

RFID and GPS based process automation

IDENTEC SOLUTIONS delivers RFID, RTLS and GPS based systems to support automation of container handling at semi-automated facilities. Real time visibility and control software ensures traceability through integration with OCR and ASC systems.



CREATING THE NEXT GENERATION INTELLIGENT TERMINAL

“You can’t improve what you don’t evaluate, and the operational data provided by IDENTEC SOLUTIONS is key to our continuous performance improvement”

Oscar Pernía Fernandez,
Processes, Systems and Innovation
Team Leader, Total Terminal
International Algeciras

First semi-automated container terminal in the Mediterranean adopts innovative process automation solutions from IDENTEC SOLUTIONS and partners to drive total traceability, control and safety of waterside and land-side container operations

Located at the southern tip of Spain on the Strait of Gibraltar, a key global maritime artery linking Europe with Africa and the Mediterranean with the Atlantic, Total Terminal International Algeciras (TTIA) is the first semi-automated container terminal to be developed in the western Mediterranean.

Delivered in record time for a greenfield terminal automation project, TTIA began receiving vessels in May 2010, less than two years after the concession to build the new facility was awarded - and a full two years ahead of original schedule. By the time of its formal inauguration in July 2010, the terminal had already reached 47 per cent of its full operational status.

Built on a 35-hectare site at the Isla Verde Exterior expansion area, TTIA is the second container terminal to open at the Port of Algeciras Bay, one of Spain’s leading container ports. With annual capacity of 1.6 million TEU, and capable of serving ultra large container vessels up to 14,000TEU, TTIA is a major new transshipment facility for South Korean parent company Hanjin Shipping.

Hanjin, the world’s 10th largest container carrier, invests in terminals at strategic locations within its global ocean transport network. TTIA is the company’s 12th facility, joining sites

in the US, North Europe, South Korea, Japan and Taiwan. At a development cost of €350m (USD450m), TTIA represents the largest single investment by a Korean company in Spain, and the first time that an Asian shipping line has financed development of a container terminal in the western Mediterranean.

Hanjin and its fellow members of the CKYH Green Alliance - COSCO, the 'K' Line and Yang Ming - have positioned TTIA as a main connecting hub for Asia, Europe and Mediterranean, West Coast Africa, South America and US East Coast shipping routes. Other global and regional shipping lines, including Boluda, Hapag Lloyd, UASC and X-Press Lines, also use the terminal for Europe-Africa traffic and other services connecting via the Mediterranean.

While developed primarily as a transshipment hub, TTIA forecasts that around 15% of its business will eventually come from direct traffic, serving Spain's import-export trade and tapping into a potential market of 10 million consumers in the southern region of Andalucía.

The Strait has become a very competitive marketplace for transshipment operations, with investment in major new facilities both on the European and African sides. To ensure that it would deliver the low cost and high service quality needed to succeed in this demanding environment, TTIA was conceived as "a benchmark of efficiency for the 21st century," according to Hanjin Shipping Chairwoman Eun Young Choi.

To help achieve this vision, the terminal adopted new process automation solutions from IDENTEC SOLUTIONS and its partners to provide total real time tracking, control and safety of container movements throughout its semi-automated facilities, based on a pioneering combination of OCR, GPS and active RFID/RTLS technologies.

"Innovation is the soul of the TTIA project. This terminal aligns talent management and high technology, ensuring maximum quality of service."

Fernando Gonzalez,
CEO, TTIA

PROJECT PARTNERS

- IDENTEC SOLUTIONS
- ABB
- Hi Tech Solutions Europe (HTSE)
- CyberLogitec (CLT)
- CARGOTEC
- ZPMC



BUSINESS AND OPERATIONAL GOALS

Five key operational goals drove planning, design and technology adoption at the new facility, explains Oscar Pernia Fernandez, Processes, Systems and Innovation Team Leader at TTIA:

Reduce call time: Achieve high performance vessel approach and berthing, with consistent quayside productivity above 30 moves per hour. Adopt a vertical layout to maximize transshipment performance.

