



My colleague is a robot!

Automation means many things to different port operators, whether it is used simply to control the gate function or to run an entire terminal, as **Geoff Adam** found out while visiting TOC Europe

Automation has become the buzzword in the ports industry as demand for greater productivity pushes more operators, big and small, into looking at ways to improve container handling processes.

What started out as simple automated systems designed to replace the old 'T cards' for positioning containers on board vessels or in the yard has now become a totally integrated component that almost removes the need for human interaction. In short, it might only be a question of time before operators actually

become the 'servants' of robotics.

One such area is the container stack, where over the years human intervention has been reduced to a minimum, with automated rubber-tyred gantry (ARTG) and rail-mounted gantry (ARMG) cranes taking over operations under instructions from the terminal operating system (TOS).

Now an entirely new concept – and perhaps one that indicates that robotics could be the future of the industry – was unveiled by

Israel Aerospace Industries (IAI) at this year's TOC Europe. Going one step further than before, the "Robotic Container Terminal" is a new and inventive high-rise storage facility located adjacent to the ship-to-shore (STS) gantry cranes on a terminal.

A platform extends from the storage building to underneath the cranes, meaning that boxes can be placed directly onto horizontal transport and taken to assigned locations in the facility. An advanced, state-of-the-art command and control (C2) system will provide

continuous container location management to optimise the use of available storage space.

"The project is called RCMS – Robotic Container Management System – and essentially it is a robotic warehouse for the storage and management of containers," Hanan Lepek, an innovation specialist at IAI, told *CM*.

"It allows better utilisation of land resources because, unlike today with the limited height of RTG, RMG and even automatic stacking crane (ASC) operations, RCMS provides capability for more

The Robotic Container Terminal is a new and inventive concept for the stack



than doubling the stacking height of containers,” he explained.

“Also, while RMG, RTG and ASC operations suffer from issues such as shuffling and housekeeping, especially when dealing with import-export truck operations, we can change the configuration of containers inside the building because everything is software-controlled. Depending on the configuration, it would be possible to have direct access to every container in the facility or part of it.”

Omni-directional L-AGV

The company has several patent applications pending on the system’s key elements: one, an “Omni-Directional Lifting AGV”, has a mechanism to load and unload containers inside the storage cell.

This one piece of equipment, Lepek said, would be able to take containers all the way through the journey from STS crane to the storage cell – “unlike today when you first have horizontal transport and then have to transfer the container to another type of equipment,” he explained. Eliminating superfluous moves and equipment transfers will increase efficiency and improve ship turnaround times, according to the company.

The unique small-size lifting automatic guided vehicles (AGVs) were designed to

comply with the requirement for a compact storage warehouse space; transfer between floors is performed via robotic elevators. Other patent applications relate to algorithms and sophisticated control logic operational methods developed by the company.

The bottom floor would be left open for trucks to drive straight into the building to pick up or drop off containers.

The design has already been worked on for several years, and Lepek stressed what a major operation it is. “It’s a lot of work in terms of design for a multi-discipline project like the RCMS,” he said, pointing out that it takes in the robotic elevators, omni-directional lifting AGVs, C2 systems, logic control, gantry cranes, power management, civil engineering design and many other important issues.

“We’re now ready to launch,” said Lepek. He would not reveal who the current design was for, but said that it could be tailored to meet the needs of customers and was scalable to the size of the operation.

Perhaps the best examples of top-end automation projects at present are APMT Maasvlakte II and DP World’s Rotterdam World Gateway facilities, which are both scheduled to begin operations in Rotterdam later this year. They will join DP World’s Jebel

Ali Terminal 3 (T3), with its 19 highly sophisticated quay cranes and 50 ARMG yard cranes.

Both operators claim that their European facilities will set new standards in automation, with little need, if any, for human involvement on the terminal itself.

At both facilities, containers will be handled at the quay and within the container yard by remote-controlled automated STS and stacking cranes respectively, with horizontal movement being performed by AGVs using on-board navigation systems following a transponder grid on the terminal. In the case of APMT, these will be advanced ‘lift’ AGVs.

3C collaboration

To achieve the best results from automation, APM Terminals and DP World, along with the Long Beach Container Terminal in the US – known collectively as the ‘3Cs’ – approached software systems specialist Navis in order to combine their general requirements to find a way forward. From this, Navis developed a common framework, with specific individual configurations to adapt to different or unique processes within different terminals.

Acknowledging that terminals do not necessarily have the same demands, Andy Barrons, chief marketing officer at Navis, told *CM* that the company is two-and-a-half years into a three-year development programme for a new automated terminal framework in its N4 TOS. “Our philosophy is to develop one standard platform, rather than customised systems that are not scalable or supportable in the long term,” he said. He continued: “The 3C is a great way to develop a



Andy Barrons, chief marketing officer at Navis

future-proofed platform for automated terminals built within our N4 system, reducing the risk when introducing new technology and software functionality. Although each terminal’s needs are similar, there is no standard in the industry yet in terms of the equipment used or the terminal layout.”

Admitting that Navis and the 3Cs are putting their necks on the block, Barrons said: “This is real transformational work; we are trying to achieve a new level of efficiency for the industry with new technology. Apart from the automotive industry, there are few other sectors where such technology is being used.”

