BROWNFIELD TERMINAL AUTOMATION
FIVE MAJOR PITFALLS

"LABOUR SHORTAGES AND ENVIRONMENTAL CONSIDERATIONS HAVE MADE AUTOMATION INCREASINGLY ATTRACTIVE."

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MORE TYPES OF AUTOMATED EQUIPMENT ARE AVAILABLE ON THE MARKET

Today, most container terminals worldwide still have a fully manual operation for the yard, quay and transport. However, labour shortages and environmental considerations have made automation increasingly attractive. Container terminals would also like to increase their capacity and efficiency on the existing footprint. This means operators are looking into automation to increase their throughput capacity and to be less affected by labour shortages.

The industry is aware of the move towards automation, with more companies looking into ways to automate existing terminal concepts. Automated Rubber-Tyred Gantry Cranes (A-RTGs) are an example of such equipment, as shown in Figure 1. With these new types of automated equipment, the road towards automation becomes more straightforward, with less infrastructural impact on the operation.

Yet, the road to automation is full of risks and challenges. If such challenges are not tackled adequately, the objectives may not be achieved. In this paper, we will discuss some pitfalls to be avoided during the implementation of (automation) technology:

1. Overestimating automation potential
2. Underestimating the changes required for automation
3. Misjudging integration timelines
4. No thorough automation roll-out strategy
5. Trouble operating a hybrid terminal with two different modes

FIGURE 1.
3D image of an Automated Rubber Tyre Gantry crane, interchanging with a terminal truck.

When these pitfalls are not remediated, the chance of additional costs, project delays and unsatisfactory automation implementation will increase.

1. OVERESTIMATING AUTOMATION POTENTIAL

Container terminal automation offers increased safety, higher storage density and the possibility to work 24 hours, 7 days per week, without much loss due to shift changes and meal breaks. However, at Portwise, we have seen terminals that overestimate the benefits of these points for their future automated operation. Consequently, business cases may be too optimistic, causing distress when the target productivity cannot be reached.

Consider a remotely operated quay crane, involving a handover between automated and manual control. This handover is not always seamless, causing longer crane cycles, due to additional braking of the hoist or trolley and could therefore result in lower productivity. Similarly, automated interchange is typically slower than manual interchange, due to positioning times of automated equipment. This must be taken into account when aiming to set realistic automation targets.

Careful estimations and assumptions are essential to setting realistic targets and creating accurate business cases. Equipment specifications and productivities should be discussed in detail with suppliers. Furthermore, by properly assessing the impact of a system change towards an automated terminal concept, for example using

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detailed simulation models, realistic expectations of the operational gains or losses can be quantified. This helps in managing expectations for the project team and overall terminal organisation.

2. UNDERESTIMATING THE CHANGE REQUIRED FOR AUTOMATION

The impact of required changes for automation is often overlooked or underestimated. Working with automated equipment has a huge impact on the way of working. If the complete terminal, including hardware, software and staff, is not fully prepared and on board with the transition, there will be costly interruptions and delays and less efficiency.

At Portwise, we have seen numerous requests for proposals with detailed equipment specifications, and little to no specifications of how the automation should interact with the operation, including workflows, but also the interaction between man and machine. Workflows and processes are often assumed to be similar between a manual and automated terminal, but more often than not, automation is different, and cannot work the same as a manual operation. Moreover, results from virtual testing are often assumed to be easily replicated after the go-live. This way, the go-live could result in disappointment due to the set expectations.

Existing operational procedures should be mapped and reevaluated against the situation with the new automated system. Automation systems can only perform up to their potential if the operational processes can be adequately adjusted to the provided automated solution. Next, personnel must be fully on board and trained to work in a new environment. Also, to manage an automated system, the (IT-)organisation needs to be prepared, trained and likely expanded. They should be familiar with the new technology, the ways to maintain it, install upgrades, but also firefight exception cases.

3. MISJUDGING INTEGRATION TIMELINES

With the change towards automation, integration of software systems of different suppliers is key to success. These systems need to work together seamlessly; equipment, control software, scheduling, TOS, etc. The time and effort needed to complete this component is often underestimated because it does not only depend on the supplier delivering automation, but also on the other systems that need to interact with an automated system.

When a container is discharged from a vessel in an automated container terminal, it often involves OCR cameras on the quay crane to validate and confirm container information. The OCR might detect a different container than expected by the automated system. When the new container information is not fully updated in all systems (e.g., equipment control system, terminal operating system), it could lead to a mismatch in validation between the different systems, resulting in delays and manual intervention. This is one of the many integration items that could be encountered the during go-live of an automated system.

Project planning is key to the success of any project. Projects should start with a proper and realistic schedule of the key deliverables. Civil project timelines and equipment delivery times are often predictable and well known in the industry. Integration of software comes with much more uncertainty, but by predefining integration needs and constructively planning with suppliers, delays can be minimised. Planning sufficient time for testing, and solving integration issues is key to success. Proven and existing solutions often help here, since general issues have already been tackled, resulting in an easier implementation.