Save costs: Compete with terminals on the African side of the Strait by deploying automation to optimize higher Spanish labour costs. Create a highly reliable, 'zero incident' facility to minimize the cost of correcting errors. Enable the most efficient utilization of cranes and mobile handling equipment assets, including dynamic equipment pooling to minimize driving distances and waiting times.

Ensure schedule reliability: Offer guaranteed fixed berth windows and support these with an intelligent TOS using auto-planning and simulation as real time operational tools. Maximize vessel operations efficiency and TOS performance by integrating the latest technologies for automated real time data capture on all waterside container and equipment moves.

Deliver full operational control: Provide 100% real time container traceability throughout the facility. Eliminate the possibility of any misplaced or lost boxes in the automated container stacks. Develop robust procedures and technology tools for equipment queue management, logistics process control and proactive exception handling.

Provide service excellence: Drive overall quality and performance through stringent internal productivity and efficiency procedures, supported by operational analysis, planning and development tools.



TERMINAL DESIGN AND LOGISTICS CONCEPT

TTIA opted for a terminal handling system of 8 ship-to-shore (STS) container cranes on its main 650m (2130ft) quay, supported by an automated container yard laid transverse to the quay. Horizontal quay-yard transfer operations are managed by a fleet of 1-over-1 manned shuttle carriers (ShCs), which handle grounded containers in 3 lanes at the quay crane backreach. Hatch covers and container lashing are managed underneath the STS cranes, which are equipped with lashing platforms.

The yard is arranged in 16 blocks, each equipped with two parallel-type automated stacking cranes (ASCs). Transfer zones are located at both the waterside and landside ends of each yard block. Here, ASCs and ShCs collect and drop containers in a fully automated operation with no remote control required. This innovative arrangement is designed to optimize terminal logistics flows and performance by decoupling gate, yard and quay activities. The transfer zones play a valuable buffer storage role, enabling parallel operation of ACSs and ShCs at full productivity even in the case of disruptions.

THE CHALLENGES

To fully realize its decoupled terminal design and logistics concept and achieve the right balance between quay, horizontal transportation and stacking yard, TTIA identified a number of key challenges for its technology solutions providers:

Challenge #1

Find a way to accurately identify and locate shuttle carriers (ShCs) at the quay cranes and reliably match this data to container ID numbers in the TOS. While DGPS technology has proven its value for position detection in container yards and elsewhere in the terminal environment, it has proved problematic to apply on the waterfront as satellite transmissions can be obstructed by the massive steel structures of today's quay cranes. An alternative approach was therefore needed.

Challenge #2

Provide 100% automatic traceability in real time for laden and empty ShCs moving between quay and yard and between gate and yard, with full matching to container ID numbers.

Challenge #3

Ensure absolute safety for ShC drivers when entering and working in the yard transfer zones. As the only area in the terminal served both by manned and unmanned equipment, robust safety logic and control systems were needed to manage the interface between ShCs and ASCs.

Challenge #4

Completely eliminate the possibility of misplaced or unidentified containers in the automated stacks. "This was one of our most critical requirements, as it was vital not to introduce any errors into the yard," says Pernia. "Our concept called for containers to be distributed over the stack blocks to optimize ASC sequencing and utilization, requiring total confidence in box identification."

Challenge #5

Clean, filter and seamlessly integrate all container and equipment traceability data with the TOS.