The software is now at an advanced release stage, with emulation testing being carried out. The next stage is to run each of the three projects separately and, once tested and proven for different equipment and layouts, the systems will ‘go live’.

Barrons continued: “This isn’t just a question of building a scheduler; there are multiple levels of testing that need to be undertaken with very skilled people; it’s rather like training airline pilots how to use the software and handle exceptions. The training is different from the regular N4 implementation.”

Unlike with Navis SPARCS/EXPRESS, which required terminals to purchase a whole new system when migrating, those on N4 heading down the



One of the best examples of current top-end automation is APMT Maasvlakte II

automated route will be able to upgrade from their current N4 to the new release with the automation functionality, once it becomes generally available next year.

This will include optimisation of equipment towards full automation, along with a new business intelligence module to help track operational key performance indicators (KPIs) at their terminals, confirmed Barrons.

Commenting on the fact that headlines tend to talk about high degrees of automation, he was keen to allay fears that the new N4 release would only include functionality for the most advanced terminals. "Up to 40% of content in the next release will be for traditional manually based terminals, where the customer can upgrade to use additional capabilities," he stressed.

The British engineering company Rolls-Royce is currently looking to develop a crewless drone vessel. When asked to look to the future, Barrons foresees an "Internet of Things" world, with a possible reversal of the current order through further development of Cloud technology, where smart containers may one day instruct the TOS where they are to be stacked and moved, rather than the other way round.

Becoming a reality

Quay crane automation is starting to become a reality, and power and automation group ABB's takeover last year of California-based APS Technology signalled an expansion of its systems, with the addition of vision-based process automation solutions to identify containers and other assets at key points of work around a facility.

Integrating these technologies on remote-controlled STS cranes, ABB has developed a system whereby the operator controls the container lift to a pre-determined point, after which the system takes over, explained Uno Bryfors, vice

president and head of ABB crane systems.

"Our cranes are fitted with ship profiling laser scanners that track the stack height of each cell throughout the loading/unloading operation. This allows the operator to pre-set the handover of a lift, with the computer taking over the box movement as a stowage move or a move to ground transportation," he told *CM*.

With the crane continually receiving updated orders, once the move is complete it automatically places the spreader above the correct cell and container ready for the next lift. Throughout the operation, crane-mounted optical character recognition (OCR) systems identify and track the container, providing a cross-reference check between the operator, the crane's programmable logic controller (PLC) and the TOS that the correct box has been selected.

Allen Thomas, VP of Operations for APS, explained that, ironically, with automation replacing human intervention, the integrated system is much like the human body, metaphorically speaking – the body, arms and legs being the crane, the brain the equipment control system linked via an on-board PLC, and the eyes the OCR cameras.

"The PLC is in command, with OCR identifying which box is being handled. If correct, the job will continue; if the box is not correct or it is not an acceptable deviation, then the system will require instructions from the operator as to what to do," he explained.

Stressing that the most important aspect is that the correct information goes together with the correct container, Bryfors said: "Today we have numerous hand-offs, from the ship to the crane, the crane to the ground vehicle, the vehicle to the stacking crane, the stacking crane to the truck – it's all about automating the motions and the flow of



The ABB system allows the operator to pre-set the hand-over of a lift

information." He added that the same applies to boxes coming into the terminals through the gates.

As ships and consignments become larger, Bryfors believes that the limiting factor to increased productivity is whether drivers are comfortable or prepared to sit in the crane, with the higher speed and acceleration required for faster handling.

"I think we have reached the limit; with driverless cranes, however, we can again increase speed and acceleration further, along with increasing multiple twin- or tandem-lift container handling, with the crane not stopping for shift changes to maximise productivity," he suggested.

Evolutional transition

Looking at the progression of technology, Mike Schwank, president of Tideworks Technology, told *CM* that in



Mike Schwank, President of Tideworks Technology

its early days automation was more about saving on labour costs; now he sees it as an "evolutional transition" driven by the arrival of larger ships.

"The rationale for automating a terminal, especially a greenfield site, is how to handle bigger consignments in a set period of time," he suggested.

However, he also believes that the industry is moving into a second automation phase, where technology is gaining a foothold in smaller brownfield ports – yet he believes that operators are facing a quandary. "Do they automate and, if so, is it to save costs or to improve efficiency?" he asked.

"While the big terminals are serving the major consumer market players, there will always be small to medium-sized terminals of less than 1m teu capacity. They will need to take on and improve automation incrementally to move more boxes across a fixed footprint to survive, because they are serving smaller yet still essential markets," he said.

Admitting that Tideworks leaves the mega-projects to others, Schwank said that the company's direction was to provide automated services to the existing, more traditional medium- to larger-sized terminals. This can encompass automating the stacking process, up to full systems automation within a manually operated terminal.

"There are a lot of traditional terminals that need incremental beneficial increases in the technology as their business and budgets

warrant. You can optimise a lot of tasks with or without automation, using software to provide smarter directions to assets, whether they are equipment, people or technology, to achieve better returns,” he remarked.

