



Seahorse Technology Journalist of the Year 2023 winning submission

Emmanuel Mair

It's all in the data

With more than half the global reefer fleet equipped with telematics devices, the next frontier is the dry container. **Charlie Evans** and **Emmanuel Mair** find out more

Data is a crucial driver of decision making in today's world, and hence all around us, there are endless metrics being tracked in real-time. When smart devices on our wrists can tally our daily steps and monitor our heart rates, users can be more informed about their health and fitness choices. This clearly has direct benefits for the individual but there are also wider economic reasons, so much so that some life insurance companies have even begun offering better deals to customers who use smart watches.

In a broader context, the same logic behind the use of smart devices can be applied to containerised supply chains – the blood cells of global commerce. When it comes to transporting perishable fruits, which respire during their transport, it has now become a no-brainer for carriers to equip their fleets with telematics devices. These provide real-time tracking and monitoring, enabling operators to improve equipment availability, while allowing beneficial cargo owners (BCOs) to understand the location and status of their cargo to better control supply chains. Indeed, a recent report from Drewry highlighted that more than half of the maritime reefer fleet is 'smart'.

However, with regards to containerised transport, the next frontier appears to be the dry container fleet where less than 1% are equipped with smart devices. Shipping lines have previously been hesitant due to several factors, noted Olaf Habert, director of container applications at Hapag-Lloyd. Since dry containers do not provide an external power source for an Internet of Things (IoT) device to connect to, ensuring sufficient lifetime of a device at acceptable costs has been a challenge, he pointed out. Furthermore, there were safety concerns over devices operating in potentially explosive atmospheres when in proximity to dangerous goods (DG)

cargo and being used on liquefied natural gas (LNG) vessels, explained Habert. These factors contributed to high hardware pricing.

Nevertheless, change is on the horizon. Drewry has forecast the global telematics-enabled equipment fleet to grow six-fold to more than 10m units in the next five years, accounting for up to 30% of global box inventories by 2027. Indeed, the first movers are beginning to emerge. Last year, Hapag-Lloyd began the process of installing real-time tracking devices on its entire dry container fleet of around 1.6m boxes. Habert expects the adoption of smart dry containers to increase in the coming years “as we prove the value of this level of visibility for dry containers for operations across the supply chain and as customers will become a driving force in demanding real-time visibility”.

Hapag-Lloyd's devices, supplied by Nexxiot and Orbcomm, will transmit data in real time from each container, providing location data based on GPS, measuring ambient temperature within the container, and monitoring any sudden shocks to it. The carrier hopes this data will help to make supply chains more transparent and efficient. The devices integrate energy-harvesting technology and low-power consumption techniques to ensure that they have ultra-long service lives with high-frequency data transmission.

Habert told **CM**: “We now see that changes in the market are paving the way for a higher penetration of smart dry container. While carriers have more capital to invest, technology is becoming cheaper and advancing in areas of power consumption and power generation i.e. through solar panels. At the same time, there is an increasing demand from customers and other industry players for more visibility on

shipments and operations. Much progress has also been made in the discussion regarding safety requirements for IoT devices, enabling carriers to have confidence in their investment in terms of safety of their crews and future regulations.”

Stefan Kalmund, the CEO of Nexxiot, shared how Nexxiot and Hapag-Lloyd have successfully addressed the primary challenges of creating smart intermodal containers in the shipping industry. Central to this transition is Nexxiot's technology, the Edge gateway, which aims to make dry container digitalisation a reality. This technology, described by Kalmund as “virtually indestructible,” promises maintenance-free operations for over a decade. Notably, he claimed that it performs brilliantly in extreme conditions like high temperatures and holds certification from Atmosphères Explosibles (ATEX) underscoring its fire-safe credentials.

Elevating this collaboration is the speed and efficiency in digitalising the entire global container fleet, even with assets dispersed globally. Nexxiot's devices are engineered for rapid installation taking less than a minute for each one, ensuring minimal disruption to maritime carriers' operations. “The goal isn't just to digitalize parts of a fleet or concentrate on specific trade routes; it's about taking a holistic approach, recognizing that containers constantly travel worldwide,” Kalmund emphasised. He lauded Hapag-Lloyd's decisive move to embrace full fleet digitalisation, which is to be accomplished in just 18 months.

