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TECHNOLOGY



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THE E-JOURNAL
OF PORTS AND TERMINALS

ENHANCING CONTAINER TERMINAL OPERATIONS





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Jack Donnelly,
Editor

FOREWORD

Welcome to the 126th edition of the Port Technology International journal!

In this edition we dive into the world of Enhancing Container Terminal Operations.

Impacts of strikes, extreme weather events, and continued COVID-19 lockdowns in recent months have highlighted the need for container terminals to push the boundaries in becoming smarter, faster and more transparent for Beneficial Cargo Owners to keep goods moving.

In doing so, a variety of technological and operational solutions can be applied: from building Port Community Systems, to standardising exchanges of information, to bolstering wireless infrastructure networks as port equipment becomes more connected.

We are delighted to bring you this latest installment of our journal series featuring contributions from a range of industry stakeholders, including Algeciras Port Authority, Nokia, and Quanergy.

Have a contribution you'd like to make to our 2023 journal editions? Email Jack Donnelly, Editor, at jdonnael@porttechnology.org!



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GUEST FOREWORD: FAREWELL TO OUR RICHARD



Port Technology International (PTI) is deeply saddened to hear of the passing of Richard Morton, Secretary General at the International Port Community Systems Association (IPCSA).

Richard was an outstanding member of the port community for many years, and left a positive impact on all of those who had the pleasure to meet him.

We would like to welcome long-time friend and colleague of PTI and IPCSA, Felicity Landon, who penned a contribution in memoriam of Richard's lifetime achievements.

Friends and colleagues from across the global maritime industry have been paying heartfelt tribute to Richard Morton, Secretary General of the International Port Community Systems Association (IPCSA), who has passed away at the age of 50.

Despite battling with illness for many months, Richard remained positive and enthusiastic to the end, his drive undiminished as he continued to support IPCSA members and make ambitious plans for IPCSA's future.

Born in Suffolk in the UK, Richard spent his early career working in European road, sea and air freight operations. He then joined the private-public sector Haven Gateway Partnership, where as

project director he secured and led the Partnership's participation in European Interreg projects including Portnet, Port Integration, Dryport and Cruise Gateway North Sea.

The European Port Community Systems Association (EPCSA) was created with six founder members in 2011, as a direct outcome of the Dryport project, and Richard was appointed Secretary General. Port Community System operators, along with Cargo (air) Cargo Community and Single Window operators, provide the vital electronic data interchange which is at the heart of smooth cargo flows on sea, land and air, and yet they had never before had a collective voice.

Thanks to Richard's dedication, determination and enthusiasm, EPCSA grew rapidly, in terms of membership numbers, reputation and influence. In 2014, the association was renamed IPCSA, the international organisation that today has more than 50 members from all regions of the world.

Richard ensured that IPCSA had a voice at the highest levels, from the International Maritime Organization (IMO) to the European Union.

He worked to support international organisations on Trade Facilitation and digitalisation, including the United Nations, World Customs Organization, World Trade Organization, European Commission and IMO, and the International Civil Aviation Organization, International Air Transport Association and TIACA, The International Air Cargo Association.

Richard was also an expert for UNCEFACT and APEC eCommerce Business Alliance Expert Council, as well as supporting organisations around the world with guidance on developing Port Community Systems and Single Windows.

Richard will be remembered by IPCSA members for his ability to bring people together, encouraging the sharing of experience and expertise for the greater good – and for creating the “IPCSA family” in which members also became friends.

As IPCSA celebrated its tenth anniversary in 2021, Richard reflected: “When we had our first conference, in Brussels, and formally launched what was then EPCSA, it was to support and provide a voice for PCSs related to Europe's Maritime Single Window proposals. Very quickly, we were joined by new members from Belgium, Spain, Israel and then Ukraine. The association broadened out and it became more like a family than an association.”

He was determined that IPCSA's success should be based on a foundation of trust and sharing. “We are proud to be a neutral

community engaging with global, regional and national logistics communities and relevant public bodies, acting in the common interest of all of our members,” he said last year.

The last major gathering of IPCSA members and partners before the arrival of COVID-19 had been a two-day meeting – hosted by the World Economic Forum in Geneva – to discuss The Future of Cross Border Digital Trade.

But next, Richard did not let the pandemic hold back IPCSA's activities – rather the reverse. During 2020 he ensured that IPCSA excelled itself in reaching out to members, pushing forward with new technologies and innovations, and helping members get to know each other even better. Regular community ‘e-coffee’ gatherings via Zoom were incredibly popular, enabling members to meet informally, share experiences and support each other through the challenges of COVID-19 as true friends and colleagues.

Among many milestones, IPCSA launched its Network of Trusted Networks (NoTN) a secure port-to-port and cross-border data exchange solution which provides predictability, visibility and certainty within the supply chain; developed and piloted a Blockchain Bill of Lading, in a project led by Israel Ports Company, operator of the Israeli Ports Community System (IPCS); was one of the leading signatories to the International Maritime Organization's ‘Call to Action’ to accelerate the pace of digitalisation to cope with a post COVID-19 new normal; and integrated the standards specialist group PROTECT into IPCSA, a significant step forward in the drive for global standards in electronic messaging at ports.

Richard met his wife, Inga, at a Portnet workshop meeting; they settled at Saulkrasti, on the Latvian coast, with daughter Aleksandra. The entire IPCSA family sends its deepest sympathy and condolences to Inga and Aleksandra for their very great loss.

Hans Rook, chairman of IPCSA, said: **“Devastated and deeply saddened, but with an indelible memory of a life marked by huge involvement, cordiality and commitment, we have had to say goodbye to Richard Morton, our dearest friend and Secretary General of IPCSA. We will miss him immensely. We wish Inga and Aleksandra a lot of strength to bear this enormous loss.”**

Paco Saucedo, of the Port Authority of Algeciras, said:

“We consider us lucky to have met Richard, he was a true team builder and facilitator, always trying to build bridges between very different people.”

“Richard was a good friend, a great person to be with and a tireless advocate for Port Community Systems. He was my ‘go to’ person on the subject and never failed to respond fully and in great detail,” said Jonathan Williams, general manager of FONASBA. “We in FONASBA will miss his wise counsel and his friendship.”

Andrea Minardi, of Ravenna Port Authority, described Richard's great competence and professionalism, “but first of all, his smile”. He added: “That informal and open way of his that really made everyone feel welcomed and important. He has made IPSCA grow into much more than an association, a friendship.”

Jerome Besancenot, of HAROPA Port, said:

“Richard is a friend, a very sympathetic person, and such a talented professional, who knew how to create an international port community and make it progress. We are now orphans.”

LIDAR FOR PORT TERMINAL SAFETY: ADVANTAGES AND USE CASES





QUANERGY

Tony Rigoni, Director of Industrial Market Development & Alliances, Quanergy Systems



One of the top concerns for any port terminal is safety. In fact, more than half of container terminal insurance claims are related to crane and vehicle accidents. With heavy equipment and crews working day in and day out every weather condition, the risk of accidents can be high without the right health and safety measures in place to protect people from injury and equipment from damage.

Furthermore, safety is key to maintaining productivity and efficiency, as accidents can lead to costly unplanned downtime. To get the work done, ports are full of moving equipment, vehicles, and people, all working day in and day out to keep supply chains moving. All of these moving parts need

ABOVE

With powerful 3D visualization, long range, and resilience to the harshest environment day or night, Quanergy's LiDAR industrial solutions solve a wide range of critical applications including positioning, navigation and collision avoidance, bulk material profiling, and perimeter security and intrusion detection.

to act in concert to reduce the risk of costly accidents that can cause injury, damage to goods or equipment, and lengthy delays.

While port safety has always been of critical importance, the need has been further exacerbated by recent shortages in skilled labour. To fill personnel needs, ports have found themselves hiring more staff members that lack the training and experience needed to safely operate port equipment. As a result, continuous improvements are needed to ensure equipment and worker safety – now and into the future.

Fortunately, recent advancements in LiDAR technology are making it possible to protect workers and equipment like never before.

THE ADVANTAGES OF EMERGING 3D LIDAR

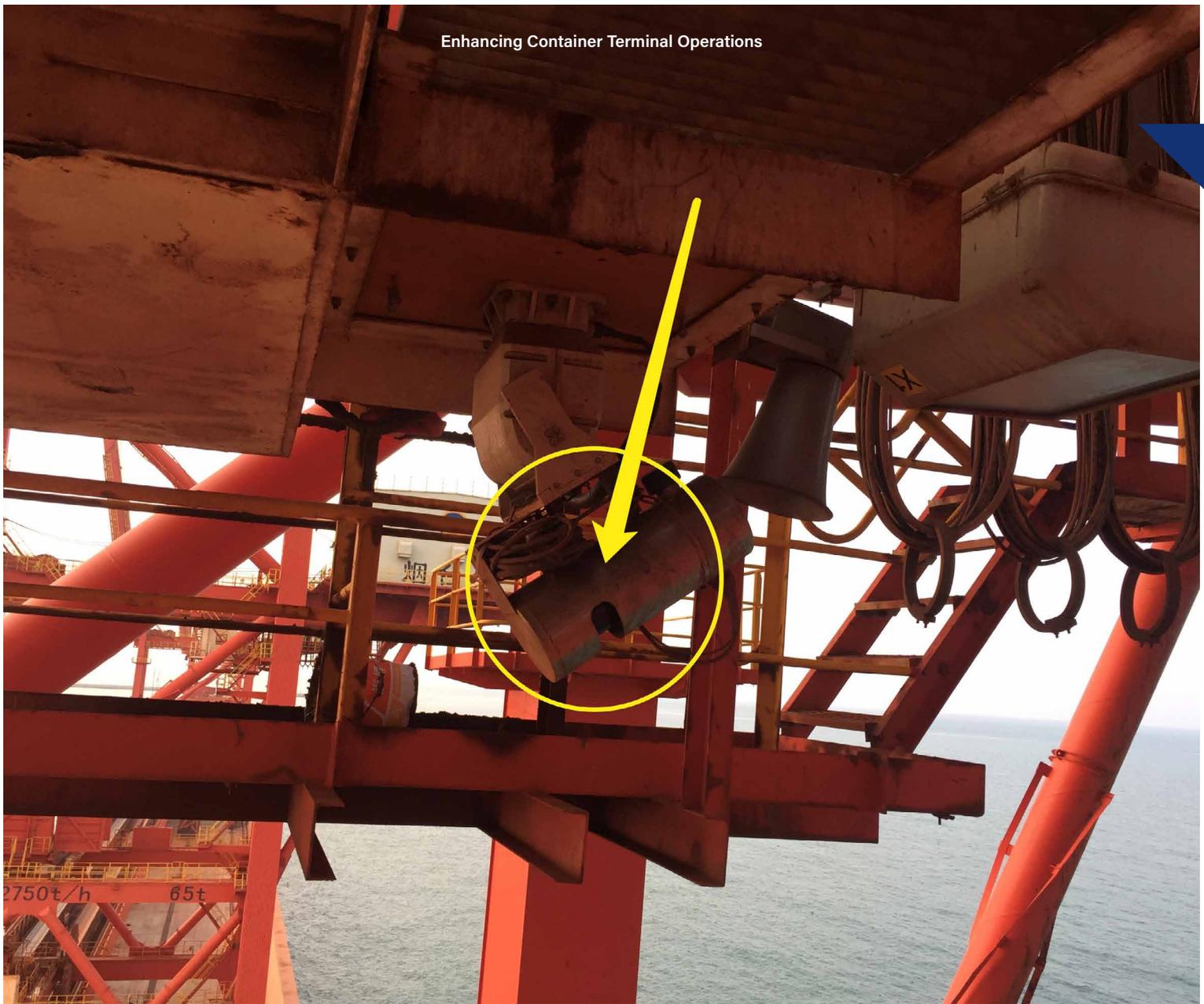
While LiDAR is not new to the port industry, older 2D LiDAR solutions – adapted from indoor industrial automation applications – have proven to be quite limited in their range and ability to perform reliably in outdoor conditions. These solutions have also been prohibitively expensive for ports to implement at scale. In addition to older LiDAR solutions, cameras have also been used for safety applications; however, they lack the depth perception and precise measurement capabilities needed to effectively protect a port's most valuable assets.

Today, however, LiDAR technology can deliver long-range measurement, precise 3-dimensional perception, and accurate outdoor sensing – at a fraction of the price compared to older technologies.

Extended Range

For one, 3D LiDAR sensors now provide a significantly longer range compared to cameras, radar, and older LiDAR technology. 3D LiDAR sensors provide 360-degree coverage, making them extremely flexible and easy to mount in a wide variety of locations, including on cranes, vehicles, and stationary infrastructure. This enables complete coverage and comprehensive safety monitoring of the port while reducing installation and maintenance costs.

With ranges up to 200 meters, these LiDAR sensors enable ports to achieve full coverage with



fewer devices required – which means lower costs and less time and expense for maintenance. An extended range also makes it possible to warn equipment operators sooner and give them more time to react and avoid potential collisions.

3D Object Visualisation with Dense Point Clouds

3D LiDAR provides a dense point

cloud, enabling higher resolution that provides more data and more accurate visualisation than competing technologies. By visualising objects in three dimensions, operators are better equipped to increase productivity.

Smart Perception

Combining highly accurate LiDAR sensors with smart perception software gives port

ABOVE

Quanergy M-series 3D LiDAR sensor is mounted on pitch control equipment with a protective cover.

management and operators actionable intelligence in real-time, allowing them to react instantly to imminent safety risks. The real-time data collected by LiDAR sensors provide a detailed and highly accurate 3D picture of activity in ports. This gives managers actionable insights into their port traffic patterns, enabling them to create more efficient and safe traffic flows.

“WHILE PORT SAFETY HAS ALWAYS BEEN OF CRITICAL IMPORTANCE, THE NEED HAS BEEN FURTHER EXACERBATED BY RECENT SHORTAGES IN SKILLED LABOUR.”

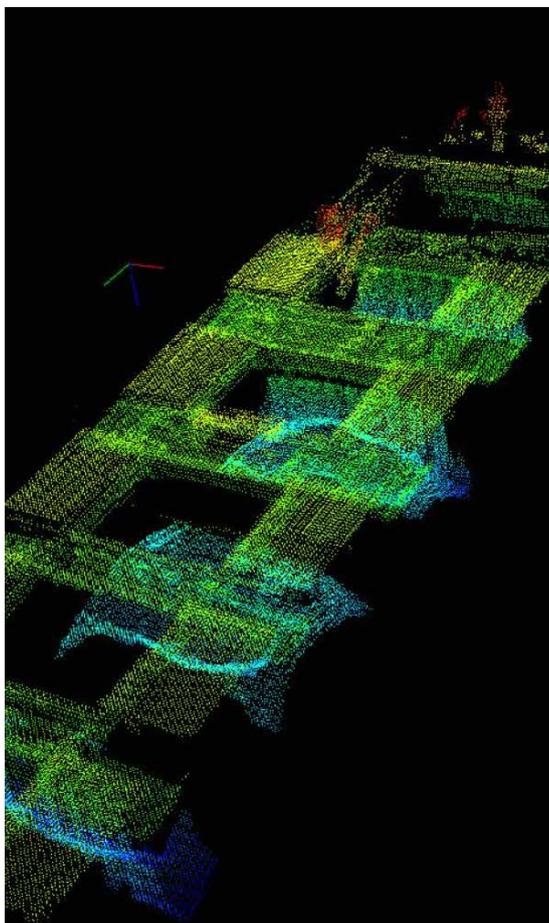
LIDAR FOR PORT SAFETY USE CASES

Ports and terminals have become increasingly automated, necessitating accurate and reliable technologies to keep operations running smoothly while protecting personnel safety. Avoiding collisions is especially critical to prevent potentially hazardous accidents, costly downtime, and damage to equipment.

LiDAR solutions enable safety, security, and efficiency at ports and terminals around the world. With powerful 3D visualisation, long ranges, and resilience to the harshest environment day or night, 3D LiDAR sensors solve a wide range of critical applications including positioning, navigation and collision avoidance, bulk material profiling, and perimeter security and intrusion detection.

LEFT

Quanergy's 3D M-Series LiDAR sensor object generates a 3D point cloud to visualise materials on a ship hatch.



The following are just a few of the most common applications for LiDAR that are making port terminals safer and more efficient today.

1. Ship-to-Shore Cranes (STS)

LiDAR makes it possible to reliably position equipment and prevent collisions at the dock. For example, LiDAR sensors can track the location of equipment and actively monitor areas around STS cranes, ships, and containers, and initiate an alarm or an automated stop if an obstacle is detected. LiDAR can further be used to prevent collisions between the STS crane boom and containers during operation, similarly triggering alarms and stop actions to avoid collision and damage.

LiDAR can also be used to prevent collisions between containers being moved and the top row of containers on a stack. During container handling, LiDAR sensors accurately profile containers and track container location to enable correct positioning for a soft landing on the stack.

2. Rubber Tyre Gantry Cranes (RTG)

LiDAR can also be used to prevent collisions between RTG cranes, vehicles, and people. The LiDAR sensor continuously monitors the area around the RTG crane and immediately detects objects or people in the crane's warning and stop zones. A LiDAR-based monitoring solution can also identify the direction of cross travel so equipment can be stopped before a collision occurs.

3. Anti-Truck Lifting

Occasionally, crane hoists can lift truck-trailers while one or more twist locks are still locked or not completely loosened, resulting in expensive damage. To prevent truck lifting incidents, LiDAR can be used to continuously monitor the truck and surrounding area in order to detect the lift of the trailer immediately. The LiDAR solution can then alert the crane controller system in time to stop the operation and prevent the trailer from being lifted into the air.

Other technologies use a single

beam with a narrow view, so the truck has to be in a specific location for the issue to be detected accurately. Meanwhile, LiDAR sensors provide a 360-degree field of view, so they can monitor both the wheels and the surrounding area and detect lift no matter where the truck is placed.

4. AGV and AITV Collision Avoidance

LiDAR also gives mobile equipment like AGVs and AITVs 'robot vision' to accurately detect objects, navigate safely throughout the terminal, and avoid collisions. LiDAR sensors are mounted to the vehicle and continuously scan the surrounding area. This enables automated ground vehicles to move independently throughout the port with advanced 3D perception that helps avoid collisions and optimise routes.