CASE STUDY TTIA

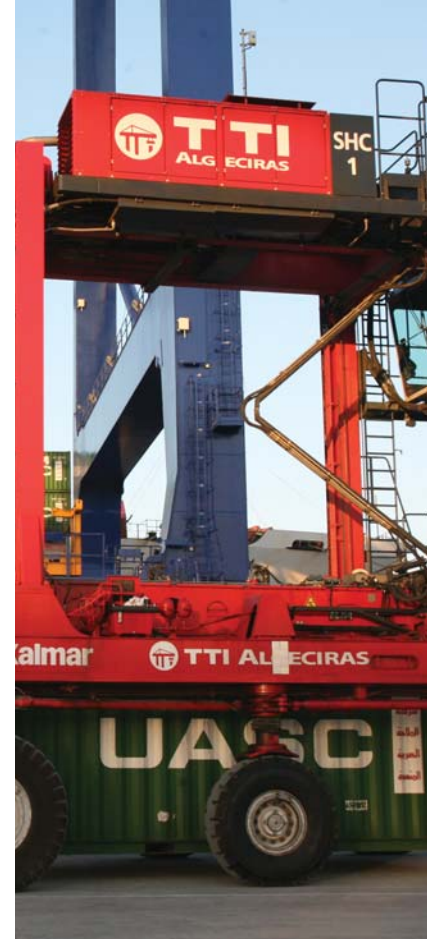
THE SOLUTION

Working closely with main project partners Hi-Tech Solutions Europe (HTSE) - OCR specialist, lead contractor and systems integrator for the automated location and tracking package - and ABB - provider of control and automation systems for the quay and yard cranes - IDENTEC SOLUTIONS was responsible for delivering the equipment tracking and control elements within the overall system solution.

To meet TTIA's multiple challenges, the company drew on its expertise in wireless sensor network technologies, including both active RFID and GPS, to provide a tailored solution comprising:

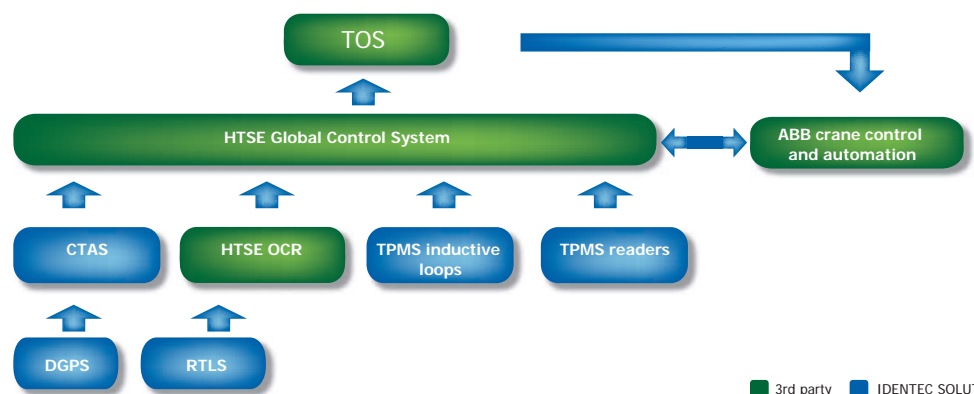
- Real Time Locating System (RTLS) – a real time locating system combining intelligent active RFID tags, wireless sensor devices and an advanced RTLS positioning and visibility system to determine the exact location of ShCs working at the quay cranes. RTLS integrates with HTSE's SeeCrane container OCR system to match container and equipment ID automatically.
- CTAS DGPS-based PDS – the IDENTEC SOLUTIONS' Container Terminal Automation System (CTAS) is a real time positioning and visibility system for precise location of quay cranes and ShCs at the quay and for all non-ASC storage areas.
- Transfer Point Management System (TPMS) – an RFID-based system combining tags, readers and inductive loops to track SHCs entering and exiting the yard transfer zones. TPMS integrates with ABB's ASC crane control system to ensure the safety of ShC operators during hand-off between manned and automated operations, as well as to provide 100% traceability in container transitions

The RFID, RTLS, DGPS, OCR and crane traffic subsystems were all integrated through HTSE's Global Control System (GCS) middleware. GCS filters and collates event data from the various subsystems and ensures smooth hand-off with the master TOS.



“We were pleased to partner with IDENTEC SOLUTIONS and ABB on this project, to provide this new concept for the industry. The IDENTEC SOLUTIONS' RTLS is a breakthrough technology in tracking systems for container handling equipment and we see significant opportunity for automation of quayside operations. Combined with OCR, the RTLS delivers increased safety, improved asset utilization and real ROI.”