“When the full fleet becomes digital, the true value arises from data insights and process automation,” Kalmund explained. “Carriers can derive insights from the entire fleet, monitoring details such as changes in movement patterns - down to individual assets or across specific lanes and areas of interest, border crossings, transport modality, and potential security or safety issues. Imagine receiving immediate alerts about unauthorised container door openings, pinpointing the exact time and location.”

From a business perspective, Kalmund is buoyant about the prospects of this technology. He anticipates that the investment in such expansive digitalisation will yield returns within 18 months of its completion. Kalmund identifies two main drivers for this return on investment (ROI): firstly, the opportunity to provide enhanced data services to shippers, like accurate ETA updates, and secondly, the considerable internal advantages of optimising container fleet operations and boosting the cost-effective management and movement of these assets and the cargo they carry.

“In every scenario we've assessed, the benefits following the digitalisation of the entire fleet become apparent within an 18-month timeframe,” Kalmund concluded, creating value for all stakeholders and painting a bright picture for the maritime industry's future.

Another shipping line which is beginning to embark on the adoption of a smart dry fleet is Ocean Network Express (ONE). In February, the Japanese company announced a collaboration with Sony Network Communications Europe to develop and integrate a “smart container solution” across its global fleet. At present, the number of dry containers involved in the project has not been disclosed.

A spokesperson for ONE told **CM**: “A primary goal of the collaboration between ONE and Sony Network Communications Europe is to enhance ONE's container fleet management capabilities. By incorporating technology into the containers, we hope to gain a deeper understanding of a fleet's operations. By developing this innovative solution for dry containers, we bring a multitude of benefits to our valued customers. We are collaborating with experts in our respective fields to ensure that we set a new standard for process excellence, ensuring a high level of service quality for our clients.”

The carrier noted that the technology will give ONE greater insight about its fleet, while the data will enable better visibility of the containers,



faster and proactive decision making, allowing more efficient container movement. Customers will also be able to access live updates throughout a shipment's journey.

The company announced plans to install telematic devices on its reefer box fleet in June, highlighting the ability to provide customers with an all-encompassing view of their cargo. This enables them to make data-driven decisions for more efficient operations, based on active monitoring data about temperature, humidity, and other conditions. In particular, ONE hopes that incorporating telematics into its reefer fleet will help it address problems as soon as they arise, such as malfunctioning reefer units, while making proactive decisions about cargo handling.

Maersk is one of several carriers which offers a smart reefer solution but does not provide a similar offering for its dry fleet. Today around 98% of Maersk reefer fleet is equipped with IoT devices, enabling a data flow during both ocean and inland journey which is used to optimise operational monitoring. Therefore, Maersk can take better care of cargo through reacting to immediate notifications from containers rather than being dependent on manual inspections, helping to reduce operational monitoring costs, according to Ken West, senior digital development manager at Maersk.

Since 2019, Maersk has also offered customers greater visibility into the shipment through its Captain Peter platform. The latest version of the platform enables customers to access the raw data via an Application Programming Interface (API) and thereby get reefer datalogs pushed to their system of choice, either their own transport management system or to a third-party platform, where customers might already aggregate data from different sources. Another feature is shared access, which allows the contractual customer to open up data access to the respective consignee and shipper.

As of now, Maersk is not working on equipping its dry fleet with smart devices. West explained: “The main benefit we've had from installing devices on the reefer containers is the savings that we have had operationally e.g. from the improved way that we do pre-trip inspections of the containers and the ability to get reefer datalogs from remote. We don't have the same level of monitoring and inspections on dry containers, so the benefits would mainly have to come from offering visibility services to customers shipping dry containers. And here we do not yet have a clear view on what customers will need in future in terms of parameters like location, temperature, humidity and what value such information would bring.”



This Page

Left: Nexxiot's Edge device

Right: ONE is working on a smart container solution with Sony

Opposite Page:

Hapag-Lloyd is installing smart devices on its full dry fleet

Digital twin-sight

Maintaining waterway depth is an absolute necessity for ports looking to attract large ships, but real-time data has been scarce until now. **Emmanuel Mair** reports

As shipping lines look to bring larger ships to the shores of Latin America, the delivery of reliable and consistent waterway depth has never been more critical to the success of a port. On a day-to-day basis, nothing is more frustrating for carriers and terminals than facing loading restrictions for containers due to a failure to maintain channel depth.

In the medium to long term, as carriers consider the most profitable routes for their services, the provision of deep draughts could be the difference between a port establishing regional hub status or falling away into the role of a feeder port.

