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Tuxpan Port Terminal

Innovative deployment of very low-cost passive RFID tags to provide a seamless process flow.

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A review of the changing dynamics offered by very low cost passive tags for identifying, tracking and automating job handovers for both internal prime movers and a large community of external trucks visiting the semi-automated Tuxpan Port terminal

Introduction

As Part of SSA Marine, and with its strategic location on East coast of the Gulf Coast of Mexico, Tuxpan Port Terminal (TPT) is the first semi-automated terminal in Mexico and the second in Latin America. The terminal has a dynamic capacity of 800,000TEU and is equipped with the latest state-of-the-art Automatic Stacking Cranes (ASCs).

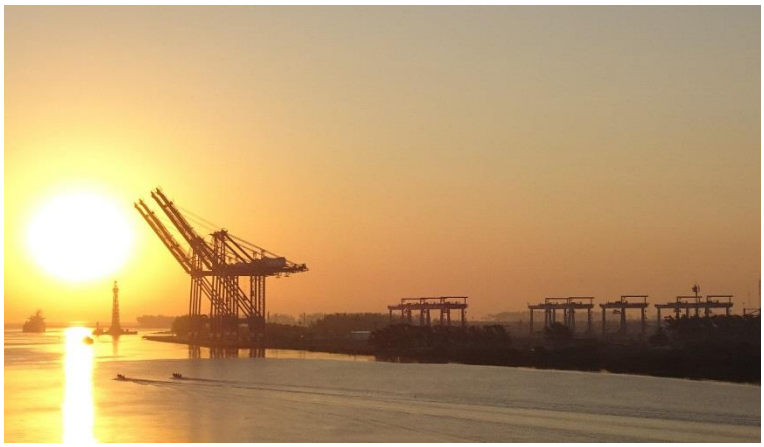

Figure 1 Tuxpan Port Terminal (TPT)

As a key import/export terminal to Mexico, TPT needed to ensure an extensive community of external trucks could be serviced efficiently when visiting the terminal, to provide the best customer service and to also realise the full potential of the automated equipment in the terminal. This means that after entering the terminal, all trucks need to become part of a seamless automated process flow, eliminating manual intervention and providing visibility on the progress of each truck through the terminal process.

To help solve this problem, TPT engaged International Terminal Solutions Ltd (ITS) to provide the means to automatically identify both prime movers in the terminal and every visiting truck, to then track the progress of each truck through the terminal and to automate container job handovers at the crane.

About Tuxpan Port Terminal

TPT is equipped with 8 ASCs and 4 super post panamax ship-to-shore cranes. The terminal has an automated gate process and a dedicated customs area. The automated terminal is designed to deliver high levels of efficiency with less resource. Each ASC achieves the productivity of 3 RTGs but with 50% less operating costs, whilst improving the stacking density by 2.3 times the container ground slots of a single RTG.

Figure 2 External trucks at the ASC stack

The use of ASCs reduces operational variability, which is particularly important for a 24/7 operation. The environment is very eco-friendly and safe, and the automated equipment also provides a much gentler handling process to reduce the incident of damages.

Optimised Process Flow

To maximise the terminal's throughput potential, TPT needed to ensure the process for each truck visit is as fluid as possible. This meant designing an optimised flow commencing with booking a truck's visit to the terminal, through to exiting the terminal and this is delivered through the integration of the following key systems:

Booking Process. There is a booking process used by the visiting trucks to pre-advise each visit. The pre-advice from this system then prompts terminal systems to identify the receipt and delivery of containers, and the work orders to be performed throughout the day.

Automated Gate. There is an automated gate which has visualisation software integrated with the TOS to establish the work order sequence and routing for each truck, based on container and yard position algorithms.

RFID System. Each prime mover and external truck is tagged. For external trucks, this is used to automatically identify the truck through terminal entry and exit processes and when inside the terminal, the tags are used to monitor all trucks through waypoint portals and to automatically promote work orders within the TOS as each truck is positioned at the crane.

Implementation of Truck-ID, the ITS system for automatic truck identification

Implementing a seamless process flow through the terminal requires a cost effective way of automatically identifying and processing all trucks through the terminal, whist eliminating manual intervention at each step of the process. To solve the problem of automatic truck identification using RFID tags, ITS implemented their Truck-ID system. This system automatically and accurately identifies every truck at a number of key points in the terminal process as follows:

1. Identify every truck coming into the terminal. All external trucks need to be tagged to enter the terminal process and then the tag will be used for all repeat visits.
2. Identify the progress of both internal prime movers and external trucks through the terminal.
3. Identify the truck being handled by the ASC.
4. Ensure import containers are loaded on the correct truck.

To achieve this, the process flow through the terminal is segmented into four key stages, as shown in the following figures.

Step 1 Technology Check. This step ensures the tag on external trucks can be read correctly before the truck is permitted to enter the terminal process. If there are any issues (damaged/malfunctioning tag, or no tag present), the truck is diverted by a traffic light system to an area where administration staff can resolve the problem. The administration staff have a set of tools to identify problem tags and resolve problems. Using these tools, they can update data held on the tag and they can also cancel and re-issue tags.

