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Improving performance at the Durban Container Terminal through automation

OVERVIEW

The Durban Container Terminal (DCT) is currently the biggest and busiest container terminal in Africa and handles about 2.7 million TEUs (twenty-foot equivalent unit) a year. The DCT handles approximately 70% of South Africa's containers and generates 60% of South Africa's revenue (Port of Durban 2014).

Increasing the automation level of a terminal with products that automate a single part of the operation or the whole process is recognised as the next step towards improving performance at today's container terminals. The benefits of automation include lower operational costs and improved terminal productivity, capacity, safety and security.

Automating an existing straddle carrier terminal is a complex project that requires expertise, careful planning, a capacity for wide-ranging systems integration and the ability to consider numerous factors beyond technical implementation. Besides the actual automated system, there is also extensive change management within the entire organisation of the terminal, as operating an automated terminal requires a thorough change of business processes, as well as different skill sets for the people operating the terminal.

INTRODUCTION

Automated straddle carriers are suitable for the same types of terminals as manual straddle carriers. The main reasons to choose a straddle carrier (SC) setup, compared to other terminal concepts, include flexibility and simplicity. The manual handling SC is popular at Pier 2 in the DCT – there are currently 113 SCs in operation at Pier 2. In a straddle carrier terminal, a single machine handles both stacking and horizontal transportation. Other horizontal transportation concepts, such as those built around automated guided vehicles (AGVs), will always need another machine to stack the containers and load landside transport vehicles.

A straddle carrier terminal can adapt easily to changes in terminal through-put. Excess machines are automatically parked away when not needed, and more equipment will be added on demand.

This article summarises a study to determine whether automating straddle carriers is indeed the way to go at the Durban Container Terminal. The study is based within the vicinity of Berths 200–205.

WHY AUTOMATED STRADDLE CARRIERS?

An automated straddle carrier terminal offers several clear advantages over a traditional manual straddle carrier terminal. The most immediate and most easily quantifiable gain is significant savings in terminal operating expenses, such as labour and maintenance costs. Other direct benefits include increased efficiency, more predictable operations, higher availability, significantly improved occupational safety, better site security and longer equipment life spans.

An often-heard remark from people seeing an automated terminal for the first time is how smooth the operation seems. No aggressive driving is seen, no containers are banging on the ground, and everything proceeds in a steady, systematic fashion. In an automated terminal, horizontal transportation and lifting equipment is always handled optimally. Collisions due to human error and unplanned repair tasks are eliminated. Automated equipment also conserves resources and contributes to the sustainability of resources. Significant fuel savings are realised through optimal driving patterns, a reduced need for air-conditioning, and consistent implementation of engine-stop functionality during equipment idle time. An automated terminal also requires less lighting in the yard, which decreases power consumption and reduces the environmental impact of operations.

TERMINAL IMPLICATIONS

The time required for the conversion of a manual straddle carrier terminal to automated operation depends greatly on the specific design, needs, operational environment and business goals of the terminal. However, a typical timeframe for an automation conversion project can be 12 to 18 months.

When planning the conversion timeframe, a key consideration is whether to optimise for maximum testing of new systems or for the swift adoption of the new processes and organisational culture required by automated operations. A slower transition will enable more thorough technical testing and training of operational personnel, but a quicker transition may be preferable for organisational reasons.

In any automation project, a key priority is carrying out the conversion with minimal disruption to the existing operations of the terminal. This requires careful advance planning, as an automated straddle carrier terminal typically needs to be automated in one go. The transition will also likely require changes to the terminal layout and operating procedures. The procedures for ship-to-shore (STS) operation, landside interface and reefer operation will be changing completely. Alternative processes may need to be introduced also to handle non-standard cargo that cannot be taken into the automated area, as well as for empty container handling. Change management of the workforce needs to be taken into account from the very beginning. The professional profile of the people operating and managing automated equipment will be markedly different from the staff running a manual terminal. Completely new skill sets are needed, and maintenance standards will need to be revised thoroughly (Alho *et al* 2015).