Although waterway depth is so important, there is a surprising lack of data available to monitor its status on a consistent basis. Ports typically initiate hydrographic surveys several times a year to access a snapshot of the seabed, from which they can judge draught levels and dredging requirements. Yet, in today's digital world, it seems unsatisfactory to have mere snapshots instead of constant monitoring.

In the eyes of entrepreneur and former Israeli Navy officer Uri Yoselevich, there are obvious benefits to plugging this black hole of information. DockTech, a start-up he co-founded and where he is now CEO, utilises digital twin technology to use bathymetric (depth measurement) data collected by tugboats and other harbour vessels to create a virtual representation of the seabed of ports and waterways. The solution consists of real-time tracking of waterway depth and understanding how the silting pattern

of ports can affect shipping and cargo transport safety.

Yoselevich told **CM**: "The main challenge of a digital twin is to keep it high fidelity. In order to keep it high fidelity, you need to have a constant stream of data that is updating it an any given time, maybe from multiple sources or from multiple places. Until now, no port had that.

"At the same time, we have an abundance of ships sailing inside ports. Every ship today is a giant hub of sensors. The speed, the depth, the position, the wind, environmental sensors etc. We understood that that's the key."

He continued: "If you want to have a high-fidelity digital twin, you need a dynamic data collection. You are taking advantage of vessels already there on the waterway and they are sensing the environment around them. If you get enough of these and they are running around, then you get the entire waterway.

"This is what we do. We collect data from tugboats to cover the port. They are the main data feed to the digital twin and we integrate some other sources. This is how we make our digital twin a high fidelity one."

According to IMO regulations, every vessel must have several environmental sensors on board. Therefore, via the tugboats, DockTech can access data on the depth below the ship from the echo sounder, the position from the GPS, the wind speed and direction from the wind sensor plus data on humidity, air temperature and water temperature. All of this information is utilised in the digital twin, which can create a sophisticated model of currents and tides.



This Page:
Santos has had a running issue with dredging

Opposite Page:
Left: DockTech can access data from Wilson Sons' tug boats
Right: Eduardo Valença (left), director of digital transformation at Wilson Sons, with Uri Yoselevich, CEO of DockTech



In 2021, DockTech and Brazilian company Wilson Sons signed a technical cooperation agreement with Santos Port Authority for the improvement and the use of the technology in the Port of Santos. The start-up has also signed letters of intent with several Brazilian ports including CODESA, Praticagem do Rio de Janeiro, Porto do Açú and Portos RS.

The company currently has operations in five countries, with 95 vessels monitored in 35 locations. In addition to monitoring the ports of Brazil using Wilson Sons' 80 tugs, the startup operates in Tampa Bay in the US, Barranquilla in Colombia, the Danube Romania and Ashdod and Danchor in Israel.

The tool has an opportunity to prove its utility at the Port of Santos, which has struggled to deal with dredging challenges for an extended period, to the frustration of Brazil's maritime sector. Dredging is not only a costly operation in a direct sense, but the activity also interrupts daily operations, reducing the efficiency of the port and its terminals.

Using DockTech's technology, the port authority can see a visualisation of the depth throughout the whole waterway, particularly highlighting areas close to the declared depth which a port authority is contractually obliged to provide all-year round. Rather than triggering a hydrographic survey on a periodic basis, the port can initiate one at the right time based on data. This is of significant use in Santos which has an ongoing sedimentation problem. From the digital twin, the port can then supply information on coordinates and volumes to the dredging contractor.

Yoselevich added: "Something that is very unique is that we can also look at the future. We want to reach out and analyse the hot spots. The first derivative of sedimentation is sedimentation velocity – how fast the sediments are moving. Areas with high sediment velocity are going to change more rapidly than others if you look ahead.

"If you are a dredging contractor or dredging manager, you can see the trends in each area rather than relying on research from historic data. Now you really have it all – data on the present day, trends and the future. This is everything you need. This can save up to 15% of the dredging expenses per year. This is just the direct value



it brings."

Besides dredging, Yoselevich is also keen to showcase multiple potential use cases. "Dredging is a concrete use case that ports came to us and asked for," he noted. "Air quality monitoring is something that customers ask us to do. There are a lot of adjacent uses that we see today. There will be much more in the future. We want to prepare for them because you need digital infrastructure."