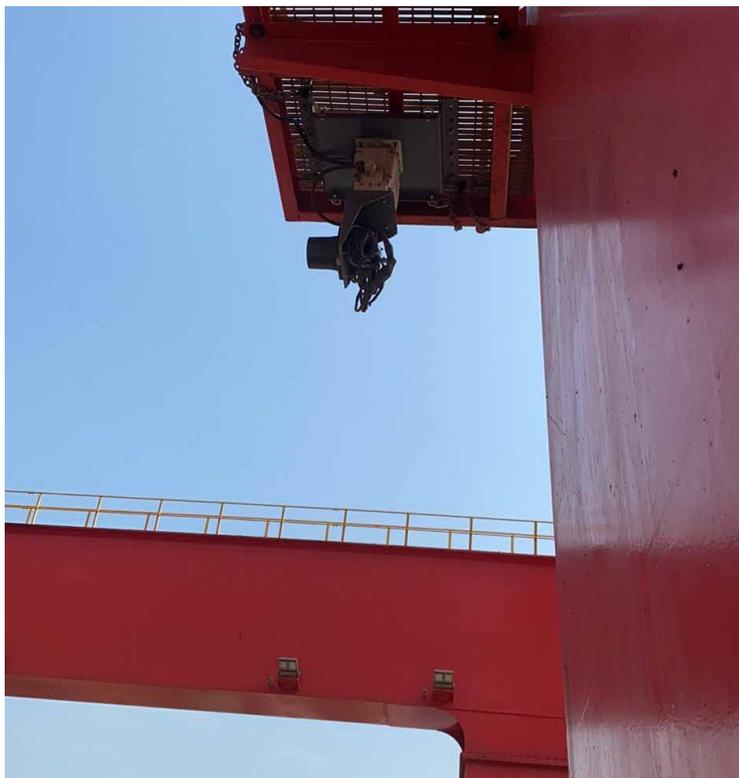
5. Port Operational Safety: A Case Study

The following case study is an excellent example of how port automation using LiDAR can not only dramatically reduce safety incidents but can also increase productivity and efficiency.

Challenge

The Shandong Port Group's bulk terminal was facing a major challenge with their port operations, but one that is not uncommon in the bulk material handling space. In this case, it was impossible to clearly and intuitively observe the shape of the stockpile, which is needed for most automation operations.

Without LiDAR, there was no way to define an accurate safe operation zone within the cabin. In addition, the cabin size could not be determined fast enough to infer the number of operation rows and grasping time of a single row or layer. As a result, before leveraging LiDAR, the bulk terminal's unloading operations in Shandong Port would be carried out by manually setting the safe



LEFT
The successful port automation of Shandong Port yielded safer and productivity increases. Quanergy LiDAR eliminated more than 90 per cent of work-related accidents, 25 per cent reduced labour costs, and a 20 per cent increase in productivity compared to that of manual labour.

“IN THE FUTURE, LIDAR SENSING WILL BE ABLE TO GIVE EVEN GREATER DETAIL FOR BETTER PERCEPTION AND ACCURACY.”

work area, relying on manual grabs by the operator. It was a risky approach, but it was the only option at the time.

Solution

Shanghai Rays chose LiDAR for their customer, Shandong Port Group’s bulk terminal in order to obtain the coordinates of the cabin and stockpile, as well as specific locations in the stockpile. With those coordinates, they are able to define the safe operation zone, move the grab bucket to the desired location, infer the number of operation rows, and estimate the grasping times of a single row

or layer. They now have a clear, visual display of the operation area that allows for full unloading automation, as well as soft-landing.

The successful port automation of Shandong Port enabled unprecedented cost and loss reductions. With a clearly-defined safe operation zone, they were able to eliminate more than 90 per cent of work-related accidents, which has lowered the risk of losses through employee compensation, turnover, and productivity loss. Labour costs have been cut by 25 per cent and they have achieved a 20 per cent increase in productivity compared to manual operation.

WHAT IS NEXT IN LIDAR FOR PORT SAFETY?

The LiDAR you thought you knew has changed. Emerging LiDAR technologies are more robust and capable than ever before, delivering advanced 3D perception that is helping ports protect and optimise their operations in new ways. But this is still just the beginning for 3D LiDAR technology.

In the future, LiDAR sensing will be able to give even greater detail for better perception and accuracy and open up more even opportunities for safety and automation. Most importantly, as the technology evolves, it is becoming more cost-effective and accessible, enabling mass adoption.

ABOUT THE AUTHOR

Tony Rigoni is Director of Industrial Market Development & Alliances at Quanergy Systems. He works with top customers and technology partners to develop innovative solutions for the Manufacturing, Logistics & Warehousing, Port Automation, Transportation, Mining and other industrial segments.

ABOUT THE ORGANISATION

Quanergy Systems’ mission is to create powerful, affordable smart LiDAR solutions for IoT applications to enhance people’s experiences and safety. Through Quanergy’s smart LiDAR solutions, businesses can now leverage real-time, advanced 3D insights to transform their operations in a variety of industries including industrial automation, physical security, smart cities, smart spaces, and much more. Quanergy solutions are deployed by over 350 customers across the globe.

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MAXIMIZING THE VALUE CREATION FROM A 3 DIGITAL LAYER PLATFORM APPROACH AT ALGECIRAS PORT

**“ALGECIRAS PORT AUTHORITY IS EVOLVING FROM
AN INFRASTRUCTURE OWNER AND PORT SERVICE
REGULATOR ROLE TO A BUSINESS FACILITATOR AND
PORT ECOSYSTEM ORCHESTRATOR.”**





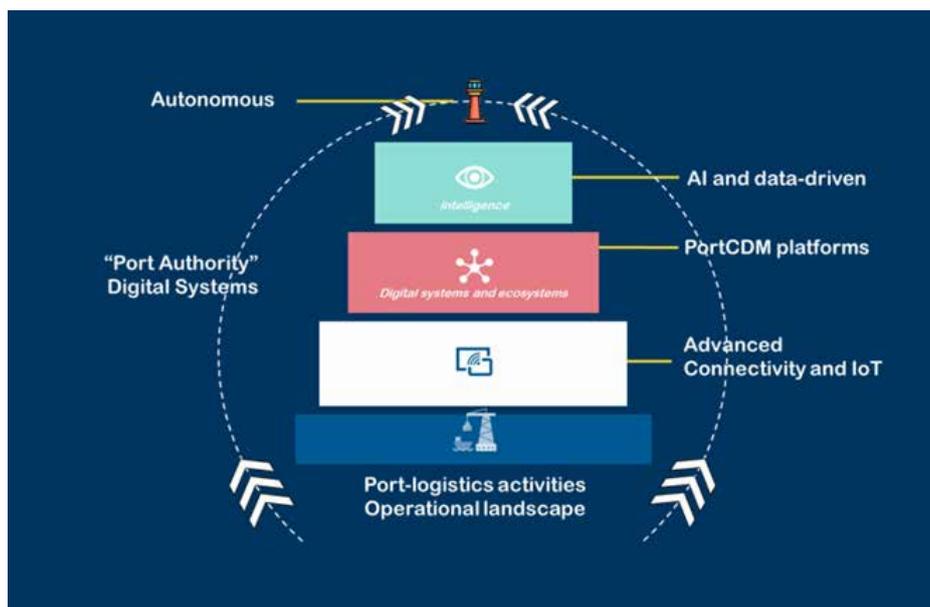
Jesús Medina, Chief Information & Innovation Officer, Algeciras Port Authority, **Agustin Martinez**, Head of the Planning and Fulfilment Operations Department, Algeciras Port Authority, and **Ignacio Serra**, Port Innovation Consultant, member of Port of Algeciras Innovation Technical Office

Nowadays, competitiveness and the quality of service are increasingly demanding in the container sector. Industry trends like just in time operations, e-commerce, supply chain bottlenecks, the COVID-19 pandemic but also Europe's decarbonisation strategy and its Emission Trading System (ETS) are pushing toward an important transformation of the container sector.

In the face of an increasingly similar service offering among competitors in the industry, following the widespread 'commoditisation myth'; ports are forced to provide their customers with more efficient and innovative services, mainly based on the creation of added value. The context of the Strait of Gibraltar and the Mediterranean Sea are clear examples of that.

Algeciras Port Authority, the public organisation that manages Algeciras Port, is not unaware of this context and it is involved in a thorough process of transformation to achieve operational excellence. In that sense, Algeciras Port Authority is evolving from an infrastructure owner and port service regulator role to a business facilitator and port ecosystem orchestrator, in order to improve the quality of service and add value to the business.

For that, its digital innovation strategy plays a main role. One of the pillars of this strategy lies in the deployment of a digital platform capable of coordinating optimally, holistically, and synchronously the port-logistic operations of cargo across the multimodal logistic node of Algeciras Port, maximising value creation. However, the starting point, creating value itself, mainly



ABOVE
Digital Platform concept for Orchestrate Operations at Algeciras Port

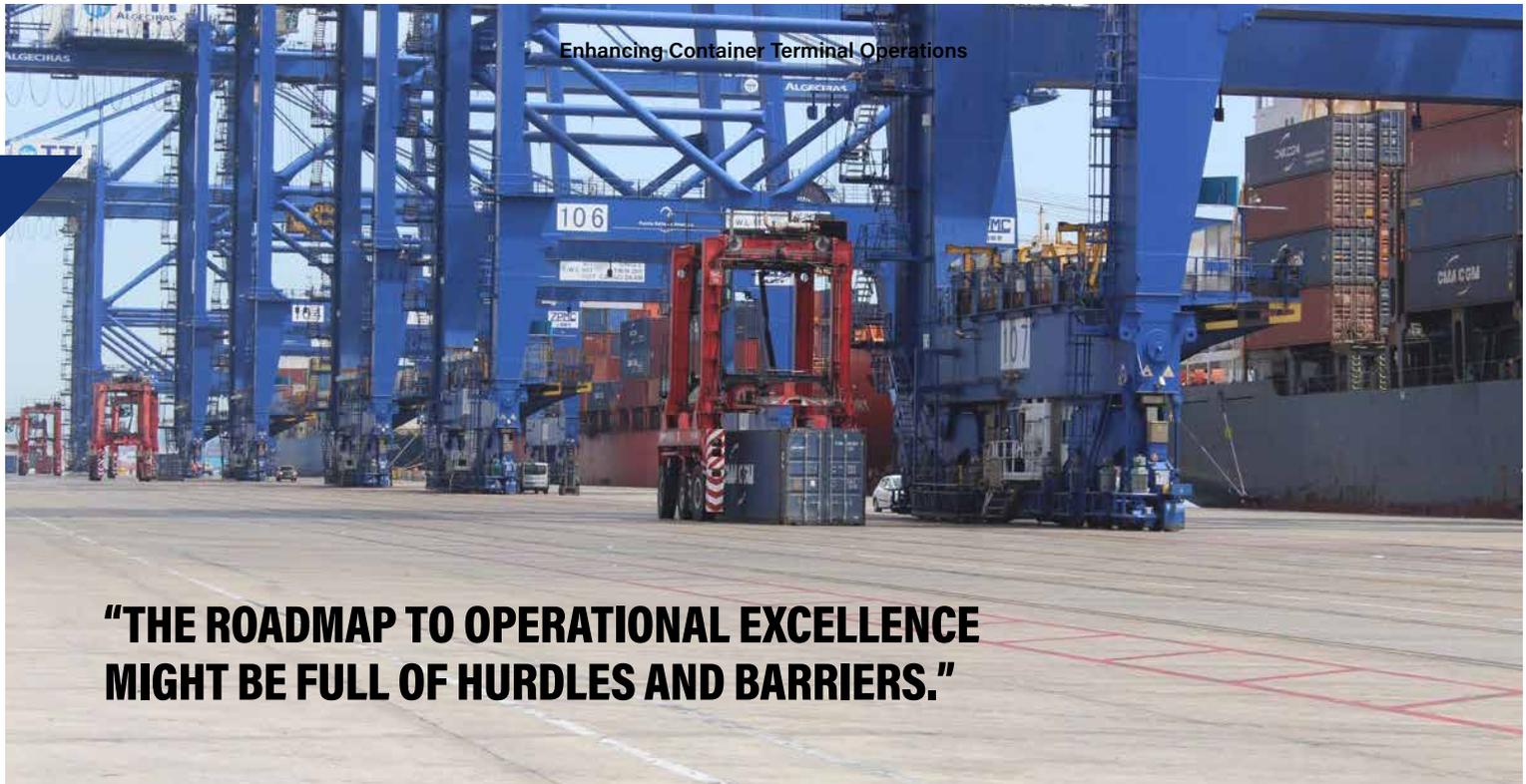
through data exchange, requires information to flow between different applications working together like a unique solution, a 'platform of platforms.'

This platform, bearing resemblance to the system to be used at a Control Tower, delivers end-to-end visibility of cargo flows through the port to encourage the early detection of inefficiencies, alerts or disruptions in the logistics chains, provides capabilities to understand and anticipate operational events and their impacts in the port's performance and, ultimately, provides capabilities to prioritise situations, manage exemptions and assist in the resolution of eventualities and bottlenecks not planned in advanced. Hence, the solution has three layers: (1) a digital layer to obtain situational awareness and

traceability by means of real time information, (2) a predictive layer to determine operational scenarios in advance, and (3) a prescriptive layer capable of assessing alternatives and offering recommended actions to streamline cargo flows and improve efficiency.

These concepts materialise with the implementation of the Digital Platform of Operations Orchestration, where the Algeciras Port Authority, from a neutral perspective, achieves its mission by maximising the Port Value of Algeciras. Value that will undoubtedly strengthen users and clients' performance, generate fact-based fidelity and will deliver attractiveness.

Layers 1 and 2 are in production, up and running and nowadays Algeciras Port is working on the third layer in order to have prescriptive capabilities.



“THE ROADMAP TO OPERATIONAL EXCELLENCE MIGHT BE FULL OF HURDLES AND BARRIERS.”

FIRST LAYER. REAL TIME INFORMATION. EARLY STEPS

Past actions at Algeciras Port have been focused on the development of the digital IT ecosystem, establishing the framework for process digitalisation and automation, real-time visibility and situational awareness of the activity within the port facilities.

The actions were concentrated on two main working lines. The first included obtaining real-time monitoring and control of port operations through the deployment of management and information systems. For this reason, the Port of Algeciras implemented its Port Management System for maritime operations and evolved the first version of its Port Community System (Teleport 1.0), adding several modules for managing port-call processes and improving land accesses traceability. For the second line, in parallel, different sensors and other event capture systems were implemented.

Between them, it can be highlighted the image capture and processing system (SCI) based on CCTV, IoT devices, a Vessel Traffic System and an access management system and advanced traceability (SIGCA).

Cutting-edge systems which enable real-time visibility of port operations.

ABOVE
Total Terminal
International
Algeciras

SECOND LAYER. PREDICTIVE INFORMATION. MAXIMISING THE VALUE CREATION

Once solid foundations for the pursued intelligent management platform were established, efforts have headed to the next meaningful field. This phase is characterised by the exploitation of the gathered data, through advanced analytics and delving into collaboration across the whole port community, for the development of new added value services, as a result of the competitive advantage offered by the port.

In this context, work has been done with regard to the technical and functional deployment of digital shared-events solutions related to the PortCDM (Port Collaborative Decision Making) concept. This concept is based on sharing information in real-time to improve stakeholders' decision-making processes due to a better characterisation of the real situation.

In that sense, Algeciras Port Authority launched the project, Container Value Chain, mapping container cargo journeys through the port and throughout its logistics chain.

Furthermore, Algeciras Port Authority, as technology agnostic, has already in production two PortCDM platforms focused on maritime operations. This is the case of the

Synchronizer (by PortXchange) and Posidonia (by Provedelop) tools that allow the port community to adopt the port-call optimisation and just in time concepts.

Certainly, these systems provide means to predict the next steps in the different supply chains and enable anticipation of possible incidents, bottlenecks, and disruptions. The treatment of data is possible not only to generate insights, detect inefficiencies or analyse behaviour patterns, but also to allow the prediction of congestions, transport demands, peaks, delays and offer estimations of the impact over the port-logistics processes.

And results prove so. Algeciras Port is now capable of predicting its future operational scenarios in the short and medium term, 6 to 12 hours in advance, eliminating waste, and reducing idle and waiting times. Additionally, port turnaround times are improved, sustainability is gained, and better use of assets and resources is possible.

THIRD LAYER. PRESCRIPTIVE CAPABILITIES. NEXT OPPORTUNITIES

The roadmap to operational excellence might be full of hurdles and barriers. Nevertheless, the future looks a bit brighter. The advent of artificial intelligence will

enable the maturation of advanced optimisation and simulation techniques. Models that will directly tackle today's optimisation challenge, brought about by the need to provide customers with more future-looking answers and recommendations: to execute decisions that cannot be only addressed by historical analysis.

To this end, the Port of Algeciras is working closely with the start-up NextPort, specialised in the application of digital twins and artificial intelligence to port operations. The scope of the project consists of the development of a digital decision support tool, self-contained and with real-time visualisation, simulation and advanced analytics capabilities. From this, it will be possible to analyse future operational scenarios, forecast the impact over operations and, finally, prescribe actions to define alternatives across the supply chain, maximising the creation of port value of Algeciras, securing seamless integrated cargo flows and fostering reliable, resilient, and competitive logistic chains.

Comprehensive developments led the way in the past, current actions keep us on track and possibilities to come feed our desire to achieve the concept of Next Generation Algeciras Port – intelligent (data-driven and innovator), synchromodal (operational excellence and logistic integration) and green (sustainable and carbon neutral).

ABOUT THE AUTHORS

Jesús Medina is Chief Information & Innovation Officer at Algeciras Port Authority. He is a Telecommunication Engineer, holds an MBA and has a proven track record in port business and technology. He is in charge of leading the digital transformation and fostering the innovation culture at Algeciras Port Authority.

