# The case for automated RTG container handling

Thomas Gylling, *head of port cranes process automation, Konecranes, Hyvinkää, Finland*

Automated container handling is a recognised megatrend in the container handling industry. It started back in the early 1990s, when the ECT Delta Terminal, Rotterdam, began to use unmanned rail mounted gantry cranes in their container yard, with considerable success. The industry noticed, and investment in new automated terminals grew. Automated container handling technology developed quickly, concentrating on the cranes handling the intermediate storage of containers in the yard.

The automated rail-mounted gantry (ARMG) crane was popular from the beginning for greenfield terminals where it was advantageous to build container blocks perpendicular to the quay, with exchange areas at the block ends. This is often called an 'end-loading' operation. A popular end-loading design uses two identical ARMG cranes in each container block, running on the same rail with the main operating areas (see Figure 1).

After the ECT Delta Terminal successfully pioneered the first ARMG yard, automated RMG operating models where taken into use at Thamesport in the UK, at Container Terminal Altenwerder in Germany, at Ohi Terminal in Japan, and at Evergreen in Taiwan. The ARMG operating model and technology were field-proven. An alternative ARMG operating concept was also developed, in which the exchange areas were moved from the block-ends to the block sides, along the full length of the block. Because the cranes need to reach over the truck lanes, larger rail-mounted gantry cranes with cantilevers (CARMG) are used for such 'side-loading' blocks. CARMG blocks are built parallel to the quay. This provides a typical CARMG container block layout (see Figure 2), which has been selected in locations with higher transshipment cargo flows.

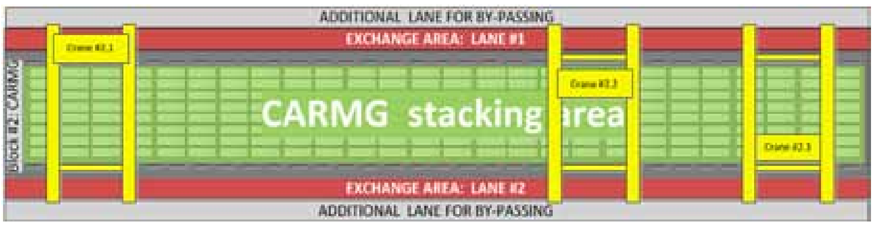
## RTG operating model gains ground

The ARMG and CARMG operating models have gained ground, but not at the expense of the rubber-tyred gantry (RTG) operating model, which has grown as well. The RTG operating model can offer important advantages for greenfield terminals, brownfield terminals and terminals undergoing conversion. The RTG operating model is suitable for container terminals with land use restricted by the surrounding environment e.g. ports located in densely-built urban areas. The RTG operating model is especially suitable for terminals, now using reach stackers or straddle carriers, which want to move to a higher-density stacking operation for higher productivity.

The RTG operating model is very adaptable and flexible. It can also achieve a container stacking density approaching that of its 'stiffer big brothers', the ARMG and CARMG. See Figure 3 for a typical RTG container block.

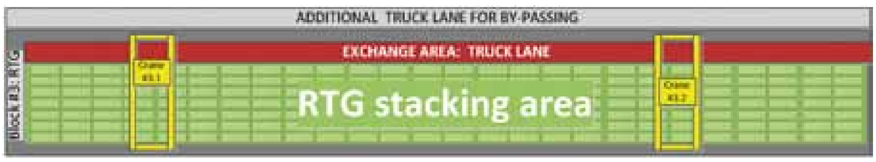

*Picture courtesy of Konecranes 2013*

Figure 1: ARMG block layout based on typical ARMG operating model.




*Picture courtesy of Konecranes 2013*

Figure 2: CARMG container block layout, based on typical CARMG operation.