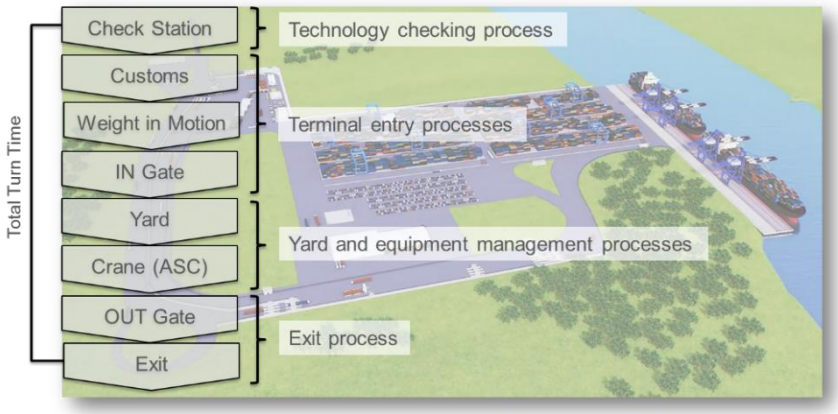

Figure 3 Seamless process flow (1)

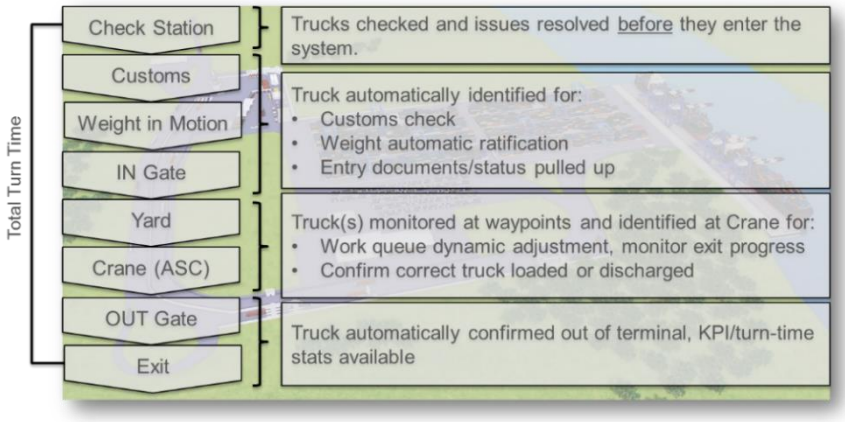

Figure 4 Seamless process flow (2)

Step 2 Terminal Entry Process. Having cleared the technology check the truck is then automatically

identified at the customs station and as it passes over a weigh in motion system, where the weight is identified and also the number of axles (there can be up to two trailers on a road truck). The truck is then automatically identified at the in-gate before progressing to the next step, the yard process.

Step 3 Yard Process. The in-gate process will direct the truck to the appropriate stack, with waypoint monitoring of the truck's progress through the yard. As each truck is read at a waypoint, the TOS is updated so that it can maintain a real-time view of the location of each truck. Waypoints at the stack lane identify the sequence at which trucks present to the ASC and this is used to dynamically adjust the TOS Work queues. At the ASC the system identifies the truck stopped at the exchange position. It will promote the job in the ASC work queue and confirm the truck is correct for load/discharge.

Step 4 Exit Process. In this step the truck is automatically confirmed out of the terminal and data from this step and all other read points is used to provide KPI information on the truck turn time.

The Truck-ID system also includes the ITS Middleware Server which provides the capability to exchange information with other systems at the terminal. Through the Middleware, the TOS system is constantly updated with the truck's progress at each stage of the terminal process and at the ASC Truck-ID will exchange information with both the TOS and the crane's PLC to correctly identify the truck in place.

Low-Cost Passive RFID Technology

A key challenge for the tagging solution is the need for it to work for both internal prime movers and for a huge community of external trucks. The choice was made early on in favour of passive tags over active tags, because passive tags have no battery; they are activated by the reader when they are in range. Having no battery means this technology lends itself to very low-cost and maintenance free windscreen tags. An alternative approach of course could have been to temporarily tag the external trucks with active tags on entry and exit to the terminal, but this was regarded as a retrograde step as it adds significant cost and two manual tasks to an otherwise seamless automated process.

Figure 5 ITS Windscreen Tag

Technology moves forward and both the readers and the read range of passive tags continue to improve. ITS aims to always implement the lowest cost tag that current technology will allow for truck identification. Following our strategy of keeping costs low means we also needed to develop innovative processes around the reader technology to ensure read accuracy with low power tags, and we have invested in many years of development to constantly refine these processes. We have now reached a point whereby our approach means we can use passive tags costing just a few cents, which changed the dynamics for TPT.

