

Quantifying the benefits of yard automation – updated

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Introduction

ABB, formerly ASEA, has been active in supplying cranes and equipment for over a 100 years and to this day has supplied electrical and automation equipment to more than 1,200 cranes of all types and in all parts of the world.

ABB has and will supply automation and electrical scope to a number of demanding automation projects including:

- Le Havre (SETO, 2003) – five double trolley STS
- Kaoshiung (Evergreen, 2005) – six cantilever RMGs
- Euromax (Rotterdam, 2005) – order for 16 STS and 58 automatic RMGs
- TPCT (Taipei, 2007) – order for 40 cantilever RMGs
- Hanjin (Busan, 2007) – order for 42 cantilever RMGs
- PNC (Busan, 2007) – order for 31 cantilever RMGs

Our focus is to use proven but at the same time state-of-the art technology in order to facilitate a safe, cost effective and highly productive handling of containers for terminal operators.

Yard automation

Several automatic concepts have been introduced and are presently employed around the world. In the following, a comparison will

be made between two handling concepts that can be employed when the available yard area is limited and high stacking needs to be introduced. Another parameter that is becoming more and more important is the reduction of emissions from diesel engines.

The automatic cantilever RMG (Cantilever Rail Mounted Gantry, CRMG)

Container transfer in and out from the stack is made alongside each other. The area in which automatic operation takes place is fenced in, while controlled access to this area is made via card operated gates.

All movements within the yard area and above a certain height over the travel lanes are performed fully automatically. RFID readers can be located at the lane entrance in order to check truck/chassis identity.

When loading/unloading manned vehicles the last part of the operation is conducted under the supervision of operators which are located in a remote office. An operator can handle four to six cranes.

Cantilever RMGs can be made with very large spans and stacking heights and can be moved along the rails over several stacks but cannot be moved from one row of stacks to the next. The crane length is larger than that of an RTG because the containers have to be lifted between its legs.