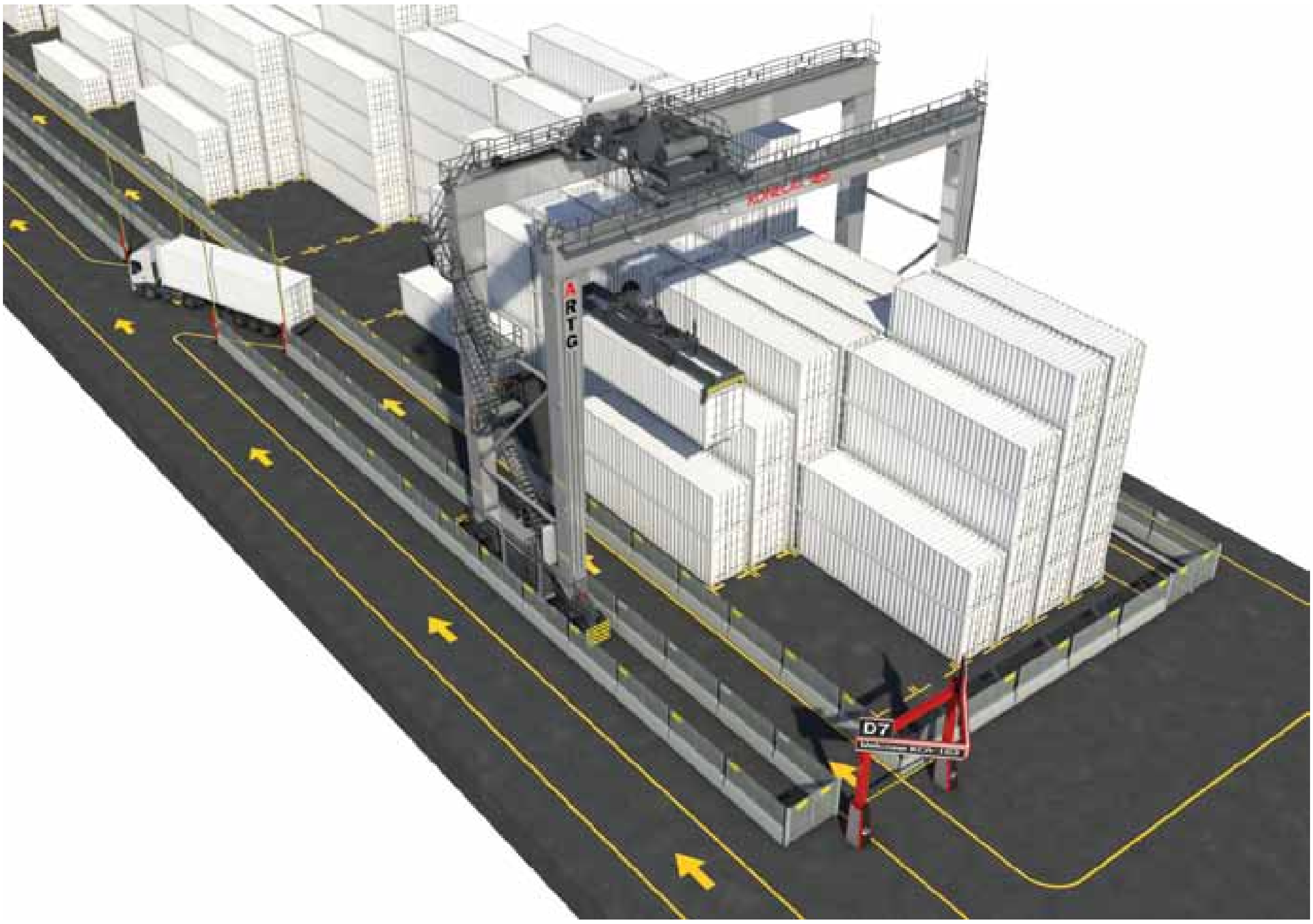



*Picture courtesy of Konecranes 2013*

Figure 3: RTG container block layout based on typical RTG operation.


*Picture courtesy of Konecranes 2013*

Figure 4: ARTG block layout, based on typical manned RTG operation.




*Picture courtesy of Konecranes 2013*

Figure 5: ARTG block layout example, brownfield layout derived from typical RTG block layout. Exchange area of one truck lane and truck by-pass lane between the blocks

When a truck 'by-pass' lane is added between the container blocks, the RTG operating model offers good truck access to the exchange area - practically as good as the CARMG operating model.