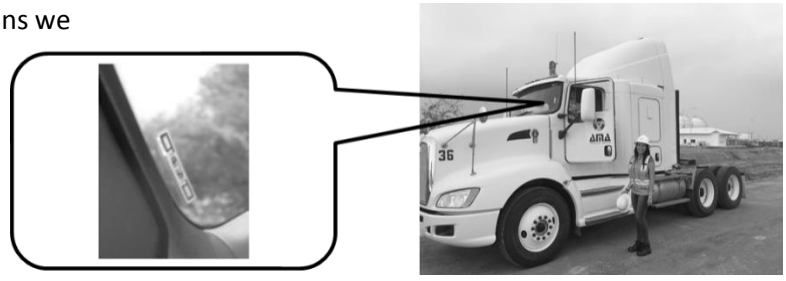
Figure 6 Windscreen tag fitted to the truck

With a low-cost windscreen tag on each truck the following is now possible for TPT:

- For a few cents it is possible to tag every external truck and the tag can then be read at all the terminal's process flow decision points and waypoints. The external trucks are now

integrated into the terminal's automations using the same technology base as used on prime movers, which use a military grade tag of the same format.

- Once attached, the tag is permanent so that it will be used for each repeat visit to the terminal. Any attempt to remove the tag will result in the tag being electronically destroyed and access to the terminal denied. As further security, the data held on the tag can be encrypted.
- The tag provides increased security for TPT's automated gate – it would be easy to switch registration plates, but not the tag!

The passive tag technology selected for this project provided a viable solution to embrace the community of external trucks into the seamless flow of TPT's semi-automated terminal .The reader system has logic to target the truck under the crane whilst ignoring false reads from passing trucks or other trucks that may be queuing at the stack. The system also has logic to cater for 20', 40' twin and multi trailers and recognises the state of the truck – whether it is in position at the crane or has moved away.

System Management

TPT have a process for sending tags out to qualified external trucking companies so that their trucks can be tagged before the first visit to the terminal. As mentioned previously, there is a check station located before the in-gate which will check for valid tags.

The remote administrators of the check station are provided with an application through which warnings are shown in the event of an issue. The operators have facilities to re-write data to a tag or to programme and issue fresh tags.

Once the truck has been released to enter the terminal, tools are provided to show the location each truck in the terminal process, as shown in Figure 7, which shows a snapshot of one of the stack areas.

This can be used to monitor activity in the terminal and can also be used to determine if queues are forming in any stack.

Figure 9 shows a schematic for the whole system. There are intelligent reader systems at each waypoint portal and on each ASC. Each system will communicate with the ITS MRS middleware and on ASC the reader system will also communicate with the crane's PLC to advise the truck is in place. The middleware manages all communications between the intelligent readers and the TOS, and it will also store each read transaction on an SQL database, which can then be interrogated to determine key performance information, including the truck turn times.

Figure 7 Check Station System

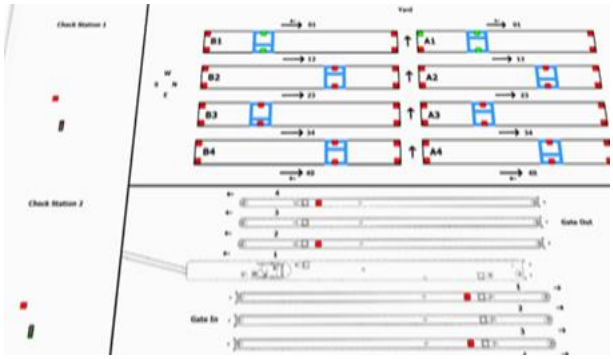

Figure 8 Real-time view of terminal activity

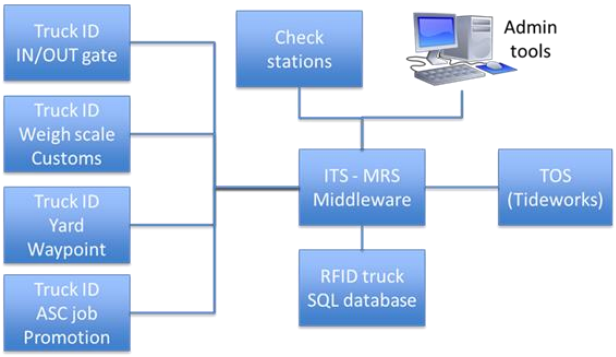

Figure 9 System Overview

Summary

The ability to accurately read low cost windscreen tags has changed the dynamics of automated identification and tracking applications in container terminals, as it is now economically possible to tag thousands of trucks and other assets. Whilst continual improvements to the tag technology make this possible, key is the use of innovative processes around the read points and data management, to ensure accurate identification of these tags in all situations. Converging innovation in both the tag technology and ITS reader processing is now changing the cost equation for using this technology to make mass tracking applications possible, whilst also strengthening the container terminal's potential to increase the security of the terminal and improve productivity. For TPT, this technology is an important element to a higher return on their capital deployed on the ASCs. The ITS Truck-ID system ensured the external trucks are integrated into the terminal's automated process flow, to eliminate manual interventions and to ensure the gains from investing in automated handling equipment is maximised for TPT.