INFRASTRUCTURE

An automated conversion will require changes to the entire infrastructure of the terminal. These changes need to be planned from a wider perspective, not just focusing on the horizontal transportation equipment. Areas to consider include:

- Terminal layout changes
- Fencing, safety infrastructure, access control
- Navigation infrastructure for the straddle carriers
- Automatic/manual interchange points (waterside interface, truck and rail handovers, maintenance areas, empty container interchange, handling of reefers)
- IT environment and wireless networks
- Yard lighting.

The number one issue in an automated terminal is maintaining strict separation between automated operations and areas in which people work, and designing safe interfaces between the two. All non-standard cargo that requires manual handling has to be kept out of the automated operating area.

When handling exceptions, for example, strict safety protocols must be developed for all activities that involve people moving in the same area as the horizontal transport equipment. Particular attention needs to be devoted to the establishment of safety procedures and access control in areas with mixed auto/manual operations (maintenance, refuelling, washing, reefers, etc).

In a typical container terminal, various facilities will be spread out across the site, either by original design or simply due to the organic growth and evolution of the terminal over several years. In an automated terminal, however, all facilities requiring mixed auto/manual operation will need to be sited at or relocated to the perimeter of the automated zone, in order to keep the automated area to a practical shape and guarantee smooth access of people to the area without disturbing other operations. Access control, safety systems and physical fencing for these functions need to be considered when planning the automation conversion.

WIRELESS INFRASTRUCTURE

An automated terminal will require navigation infrastructure for the automated equipment. Typically this will be either radar beacons installed on lighting towers and buildings around the site, or magnetic markers embedded in the yard pavement. Accurate and reliable position measurement for STS cranes also needs to be considered (Alho *et al* 2015).

SOFTWARE INTEGRATION

Automated equipment is only as good as the software controlling it. To obtain the desired performance from automated horizontal transport equipment, the terminal's ERP (enterprise resource planning), TOS (terminal operating system) and other systems must be up to the task, and designed to seamlessly fulfil the required business processes while providing efficient ways to handle exceptions (Alho *et al* 2015).

SAFETY AND SECURITY

Safety is always paramount in any terminal operation. Automated terminals provide significant improvements in occupational safety by keeping people out of the operating area of moving heavy machinery.

From the safety perspective, a straddle carrier terminal is relatively easy to automate, since there are no manual

truck lane operations as with an RTG (rubber-tyred gantry) terminal. However, in addition to infrastructure and terminal layout considerations, a different kind of safety mindset will need to be instilled throughout the workforce. Adoption of safe working procedures for accessing the automated area is required. Employees will also need to be trained locally – a safety handbook in English is not enough.

Furthermore, automatic driving eliminates collisions and accidents in the container yard, which will decrease the insurance premiums of the terminal.

Automated terminals improve the security of both cargo and personnel thanks to automated container handling and location tracking of all containers. Containers are not accessible by people in the automated zone and cannot be set down in unauthorised areas. Increased security contributes to customer trust and terminal competitiveness while reducing financial losses.

MAINTENANCE MANUAL

Horizontal transportation systems will work even if the equipment is not in perfect condition, since human operators can usually compensate for the quirks and deficiencies of each individual piece of equipment. By contrast, automated equipment always needs to be in 100% working condition to deliver its full potential.

This requires a major change in attitude for maintenance operations. With automated operations, the emphasis shifts to more frequent preventive maintenance. However, as this maintenance is usually done at planned intervals, the caused impact to the operation is minimal. As collisions and other accidents due to human error are eliminated, the need for ad hoc repairs is also reduced dramatically, bringing cost savings in the long term (Alho *et al* 2015).

AUTOMATING EXISTING EQUIPMENT

The actual automation of most straddle carriers of recent models is relatively straightforward. Electric or hydraulic steering is controlled by on-board automation systems instead of from the cabin, while sensors and data links are added for control, monitoring and system diagnostics.

In any automation project, third-party or mixed fleets can create challenges in, for example, the division of responsibility in maintenance questions, access to proprietary system data, as well as guaranteeing performance levels for yard equipment. The best automation solution will always be based on the needs of the customer, but working with a fully integrated system from a single vendor – and upgrading the straddle carrier fleet when necessary – is often the most cost-effective solution for the terminal in the long run.