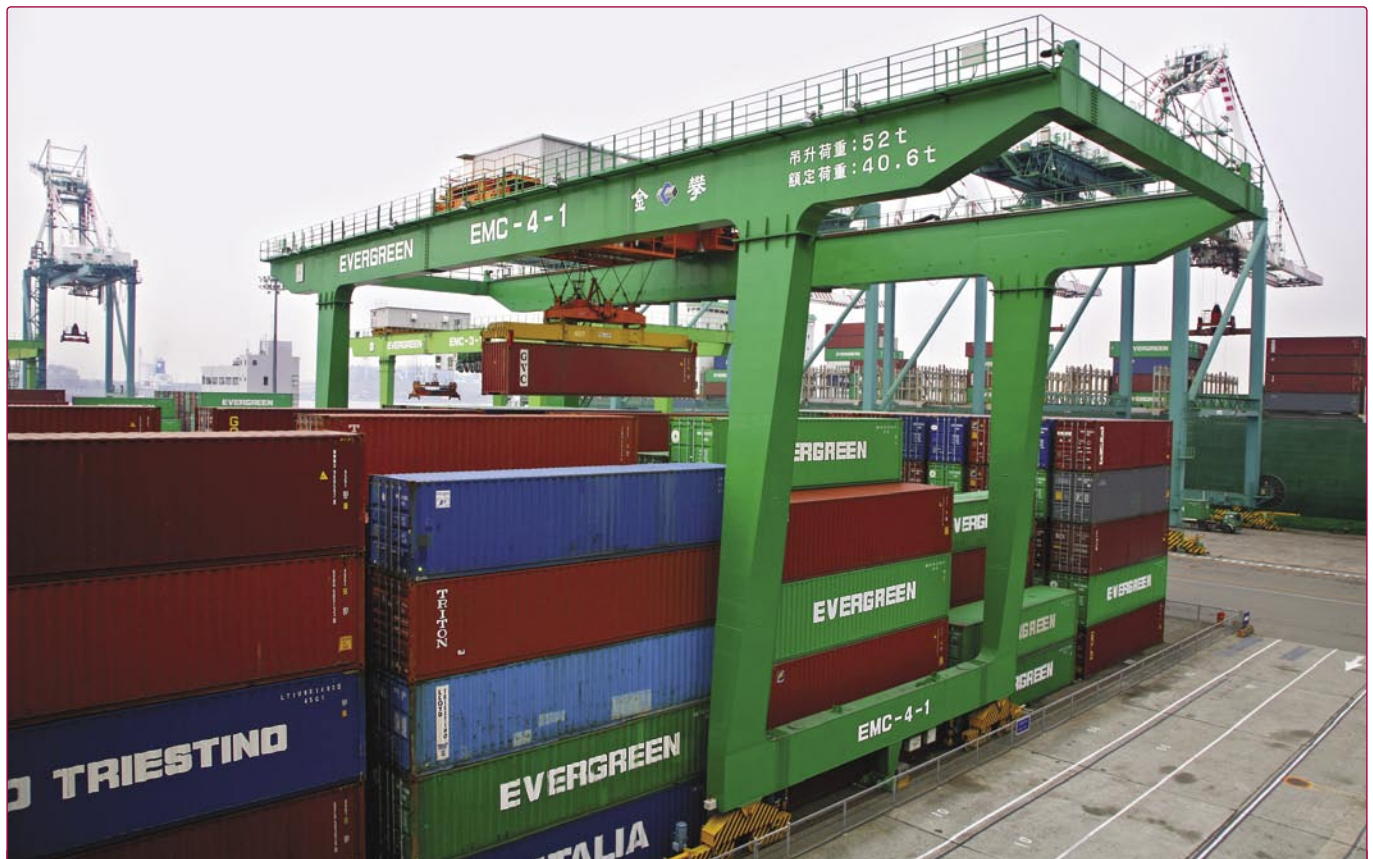


Figure 1. Cantilever Rail Mounted Gantry.

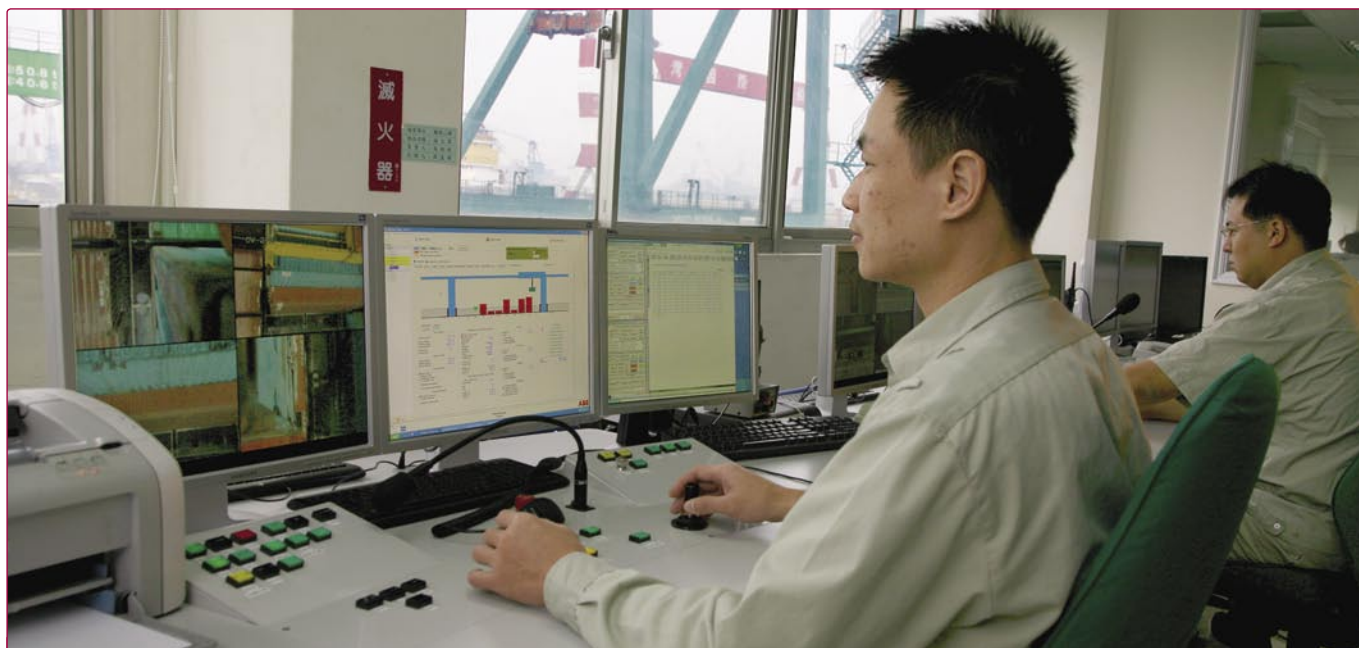


Figure 2. All movements within the yard area and above a certain height over the travel lanes are performed fully automatically.