Agustin Martinez is Head of the Planning and Fulfilment Operations Department at Algeciras Port Authority. His duty is to lead the implementation of a process management operative model in the Port Authority and to be in charge of Maritime

Operations. He holds a MSc in Telecommunications Engineering

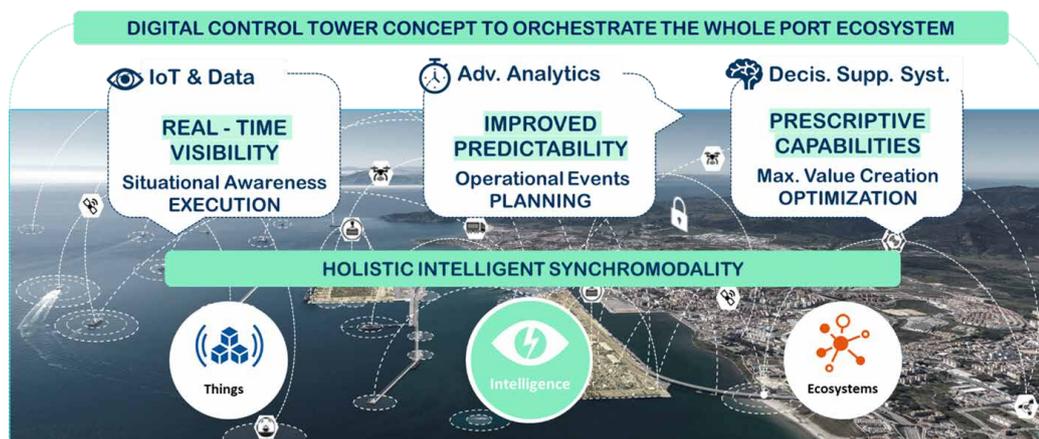
Ignacio Serra is a port innovation consultant, member of Port of Algeciras Innovation Technical Office. He holds an MSc in Civil Engineering and University Expert in Innovation and Digitalization of the port-logistics sector. His duty is to develop Algeciras' innovation programme and initiatives, while fostering a framework for open innovation and innovation culture.

ABOUT THE ORGANISATION

Algeciras Port Authority, located at the Strait of Gibraltar, is the first Spanish and fourth European port in terms of total cargo. With more than 110,000 ships/year crossing the Strait of Gibraltar and 7,500 hectares of deep and sheltered waters, Algeciras is promoting a one-stop-shop port concept for vessel services (bunkering, repairs, ship supplies and others).

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RIGHT

Three digital layer platform approach. Real time, predictability and prescriptive capabilities

“THE TREATMENT OF DATA IS POSSIBLE NOT ONLY TO GENERATE INSIGHTS, DETECT INEFFICIENCIES OR ANALYSE BEHAVIOUR PATTERNS, BUT ALSO TO ALLOW THE PREDICTION OF CONGESTIONS, TRANSPORT DEMANDS, PEAKS, OR DELAYS.”

BUILDING PORT 4.0 WITH LTE/5G PRIVATE WIRELESS



NOKIA

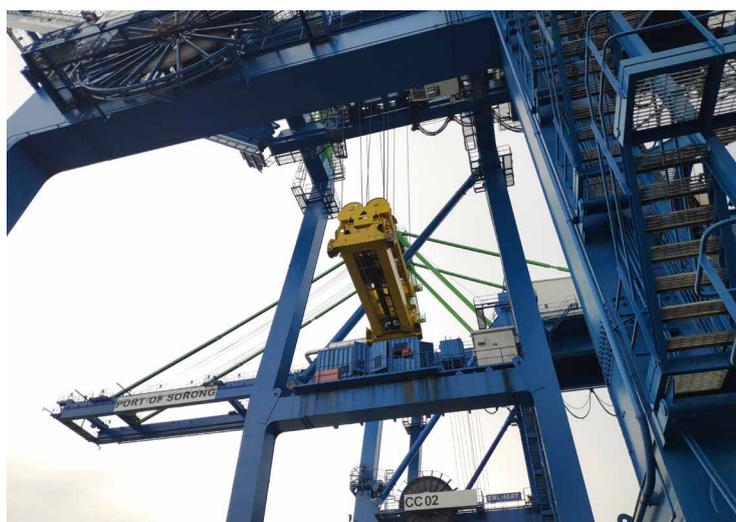
Venkatesh Ramakrishnan,
Head of Maritime & Supply Chain
Logistics Verticals, Nokia

Ports have been put on the front page of national newspapers as supply chain concerns have roiled global markets and disrupted the normal operations of many businesses. Hundreds of ships lining up to unload containers has become a familiar site from Shanghai to Rotterdam. Staff shortages during pandemic lockdowns, a lack of containers and fast-rising freight costs all spell trouble for smooth port operations, putting a renewed emphasis on port efficiency, digitalisation, and automation. One of the technologies playing an important role in port transformation is industrial-grade private wireless based on LTE and 5G, providing pervasive connectivity for the fully digital port.

THE TRANSPARENT PORT

As with many other areas of life, the pandemic accelerated trends that already existed. Over the last decade, the stresses on ports have included expanded loads, bigger ships, and larger call sizes, all of which have led to increasing idle times and yard congestion. As an important link in the global intermodal supply chain, port operations need to improve throughput and become more flexible and resilient to accommodate rapidly shifting requirements.

During the height of the pandemic, many downstream businesses began demanding greater data transparency from end to end; they needed to know where key goods were and whether to arrange for alternate suppliers. Many ports still work with paper forms, thus having real-time data on where shipments



“HAVING SEAMLESS CONNECTIVITY ACROSS THE PORT ALSO SOLVES A LONG-STANDING ISSUE WITH PORT COMMUNITY SYSTEMS, WHICH TEND TO STRUGGLE WITH ISOLATED DATA LAKES AND DOCUMENTATION BACKLOGS.”

are not always feasible. This makes improving data transparency one of the key priorities for ports and their multimodal partners. There are several key digital technologies that will play a role in providing a solution.

The first step is to connect workers, cranes, trucks, trains, and vessels across the entire port system so that data can be made available. With this kind of ubiquitous

connectivity, a Terminal Operations Systems (TOS) can maintain real-time connections to all the key assets and stakeholders in the port system, including connecting mobile workers and machines to the TOS. This is where having an industrial-grade wireless connectivity platform such as private wireless based on LTE/5G is essential. Equipped with handheld terminals that support

push-to-talk radio as well as data and video, yard workers, ship crews, truck and train personnel can exchange any kind of information with central office systems.

Having seamless connectivity across the port also solves a long-standing issue with Port Community Systems (PCS), which tend to struggle with isolated data lakes and documentation backlogs. Private wireless can solve these issues by making it possible to connect gate automation and vehicle booking systems to traffic management and yard crane scheduling. Using edge cloud computing running AI and

machine learning software, the data generated by each transportation mode within the port can be captured, updated, and analysed. This enables better planning of resources and personnel, simplified documentation processing and real-time transparency to other intermodal supply chain partners on the status of their goods.

CLEARING YARD CONGESTION

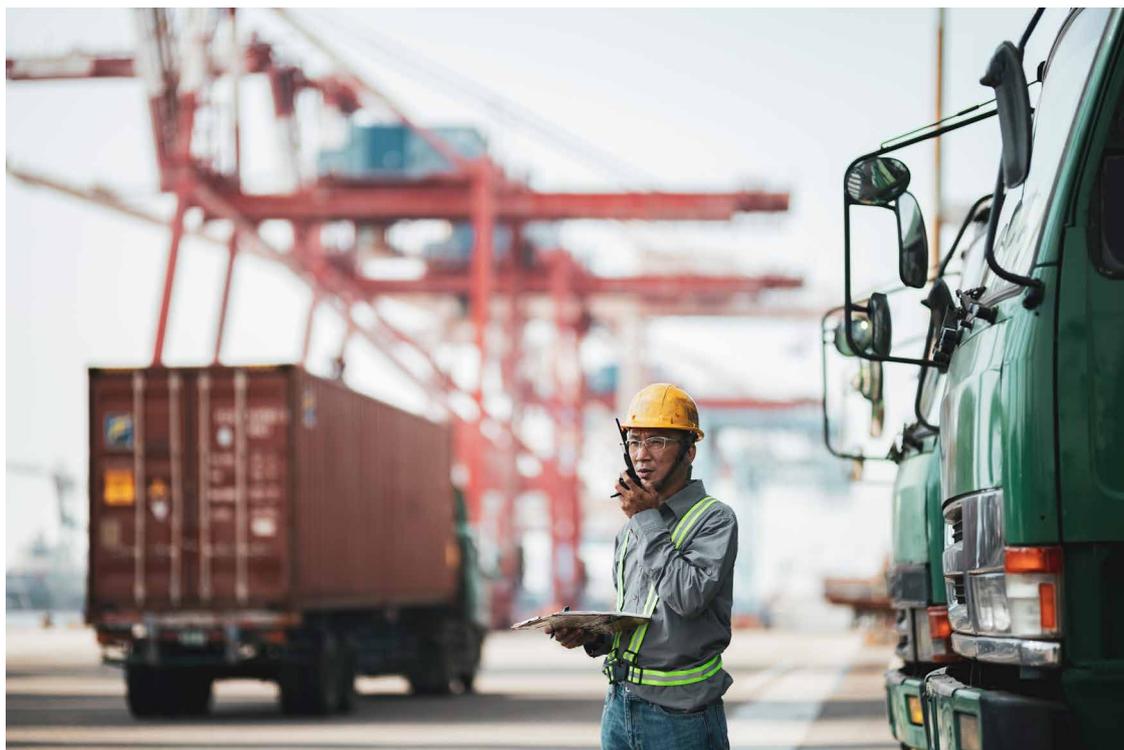
For several decades, research on yard automation has focused on container handling equipment such as RTGs and RMGs, the two most popular yard machines. The first

automated equipment included rail-mounted gantries (ARMGs) and automated electrified rubber-tyred gantry (AERTG) cranes, which appeared in the early 2000s. Unfortunately, they needed to be tethered to fiber optic links because no wireless technology at that time could provide the high bandwidth and reliable communications needed. With six to eight 4K video cameras, the streaming video needed to remotely operate an AERTG is beyond the ability of any wireless technologies prior to 5G.

The high-speed bandwidth provided by 5G is sufficient for these remote-controlled

“DURING THE HEIGHT OF THE PANDEMIC, MANY DOWNSTREAM BUSINESSES BEGAN DEMANDING GREATER DATA TRANSPARENCY FROM END TO END.”





operations. This will untether RTGs and RMGs, thereby dramatically increasing their mobility and, thus, the flexibility and adaptability of container handling operations. 5G can also achieve latencies an order of magnitude faster than other wireless technologies. This means that machine-to-machine communications and remote-control interfaces can support much greater precision. Faster feedback means that remote operators have greater 'feel'. The equipment vendor Kalmar, for example, is incorporating both 4G and 5G into its systems for straddle carriers, rubber-tyred gantries, and automated stacking carriers.

SMART MAINTENANCE

One of the other benefits of ubiquitous connection is the ability to log sensor data from all the various pieces of equipment and machinery. Sensors can monitor variables such as temperature, vibrations and use cycles, feeding data into centralised analytics software. AI/ML software that has been trained on the historical data is able to spot anomalies in the data patterns that correlate with possible future equipment failure.

Besides identifying potential failures and reducing downtime due to unscheduled and expensive equipment malfunctions, the technology can also be used to optimise performance of engines and reduce fuel costs. This 'predictive' ability is also a more precise way to schedule maintenance, ensuring crews are focused on the highest priority maintenance. It also feeds important data for the scheduling of equipment replacement and capital planning.

YARD SAFETY

Providing wireless broadband coverage of the entire yard also promotes safer operations. Workers equipped with smart personal protection equipment (PPE) and connected wearables can be tracked so that central software always knows their locations. Smart PPE can monitor vitals, report man down situations and alert workers to hazardous gases using sensors. Coordinating the movement of workers and machines and using geo-fencing to ensure workers are alerted to high traffic areas are just some of the safety aspects provided by pervasive wireless coverage.

When events do occur that pose a safety risk, wireless directed drones can be used to quickly observe and understand the situation using infrared and normal video cameras. Central crisis control personnel can then use speaker-equipped drones to communicate with personnel in the area and direct them to where they are needed or, alternately, to where they will be safe.

CONSOLIDATING COMMUNICATIONS

Older wireless technologies can be supplemented or even replaced by LTE/5G, enabling IT to consolidate and simplify operations. Many ports currently run several different wireless communications systems such as wireless sensor networks using low-powered wide area networks (LPWA) and proprietary systems for machine-to-machine communications such as beacon networks for AGV guidance. Dock and yard workers typically rely on professional mobile radio, TETRA and P25, for push-to-talk services, while WiFi provides an outdoor extension of the central office LAN for general purpose data communications.



“PROVIDING WIRELESS BROADBAND COVERAGE OF THE ENTIRE YARD ALSO PROMOTES SAFER OPERATIONS.”

LTE/5G private wireless can replace all these technologies with a single network solution, providing narrowband IoT communications, push-to-talk and, even better, push-to-video services for workers on the move, as well as data communications that are more reliable and deterministic than on WiFi. WiFi struggles with the many metal surfaces of container stacks, which cause radio interference that can create dead zones. A WiFi radio network can find these 'noisy' environments difficult to solve for on a regular basis, especially when the environment is so dynamic with containers being moved constantly. LTE/5G employs much more robust technologies for overcoming interference and can provide seamless coverage with less outdoor radio access points and no need to re-engineer coverage as the yard configurations change.

PORT-WIDE COMMUNICATIONS

In a complex multimodal port terminal, private wireless provides a

connectivity platform that all players can leverage for better coordination, productivity and safety. It has the speed and low latency to support the entire spectrum of application needs, from mission-critical voice to autonomous and remote-controlled operation of equipment. It can be a platform to support digitalisation and automation of operations from localised sensor networks to system-wide Port Operating Systems that use digital twin technology and edge computing to coordinate and optimise the entire workflow from ship to shore to rail and road.

LTE/5G private wireless has been specifically designed to meet the industrial needs of today's most advanced enterprise infrastructures. The pandemic has focused governments and enterprises on the importance of our supply chains and logistics, and ports and terminals are feeling the pressure to respond. LTE/5G can play a key role in the digital journey to reduce congestion, provide more transparency, and realise greater resilience, flexibility and safety with Port 4.0.

ABOUT THE AUTHOR:

Venky Ramakrishnan is the Head of Maritime & Supply Chain Logistics Verticals within Nokia. His work includes consulting and helping enterprises with their supply chain digitisation/automation vision, rolling out dedicated LTE/5G networks and deploying use cases with strong business benefits for end customers. He is based out of Munich, Germany and comes with experience in retail and supply-chain.

ABOUT THE ORGANISATION:

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INNOVATION IS KEY TO SAFER CARGO HANDLING

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Richard Steele, CEO, International Cargo Handling Coordination Association (ICHCA), **Mike Yarwood**, Managing Director Loss Prevention, TT Club

Innovation is key to safer cargo handling: so say international freight transport insurer TT Club and the global cargo handlers association ICHCA International who together have been collaborating in a long-term campaign to encourage innovation in safety across the global supply chain.

Cooperation between the two organisations on issues of safety stretches back well over 10 years but their innovation campaign began in earnest with the inception of the TT Club Innovation in Safety Award in 2016.

Recent widespread disruption to global supply chains and the consequent pressures on freight transport capacity and cargo handling facilities requires a corresponding focus on safety measures throughout the system. The response from the industry to these challenges has been impressive and there have been numerous ground-breaking innovations with multiple applications aimed at reducing these safety risks. However, the two organisations are keen to raise the awareness of the need for continuous development of the ways that safety is managed so as the use of such innovation can proliferate to the benefit of all.

The Award provides just such an opportunity for companies to showcase their innovative safety devices, processes and products. All aimed at championing safety in the supply chain and developing new solutions to managing risks. Over the years submissions to the Award programme have ranged in focus from bulk cargo handling

to securing containers and their cargoes; from safety reporting and education to the correct handling of dangerous materials; from environmental monitoring to fire detection and suppression. The Digest demonstrates the energy deployed globally in enhancing safety and the quality of developments. It is hoped its publication will further encourage the industry's commitment to safety efforts throughout the supply chain as a whole.

For its part TT has maintained a consistent mission to increase the levels of safety across the myriad of operational functions that constitute the global supply chain. Innovation is encouraged across all modes from securing unit loads to the correct handling of dangerous materials, and from safer working practices and equipment in cargo handling facilities to avoidance of vehicle collisions and fire prevention.

ICHCA International, as the representative body for cargo handling operators is equally passionate about sharing innovation and learning across the industry. In the recent past the Award campaign has helped promulgate safety innovations including Hapag Lloyd's Cargo Patrol that detects suspected misdeclared dangerous goods; terminal automation advances from Künz and Yardeye in cooperation with CSX Terminals; as well as safety devices developed by PSA International and Cargotec.

A record number of submissions were received for last year's Award and VIKING Life-Saving Equipment A/S was announced the winner for

its HydroPen system designed to fight onboard container fires. The HydroPen has subsequently gained sizeable uptake among container shipping lines and its success is to be applauded.

Yet these examples represent just the tip of the iceberg in terms of the detailed submissions that have been received, and to give maximum visibility to them, we have summarised them all in a Digest. This contains details of innovation from the over 30 organisations that made submissions to the 2021 Award, covering products and procedures that have achieved a demonstrable safety improvement in cargo handling and transport. They all deserve acknowledgement as leaders in innovation in the pursuit of safety in the industry. With over 50 per cent more submissions than in any previous year, we were impressed by the quality of the 2021 entries, as much as the quantity. Needless to say, the judges were challenged in making their decisions by the abundance of creative, innovative and thought-provoking content.

It is for these reasons that ICHCA and TT agreed to present a Digest of all the entries in the knowledge that any of them will help other organisations in creating a safer working environment within the cargo handling sector.

[DOWNLOAD DIGEST](#)

Nor does the commitment of the two organisations end there. In particular as part of the safety

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campaign TT has updated its 'Book it Right, Pack it Tight' (BIRPIT) publication, which provides key insights for all participants in the freight supply chain responsible for preparing unitised consignments of dangerous goods for carriage by sea. The guide is intended to support shippers, forwarders, shipping line booking personnel

and those who pack dangerous goods into cargo transport units (CTUs) in the technical aspects of the IMDG Code. The aspiration is to influence behaviours and levels of compliance by assisting all involved to understand their own duties and the duties of their contractual partners through the global supply chain.