CONCLUSIONS AND RECOMMENDATIONS

The unmanned automated straddle carriers can operate 24/7 in almost any weather conditions, ensuring smooth flow of cargo and significant cost savings. The transition to automation can be done quickly and at low cost.

Unmanned operation cuts labour costs in the terminal. Machine hours are minimised by employing automatic shutdown, which reduces idle-time costs to zero. Additionally, as automated operation does not require night-time lighting, energy savings in a terminal can be significant.

Fully automated straddle carriers can operate all day, every day and cut labour costs.

Eliminating human error is one of the main benefits of an automated system. The result is a marked improvement in workplace safety.

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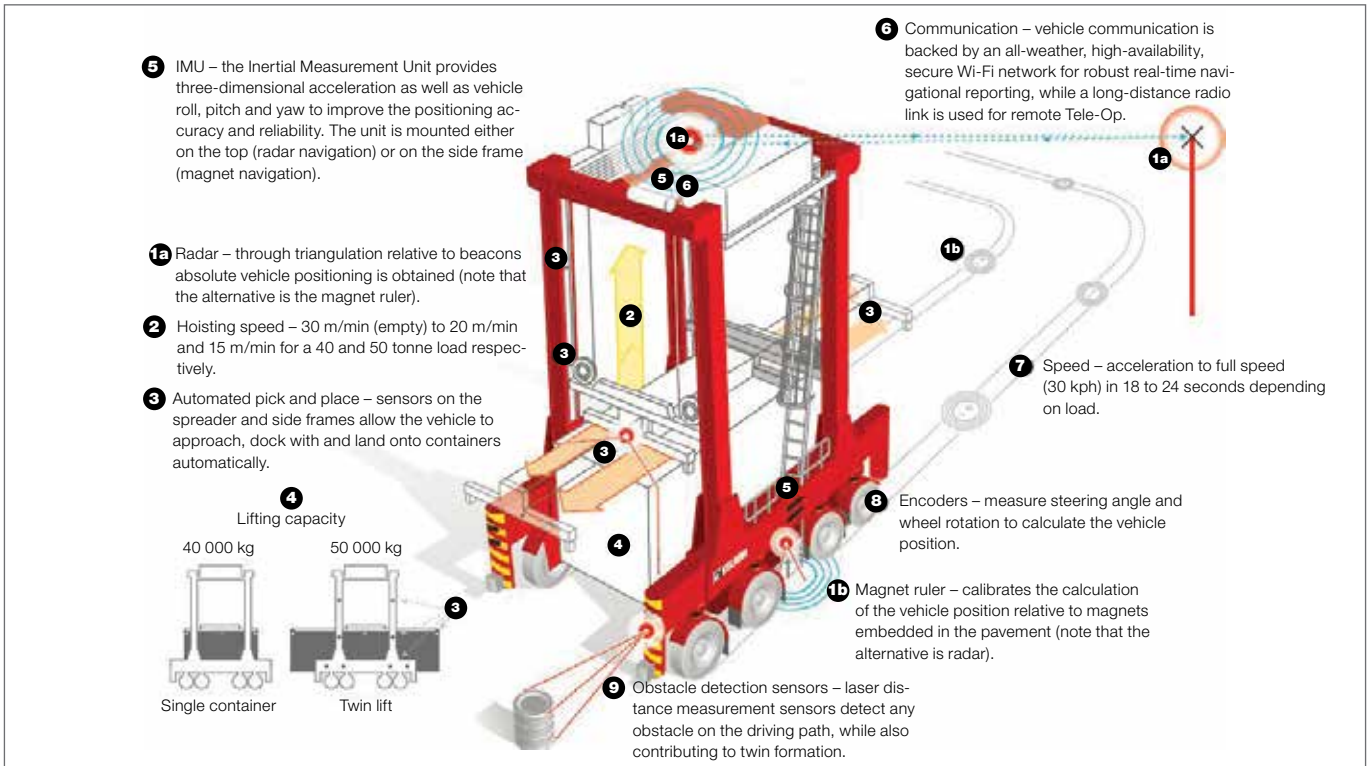

Automated straddle carrier