The RTG (Rubber Tire Gantry)

This is one of the most commonly used vehicles for yard stacking and needs no further introduction. Each vehicle is manned with a driver; house-keeping is limited since the ability to move a loaded container in gantry direction is limited.

The RTG can be moved between different stacks in the terminal. Modern RTGs are equipped with positioning systems, (e.g. auto-steering, DGPS and cameras are being introduced in some places in order to improve the driver's overview).

Comparison

The CRMG can replace the RTG in almost any terminal and a comparison between the concepts can be made (see Table 1).

Economics

When comparing the two alternatives the following factors are the most important:

- Crane prices
- Labour costs
- Operational differences

TABLE 1.

	RTG	CRMG	Comment
Investment	(+)	(-)	Depending upon crane price
Operating costs	-	+	Large reduction in labour
Cycle time	-	+	Higher trolley and gantry speeds
Yard utilisation	-	+	More advanced stacking
Flexibility	+	-	Movement on rails for the CRMG
Civil works	+	-	Rails vs concrete track
Infrastructure	+	-	HV – lines, remote, net-work
Maintenance	-	+	No tire changes etc
Environment	-	+	Electrically fed, no emissions
TOS	+	-	More advanced
Service level LS/WS	-	+	Faster repositioning of cranes
Productivity	-	+	Better housekeeping, less dependence upon driver skills

Current prices for a typical RTG are well above one million US dollars (dimensions: 1 + 6 wide and 5 height).

For automatic CRMGs, more than 100 have been ordered during the last year and a standard price basis established. The conclusion is that price difference between the two alternatives can be assumed to range between 0.5 – US\$1 M/crane. Labour costs vary from US\$10,000 – US\$100,000/man-year and includes social cost, administration and labour planning etc.

The RTG flexibility is compensated by the fact that the CRMG can perform automatic house-keeping, has a shorter cycle time and can reposition itself quicker due to a higher gantry speed.

Furthermore, with the introduction of modern TOS-systems, containers can be more evenly distributed over the yard so that the cranes are not required to move between rows of stacks. For the CRMG alternative, an additional TOS-investment of US\$2 M has been taken into account. This investment depends upon the size of the port. A cost capital of six per cent has been assumed.

Simulation

In order to compare yard operations using the two alternatives, a simulation has been performed in cooperation with TBA, Netherlands.

A model port with the following data was used:

- 600,000 boxes/y
- Six QCs with a WS peak of 180 moves/h
- Export/import
- ITVs between quay and CRMG on the WS, external trucks serviced on the LS
- Dwell time five days
- Empties handled by FLT's

These assumptions allow for a real comparison between the two alternatives as the operations and all employed cranes and vehicles are similar.

Yard operations were simulated using RTGs and automatic CRMGs respectively, and simultaneous LS and WS peaks were assumed. For the RTG results, a bench-mark has been performed with an operational RTG terminal.

As input to the transport cycle for the auto CRMGs, real data from performance testing real data from performance testing was utilised.