## Automated RTG model: solving the process problems

Despite the strong evolution of container yard automation globally, there has been only one implementation of unmanned RTG cranes. This was at TCB Japan, where unmanned RTG operation was achieved in 2008.

Why has automated RTG operation not gained more commercial ground? Theoretically, building an automated RTG (ARTG) operation should not be that different from building an ARMG operation. In practice, however, an automation model based on rubber tyres is very different from an automation model based on rails.

Let's look more closely at the processes involved in building an ARTG operating model. Let's start with a typical manned RTG container block (see Figure 3). When this is converted directly with the same layout, the ARTG block would look like Figure 4.

When we compare the ARTG block layout with the field-proven ARMG and CARMG block layouts, the main difference in the ARTG layout is how the exchange area is integrated in the area of ARTG operation. In ARMG and CARMG blocks, the manned vehicles are kept separate from the automated cranes in the exchange areas. The separation is typically achieved using fences and truck driver booths. In manned RTG operations, 80 percent of the accidents in the RTG yard area are related to running over personnel.[i] A safety-first approach is vital for the ARTG operating model

A key process problem in the ARTG operating model is found in the areas where the truck is being loaded and unloaded by the unmanned crane. Safety must be ensured in the exchange area. Fencing can be the solution, following the model of the ARMG yard. The exchange area can be fenced off from the stacking area and the crane runway, creating a fenced truck lane. Block perimeter fencing can be added for additional security. This setup will have implications for the movement of truck traffic. Truck traffic pressure can be relieved by adding block exit points. Figure 5 shows this basic setup at a typical brownfield RTG yard, with one additional exit point at the side of the block.

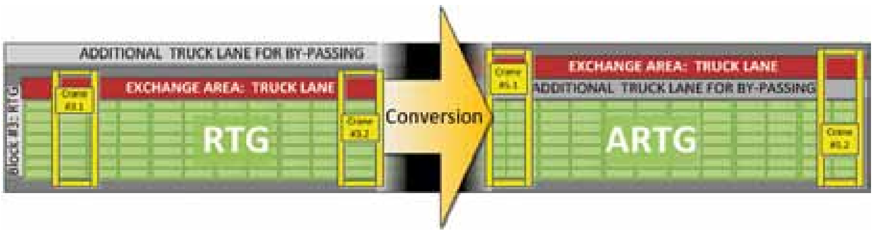
Handling of truck traffic is a major process change. The ARTG block in the example image has one truck lane that acts as the integrated exchange area, with end-loading. An additional exit point at the block side releases the truck traffic pressure though the block. Looking at this layout, we can see that truck traffic planning and control are essential in building a successful ARTG operating model.

## Automated RTG model: solving the tolerance problems

From the crane design point of view, the ARTG operating environment poses a number of difficult technical problems related to 'the three deltas' of yard crane operation:

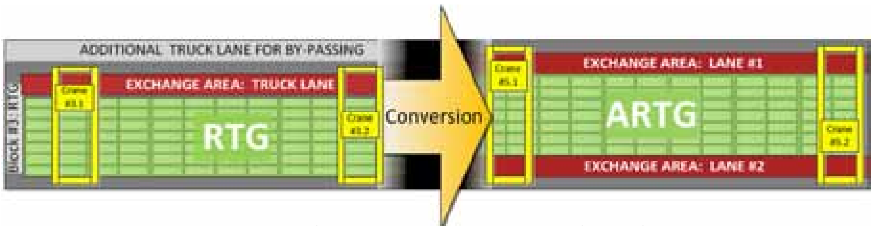
1. RTG crane runway tolerances
2. RTG stacking area tolerances
3. RTG rubber tyre tolerances

The three deltas of ARTG operation are much more difficult to handle than the three deltas of ARMG operation. The reasons why are found in the unevenness of typical RTG runway, and yard surfaces, contrasted with the




*Picture courtesy of Konecranes 2013*

Figure 6: The ARTG system can be built up per block while retaining conventional RTG operation blocks. The new ARTG block here can cater for higher truck traffic flow thanks to the two truck lanes.




