Automation for brownfield terminals

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Automating a greenfield (newly built) terminal from scratch is often what comes to mind when discussing automated terminals. However, existing (brownfield) terminals can be automated partially or wholly to achieve the benefits of automation. At brownfield terminals, the transition to automated operation is carried out step by step in different areas of the terminal to avoid loss of capacity. Automation can also be implemented by expanding the terminal to an unused area.

No matter what the approach, the project requires thorough analysis and terminal layout planning. Numerous technology and equipment combinations are available and these need to be studied carefully in order to identify the best choice for the operator. Solutions include automated stacking cranes (ASC) with manned or automated shuttle carriers for horizontal transport; ASCs and automated guided vehicles (AGV); fully automated straddle carrier terminals; automated rubber-tyred (RTG) with automated shuttles; and various combinations of the above.

Driven by business needs

Terminal and process automation are recognised as the next steps towards improving productivity and performance at today's container terminals. Automation has been steadily gaining ground over the last decades, driven by numerous industry trends.

On the one hand, terminals need to utilise their existing equipment, resources and space to maximum capacity, and every incremental improvement adds up to massive savings over the course of a fiscal year. On the other hand, qualified labour can be hard to obtain, and safety issues as well as human factors often restrict the performance of terminal equipment from its full capacity. The latest supersized container ships place additional competitive pressure on terminal operators to maximise throughput and minimise turnaround times.

Evolution by design

The history of container terminal automation extends back some 20 years. The world's first automated terminal was ECT Delta in the Netherlands, operational since the early 1990s. The terminal is based on the AGV concept with automated stacking cranes. The container stack follows the typical European layout of being perpendicular to the quayside. Each STS crane is served by four AGVs, and the handover is a coupled process taking place under the STS crane legs. A single ASC serves each block of the 6-wide container stack, which is stacked at 1-over-3 and 1-over-4 heights.

A somewhat similar ASC and AGV concept, although with larger stacking capacity and two ASCs per block is also used at the newer ECT Euromax terminal in the Netherlands, operational since 2008.

The next generation of automated terminals took the concept a major step ahead, obtaining higher capacity and more flexibility in container handling. Opened in 2000, the HHLA CTA Terminal in Hamburg introduced a second ASC to the container block, now stacked 1-over-5 with a width of 10 or 12 containers. The ASCs ride on two sets of rails, allowing the smaller crane to pass under the larger one. The AGV-STS handover takes place under the backreach of the STS crane, improving safety by keeping workers out of the handover area.

A decade later, the HHLA CTB Terminal, also in Hamburg, developed these ideas even further. Operational since 2010, the terminal features a novel and highly flexible arrangement of three ASCs per block (two small and one large). The ASCs are coupled with manned shuttles for horizontal transportation.

For a very different concept, one can look to the Patrick Container Terminal in Brisbane, Australia. The terminal, operational since 2007, is the world's first fully automated straddle carrier terminal. A fleet of 27 Kalmar AutoStrads handles both quay and landside operations. Three AutoStrads serve each STS crane, and the carriers are pooled for maximum efficiency. The straddle carrier concept enables a fully decoupled process, as the STS cranes and carriers can place containers in the crane backreach without having to wait for each other to finish their ongoing work cycle. The result is a marked improvement in productivity. The terminal also has an excellent safety record since the system has been in place.