He also raised questions about the next wave of innovation. “A lot of containers now need to be moved into the hinterland; I think the next challenge for all ports, whatever their size, is going to be how to move containers off the terminal rapidly, without causing other disruptions and cost factors,” he suggested.

BoxCatcher concept

Anton Bernaerd, business development director at Camco Technologies, a company directly involved with OCR, acknowledged that no one solution fits all requirements and therefore processes need to be adapted to match customer requirements in improving performance, safer handling and profitability.

“The TOS is an important element, but if it cannot capture data efficiently and effectively it’s blind,” he pointed out. To overcome this, the company



BoxCatcher takes high-quality pictures of the box under the spreader

has introduced what it calls the “BoxCatcher” for use on manually operated and automated quay cranes.

Camco is the only supplier of this new OCR concept, which requires only two high-speed 12 megapixel resolution cameras fitted on a movable linear table located on the legs or beams of the quay crane. As a result, installation and maintenance support are easier, as the unit can be returned to its ‘home’ or maintenance position during shift changes if required,

without the need for high-level working.


According to Bernaerd, the system gives the crane ‘eyes’ and the ability to read IMDG classification numbers, the smallest-sized IMO codes and the presence of seals.

“BoxCatcher is unlike standard fixed OCR systems,” he claimed, “not only because fewer cameras are required compared with conventional systems, but also because the cameras follow the flightpath of the container during loading and discharging cycles.”

“Drivers will operate the crane in the most optimal way, determining the ideal flightpath by taking into account the operational conditions – the container weight and balance and its speed, along with the tide, wind and lashing sequence. The system follows this path, taking high-quality pictures of the box under the spreader at the optimum point,” he told CM.

“Interfacing with and using information from the crane’s PLC, our inventive and innovative solution compensates for the swing of a box as it moves, and calculates where the box will travel.

This allows for continuous acquisition of images at exactly the right time, no matter what size box is being moved and with no need to reduce the crane’s speed,” he added.

Camco is currently installing BoxCatcher on the cranes at DPW’s London Gateway and at APMT’s Rotterdam Maasvlakte II and DPW’s Rotterdam World Gateway facilities. It has other contracts awaiting installation while others are still at the negotiating stage, although Bernaerd was not prepared to name them at this point. 

Automated reefer monitoring

A new-generation, real-time wireless automated monitoring system is set to address the concerns of owners of refrigerated products about stability of temperature being maintained throughout shipment.

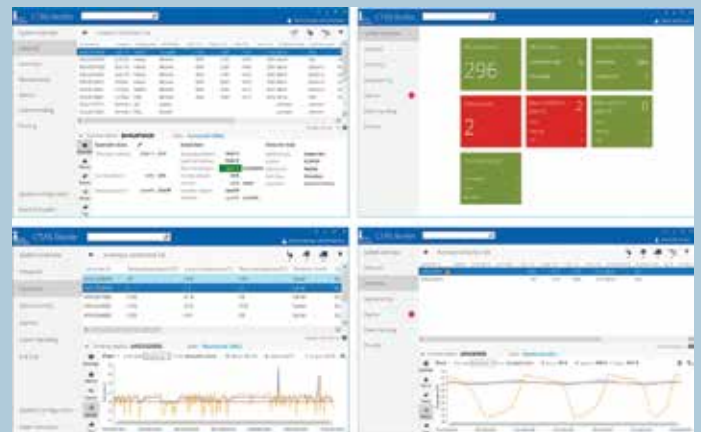
CTAS 7.0 Reefer by Identec Solutions allows ports and terminals to fully automate reefer container management. Using a Windows-based interface and middleware platform, the system provides ‘dashboard-style’ alarms, alerts, reports and business intelligence to deal with out-of-spec reefers.

Long Beach Container Terminal (LBCT) and ICTSI’s Tecplata terminal in Buenos Aires are the first customers for the system, which provides monitoring at their modern facilities. In both cases, CTAS

7.0 Reefer will integrate with the Navis N4 TOS.

The system also proactively identifies ‘at risk’ reefer boxes, even before they arrive at the terminal, alerting operators to possible non-conforming units that can be targeted immediately. If a reefer arrives out of the correct temperature range, the system will know and will notify the terminal that the box needs to be cooled more than expected.

Suitable for use in genset, stack and rack operations, the system remotely monitors a reefer’s status (including temperature) in real time, enabling operators to adjust set points, perform pre-trip inspections (PTIs) and download data logs. Data is captured by purpose-developed ‘plug-and-play’ long-range active RFID tags, which



CTAS 7.0 Reefer proactively identifies ‘at risk’ reefer boxes

connect to the reefer machine’s serial port.

The tags can be plugged in as equipment enters the terminal via land or sea gates, to provide near-total visibility of reefer units and to avoid problems such as reefer boxes being accidentally unplugged.

Peter Cosgrove, senior VP sales and services at Identec, told CM: “Our goal

is for the system to automate reefer management at the terminal, rather than relying on monitoring technology provided by shipping lines. This solution hands direct control to the terminal operator, with the data, alarms, audit trail, billing and claims handling reports needed to eliminate the risks traditionally associated with reefer box management.”