Last year, the start-up raised about US\$2.5m in new capital injections from investors, with Wilson Sons increasing its minority interest in DockTech. The new investment round also included the participation of venture capital funds theDOCK from Israel and Cultivation Capital from the US, as well as some retail investors. The funds raised will support the start-up in the development of new applications, commercial prospecting and will help scale up the product.

Some potential examples of further use cases include adding air quality sensors to tugboats, using tug boat sensors to create better tidal models, which is of particular interest to pilot groups, and calculating the amount of CO₂ emissions from a vessel by understanding the current in real-time. With regards to maritime insurance, by reducing the risk of a grounding or an accident, there are potential implications for premiums and the entire risk assessment process.

Experience over the past year has also yielded new information on how ports are using the digital twin. Data has proved useful for post-incident reports, helping to resolve issues with multiple stakeholders, as well as verifying post-project completion with dredging contractors.

Looking ahead, Yoselevich is keen to keep getting the message across about the benefits of having a digital twin for the waterway. In this way, it will be a natural progression to turn pilot customers into paying customers.

He concluded: "Waterways can be very political because they are costly assets for ports and countries. I believe in the single source of truth. Everyone is looking at the same facts. You can argue about responsibility, but you cannot argue about facts. The digital twin is the only way to get a single source of truth, which is essential in our industry where there are ten stakeholders for every ship movement in and out of a port."

Changing the game

With ambitions of reimagining container port operations, BOXBAY's high bay storage system is set for commercial use in Busan. Emmanuel Mair finds out more

Wherever you look right now in the container port sector, there is plenty of innovation happening. Operators are using AI and machine learning to deliver smarter operations, more efficient container movements and provide greater reliability and visibility. Yet, it can be said that a lot of the developments in motion are in the sphere of incremental steps rather than game-changing leaps. Taking existing processes and doing them in a more intelligent way is clearly beneficial to users, but it isn't often that a development comes along with the potential to remodel operations altogether.

Against that backdrop, BOXBAY's high bay storage system appears to be one of the boldest innovations in the industry. By utilising a steel structure where each individual container can be directly accessed rather than a traditional stack, unproductive shuffling moves can be eliminated. Until now, containers have been stacked on top of one another, which means many containers have to be moved to access containers lower down in the stacks, representing as much as 60-70% of all moves. Therefore, in theory, the container yard layouts familiar to ports around the world can be transformed. Naturally, the company believes it can be a gamechanger for terminals with limited yard space or restrictions on room for expansion.

Formed as a joint venture between port operator DP World and industrial engineering specialist SMS group, BOXBAY commissioned a proof of concept (POC) project at Jebel Ali Port in Dubai at the start of 2021. The high bay storage (HBS) design is an adaptation of the technology used by SMS Group-subsiary Amova for the handling of metal coils. BOXBAY's designers aim to deliver more than three times the capacity of a conventional yard with enhanced performance, so the footprint of terminals can be reduced by up to 70%.

In Dubai, the POC can store more than 1,000 teu. It comprises two aisles each running with one stacker crane. The interface to the waterside is realised via handover tables while the landside is served by an automated truck crane.

Martin Aufschläger, managing director of Amova, told **CM**: "Until mid-2021 we did extensive performance testing to confirm some of the assumptions in the data that we used for simulations. We confirmed that we either met them, or are even better than we had initially assumed. Then we decided that we have a marketable product to take to the market."

In March this year, the company heralded a key milestone, signing a contract with its first commercial user Pusan Newport Corporation (PNC), initiating the design and engineering works for the site. BOXBAY's high bay storage technology will be integrated along with the existing mode of automated rail-mounted gantry (ARMG) crane/truck operations as a retrofit on an existing empty storage area. With the project now in its design phase, works on site are expected to start by the end of next year or early 2025. In the case of PNC, it is hoped that the direct container access will eliminate 350,000 container moves per year, improving the overall truck servicing time by 20%.

Tiemen Meester, chief operating officer of ports and terminals at

DP World, said: "It's a tremendous step forward to announce our first commercial use of BOXBAY. The PNC terminal is an exemplary operation that is already technologically advanced and forward focused. With the introduction of the BOXBAY high bay storage system, we will be able to better serve our customers while keeping our people safe and cutting carbon emissions from the environment."