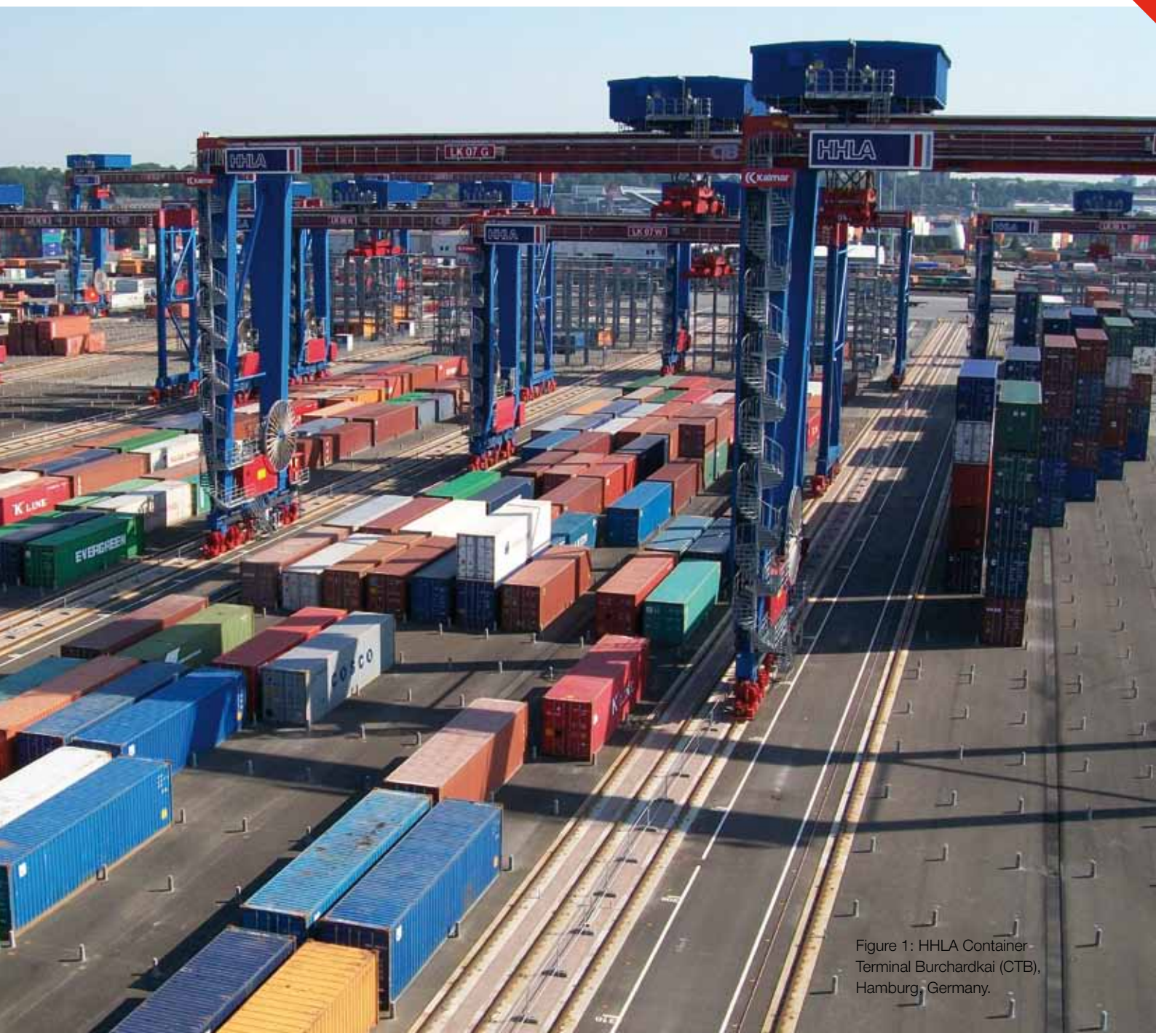

Figure 1: HHLA Container Terminal Burchardkai (CTB), Hamburg, Germany.

Global potential

There are approximately a dozen fully automated container terminals around the world. With some 1,400 container ports around the globe, the future potential is massive.

Many of the most dramatic examples of automated container terminals are greenfield installations built from the ground up. However, automation also holds significant potential for increasing the performance and capacity of existing terminals.

The latest innovations in terminal design are centered on decoupling the container handover and creating new hybrid terminal layouts that combine the best of multiple container handling technologies. As a result, the benefits of automation are increasingly accessible for terminals of all sizes.

Automation has proven itself for ship-to-shore container handling rates of 25 to 30 containers per hour. As to what is possible in the future, a lot depends on the individual cargo handling patterns of the specific terminal. However, for projected future performance of around 40 to 45 moves per hour, one of the key concepts is the decoupling of vessel and yard operations. This enables operators to maintain smaller fleets while reducing traffic congestion and equipment idle time.

One of the most interesting new terminal designs is the TraPac extension to the Port of Los Angeles, scheduled to be operational this year. Built around a fully decoupled process, the terminal combines three very different automation concepts on a single site. In addition to both perpendicular and parallel container stacks served by ASCs, the terminal also includes a third, diagonally placed AutoStrad stack that allows the terminal operator to make the most of previously unused land. As in Hamburg and Brisbane, the change to automated operation is done step by step in different areas of the terminal to

Figure 2: TraPac Terminal , the Port of Los Angeles, CA, US.

Figure 3: Patrick Brisbane Autostrad Terminal, the Port of Brisbane, Australia.

keep the port online and to avoid loss of handling capacity.

Multiple avenues for growth

The selection of a terminal concept (RTG, ASC, straddle carrier etc.) has massive implications for the future of any terminal. However, it is important to realise that concepts can be combined, thus providing new avenues for future growth.

For example, a midsized container terminal could begin automating its operations with an AutoStrad stack for a relatively small initial investment. In the future, a few ASC blocks could be added for a dramatic increase in stack density. Due to the simple laws of geometry, an 8-wide ASC can stack up to 25 percent more containers than traditional 6- or 7-wide RTGs that need to leave a lane for terminal tractors or shuttle carriers at the side of the stack.

The benefits of automation thus include improved terminal capacity in addition to better performance and lower operational costs. For this hypothetical midsize terminal (See Figure 1), an increase in capacity from 250,000 to 1,000,000 twenty-foot equivalent units (TEU) per year would be well within reach – all without expanding the land area used.

Hybrid terminal designs also hold great promise for other applications. ASCs and shuttle carriers could be combined for more efficient handling of reefers or empty containers (See Figures 2 and 3).

Future directions

As vessel sizes increase, the demands on crane speeds will grow commensurately. As a result, remotely operated STS cranes are likely to see rapid development over the next five to ten years.

In addition to port equipment, process automation allows terminal operators to gain new levels of performance from their existing infrastructure, and operators to gain immediate benefits from adding automation for a very moderate initial investment. For example, the Kalmar SmartPort process automation portfolio includes several modules to gain efficiency and safety benefits.

Another area of great interest is automated lashing and twistlock handling. Again, the issue is decoupling – how to ensure optimum performance by eliminating the need for one piece of port equipment to wait for another. The automated lashing platform is a solution designed to address this need. The system currently supports 95 percent of all twist locks and is expected to gain ground rapidly as the technology matures.

About the author

Elmar Hendriks is the director for terminal development and automation at Kalmar. He joined Kalmar in 2008 and has since been working in various positions including sales, product management and business development worldwide. Most recently he was responsible for mega project sales in Europe, the Middle East and Africa. Before joining Kalmar, Elmar has held various positions in operations management in ECT Delta and Euromax terminals in Rotterdam.

About the organisation

Kalmar offers the widest range of cargo handling solutions and services to ports, terminals, distribution centres and to heavy industry. Kalmar is the industry fore-runner in terminal automation and in energy efficient container handling, with one in four container movements around the globe being handled by a Kalmar solution.

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