The guidance is split into two parts. Part A of the guide breaks down the process of preparing and booking the cargo into practical steps and explores the roles and requirements of those involved in each step. Part B provides background information to the IMDG Code, classification and references to further materials.

“INNOVATION IN SAFETY IS NOT SOLELY RELIANT ON COMMERCIAL ENTITIES CREATING NEW PRODUCTS AND SYSTEMS TO INCREASE SAFETY IN THE INDUSTRY BUT ALSO BY TRUE COOPERATION.”

Closely related to the issues specific to dangerous goods are the broader issues of packing cargo in general. While the IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code) remains non-mandatory international law, it is clearly referenced from the IMDG Code. Equally, BIRPIT refers to the CTU Code as the definitive industry code of practice on how to pack and secure cargo of all types in cargo transport units, imploring all operators to adopt the principles therein, thus improving operational practices.

DOWNLOAD BIRPIT

Continuing the safety theme ICHCA has recently participated with other international organisations in the production of The Dangerous Goods Warehousing White Paper, and its accompanying Checklist. This has been created by the united efforts of the International Vessel Owners Dangerous Goods Association (IVODGA), National Cargo Bureau (NCB) and World Shipping Council (WSC), together with ICHCA.

The White Paper details the risks involved in storing and handling dangerous goods and, importantly the measures to be taken in containing them. Topics covered include: competency and training of workforces; property construction; fire protection; security equipment and protocols and emergency response procedures. It is intended as a practical guide to systematic and documentable processes for those managing and operating storage facilities to ensure ongoing safety but also that incidents are

containable if and when they arise.

A pivotal element of the guidance is the Warehouse Checklist, which given the aim to provide a practical management tool, is a significant addition to the other elements of the White Paper. Broken down into eight key functional areas of operation, this comprehensive 14-page Checklist is designed as both a planning guideline and a review tool, as well as an everyday device for maintaining safety management vigilance. Download White Paper

DOWNLOAD WHITE PAPER

The Dangerous Goods Warehousing White Paper has been endorsed by influential industry stakeholders including Baltic and International Maritime Council (BIMCO), Bureau International des Containers (BIC), Container Owners Association (COA), Council on Safe Transportation of Hazardous Articles (COSTHA), Danish Shipping, International Chamber of Shipping (ICS), International Federation of Freight Forwarders Association (FIATA), International Group of P&I Clubs (IGP&I) and of course TT Club.

Innovation in safety is not solely reliant on commercial entities creating new products and systems to increase safety in the industry but also by true cooperation by parties representative of all who are involved in the complex supply chains around the world. Every opportunity to work with these bodies to innovate, develop and refine appropriate safety instruments, codes and circulars should be capitalised upon.

ABOUT THE AUTHORS:

Richard is a safety and skills professional with a Masters in Training and Development who has been involved in the ports industry for 21 years. Prior to ports, Richard worked in the nuclear industry on safety and skills provision. Richard was the Learning and Development manager for Associated British Ports for 10 years and has led Port Skills and Safety for 11 years.

Mike is the Managing Director for TT Club's Loss Prevention Department. Mike joined TT Club in 2010 as a Claims Executive providing advice to transport operator Members globally, having previously held operation management roles within the logistics industry for 13 years. Previous roles incorporated full responsibility in terms of budget, legislative, operational and health and safety compliance, including being the nominated dangerous goods safety advisor.

ABOUT THE ORGANISATION:

TT Club is the international transport and logistics industry's leading provider of insurance and related risk management services. Established in 1968, the Club's membership comprises ship operators, ports and terminals, road, rail and airfreight operators, logistics companies and container lessors. As a mutual insurer, the Club exists to provide its policyholders with benefits, which include specialist underwriting expertise, a world-wide office network providing claims management services, and first class risk management and loss prevention advice. TT Club is managed by Thomas Miller.

The International Cargo Handling Coordination Association (ICHCA), founded in 1952, is an independent, not-for-profit organisation dedicated to improving the safety, security, sustainability, productivity and efficiency of cargo handling and goods movement by all modes and through all phases of national and international supply chains.



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VISY TOPVIEW – A NEW ANGLE FOR TERMINAL AUTOMATION

DDDU 201992 2



John Lund,
Global Sales and Marketing
Director, Visy

Container terminals use a variety of equipment to move and stack boxes: large ship-to-shore cranes at the quayside, gantry-type RMGs and RTGs, mobile harbour cranes, and reachstackers roaming in the yard area. Despite the clear differences in the various types of container handling equipment (CHE), the common denominator is that they all move containers with spreaders. In fact, a spreader touches every single container that arrives or leaves a terminal via the quayside or is moved within the yard. Therefore, turning the spreader into an automated smart device presents a multitude of benefits for operators.

UNIVERSAL SPREADER OCR SOLUTION

Visy TopView is a universal optical character recognition (OCR) solution that fits any type of spreader on any CHE. TopView automatically gathers images for recognition data while the spreader is in action – regardless of the time of day or environmental conditions – making it a reliable tool for terminal operators in container handling processes. TopView is

now a standard offering in all Visy ship-to-shore OCR systems.

Using the latest camera hardware and artificial intelligence software, TopView transforms every spreader into a smart device and gives the CHE a set of ‘eyes.’ The wide feature set which drives process automation saves operators time and money on every box move. Those features and benefits include:

- Container ID recognition
- Visy ADDS – Automatic Container Damage Detection System
- Communication with TOS and other third-party systems
- Early alerts for wrong moves
- Verified stack integrity
- Improved safety due to less manual work around the cranes
- Twin-20 detection system

TopView takes high-quality images of the roof of each container and utilises vision technology to automatically extract the container IDs printed on the roofs. Because the system is installed directly on the spreader, the images are captured wherever the spreader goes, regardless of

the container flight path.

When the spreader picks up a container, TopView has already captured the container ID and other pertinent information from above. The digitised data is then automatically shared with the TOS or other third-party systems, and the move is verified. Clerks no longer need to manually verify box IDs. TopView automatically collects and shares the data as required.

RUGGED HARDWARE

Each spreader is equipped with robust cameras, LED illuminators, cabling, and a device cabinet. The system works in every environment, from the high winds and freezing temperatures of the subarctic climate of Visy’s native Finland, to the heat and humidity of the tropics. The first TopView system was deployed in 2018 and is still in operation.

TopView supports all makes and models of spreaders, including single, twin, tandem, and quad. The system can be installed into new spreaders at the factory, or as a retrofit onsite. Depending on operational requirements, TopView works both as a standalone solution and in cooperation with other Visy Crane OCR products. TopView delivers results regardless of whether the operation commences over vessel, truck, train, or yard.

It’s no secret that spreaders are subject to harsh treatment including shaking, vibration, knocks, and hard collisions. Recent developments in the durability of cameras play an important role in the versatility of modern OCR

“VISY TOPVIEW IS A UNIVERSAL OPTICAL CHARACTER RECOGNITION SOLUTION THAT FITS ANY TYPE OF SPREADER ON ANY CARGO HANDLING EQUIPMENT.”



systems. Vehement environmental factors no longer limit smart camera applications. The TopView system does not require any special support or maintenance beyond that of a standard OCR setup.

CONSTANTLY EVOLVING SOFTWARE

Artificial intelligence and vision technology have become mission-critical components in modern container terminal operations. With the huge numbers of moves that happen every day in a terminal, the financial implications of the difference between 95 per cent and 99 per cent accuracy in an OCR system can be astonishing. Therefore, Visy guarantees industry leading OCR read rates on every project.

Continuous investments in R&D have enabled Visy's OCR software, powered by an in-house deep neural network (DNN), to provide

exceptional results. Utilising a state-of-the-art DNN provides a faster, more accurate, and more efficient way to extract data from images. The system recognises worn, scratched, and only partially visible numbers faster and more accurately than a human.

In addition to recognising characters, the versatility of vision technology is astonishing. Modern DNNs are taught to recognise virtually anything from an image. For example, the same image set that is utilised for container OCR is also utilised for twin-20 detection. All the data that is extracted from images is automatically digitised and used in process automation.

DAMAGE DETECTION AND IMPROVED SAFETY

One of the revolutionary aspects of vision technology is the Visy Automatic Damage Detection System (ADDS). TopView collects

ABOVE
Visy TopView

damage inspection images of the roof when the spreader locks on to the container. The damage condition of each container is therefore recorded even before the terminal unloads it from the vessel. The TopView images themselves help operators refute damage claims because they have photographic evidence that the container was damaged before it arrived at the terminal. Furthermore, due to the proactive nature of ADDS, the system can be programmed to create an exception handling event for severely damaged boxes.

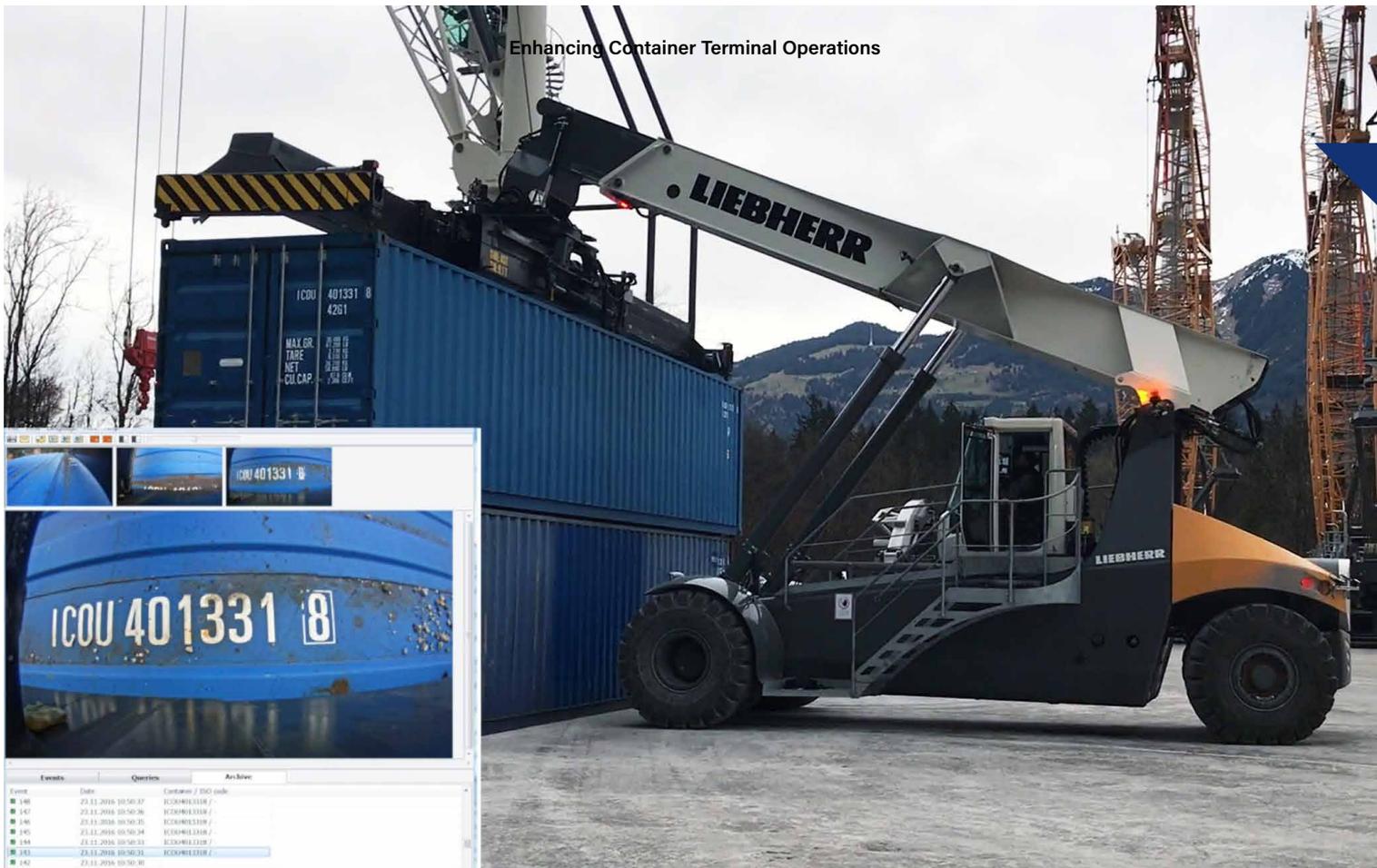
TopView also improves operational safety by reducing the need for hatch clerks to be in harm's way. Using OCR, TopView identifies the box as soon as the twistlocks engage. The OCR results are immediately verified against the TOS. In case of a discrepancy, the clerks may simply look at event images from a remote location rather than having to physically be near the box itself. This way of working improves health and safety and improves the quality of life of terminal staff.

TopView also utilises vision technology to prevent lift accidents. The twin-20 recognition feature prevents hazards associated with picking two 20-foot containers when only one 40-foot container is scheduled and the spreader is in single lift setting. The container formation is determined from the spreader camera images and compared with the current spreader setting. The crane operator receives an alert if the selected lift type does not match the images, thus preventing accidents where the middle locks are not engaged.

NEW ERA OF TERMINAL AUTOMATION

The benefits of vision technology systems in container handling are too big for operators to ignore. From an operational standpoint, utilising TopView will increase throughput capacity and reduce

"ARTIFICIAL INTELLIGENCE AND VISION TECHNOLOGY HAVE BECOME MISSION-CRITICAL COMPONENTS IN MODERN CONTAINER TERMINAL OPERATIONS."



“TOPVIEW DELIVERS RESULTS REGARDLESS OF WHETHER THE OPERATION COMMENCES OVER VESSEL, TRUCK, TRAIN, OR YARD.”

operating expenses through accelerated handling processes. With TopView, terminals also experience significant operational improvements in other areas, such as health, safety and security.

TopView produces data that is instantly utilised in process automation. By turning the spreader into a data collection point, operators receive automatically digitised data every time a container is moved. The recognised container IDs are confirmed through communication with the TOS, which eliminates time-consuming wrong moves. TopView also verifies stack accuracy by automatically identifying every box on every move, including shuffling

operations, and referencing the results against the position detection system (PDS) and TOS in real time.

Data exchange with third-party systems and the workstation user interfaces are highly customisable to fit the unique needs and expectations of each customer. Light but durable infrastructure and easy maintenance make TopView a cost-efficient solution.

TopView presents a massive opportunity for terminal operators. In this new era of terminal automation, modern operators are taking advantage of vision technology to make prudent business decisions, offer better customer service, and reach new levels of productivity.

ABOVE

Visy TopView in use on a Reach Stacker

ABOUT THE AUTHOR

John Lund is the Global Sales and Marketing Director of Visy. Lund has more than 15 years of experience in helping marine and intermodal terminals achieve their operational objectives through implementation of technology. A Boston native, Lund has lived in various parts of Europe and the US, and now resides in Tampere, Finland.

ABOUT THE ORGANISATION

Visy specialises in saving customers time and money through automation solutions that feature optical character recognition (OCR) and other vision technologies. Visy has over 25 years of experience in deploying mission critical systems and has established itself as a global leader in gate automation and access and area management solutions for the logistics industry.



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ROLLER SUPPORTED CABLE CARRIER SYSTEM: EFFICIENT CONTAINER CRANE OPERATION





David Smith,
 Director of Sales, KabelSchlepp
 Division, U.S. Tsubaki, Wisconsin,
 USA

Ship-to-shore (STS) loading systems form a bridge between container ships and port facilities to allow easy loading and unloading of cargo hold. At the Manzanillo International Terminal (MIT) in Colon, Panama, several container cranes are in operation around the clock. This requires a particularly high level of robustness and availability for the systems and all components to prevent costly failures and downtimes.

This was the case with their Shanghai Zhenhua Heavy Industry Co. (ZPMC) Crane #23 at this port facility – the old cable carrier was no longer able to meet the requirements. MIT was in the market for a new turnkey system that would take the performance of their cable track systems to the next level.

MIT is one of the largest container logistics networks in the Americas. Their location at the entrance to the Panama Canal makes this a key logistics point for container traffic as ships pass between the Atlantic and Pacific Oceans. This terminal operates over 25 STS cranes that all need to operate reliably 24/7, seven days a week. With this type of reliability requirement, when it came time for MIT to replace their cable track system on Crane #23, they decided to conduct a broad search to insure they reviewed and implemented the latest in cable track technology to get the maximum life and reliability of their system.

TRACK AND CABLE LIFE

MIT was looking to improve upon some of their current cable track problems. The current track

RIGHT
 Installation photo
 of TKHD/RSC
 at Manzanillo
 International Terminal



installed on their crane had small rollers that were integrated into the sideband links of the track at every metre. This design initially lowered the tow friction, but because only a very small portion of the roller was exposed over a relatively large gap, the wheels eventually failed turning this system into a gliding system.

Once this happened the tow forces increased and track abrasion began to take place. Because the wheels rode over each other in their current design, this also caused increase vibration and noise.

The final point of improvement that MIT was demanding from any potential replacement cable track was to stop cable jacket abrasion from taking place within the cable carrier. In their current system they had seem cable jacket abrasion taking place where the cables interacted with the cable track cross-bars.

TURNKEY PROBLEM SOLVER

MIT contacted several suppliers and asked for suggested solutions. Despite the problems with the old

system, a cable carrier was the optimum choice. Because of the application requirement, neither a festoon system nor a conductor rail would be considered for this application. The type of cable carrier consequently was to remain the same, but a lot of other aspects had to change, especially with regard to wear. The improvements in this area had to be clearly demonstrated by comparative measurements.

Other requirements were easy maintenance and a high level of reliability. And of course the general specifications had to be met as well: the ZPMC crane required a travel length of 112 metres which can support a velocity of up to 2 metres per second, acceleration of up to 0.5 metres per second squared and an additional load of 35 pounds per metre, and last but not least they wanted a ‘turnkey system’.

