North America, Australia and Europe and worked with many freight rail operators in these regions. Tom came to Navis through the acquisition of Biarri Rail, where he was CEO. Prior to Navis he was Managing Director of a Boeing subsidiary in Australia, where he sat on the board of Boeing Australia. He holds an MBA from the Queensland University of Technology and currently lives in Chicago.

## ABOUT THE ORGANISATION

Navis, a part of Cargotec Corporation, is a provider of operational technologies and services that unlock greater performance and efficiency for the world's leading organisations across the cargo supply chain. Navis combines industry best practices with innovative technology and world-class services, to provide comprehensive management of the supply chain for safer, smarter and more efficient cargo operations. Navis Rail offers a SaaS suite for the planning and optimisation of freight railroads including the network, schedule, traffic cars, locomotives and crew. [www.navis.com](http://www.navis.com)



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- Discover the best strategy for automation and hear from successful adopters.
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