

THE CASE FOR AUTOMATED RTG CONTAINER HANDLING



KONECRANES

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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 were 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.

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.¹ 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



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

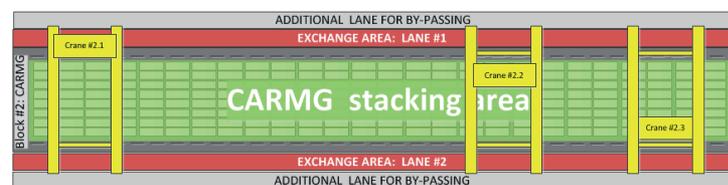


Figure 2: CARMG container block layout, based on typical CARMG operation.

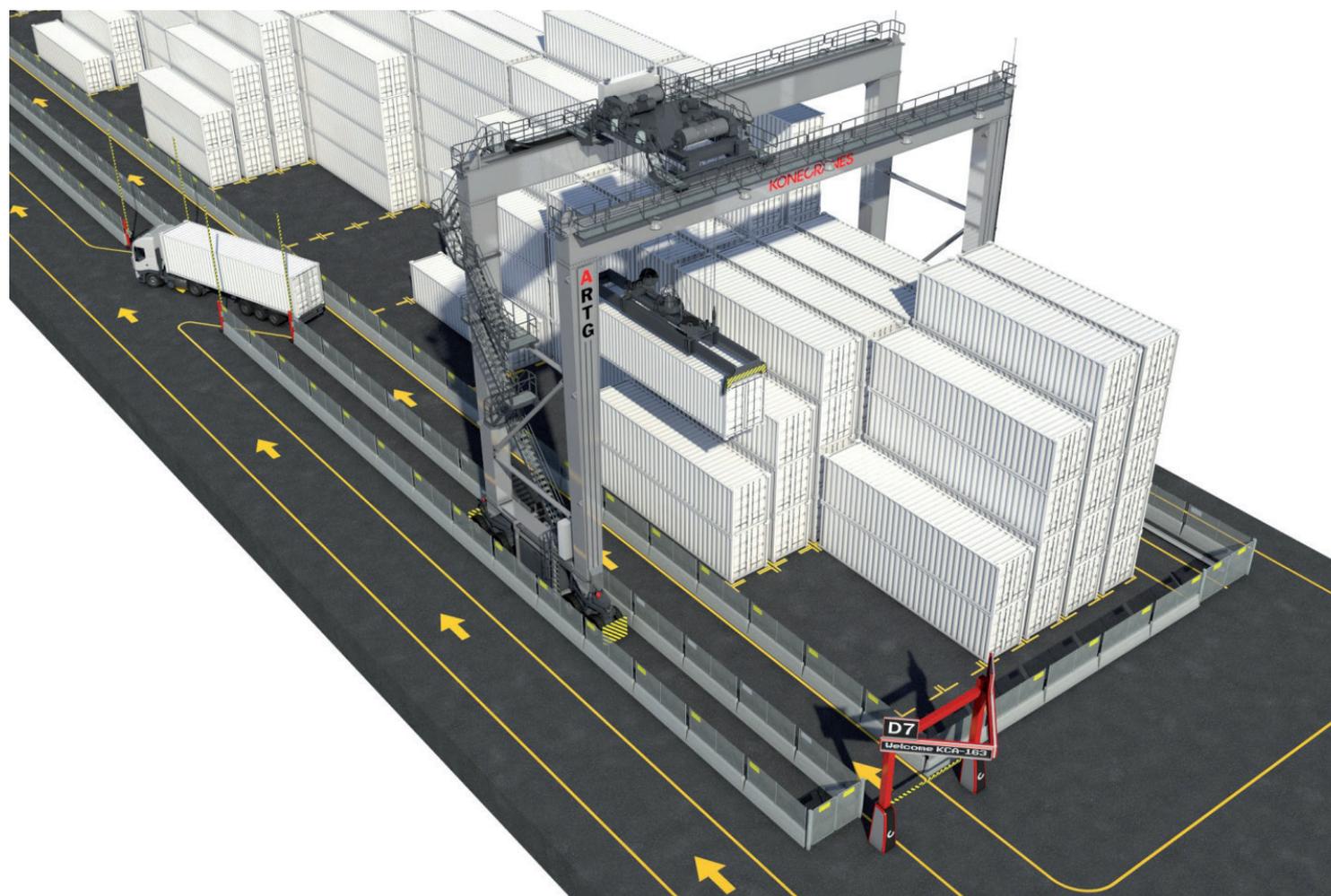


Figure 3: RTG container block layout based on typical RTG operation.