MIT was looking for a supplier to completely design and implement the project, from overseeing the demolition of the old system to the commissioning and installation of the new. After viewing cable track

options in the market, MIT decided to work with Tsubaki KabelSchlepp. MIT was particularly impressed by the proposed design to make this cable carrier a fully exposed wheeled system that would ride on rails. At no point would it be possible for the top and bottom sides of the cable track to touch each other. This would fully eliminate the track abrasion issue they had experienced.

Also, because the wheels ride on a rail, and not on the side-band, the design eliminated the vibration concerns that had been expressed. Installation on the ZPMC Crane #23 of the terminal began in March of 2018 and was completed that same week. The team led by project manager Thorsten Serapinas, Manager Project Engineering at Tsubaki KabelSchlepp, implemented a turnkey system consisting of a cable carrier and guide channel, including a floating drive arm and proper strain relief as well.

FLEXIBLE, ROBUST, EASY TO MAINTAIN

The selected carrier for this application was the new TKHD90 that had been specifically designed and tested by Tsubaki

KabelSchlepp for long travel crane application and to be used in a roller supported chain (RSC) guide channel configuration. The TKHD90 also features anodised aluminium cross bars to provide maximum strength and at the same time reduce the potential for cable jacket abrasion. These bars can be easily opened from both the inside and outside radius of the track.

With the RSC, the upper track section does not glide on the bottom track or trough, since it runs on rollers. The fully exposed rollers are mounted on ball bearings at the side of the carrier and allow very long travel lengths requiring substantially less driving power. The tension and thrust is 90 per cent less than a comparable gliding system. Since the wheels are fully exposed, there is also no concerns of them 'locking' in position. The rollers run on the guide rail and do not contact other rollers. Ball bearings and a polyurethane roller surface additionally contribute to quiet and smooth operation.

"We are fully satisfied with the new system and with the cooperation with Tsubaki KabelSchlepp," David Avice from MIT confirmed. "The well thought out design is meeting our expectations."



RIGHT

Testing of the RSC system to duplicate the actual travel and speed that a cable track system on a STS crane



ABOUT THE AUTHOR

David Smith is the Director of Sales for the KabelSchlepp Division of U.S. Tsubaki Power Transmission LLC. He has been a part of the KabelSchlepp team for the past 17 years and has been involved in the industry for 25 years.

ABOUT THE ORGANISATION

U.S. Tsubaki is a subsidiary of Tsubakimoto Chain Co., a leading manufacturer and supplier of power transmission and motion control products and is the world's market share leader in roller chain. Tsubaki provides optimal and customisable solutions for a range of applications within the Port Crane Industry. These include Cable & Hose Carriers and Cables, Roller Supported Chain Systems, Drive Chains, Leaf Chains, Backstops & Clutches and Electric Actuators. With nearly a century of successful manufacturing know-how and technical expertise, Tsubaki can provide the best engineered solution to fit your specific needs, and provide the Tsubaki Advantage.

LEFT

Second installation photo of TKHD at Manzanillo International Terminal

APPLICATION OF TIC4.0 STANDARDISED DATA EXCHANGE FOR IMPROVING PREVENTIVE MAINTENANCE IN THE CONTAINER TERMINAL OF MALTA FREEPORT





Ángel Martínez, Head of Products, Maritime & Terminals Solutions, Prodevelop, **Francisco Blanquer**, Innovation and Development Senior Manager, Terminal Link, and **Jan Willem Houwers**, Senior System Engineer, Product Digitalisation & Automation, Hyster

Container terminals are living ecosystems deployed over complex and large infrastructures with a rich number of stakeholders interacting in a coordinated way to offer logistic services under a strict operational planning and tight control of costs. Due to the strong competitiveness, challenging requirements and demanding needs of the port and shipping industry, cargo operations must be carried out in a very accurate manner to achieve high operational efficiency, while ensuring that the Container Handling Equipment (CHE) are used effectively in order to maximise productivity rates (i.e., increase movements per hour) and minimise both idle times of the equipment and demurrages during the whole supply chain in a port call process. CHEs are the heavy machinery (i.e., Ship to Shore, Rubber-Tyred Gantry, Reach Stacker, Straddle Carrier, Terminal Tractor, etc.) available in the facilities of the infrastructure which are at the disposal of the terminal operators and the stevedores for the handling, storage, loading and unloading of cargo from one mode of transport to another (i.e., vessel, yard, rail, truck, etc.) during the non-stop working shifts of the staff.

The maintenance of the assets and resources is a critical process in any industrial environment (and

the container terminals are not an exception) whose aim is to reduce breakdowns and increase uptime of the equipment in order to ensure that they are always maintained in good shape and ready to work in the most fruitful conditions. The consequence of unplanned downtimes from unexpected failures is that CHEs are not available for the management of the cargo operations, which ultimately reduces profitability of the business while increases uncertainty and bottlenecks. That is the consequence of why one of the top highest priorities of companies in general, and container terminals in particular is to try to define predictive (condition based) maintenance strategies bearing in mind the prevention of unexpected failures having a more proactive approach mitigating potential causes of failure before they succeed (i.e., preventive maintenance) and the opposite one, which means, acting after one asset breaks down or a machine is already showing signals of bad performance during their daily duties (i.e., reactive maintenance).

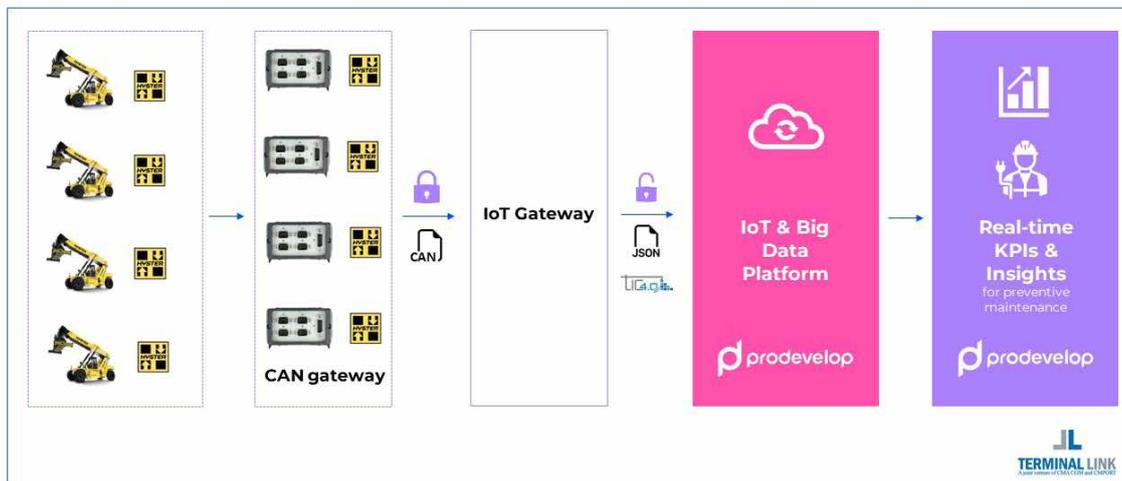
Malta Freeport Terminal (MFTL) is a good example of an entity which is continuously looking for innovative driven solutions and services for the continuous

improvement of the business, contributing to the enhancement of the region's influence in the global trading system whilst sustaining its leading role in the Mediterranean transshipment trade as a reference communications hub for the maritime sector. This technical paper describes the use case carried out in MFTL by Terminal Link (i.e., owner of the terminal), Prodevelop (i.e., technological provider) and Hyster-Yale Group (i.e., supplier of the equipment) as part of the European initiative iTerminal 4.0, whose objective is (1) to boost the digitalisation of port operations, (2) to facilitate the interoperability of different information systems of cargo handling facilities provided by different vendors for seamless data communication between them and (3) to advance towards the standardisation of processes thanks to the adoption of Industry 4.0 technologies and TIC4.0 standards. In detail, this pilot has tested and validated an Industry 4.0 operational scenario with live data where equipment specific systems sensors and IoT (Internet of Things) devices have been deployed in two Reach Stackers (RST) and two Empty Container Handlers (EHL) so that they are being continuously monitored helping to replace internal components before they are degraded preventing unscheduled

“A GOOD MAINTENANCE STRATEGY WHICH MINIMISES UNEXPECTED BREAKS OF THE MACHINERY IS THE ONLY WAY TO REDUCE OPERATIONAL COSTS AND INCREASE SAFETY.”



Application of Industry 4.0 Technologies towards Digital Port Container Terminals



“DIGITALISATION, AND THE USE OF INTERNATIONAL STANDARDS... HAVE PROVIDED SIGNIFICANT BENEFITS FOR THE DEVELOPMENT AND DEPLOYMENT OF THE PREVENTIVE MAINTENANCE SCENARIOS.”

downtimes, which (as it has been said before) increases reliability and lifetime as well as reduces general maintenance costs. Specifically, the two preventive maintenance use cases stressed in real working conditions are:

- The tyre pressure monitoring system. When running a vehicle, the maintenance of its tires is one of the highest costs in operations (running at a x per cent below recommended pressure means service life is reduced by y per cent, so a limited of the designated tyre life is used). Furthermore, its proper maintenance not only extends the tyre's lifetime but also promotes operational safety for the workers who use the equipment. To sum up, this use case allows the real-

time monitoring of key indicators to know the tyre status in real-time (i.e., pressure, temperature, and distance) thus allowing to perform any kind of preventive maintenance while raising awareness and compliance according to different levels of service agreement.

- The real-time oil monitoring proof of concept, where oil is sampled and sensed. The main objective pursued by this is 1: continuously monitor the oil throughout its operational life, alerting when oil conditions are changing below set conditions, 2: where the possibility is there set the Oil Drain Interval (ODI) to the right point for change, so oil can be changed based on the information. In the iTerminals proof of concept

good progress has been made, but this is still in a conceptual development phase. This enriched information created out of Truck sensor & offline sampling and maintenance information makes it possible, bringing that combined information level to TIC4.0 would be a next step.

Besides that, the deployment of an IoT & Big Data platform in compliance with an international standard like the TIC4.0 has enabled the use of open formats for the exchange of data as well as the availability of technological providers for the exploitation of the information stored in the Data Lake. In this pilot the data source of the information is the CHEs manufactured by Hyster which are RAW electrical signals

delivered in a proprietary and closed Industrial protocol (i.e., CAN bus) so a Hyster CAN Gateway is required to form a secure information path from the origin until the IoT Gateway. The CAN Gateway comes with a CAN Database file allowing the IoT Gateway to translate this to a harmonised human understandable language which is globally accepted by terminal operators, port equipment manufacturers/vendors and technological companies in charge of the development of software solutions and services. The final information is merged and stored in the Data Lake of Posidonia Terminal 4.0* (i.e., real-time IoT & Big Data Platform owned by Prodevelop that leverages CHE telemetry data to measure actual operational performance in combination with the information populated from the Terminal Operating System) in an open and flat format which could be exploited by any third party for the provision of user-friendly dashboards, or added value services like Artificial Intelligence (AI) or Machine Learning (ML) algorithms.

Congestion of terminals and, even more, a collapse, result in four major negative effects, particularly in transshipment hubs like MFTL: (i) longer stay times of vessels; (ii) increase in the vessels berthing-wait-time; (iii) vessels being diverted to other terminals, of the group, in other ports and (iv) cost of useful movements increases (i.e. useless movements of machinery and movement time increases, due to delays and non-productive shifts which affects negatively to productivity/efficiency the terminal). That is why both the performance and productivity of the container terminals plays such an important

role in the whole maritime supply chain and to have a predictive maintenance strategy which minimises unscheduled downtime of the equipment is a way to reduce operational costs and improve safety for the operational staff while avoiding a dangerous asset stoppage. Through this article the authors have described the use case tested under real conditions in the container terminal of Malta Freeport where it has been deployed an IoT & Big Data Platform for the autonomous and continuous real-time monitoring of both the status of the tyres and the oil of four cranes manufactured by Hyster. In conclusion, the digitalisation, and the use of international standards like TIC4.0 have provided significant benefits for the development and deployment of the preventive maintenance scenarios since operations are highly dependent on equipment and machinery reliability. To name only a few of the most important ones: (1) real-time monitoring of critical vehicles foresees mechanical problems (or underperforming) which appropriately enables the staff to respond accordingly to unexpected failures avoiding unplanned breakdowns and (2) rely on international standards for the management of the data demonstrates the exchange of information between assets and software solutions provided by different companies in an ease and seamless manner. Predictive maintenance is a good strategy for container terminals in order to detect and manage, in advance, equipment incidences thus improving the overall efficiency and also enhancing performance and lifetime.

“THE CONSEQUENCE OF UNPLANNED DOWNTIMES FROM UNEXPECTED FAILURES IS THAT CHES ARE NOT AVAILABLE.”

ABOUT THE AUTHORS:

Ángel Martínez is a Telecom Engineer and PhD student and Head of Products, Maritime & Terminals Solutions for Prodevelop where he has the opportunity to validate new business models as well as to build solid and innovative technological ICT solutions in order to improve performance, user experience and Rol of industrial partners.

Francisco Blanquer is a Civil Engineer and Innovation and Development Senior Manager for Terminal Link where he has the opportunity to perform complex multidisciplinary projects in the port sector managing all greenfield projects as well as introducing technologies and industrial culture in their terminals. Currently, he is giving and growing all his innovation experience in Terminal Link (CMA-CGM).

Jan Willem Houwers has a Bachelor's degree in automotive engineering with embedded systems. Senior System Engineer, Product Digitalisation & Automation (Hyster) where he has specialised in system integration. Currently he is Big Truck technical lead in Product digitalisation & Automation and participates in several R&D initiatives since 2019.

ABOUT THE ORGANISATIONS:

Prodevelop is a highly specialised ICT company with a growing product portfolio to digitalise and optimise the maritime industry. Prodevelop prides itself on its ability to also offer customised, flexible, and innovative solutions that are designed to meet the specific requirements of port authorities and terminals.

Terminal Link is an international container terminal operator, developer, and an investor with interests in 33 terminals to date, whose network currently covers the Far East, North Europe, Mediterranean, West Africa and North America.

Hyster is the leading global supplier of materials handling equipment. With a network of independent, experienced dealers providing sales & service support worldwide, Hyster delivers tailored, innovative, cost-effective solutions for a vast range of demanding applications.

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EXTRACTION MEANS
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WE THINK
DIFFERENT.**



INDUSTRY Q&A: **WESTWELL**

“WESTWELL USES AI TECHNOLOGY TO HELP PORTS TRULY APPLY INTELLIGENCE TO SOLVE THE TRANSPORTATION AND SCHEDULING LOGIC PROBLEMS.”



Kuo Ralph Ren,
Qomolo Autonomous Driving
Senior Project Manager

Shanghai-based Westwell is making major waves on the international circuit by providing new-era technologies for enhanced port operations. But how does the company see digitalisation across the ports and maritime landscape? And where could the company's solutions fit in? **Jack Donnelly**, Editor, Port Technology International, spoke to **Kuo Ralph Ren (RR)**, Qomolo Autonomous Driving Senior Project Manager, to find out more.

Tell us a little how Westwell formed and what are the main solutions that you can provide to the ports industry?

RR: Westwell is a Shanghai-based company founded in 2016. We provide commercial AI application solutions based on computing power and algorithms, smart perception, autonomous driving, and smart operation, as well as consulting services for global hub ports and new cities.

Our major products, including WellOcean (the AI-driven smart port solution), WellSecurity (the AI-based security monitoring system for ports), and Qomolo (the commercial solution of new-energy autonomous driving), are making the innovation of global and multi-scenario AI application portfolios simpler, faster, and more efficient.

Regarding port scenarios, Westwell assists in upgrading to smart ports in a global thinking manner. We offers smart upgrading in gates, QCs, yards and so on. In this manner, the autonomous driving system can share data generated by other products in the same scenario.

BELOW

WellOcean (the AI-driven smart port solution) assists in upgrading to smart ports in a global thinking manner



Westwell uses AI technology to help ports truly apply intelligence to solve the transportation and scheduling logic problems, initially work out a complete set of operating procedures and standards, reduce operating costs, and create more efficient and sustainable productivity value for end users.

Where are Westwell's solutions already in use?

RR: To date, WellOcean, Qomolo, and WellSecurity have been put into operation in ports and logistics parks for more than 100 business clients around the world, helping global ports and other bulk logistics hubs implement automation upgrades.





“AS OF OCTOBER 2022, WESTWELL HAS COMPLETED 150,000 TEU VESSEL OPERATIONS IN 26 MONTHS IN THAILAND.”

Moreover, the autonomous driving Q-Truck fleet has been commercially deployed in Thailand and the United Arab Emirates.

At the Laem Chabang Port in Thailand, the world's first AI terminal for manned and unmanned truck operations built by Westwell and Hutchison Ports is now in full commercial operation. As of October 2022, Westwell has completed 150,000 TEU vessel operations in 26 months in Thailand. The autonomous Q-Truck fleet has now been fully delivered for local user operation, which is a world first.

At COSCO Shipping's Khalifa Port Phase II terminal in Abu Dhabi, UAE, Westwell has pioneered an operation-based commercial model using the Q-Truck fleet. The Q-Truck fleet has supported Khalifa Port to become the first port in the Middle East to employ autonomous driving technology, thus enabling a progressive development from products and single points to models and systems. The model helps users reduce upfront procurement capital and

promote the rapid deployment of autonomous driving products. It also helps companies improve their operational efficiency and overall operational safety to manage ports in a more refined manner.

What's your opinion on the current status and future prospects of the intelligent transformation and upgrade of global ports? What role will AI and autonomous vehicles play in the development of smart ports?

RR: The development of smart ports has become the main direction for the upgrade of global ports, which is also an important aspect of the competitive differentiation among global ports. The market for the development of smart ports is promising.

Firstly, under regular pandemic prevention and control, global port companies have suffered from many problems such as overworked truck drivers and inadequate transport capacity.

ABOVE

The design of Q-Truck, the fully autonomous commercial vehicle

As a result, more and more companies are seeking to achieve lean port management by using technologies such as IoT and AI in port scenarios to reduce labour and operating costs and increase operational efficiency. In addition, global port companies accelerate their intelligent and electric deployment to meet green and low-carbon development.