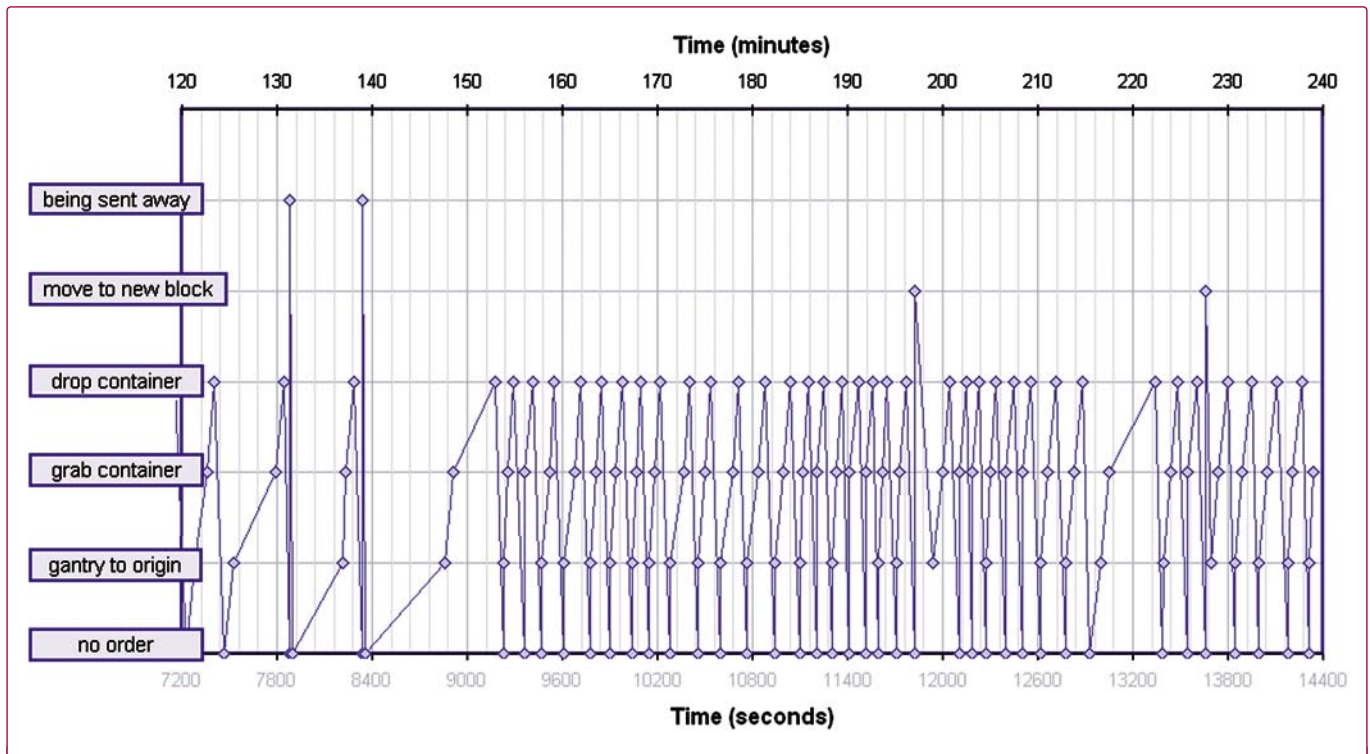


Figure 3. Move pattern RMG in export area.

The results were introduced into a complex model calculating the number of equipment needed during the year, the resulting man-hours, the total investment and the cost per handled box.

Movements in and out of one of the blocks during a two hour time span (7,200 – 14,400 seconds) are depicted in Figure 3.

The Figure shows that productivity is highly dependent upon the number of gantry moves (time elapsed between grab and drop container).

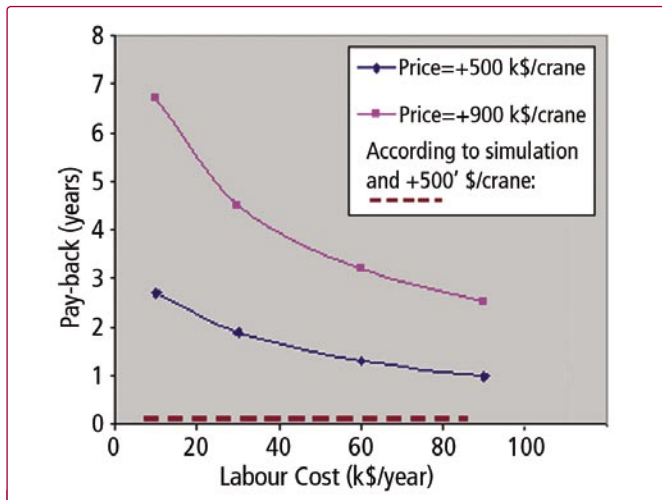


Figure 4. Conservative simulation results for automation.

Results

The results from the simulation show that three auto CRMGs are able to replace five RTGs.

Assuming that the price of an auto CRMG will be 500,000 USD higher than that of an RTG – automation will always be profitable – regardless of labour costs – since the investment will be the same and operational costs are substantially lower.

Figure 4 shows the result with more conservative assumptions for automation:

- Three auto RMGs are required to replace four RTGs
- Price difference between \$US500 – \$US900,000 per crane

Conclusion

The automated RMG equipped with electrical and control system from ABB is becoming a standard product, and the introduction of automation is profitable, not only for large ports (> 1 MTEU/y), but also for medium large ports (down to below 0,5 MTEU/y) in countries with low labour costs.

The labour required for yard operations can be reduced substantially – a clear advantage from a cost perspective and also in regions where the supply of skilled labour is scarce.

ABOUT THE COMPANY

ABB Crane Systems' main mission is the efficient and optimised handling of containers, bulk materials and steel products in ports, power plants and steel mills. The productivity and quality of the installations are improved in a cost-effective way by applying total solutions based on knowledge of the customer's processes.

ENQUIRIES

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