Dr Mathias Dobner, BOXBAY CEO, stated: "Realising our first commercial BOXBAY system is a tremendous success within such a short period of time after finishing the tests in our proof-of-concept facility in Dubai. With BOXBAY, we will help PNC to increase its competitiveness further. In Busan, we will once again demonstrate that our system can help port operators worldwide to overcome current challenges and get ready for the future. With the trust of a highly efficient terminal like that planned for PNC, we are confident of expanding our business further across the industry."

The system in Busan will be five times the size of the POC in Dubai. Aufschläger noted that it represents a "good scale up factor" as it is neither too large nor too small. Compared to the POC, there are upgrades in the mechanical design and updates in the steel structure. Busan along with any other future location will have a cladded system, as opposed to the uncladded system at Jebel Ali Port, which was designed to showcase the operations going on inside.

PNC's development will have a so-called Hybrid Grid system, which is elevated in order to interface with autonomous prime movers. These vehicles will drive directly under the system and containers will be loaded and unloaded directly from the stacker cranes. Landside vehicles will be handled via truck cranes and a pallet system, the same interface as in Dubai. At first, also waterside traffic will be handled with the truck cranes. Over time, however, it is expected that the terminal will move in the direction of autonomous prime movers.

The ability to directly access containers means that it is easy to calculate how long it takes to get that container to the transfer point, and then to the quay crane. This can lead to a better utilisation of transfer equipment such as terminal trucks and automated guided vehicles (AGVs). Simulations showed that quay crane productivity can be improved by as much as 20%.

Detailing the benefits for PNC, Aufschläger explained: "The key reasons are better efficiency and being able to serve the customers better, reducing waiting times and loading times both at the waterside and the landside. We will use this system primarily for import containers. We will reduce the number of reshuffling or housekeeping moves significantly, thereby reducing operational costs. Also, with future autonomous and automated operations BOXBAY helps to improve safety.

"There are also environmental reasons. We intend to run the system with a solar system on top so that the operation itself is 100% CO₂ neutral. We will most likely produce more energy than is required for the system so we can even feed some of the excess energy back into the grid or use it to, for example, power the ship-to-shore (STS) cranes, or to in future use it for charging the electric trucks or prime movers."

This issue is increasingly important, as terminals look to decarbonise



their operations, with many global operators already setting net zero targets. Even in regions where energy costs are very cheap, there is enthusiasm from potential customers over the potential sustainability, noted Aufschläger.

Of course, while BOXBAY can talk a good game, for a wide range of terminal operators to invest, there needs to be a return on investment. As the premium product in the container port market, significant capital expenditure (capex) will be expected. "It's very much dependent on where you are," commented Aufschläger. "If you are landlocked or need to expand into the sea, or need to reclaim land, or if you have the chance to re-dedicate part of your land to other revenue-generating services, then BOXBAY becomes more attractive. There's a trade-off between newly created land and going vertical. In a situation where land doesn't matter or it's more or less available, BOXBAY is harder to sell."

On the operating expenses (opex) side, the system's fully automated nature means that there are no labour costs. This makes it attractive to ports in areas where there are increasing labour costs and/or a shortage of skilled labour. Meanwhile, compared to direct competitors like ARMGs or automated stacking cranes (ASCs) at the high end of the crane automation market, BOXBAY's advantage comes from its elimination of

reshuffling moves. Saving moves saves energy and reduces the stress on the equipment and the maintenance cost. As the number of gross moves is equal to the number of net moves, the expected life is longer and operating costs are lower than for conventional crane systems, pointed out Aufschläger.

Yet, the container port industry is known for being conservative in nature. It is not one prone to embracing new technology. Aufschläger is keen to point out that Amova already has 30-40 references worldwide for similar high bay storage systems for coils with a similar weight profile. This gives it experience in designing a steel structure according to local requirements and standards that is not too heavy, meaning too expensive.

He is confident that despite any worries, BOXBAY has a compelling case to shake up the market. Aufschläger concluded: "This is an extremely asset heavy industry and capex heavy so you want to be damn sure that whatever you implement will work. That's what made the POC so important. As of today, we've done more than 200,000 moves for this system. It's important to improve the system on the one hand but it's also important to show potential customers that it's working. This really helps. When you take people there, they understand the system better, they see that it's not rocket science. It's simple but smart."

This Page:

Top: The proof of concept in Dubai

Bottom Left: Sultan Ahmed Bin Sulayem, Group Chairman and CEO of DP World at the contract signing

Bottom Right: BOXBAY is a joint venture between DP World and SMS Group