With the accelerated implementation of AI and autonomous driving, the automation and intelligence levels of terminals have been continuously improved. Full-scenario smart applications such as autonomous container trucks, remote control, and so on have been continuously launched, gradually implementing the full-chain automation construction for unloading, transportation, stacking, and other projects at ports. This can effectively address the labour shortage issue and ensure overall operational safety with reduced costs and improved efficiency based on automatic operation.

We launched the Q-Truck in 2018, which is the world's first fully autonomous commercial vehicle. We removed the cab, and installed a battery and cooling system at its front end to protect its core hardware from the complex working conditions. The truck is equipped with industrial-grade sensors that can perform ultra-precise positioning and identification by using a complete full-stack system. This allows the Q-Truck to travel 200 kilometers with an 80-ton load on a full charge without relying on underground magnetic transponders. The Q-Truck can smoothly perform intelligent operations such as turning, lane changing, and safe overtaking, and fully integrated into port operations. For example, when operating with quay cranes or yard cranes, there will be no more than 3 centimeters of error in the alignment of the spreader lock with the container twistlock hole, which is an accuracy rate close to 100 per cent.

This year, the truck was upgraded with an intelligent power swap feature that can swap out its battery on its



LEFT
Qomolo provide eight autonomous driving technologies, including the WellFMS, fleet management system

own in just six minutes. Which takes two hours in fast charging mode.

Can you introduce the advantages of Westwell in the context of global smart port development? What challenges will Westwell face?

RR: Westwell can provide integrated solutions for global smart ports, with different operating procedures covered. We provide autonomous driving module with fleet management system, which connects the TOS with our autonomous driving vehicles. Thus the customers' business can be presented through our system and can also be delivered to the vehicle platform via the system for overall transportation. This way, in addition to the implementation of autonomous driving on a single car at ports, we can help customers improve their overall abilities to move containers horizontally in an unmanned and efficient manner.

We adhere to the dual-track orientation consisting of both market and technology. Commercialisation represents the actual needs of customers, while technology implementation will be better with the dual-track orientation.

Our team is strong, hardworking, and always one step ahead, and we conduct rapid iterations as needed. This is a major reason for us to achieve mass commercial delivery and also a faith or resolution for us to stretch into the global market.

Of course, the uncertainty caused by the pandemic also brings challenges to our global business expansion. But from

another point of view, these challenges have also slowed down the development of our competitors. Fortunately, we had already started to make arrangements before the pandemic, and we are prepared with some advantages.

Can you introduce Westwell's strategic layouts in supporting global smart port development? What preparation has Westwell made so far? What does success look like for Westwell by the end of this year?

RR: Westwell has always been committed to using AI technology to help achieve intelligent and sustainable transformation at ports.

In smart port development, we work with users and make full use of our technical advantages to focus on the resource allocation and transport capacity network of container logistics. We developed the LOOPO platform, hoping to build it as the best standard online logistics SaaS platform for the container logistics industry. Then, we can use this platform to streamline the whole process of the supply chain, enabling the transport capacity platform to become standard, large-scale, and smart.

So far, Westwell has nearly 100 autonomous vehicles in operation around the world. These build a whole-process and total-factor digital foundation for insight into logistics resource allocation and transport capacity networks, as well as for system R&D and technology improvement in the digital and intelligent transformation of the industry.

In green and low-carbon port development, each Q-Truck can reduce carbon emissions for customers by 10.7 tons per year. Compared with diesel vehicles, Using a Q-Truck is equivalent to planting around 594 trees.

Westwell is taking energy conservation and carbon reduction as the next goal for development. Westwell is taking ports as the fulcrum, continuing to focus on logistics resource allocation and transport capacity networks, developing autonomous driving technology with the support of our AI foundation, and empowering the circulation and operation of production and life factors with technology, to help users optimise the efficiency in the distribution of value elements; assist the digital, intelligent, and green transformation of the industry; and inject our power into the digital and intelligent transformation of the industry.

Of course, we are also working on the global business layout. We will launch our business in Sweden, Denmark, Malaysia, Mexico, and other places, and provide the battery swapping service for autonomous driving in specific scenarios.

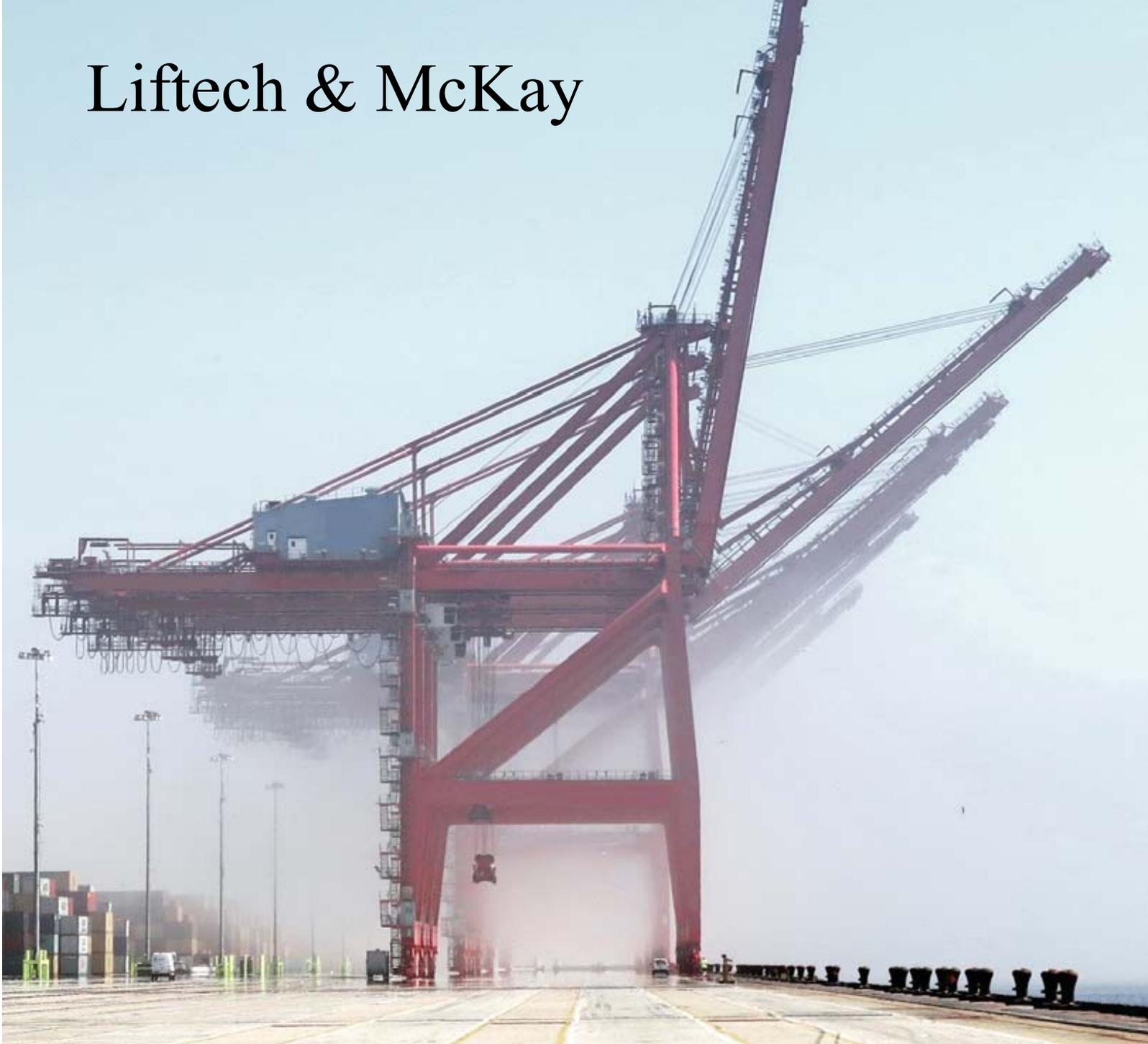
ABOUT THE AUTHOR:

Kuo Ralph Ren, Qomolo Autonomous Driving Senior Project Manager, is engaged in the vehicle manufacturing industry. Experienced in vehicle chassis project development, and vehicle exterior structure project development, dedicated to vehicle development, and global project advancement and delivery.

ABOUT THE ORGANISATION

Westwell, an artificial intelligence (AI) company founded in 2015, provides full stack AI development to businesses across multiple industries. Westwell is now leading in the global market of autonomous-driving commercial solutions and of all-round AI implementation in container logistics. The company has cooperated with more than 90 business clients globally.

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CALL FOR QUICKER AND BETTER DECISION MAKING AT MARITIME TERMINALS

“WITH THE SCHEDULED ETAS NOT BEING FOLLOWED, SHIP VISITS TEND TO CLUSTER AT SOME DATES, LEAVING OTHER DAYS WITH NO ARRIVALS.”



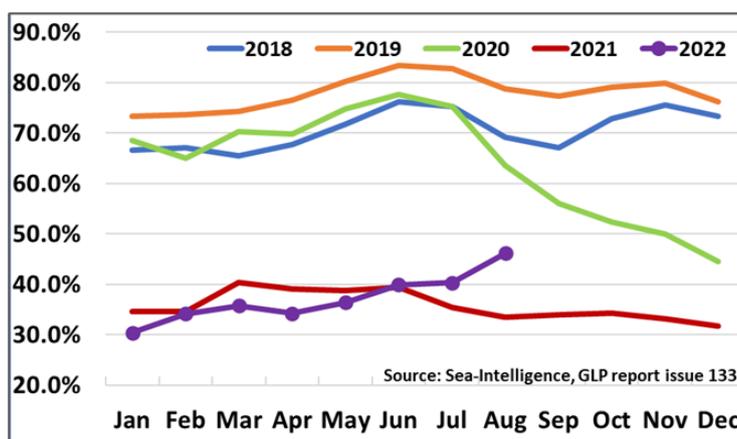


Karol Suchan, Head of Centre for Innovation in Transportation and Logistics (CITYLOG), Universidad Diego Portales, Chile, **Rosa G. González-Ramírez**, Associate Professor of the Faculty of Engineering and Applied Sciences, Universidad de los Andes Chile, **Luis M. Ascencio**, Director of Porthink and SCM-think portals and part-time professor at the Faculty of Engineering and Applied Sciences at Universidad de los Andes Chile

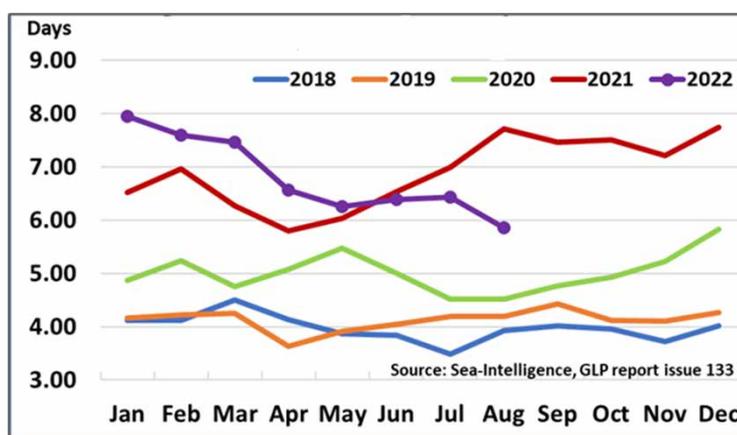
COVID-19 & MARITIME SUPPLY CHAINS

The COVID-19 pandemic has left a deep mark on the maritime shipping industry. In the past two years, the Global Schedule Reliability (GSR, the percentage of ships that arrive within the 48 hours window around the scheduled Estimated Time of Arrival (ETA)) has fallen far below the 75 per cent mark that was common before the pandemic (see Figure 1). With GSR about 35 per cent to 45 per cent, maritime terminals have been forced to replace well optimised operational plans based on service demand well spread over the planning horizon with ad-hoc contingency plans for alternating periods of peak demand and idle time. Indeed, with the scheduled ETAs not being followed, ship visits tend to cluster at some dates, leaving other days with no arrivals. Although we can observe a recovery trend since April 2022, the Global Average Delays for Late Vessel Arrivals (see Figure 2), delays increased from 3 to 4 days, to up to 7 to 8 days during the pandemic and presenting at present, 6 days on average.

Such a mixture of periods of demand that exceeds the capacity of a terminal with intervals of idle time leads not only to much higher operational costs, but also produces even greater delays for the shipping companies due to congestion: with longer vessel waiting times and truck congestion at peak demand. These delays have been reflected in the evolution of the



LEFT
Fig. 1. Global Schedule Reliability. Source: Sea-Intelligence, GLP Report Issue 133



LEFT
Fig. 2. Avg. Delays for Late Vessel Arrivals. Source: Sea-Intelligence, GLP Report Issue 133

“QUICK ADJUSTMENTS ARE POSSIBLE ONLY WHEN INFORMATION FLOWS AND PLANNING PROCEDURES ARE DIGITALISED AND AUTOMATED.”



Ocean Delivery Times indicator prepared by Flexport (see Figure 3), which measures the amount of time it takes for a shipment to travel from the port of departure to the port of destination. On the two main maritime routes, Far East Westbound and Transpacific Eastbound, transit times rose from an average of 50 days in 2019 to almost 120 days in April 2022. Moreover, this increase in shipping times have been accompanied by almost 600 per cent increase in shipping costs, due to an attempt to adjust supply and demand. These two factors together have led to important disruptions in the supply chains of large importers in North America and Europe.

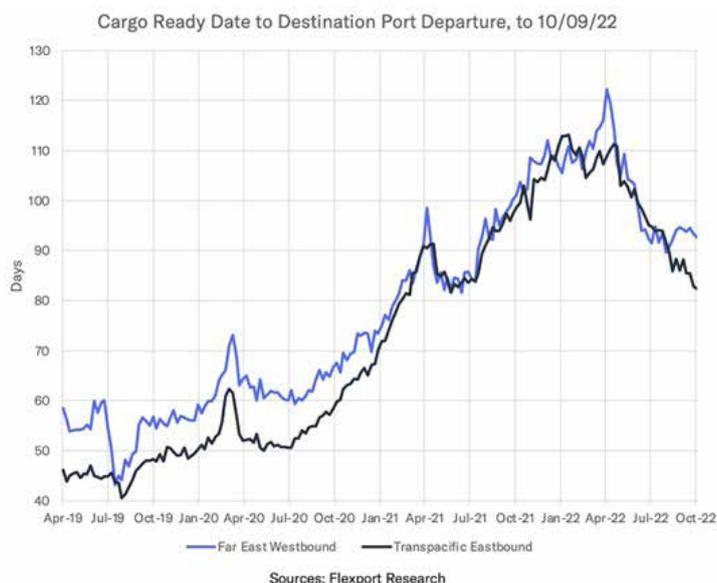
High rate of disruptions calls for more agile supply chains in general and, in particular, for maritime terminals to respond quickly when original schedules cannot be followed. But quick

adjustments are possible only when information flows and planning procedures are digitalised and automated. Unfortunately, despite the availability of technologies such as the internet of things, blockchain, cloud computing, digital twins, and artificial intelligence, many ports are still lagging in their journey towards digitalisation. In other words, most procedures are still carried out in person and communications are based on paper, or on rudimentary digital means such as email, with little structure that could speed up information processing and facilitate integration of diverse information systems. This implies greater inefficiency in operations and, in turn, greater vulnerability to the uncertainty of operations and the occurrence of disruptions such as those caused by the COVID-19 pandemic.

ABOVE
Ports in Chile

DIGITAL TRANSFORMATION FOR BETTER OPERATIONAL PLANNING

Digitalisation of port operations is a critical factor to enhance port resiliency when facing challenges and disruptions of port operations such as those that the pandemic COVID-19 has imposed, along with other geopolitical issues faced nowadays. Automating time-consuming and repetitive tasks reduces human error and improves workplace safety and productivity. Moreover, digitalisation of communications, planning and execution control allows for a much faster implementation of all kinds of adjustments necessary in case of a disruption. Efforts of digital transformation of ports can be classified at three main levels. At the first level, there are Terminal Operating Systems (TOS) that digitalise and integrate all transactions of



LEFT
 Fig. 3. Ocean Delivery Times. Source: Flexport Research

“HIGH RATE OF DISRUPTIONS CALLS... FOR MARITIME TERMINALS TO RESPOND QUICKLY WHEN ORIGINAL SCHEDULES CANNOT BE FOLLOWED.”

a terminal. At the second level, there are single window-based systems, that integrate the information systems of different stakeholders that are part of a port community, denoted as Port Community Systems (PCSs). Integration of data within a port community permits better planning and coordination among the stakeholders, reducing port congestion, waiting times and delays. Furthermore, visibility and traceability of cargo can be offered to the shippers and consignees to facilitate control of their supply chains. At the third level, there exist initiatives that foster integration between different ports. For example, the Port of Hamburg is networked with other ports to create a chain of smart ports around the world: the chainPORTs. This association, created together with the Port of Los Angeles, and which today also includes Barcelona, Montreal

and Antwerp, poses the challenge of facing digital transformation with a collaborative approach.