*Picture courtesy of Konecranes 2013*

Figure 7: The converted new ARTG block here is similar to the CARMG and existing implementation which can separate the land side and water side horizontal traffic with the container stack between them.

straight rails and stacking areas of RMG yards, and how this affects container handling and stacking precision. All of the 'process and tolerance' problems have now been solved. The benefits of automation are now within reach for RTG-based terminals.

## The benefits stack up

The well-known benefits of automation - greater productivity, greater safety, and cost savings - are now available for RTG-based container terminals. The ARTG offers stable and predictable productivity, around the clock. The machine never gets tired, it will operate without performance deviations. The container moves are executed automatically across planned usage patterns that treat the machine gently. Its lifetime can therefore be extended. The control system chooses the container moves instead of a human operator. This makes for a more predictable operation, and also ensures information exchange, keeping the terminal operating system up-to-date.

Whenever automation is implemented, the processes involved must be clarified, defined, streamlined and standardised. Done well, this will increase both productivity and safety. The ARTG operating model provides fundamental improvements in safety, since the horizontal traffic with manned vehicles is under much better control. Furthermore, the ARTG offers benefits that are unique to the RTG-based operating model. Compared to existing ASC systems consisting of either ARMG or CARMG, the investment cost is lower: the ARTG system does not need rails. The rubber tyres of the ARTG run on virtual rails. It's very feasible to implement ARTG automation incrementally in the terminal, making the ARTG applicable for brownfields and greenfields alike. The ARTG operation can be built up in controlled phases, at reasonable cost, with minimal interruptions to terminal operations.

The terminal can retain its established RTG operating model, while gearing up for ARTG operation. The biggest strength of the ARTG is its adaptability to change. If the terminal is undergoing changes related to import/export and transhipment traffic, implementation of the ARTG system can be adapted to the new demand (see Figure 6). Such yard conversions enable a higher truck traffic flow thanks to the two truck lanes, thus catering for increased transhipment traffic. Alternatively, the conversion can adapt the CARMG thinking with two exchange area lanes on each side of the stack. This enables the separation of land side and water side horizontal transports (see Figure 7).

## In conclusion

The benefits of ARTG operation are clear. The process and technical problems related to ARTG adoption have been solved by Konecranes. ARTG technology can be adopted now by RTG-based container terminals gearing up for greater traffic and productivity. The stage is set for the automation megatrend to grow even further in the container handling industry.


## References

[i] Laurence Jones, TT Club/ICHCA Director Global Risk assessment, PEMA Equipment Technology Forum at TOC Europe 2013


## About the author

Thomas Gylling has been heading the Konecranes port cranes process automation unit since 2011. He has held various positions at Konecranes over the last 10 years focusing on sales and project execution. He started his career with Konecranes by cooperating with the company on his Masters thesis, studying total cost of ownership of automated versus manned cranes. He continued as a project manager, delivering electrical overhead travelling cranes to the US market, then RTG cranes to the global market and then switching to container crane sales for Europe and South East Asia.

## About the organisation

Konecranes is a world-leading group of Lifting Businesses™, serving a broad range of customers, including manufacturing and process industries, shipyards, ports and terminals. Konecranes provides productivity-enhancing lifting solutions as well as services for lifting equipment and machine tools of all makes. In 2012, group sales totalled €2,170 million. The group has 12,100 employees, at 626 locations in 48 countries. Konecranes is listed on NASDAQ OMX Helsinki (symbol: KCR1V).

## Enquiries


Mr. Thomas Gylling
Manager, Head of Yard Process Automation
Konecranes Finland Corporation, Port Cranes

Direct: +358 20 427 2219
Fax: +358 20 427 2599
Konecranes - Lifting Businesses: www.konecranes.com

Company address: Konecranes, P.O Box 662, Koneenkatu 8, FI-05801 Hyvinkää, Finland