Phil Elovic, President and CEO,
Hi-Tech Solutions



HOW IT ALL WORKS

Traceability step 1: quay crane OCR and RTLS

As containers are unloaded from the ship onto the quay crane lashing platform, the HTSE OCR system automatically reads the ISO container number and performs additional checks, including a damage inspection scan, check for seal presence and verification of door direction.

Containers are then assigned by the TOS for discharge to one of the crane back-reach lanes. When the twist-locks are released, the OCR system measures the spreader position via an interface to the ABB crane PLC. The absolute position of the crane on the quay is determined via DGPS as part of the IDENTEC SOLUTIONS' tracking package.

The Global Control System (GCS) advises the TOS that a container has been deposited and holds data on the transaction for matching with ShC position data. The TOS then assigns the job to one of the ShCs and instructions are sent to the on-board radio data terminal (VMT) in the driver's cab.

As the ShC arrives at the designated lane and positions itself over the container, the RTLS gets to work. An active RTLS tag attached to the top of the ShC transmits its unique ID number to four iSAT RTLS readers mounted on the quay crane legs. The readers send shuttle ID and time of flight data to the IDENTEC SOLUTIONS position software, which calculates ShC location up to +/-1m

(3,3ft). Shuttle ID and location data are then fed via GCS to the TOS, which compares the information with the container ID already stored in the system and confirms that the ShC is collecting the right container.

Drivers are only able to engage twist-locks and lift the box once the ShC-box match is fully approved. A controller on the shuttles logically prevents twistlocks from being engaged or disengaged until authorized and is one of the critical control mechanisms for ensuring accuracy. As ShCs leave the quay area, tracking seamlessly transitions from RTLS to DGPS, which is used to manage and monitor equipment moves throughout the rest of the terminal.

The ShC fleet is managed on a dynamic pooling basis, with optimal job order assignment based on real-time information and driving distances.

Traceability step 2: transfer zone management

As well as a roof-mounted RTLS tag and DGPS transceiver, each ShC also carries four RFID beacon tags. Fixed to the ShC undercarriage, one at each corner, these tags form the basis of the IDENTEC SOLUTIONS' Transfer Point Management System (TPMS).

As shuttles approach their assigned lane in the yard transfer zone, they pass over the first in a series of loop antennas in the ground. The loop transmits a signal that

'excites' the tags on the base of the ShC and prompts them to start broadcasting their unique ID data. At the same time, the loop transmits its unique positional ID to the four tags. The four tags then report their own ID and the loop position to any of the 40 IDENTEC SOLUTIONS' RFID readers mounted in the transfer zone, which operate within a read range of about 500m (1640ft).

This data is sent to the ABB automated yard control system via GCS. The ABB system checks that there are no ASCs working the area in question and that the data just received from the ShC matches the job assignment in the TOS. The system then activates a traffic light that gives the driver a green light to enter the transfer zone, or a red light to await further instructions.

Once the ShC enters the transfer zone, two further loops in each lane are used to verify that the driver grounds the container in the correct position - each lane can hold 2 x 40ft or 4 x 20ft containers. If all the data matches up, the ShC controller is authorized to release the box. As the twist-locks are disengaged, the controller updates GCS and the shuttle is reallocated as 'available' for the next assignment. The TOS then uses the position data generated by the TPMS to track when and where a shuttle leaves the zone and select the optimal next task.



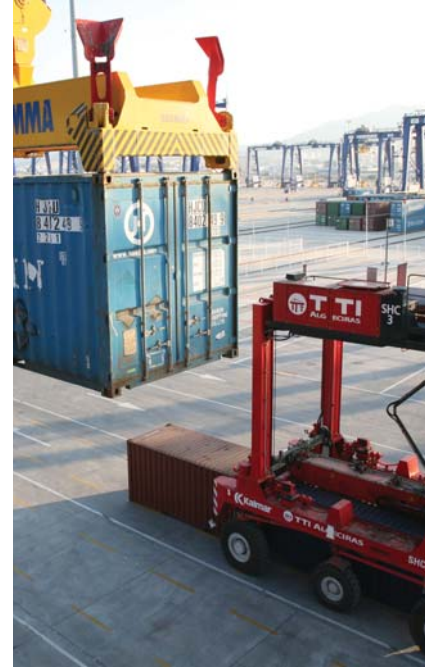
Traceability step 3: non-automated areas