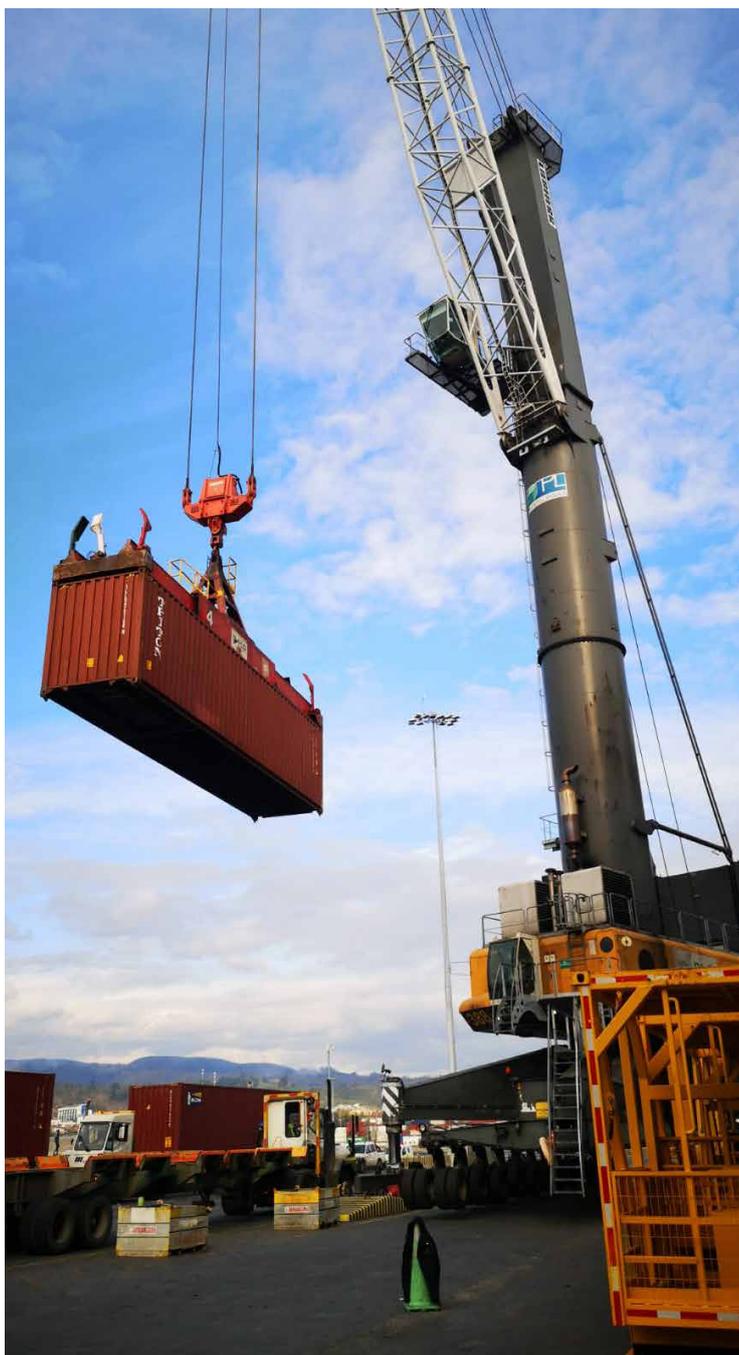
DECISION SUPPORT SYSTEMS AS ENABLERS OF DATA-DRIVEN DECISION MAKING AT PORTS

In a port terminal, there are many discrete choices to be made when managing resources and tasks necessary to carry out the cargo transfer processes within a terminal, as well as the coordination of cargo transport to and from the hinterland. These decisions correspond to three areas of action: planning, execution, and control, and can be supported by systems called Decision Support Systems (DSS). These systems are based on artificial intelligence algorithms and mathematical models to support the decision maker, usually implemented as modules of the TOS with a user interface that may

complement the transactional capabilities of the TOS.

For an example on the landside interface, consider a machine learning algorithm that helps to predict the dwell times of import containers at a terminal at which truck arrivals for the dispatching of import containers present high levels of uncertainty. Based on such predictions, better policies for stacking containers in the yard could be determined, resulting in lower numbers of container relocations (rehandles) needed when dispatching those containers to external trucks and better equipment utilisation at the port terminal. As other means of dealing with uncertainties and high peak demands on the landside interface, Truck Appointment Systems (TAS) or Vehicle Booking Systems (VBS) have been implemented in several ports to mitigate congestion. Such systems require port terminals to determine the assignment of gate capacity to the different containers expected to arrive. An algorithm or mathematical model that recommends slots assignment per service or segregation of containers may improve truck turnaround times and enhance yard equipment productivity due to an improved capacity management for all resources at the terminal. On the seaside interface, decisions associated with berth allocation to incoming vessels as well as quay cranes assignment and scheduling could be supported by machine learning algorithms that predict weather conditions and anticipate possible port closures, for instance, to proactively prepare contingency plans for such occasions. Or, reacting to a maritime disruption that has already occurred, a mathematical optimisation model could be used to quickly reassign resources to better respond to the new schedule, but still limiting the number of changes to the original plan – to quickly get an actionable recommendation for contingency management.

“A MATHEMATICAL OPTIMISATION MODEL COULD BE USED TO QUICKLY REASSIGN RESOURCES TO BETTER RESPOND TO THE NEW SCHEDULE.”



LEFT
Ports in Chile

LOOKING AHEAD

Disruptions originated by the COVID-19 pandemic, geopolitical issues, and other causes are likely to stay with us for the foreseeable future and continue to impact the maritime sector. So, it is mandatory to accelerate port digital transformation and adopt new technologies both at a transactional level (TOS, PCS, etc.) and at an analytical level (DSS) to enhance data-driven decision making. Ports are not alone on their way of digital transformation. They can seek guidance and help from technology service companies and research centres. Once digitalised data is available, DSS can complement the transactional systems in use, providing for a better and quicker decision-making.

ABOUT THE AUTHOR

Karol Suchan is Head of Centre for Innovation in Transportation and Logistics (CITYLOG) at Universidad Diego Portales, Chile.

Rosa G. González-Ramírez is an Industrial Engineer, Master in Industrial Engineering from Arizona State University, and Doctor in Engineering Science from Monterrey Tech in Mexico. She is an Associate Professor of the Faculty of Engineering and Applied Sciences at Universidad de los Andes Chile, Chile.

Luis M. Ascencio is an Industrial Engineer with Graduate Studies in transport planning and policy. Director of Porthink and SCM-think portals. Part-time professor at the Faculty of Engineering and Applied Sciences at Universidad de los Andes Chile, Chile.

ABOUT THE ORGANISATION

Universidad Diego Portales has been consistently ranked among the top 3 in Latin America, according to the Times Higher Education University Rankings.

Universidad de los Andes is a private research institution located in Santiago Chile. It has been ranked among the top 10 universities in Chile.

FROM COLLECTING A LOT OF DATA TO 'WE TALK TIC' AS A GAMECHANGER



Francisco Blanquer, Norbert Klettner, and Luisa Kempf,
Terminal Industry Committee 4.0
(TIC4.0)

How can we translate IoT data and systems of mass data harvesting into an approach of data value creation?

Information has always, and should have always been, one of the main sources for decision making. The better the information, the better the decision can be based on it – which does not mean the decision itself was better. But usually, a decision is not made on one piece of information, because where would the choice be in that scenario? Instead, a decision should be based on more than one piece of information, which brings us to the point of weighing the different information against each other and comparing. And we all know, you should compare apples with apples.

In today's world, information usually means some kind of data and some kind of data exchange or data harvesting. The exchange and harvesting of data will be done across multiple sources, often starting with the 'most expensive' physical assets like the handling equipment such as cranes, rubber-tired gantries, straddle carriers, reach stackers or automated stacking cranes. Over time, more and more systems and other logical assets are added to the data sources. New pieces of equipment bring in more and more complexity, transforming the different data into useful information.

The first item in fixing this puzzle as TIC4.0 was to unify one major part of the data source: the cargo-handling equipment (CHE). Talking TIC on the CHE level does not mean that the same technical protocol is used to exchange

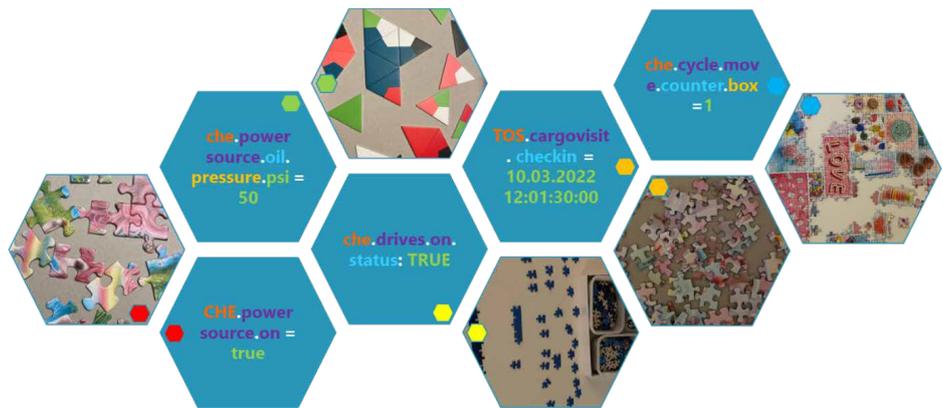


FIGURE 1
Putting the data puzzle together using TIC4.0 language

the data such as MQ Telemetry Transport (MQTT) or OPC Unified Architecture (OPC UA). It also does not necessarily mean the level of detail exchanged and the amount of data is the same.

It means the data transferred carries the same information with the same meaning about an operational process/step, even from many different sources – in this case meaning different machine models and/or manufacturer.

In TIC4.0 we started with a bottom-up approach defining the language to translate different

equipment data into a unified, standardised data view, meaning into the same type of information. Then we realised the industry needs more: and so expanded the engineering driven language into a language to represent any type of reality in a data driven digital view. In future it will not be enough, if you have a unified view on your equipment information, it will require the use of unified and comparable information across many different data sources. This will include multiple systems that are supporting, planning or driving the processes.

“IF YOU HAVE A UNIFIED VIEW ON YOUR EQUIPMENT INFORMATION, IT WILL REQUIRE THE USE OF UNIFIED AND COMPARABLE INFORMATION ACROSS MANY DIFFERENT DATA SOURCES.”



FIGURE 2
One approach to visualize different data sources in a unified view (Example from iTerminals project - CHESCON Digital Twin)

But 'CHE talks TIC' is only the beginning!

The terminal industry needs to talk TIC from every angle. So you need to teach your terminal

components such as CHE, TOS or other parts in the process to talk TIC4.0. With this combination, you can have your terminal talking TIC4.0.

Digging into the details of the TIC4.0 language the following shows you how to translate data into decision making as an example:

Information = data "level" vs "data provision":

Combination of subject + concept (**che.@.on**) enables the possibility to convert data in information. It is when we add the observed property (**che.@.on.status**) and point of measurement (**che.@.on.status.output.actual**) when the value becomes information (**che.@.on.status.output.actual.value: TRUE**).

Adding different observed properties to a concept gives you different information from same concept, i.e: **che.@.on.duration.output.actual.#unit#second.value = 2**; **che.@.on.timer.output.actual.#unit#second.value = 364**; **che.@.on.totaltimer.output.actual.#unit#hourvalue = 13.693**

Data 'level' is just the raw data: **che.@.on**;

Data 'provision' is the way we aggregate and observe the data to create information. It can go from raw (just the status of True/False) to very complex way to aggregate how long or how much cost the concept for that specific subject.

From information to business value:

To create business value, you need to compare different pieces of information to realise what option is better or if some activity doesn't perform as should:

che.@1.idle.timer.%value vs che.@2.idle.timer.%value ; comparing the idle time of 2 CHE.

che.@.idle.timer vs tos.@.jobinstruction.@.order.@.dispatched.timer; comparing how long the CHE is idle with a dispatched order of a jobinstruction from the TOS.

At the data end, this will allow a terminal or group to gather data with the same meaning in the information and allow other processes and/or system to benefit from this. When you move ahead with this approach, it will allow automated decision making based on data-represented information.

To move forward here will inevitably require a unified view on the information with data, which is created for the business decisions, not IT systems. The real service value of data is in the reliability and consistency of the information it carries. Making your terminal talk TIC as a holistic approach will enable you to be more flexible in components used, more unified on the view of data and information.

So, the business value creation is in the data transformed to information, allowing decision making. The first step is for human decisions based on valid information, then transitioning to automated decision making. Especially for that last part: data and information that has the same meaning, even from different sources, is the key.

Our TIC4.0 allows every terminal and equipment and solution provider to supply standardised data in the TIC4.0 language making others understand.

Talking TIC4.0 allows you to constantly check between what should be logical/planned processes and what actually is. With TIC4.0, both worlds speak the same language which brings you to the permanent and automated check on inconsistencies.

Already today it is not only the different sources of data that creates challenges, but it is this with the combination with the steady exponential increase of data created. If you want to create value from the data created and turn it into information and business value, your terminal needs to talk one language in every angle or at least when it comes together every language needs to be translated to one language called TIC4.0.

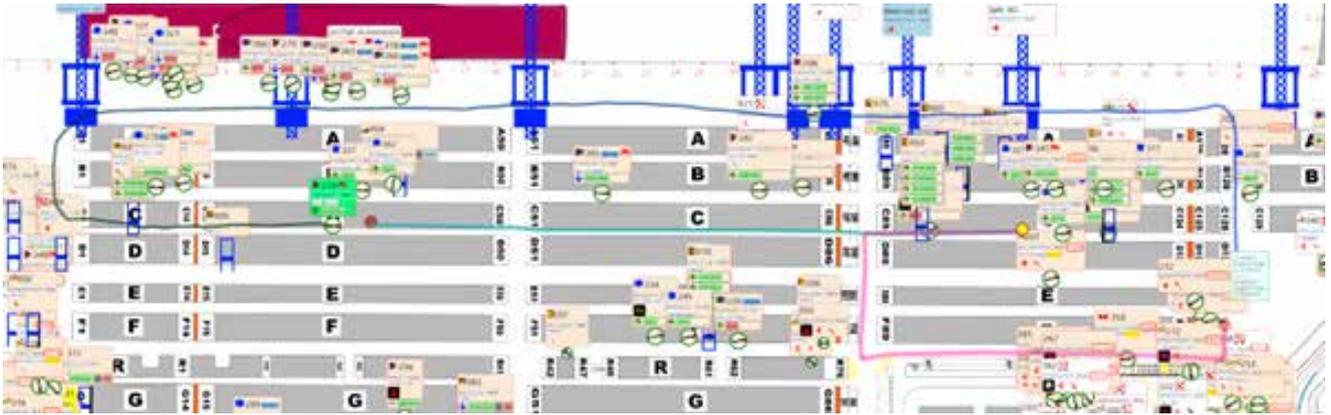


FIGURE 3

Example for using TIC4.0 data to create value and compare shortest (pink) vs. actual (blue) route taken by a CHE

THE GAMECHANGER:

As the TIC4.0 has no limits any comparison can be done. If the data quality is good enough then the automatic decision making can be set on place.

Let's go for **"We talk TIC"** by using **"CHE talks TIC"** + **"TOS talks TIC"** + ...

ABOUT THE AUTHORS

Francisco 'Curro' Blanquer started his innovation carrier in the pulp industry 20 years ago, working on an AI autonomous dam. Curro has worked the last 14 years working for the port industry, mainly in development and innovation starting in Dragados SPL, Noatum and the last 4 years in Terminal Link (a CMA CGM company) as Innovation and Development Senior Manager.

Curro was the Co-Founder of TIC4.0 in 2018, and currently holds the Chair of the Operations Council contributing to the terminal industry

with his experience in engineering, IoT, Big Data and Operations.

Norbert Klettner has working for almost 20 years in the industry implementing and integrating TOS systems first for the terminal operator EUROGATE, now for many years as the Managing Director of the RBS EMEA Office and also implementing digital twin solutions with akynet port consulting. Founding member of TIC4.0 since 2018 he is member of the Operations Council, the Executive Committee and Vice-President of TIC4.0.

Luisa Kempf started her career in engineering and maintenance & repair of straddle carrier. She is working for almost 20 years in various roles in the container handling industry for the terminal operator EUROGATE. Since 2 years Luisa is holding the position Chief Technology Officer in the Engineering and Technical Service Division EUROGATE Technical Services. Co-Founder of TIC 4.0 in 2018 currently

holds the Vice-Chair of the Operations Council contributing to the terminal industry with her experience in engineering and management.

ABOUT THE ORGANISATION

The mission of Terminal Industry Committee 4.0 (TIC4.0) is to promote, define and adopt standards that will enable cargo handling industry to embrace the 4th industrial revolution.

The TIC4.0 initiative aims to bring together representative companies from both the terminal operators industry and port equipment manufacturers and suppliers to collectively work on the elaboration of such standards.

The TIC4.0 initiative has been endorsed by the Federation of European Private Port Companies and Terminals (FEPORT) and of the Port Equipment Manufacturers Association (PEMA).