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

Picture courtesy of
Konecranes 2013



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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

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 through 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 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 transshipment traffic, implementation of the ARTG

Picture courtesy of Konecranes 2013

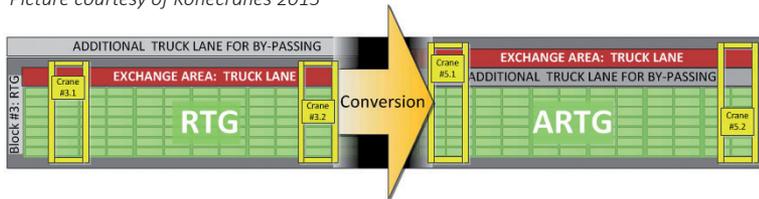


Figure 6: The ARTG system can be built up per block while retaining conventional RTG operation blocks. The new ARTG block here can cater for higher truck traffic flow thanks to the two truck lanes.

Picture courtesy of Konecranes 2013

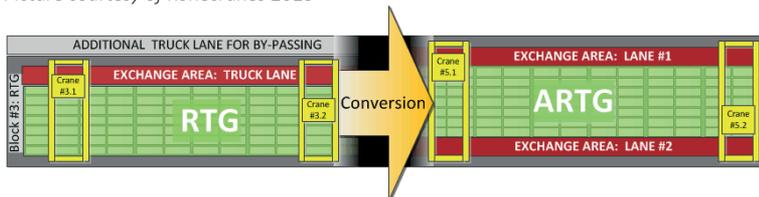


Figure 7: The converted new ARTG block here is similar to the CARMG and existing implementation which can separate the land side and water side horizontal traffic with the container stack between them.

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 transshipment 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

¹Laurence Jones, TT Club/ICHCA Director Global Risk assessment, PEMA Equipment Technology Forum at TOC Europe 2013

ABOUT THE AUTHOR

Mr. Thomas Gylling (MSc Tech) is leading Konecranes/Port Cranes container handling automation sales and marketing worldwide. Prior to his current position, he held various positions at Konecranes for 12 years, concentrating on the container handling industry. His areas of focus have been automation business, automation R&D and productizing, project delivery, sales and marketing. Recently he has been deeply involved in the company's first automated RTG delivery project, which is pioneering the industry and recently handed over for operations. Mr. Gylling brings energy, insight and vision to the drive for automation in the container handling industry.

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 2015, Group sales totaled EUR 2,126 million. The Group has 11,400 employees at 600 locations in 48 countries. Konecranes is listed on Nasdaq Helsinki (symbol: KCR1V).

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KONECRANES ARTG SYSTEM DELIVERS ON ITS PROMISE IN SEMARANG



Indonesia's container traffic growth ambitions are becoming reality, step by step. About a year ago, Konecranes began deliveries of its ground-breaking ARTG system to Terminal Petikemas Semarang (TPKS) in Semarang, Central Java. There are ambitious growth targets for TPKS Semarang: the road map has the terminal reaching the 1 million TEU mark in 2017. The terminal is on track to reach this figure, thanks to its Konecranes ARTG system which is now fully operational with a formal terminal inauguration scheduled for early December of this year.

When Konecranes "declared the case" for ARTG in October of 2013 in Port Technology International, we had finished the system design and testing. We had carefully analyzed all the processes surrounding the automation of RTG blocks, paying special attention to safety factors. Upon releasing the news of our first ARTG system contract with TPKS Semarang, we began the detailed design of the first real implementation, working closely with the customer, analyzing the Semarang container terminal and its processes.

Anybody with experience of implementing a pioneering new system of any kind knows about how much work and effort are needed to reach

successful, on-time hand-over for commercial operation. Almost every day, certainly every week, unforeseen technical problems crop up and have to be solved – immediately and elegantly. I am pleased to write that we have successfully handed over the TPKS Semarang ARTG system for commercial operation. We have learned many lessons, which we have built into our ARTG system design and project delivery processes.

Every month, the TPKS Semarang ARTG system is moving significantly more containers than the month before. The Konecranes ARTG system is now being field-proven. The benefits of automating RTG yards are clear and measurable. We see growing market interest in the Konecranes approach to RTG yard automation, which is equally applicable to brownfield and greenfield development. Of course, seeing the ARTG in action with your own eyes is the best evidence. After all, these machines are the first of their kind, unmanned, cabin-free and highly automated RTGs that are widely applicable in thousands of container terminals around the world. Making the journey to visit TPKS Semarang will be well worth the effort!