Problem and sensitive container loads, including hazardous cargoes and wet boxes, are dealt with in manually-operated exception handling areas located either side of the automated stacks, which are fully integrated into the terminal mapping and TOS database. Shuttles working in these areas are monitored in real time using the IDENTEC SOLUTIONS' DGPS tracking system, allowing equipment ID and position to be matched with container numbers in the TOS.

Exception management

No system is ever perfect. From the outset, TTIA thought carefully about how to manage the inevitable exceptions to the norm arising from problem containers and technology issues. The answer, explains Pernia, was to create the new position of Process Supervisor as an integral part of the control team in the operations tower. Every shift, all system exceptions go back to a single, dedicated process engineer, who has the combined operational and IT expertise to review and resolve queries.

Tasked with analyzing and diagnosing exceptions, problems, bottlenecks, and associated KPIs, this new generation of terminal process professionals is the "intelligent link" between Operations, IT and Equipment Maintenance, says Pernia. "Our Process Supervisors are fully integrated into both our Operations and IT Departments and take part in the fine tuning and optimization of all the technologies involved, with the TOS as the central brain".



RESULTS AND THE FUTURE

"As of November 2010, our integrated system combining OCR, RTLS, RFID and DGPS was working above 97% accuracy," says Pernia. "These technologies are now providing TTIA with full control and automatic traceability that allow us to operate our whole facility with a shift of just four people in the operations tower and 10 people in the quayside stevedore gang."

"From an economic, efficiency and environment perspective, the advantages of automation are clear," says Pernia. "But starting up a greenfield automated facility is still a steep learning curve, requiring intense focus and commitment from everyone involved. Our project is a record in terms of schedule and timing and this could not have been achieved without the full co-operation of

our technology partners, including IDENTEC SOLUTIONS."

During the first seven months of operation from May 2010, productivity at the terminal rose steadily from an initial 16 moves/hr at go-live, to over 25 moves/hr by the year end. In 2011, TTIA aims to achieve more than 30 moves/hr when it moves to Optimization Phase of its TOS development. This will include the introduction of proactive simulation and auto-planning tools into its operations.

"Adapting operations concepts and enabling technologies, meet the specific needs of our traffic pattern, competition and labour scenario is one of the keys to ensuring a low cost and profitable terminal project," adds Pernia. "The ability to identify events via

IDENTEC SOLUTIONS' technology is critical to our concept of a process-driven operation based on an exception management and analysis philosophy, versus the traditional transactional approach."

Pernia adds that the IDENTEC SOLUTIONS technology also provides TTIA with reliable scientific data and analysis that the terminal uses as part of its continuous performance monitoring and improvement approach. "As we move into our next phase of development, where we integrate simulation technology as a core operating tool, this data will become even more important to our future success. You can't improve what you don't evaluate, and operational data is the key."



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ABOUT IDENDEC SOLUTIONS

IDENDEC SOLUTIONS is the world leader in long-range, low-power wireless sensor technology that automatically identifies, locates and controls assets, personnel and inventory.

IDENDEC SOLUTIONS' robust active RFID, GPS and wireless sensor technologies and applications are ideally suited for the dynamic, challenging environments associated with ports and container terminal operations.

Today, we have the largest installed base of systems in the marine and intermodal markets, with proven installations in Australasia, Europe, Middle East, North and South America for industry leading clients including APM Terminals, DP World, Grup TCB, Hanjin and ICTSI.

An IDENDEC GROUP company, IDENDEC SOLUTIONS is privately held, with its corporate office located in Lustenau, Austria, and North American headquarters in Dallas, Texas, along with service centers in Norway, Australia and Germany. For more information, please visit www.identecsolutions.com.

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