<https://tic40.org/>

Understanding the data and getting the right conclusion

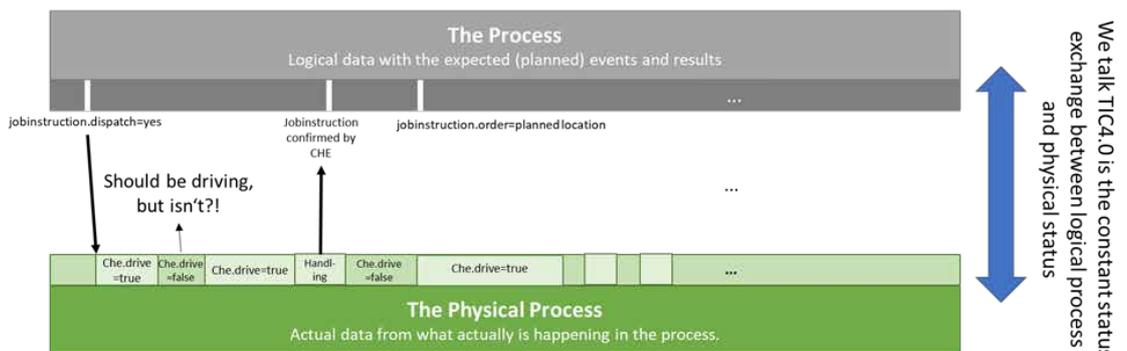
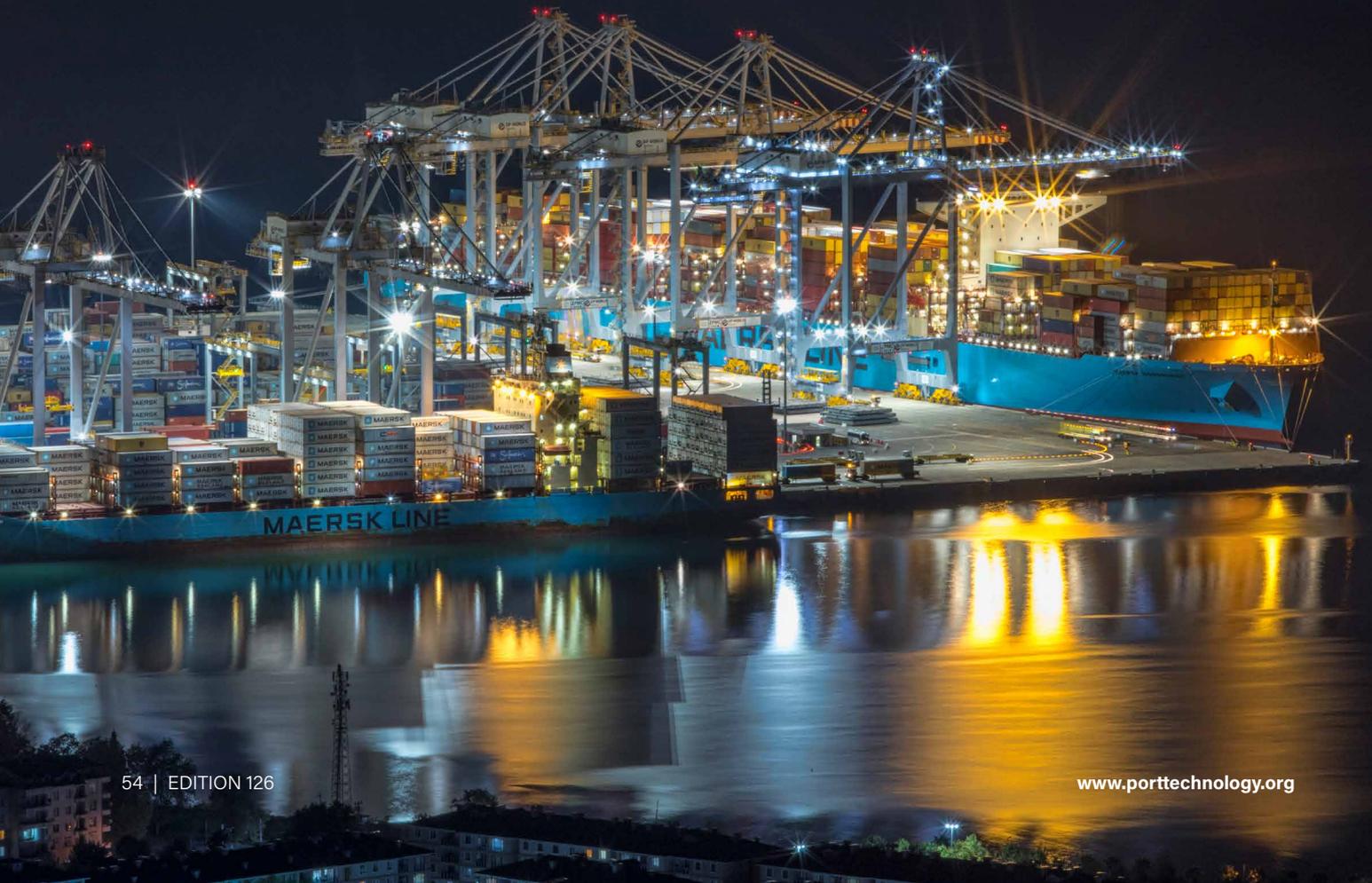


FIGURE 4

Example for talking TIC4.0

SUPPLY CHAIN INNOVATION IS WORTHLESS WITHOUT SAFETY





Enoma Woghiren,
Regional Head of HSSE, Europe,
DP World

Discussions about enhancing our supply chains always centre around the same few topics: digitalisation, automation and the diversification of trade infrastructure. A key area that I feel is too often overlooked, however, is the role safety plays as a foundation to a truly efficient global trade network.

It is not that these trends have no value to add – far from it. Evolving shipping and logistics from analogue systems to agile models that can keep pace with modern demand is a no-brainer. In fact, it is essential if we are to continue supplying vital commodities to those in need during times of crisis, from pandemics and political turmoil to climate change. But informing the application of these factors with safety across the world's ports and terminals could expedite a shift towards sustainable efficient supply chains that offer greater value to customers.

Most importantly, using these tools to enhance safety will create a better place to work for current employees and the future generation of talent who will shape our industry for many years to come.

SAFETY FIRST

The human beings that define a company and its culture are also the lifeblood of everything it offers customers, so protecting their welfare should be a priority for any business looking to sustain operations. Reducing risk in all scenarios should be paramount.

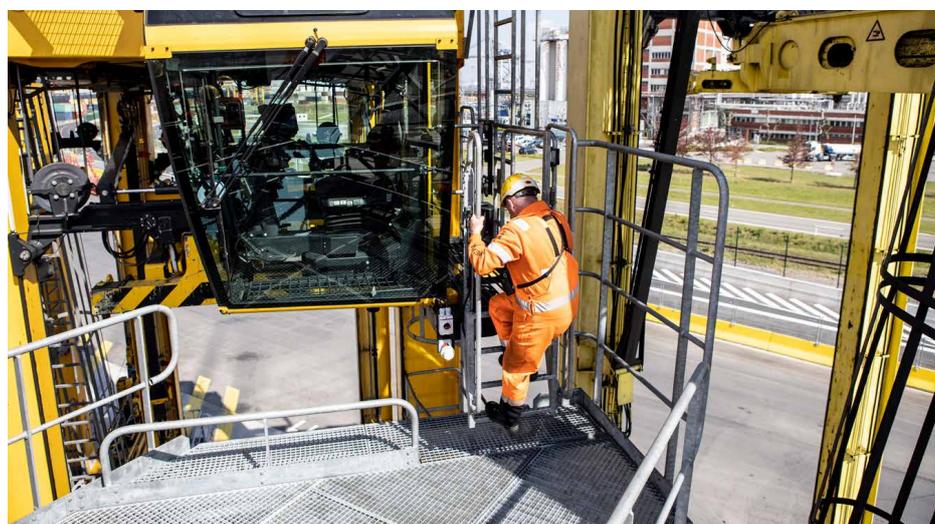
Why does this matter when it comes to enhanced supply chains? Because regardless of how smart our solutions for streamlining the

“IN TODAY’S INFORMED SOCIETY, INSTILLING SAFER PRACTICES AS WE IMPROVE OUR SUPPLY CHAINS IS HOW WE, AS AN INDUSTRY, CAN MAINTAIN TRUST WITH CUSTOMERS, WHICH IS FUNDAMENTAL TO OUR LONGEVITY.”

trade network are, they will be defunct if the heart of our industry – our staff – aren't valued or considered during implementation. Keeping people safe so they can do valuable work is part and parcel with them feeling empowered to do their jobs. Therefore, considering safety as a fundamental part of innovation will ensure its success.

An example of this is to use digitalisation to minimise high-risk scenarios at a terminal. Virtual

reality is a technology we are now using to train employees for dangerous jobs but in a risk-free environment. Throughout our terminals, we use infrared cameras to detect fatigue in our drivers so we can anticipate vehicle injuries and stop them. In Yarimca, Turkey, meanwhile, we are using Digital Surveyor, a programme that virtually assesses a vessel and its cargo for faults, so a human does not have to. This saves time (78



“IF A TERMINAL VEHICLE HAS WORN BRAKE PADS, IT WILL BE FLAGGED AND REPAIRED BEFORE IT BECOMES AN ACCIDENT RISK - OR DELAYS A SHIPMENT.”



LEFT
Straddle carrier in operation

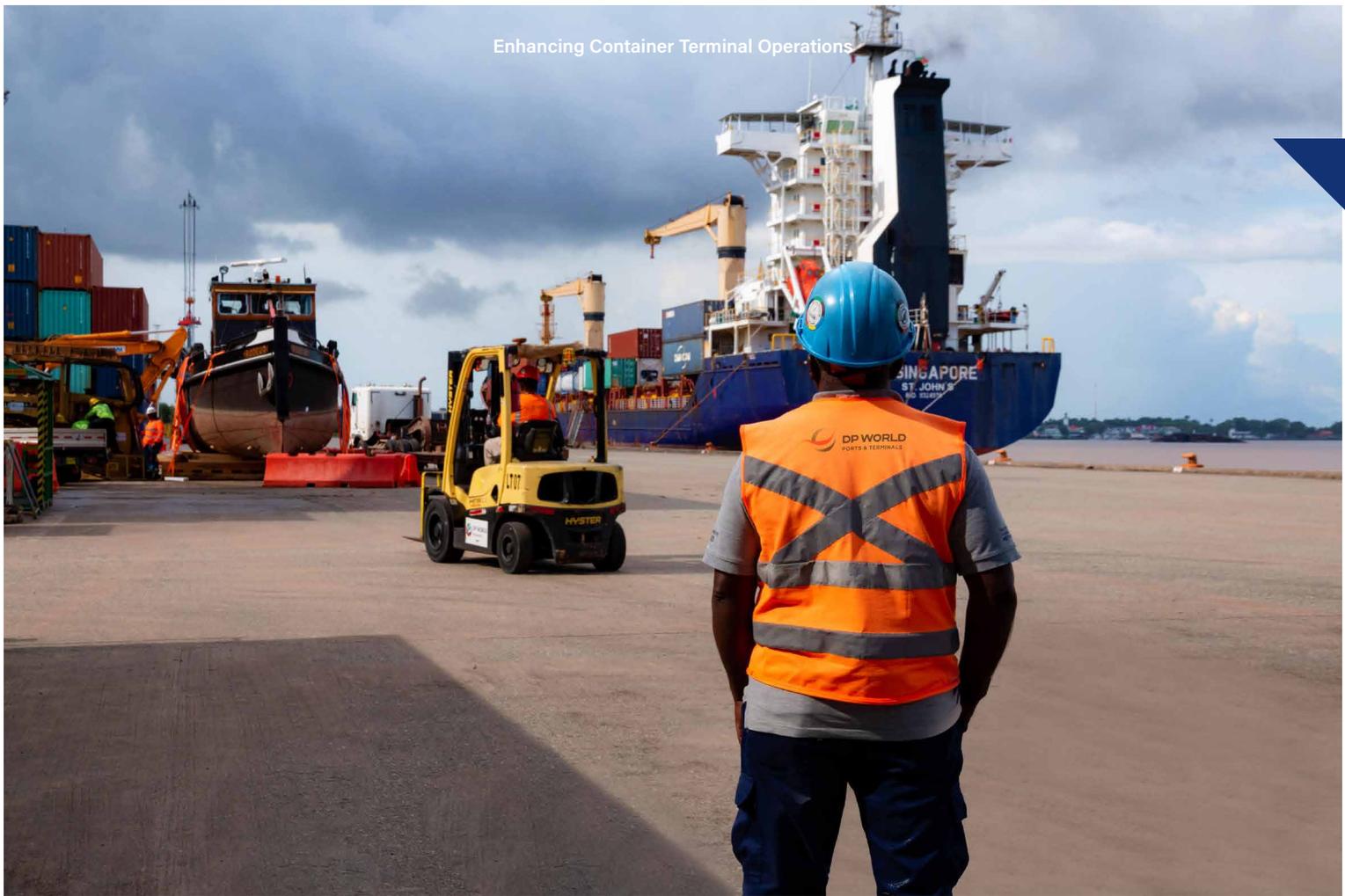
hours a month per vessel) and saves staff from carrying out risky physical assessments – or having to stop working because of injury.

There are numerous business benefits to these smart solutions. Giving staff greater flexibility to upskill being one of them; maintaining flow during periods of staff sickness is another. However, for me, what underlies the success of these benefits is the employee wellbeing. Rather than replacing humans in the workplace, digitalisation and automation enables them to work safer. And while people are physically able to work, they can be made available for other port operations, meaning they can contribute more to a terminal's efficiency and develop their own skillset. By doing this, they can run the more streamlined, resilient supply chains of tomorrow.

The way we are combining innovation with safety across our ports, providing scalability, and meaning we can create a strong foundation for safety and efficiency globally. Whereas traditionally an HSSE development may have only occurred in one port within a network, digitalisation provides a way of expediting these same improvements to the rest of the supply chain.

For example, an interactive digital port map, like we have at Jebel Ali, Dubai, is plugged into every aspect of the terminal. We know the exact location and status of vehicles, cargoes and the people looking after them. If a terminal vehicle has worn brake pads, it will be flagged and repaired before it becomes an accident risk – or delays a shipment.

Another bonus of strategically applied innovations like these are the insights they provide. We can foresee risk, test it and create plans to eradicate it throughout every level of the terminal through digital auditing – and apply it across our business. Likewise, we can better track safety data from other regions, compare stats and implement change faster than ever before. The result is an equal



rollout of safety improvements that are ensuring safe, empowered employees; fewer insurance claims; smarter, safer ways of working; and an industry that works seamlessly for employees and customers alike.

All these factors are characteristics that clients, workers and customers value – they even boost confidence in potential investors too. Further, in today's informed society, instilling safer practices as we improve our supply chains is how we, as an industry, can maintain trust with customers, which is fundamental to our longevity.

MAKING CHANGE COUNT

Enhancing port efficiency through safety is the ideal, but it is not the norm for our industry – yet. Having worked in HSSE for 21 years I am

fully aware of the challenges we face in driving meaningful change through a safety lens. Yet while the journey to safer, more efficient end-to-end supply chains may take time, it is possible. As we are proving.

The age-old issue we have had to overcome – and that many still face – is that 'safety' is seen as a barrier to work; by adding layers of rules and precautions, it is considered a hinderer to progress rather than an enabler. This is at odds with the promise future-ready software and infrastructure brings. Yet what I'm seeing within DP World so far, where we're putting safety at the heart of our innovation strategy, this isn't the case at all. Even the simplest changes, such as adding collision detection software to all terminal vehicles or

using drones for high-risk security checks throughout our European region, are keeping goods and people moving and locking in more revenue in the long term.

To address this challenge, educating every level of our business has been key: engaging employees, building confidence in stakeholders to drive buy-in, and demonstrating to our leaders why safety must underpin all innovation. However, this is a two-way process. By including everyone, safety leaders should also learn from their teams on the ground about what needs to change – and can better understand what the company hopes to gain from change too. All this information can be used to implement change faster, in the right way and to the benefit of all employees.

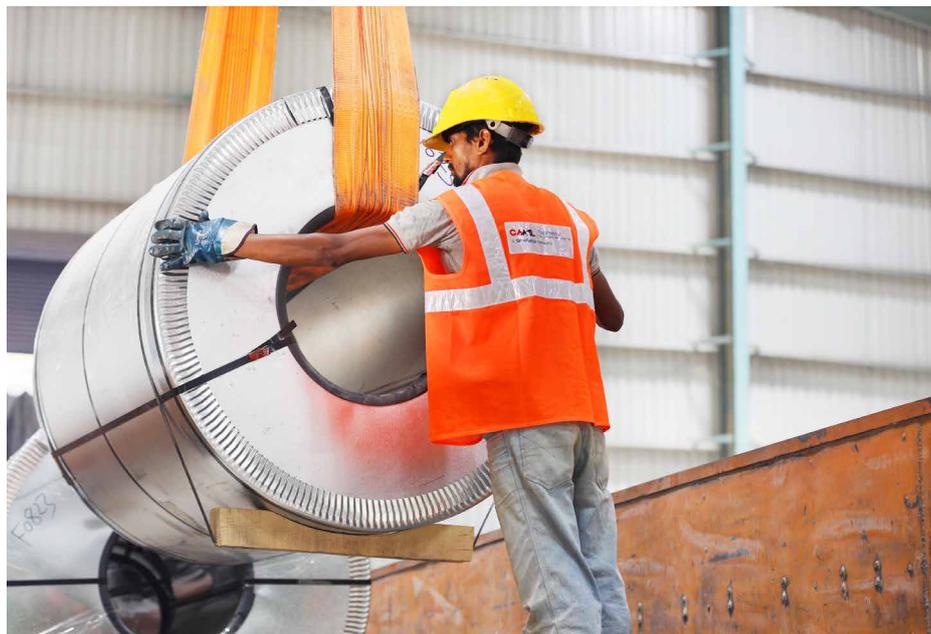
ABOVE
Safety on port

“PROTECTING THEIR WELFARE SHOULD BE A PRIORITY FOR ANY BUSINESS LOOKING TO SUSTAIN OPERATIONS.”

In my experience, this education phase also involves understanding how the innovations we make as a company can contribute to a just transition. By transforming our supply chains in a safe way together, we serve our employees and clients and the environments and communities in which we operate. Reducing workplace injuries across our global network protects families and their livelihoods while building consumer confidence in what we do as a business. Making our equipment safer is not only protecting staff but reducing industrial wastage from ill-managed equipment, reducing our environmental impact.

Supply chains keep the world turning. Therefore, as we consider the best course of action for making them more resilient, we must make sure whatever we do can stand the test of time and endure any crisis. Achieving this is only possible by making safer practices part of this transformation.

As testament to this belief, we announced an €80 million investment in European safety innovations this year. Already, this has led to a staggering 40 per cent decrease in injury risk. While there is still progress to be made (as 0 per cent injury risk is the goal we should all aim for), this dramatic decline in injuries shows just how quickly this approach can produce good results. By considering human impact in every innovation we make in our efforts to enhance our supply chains, we are creating sustainable solutions that will ensure our industry can continue benefiting consumers whatever happens.



ABOVE
Employee working on steel coil at cargo depot

ABOUT THE AUTHOR:

Enoma Woghiren joined DP World in 2019 as Regional Head of Health, Safety, Security and Environment for the Europe region, bringing extensive leadership and international experience from across the maritime, transport and engineering sectors.

In his current role, Enoma leads and delivers the region's safety strategy to ensure that everyone goes home safe, and that the environment is protected and enhanced wherever possible.

A vastly experienced leader, Enoma passionately believes that employees are the lifeblood of any organisation, and protecting their welfare should be a priority for any business looking to sustain

operations. He also strongly believes that using technology and innovation to enhance safety will create a better place to work for current employees and the future generation of talent who will shape our industry for many years to come.

ABOUT THE ORGANISATION:

DP World is the leading provider of worldwide smart end-to-end supply chain logistics, enabling the flow of trade across the globe. DP World's comprehensive range of products and services covers every link of the integrated supply chain - from maritime and inland terminals to marine services and technology-driven customer solutions.



LEFT
Operating on lifting cargo

“THE AGE-OLD ISSUE WE HAVE HAD TO OVERCOME - AND THAT MANY STILL FACE - IS THAT ‘SAFETY’ IS SEEN AS A BARRIER TO WORK.”



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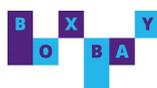
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