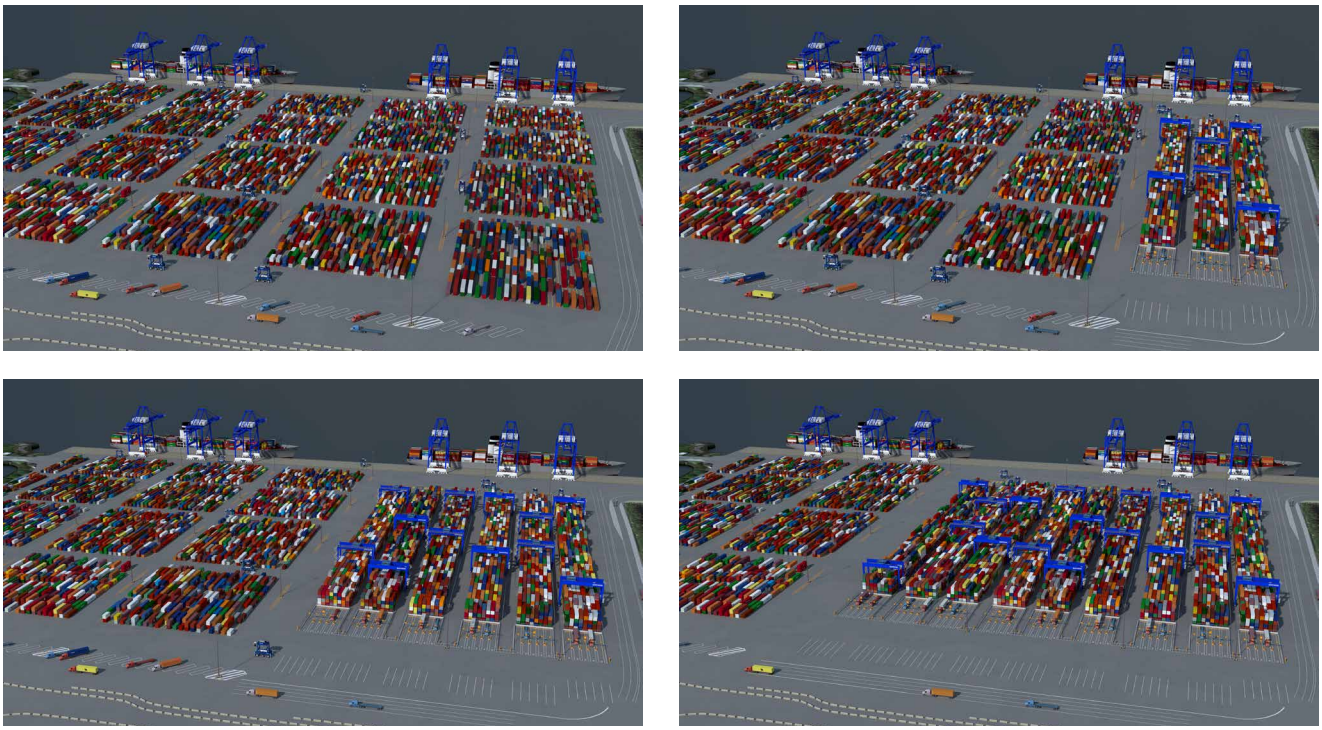
4. NO THOROUGH AUTOMATION ROLLOUT STRATEGY

When civil works are completed, the equipment has been facilitated, planning control software is installed and the terminal can start transitioning operations from manual to automated. This rollout requires a clearly defined strategy, which could be a gradual transition or a so-called big bang. Every strategy has advantages and disadvantages, but not having one in place will inevitably lead to problems when going live.

There are three different ways of implementing a new automated container terminal concept;

1. Big-bang transition; switching from the old mode of operation to the new mode of operation in a couple of days.
2. Greenfield expansion, with the new mode of operation.
3. Gradual transition to the new mode of operation.

Planning a big bang could be a way to mitigate the impact of transitioning, but it includes many risks such as:



- Edge cases (non-happy flow) not properly defined and tested
- Integration between different system components is not adequately tested.
- Personnel has not been given enough time and training to work in the newly automated system

A greenfield expansion, where an additional piece of land is used for testing and commissioning an automated operation, has a lower risk, but cannot be performed everywhere due to lack of space. It ensures that sufficient testing and familiarising with the system can take place, before further roll-out to the brownfield piece of the terminal.

Gradual transition is a way to provide sufficient time for testing and commissioning, but results in a reduction in capacity, or a change of operation throughout the testing period. A phased transition is shown in Figure 2.

Having a well-defined rollout strategy that is clear to every member of staff involved in the step towards automation is essential for a successful go-live. When going through an extensive go-live with an existing running operation, always ensure that a fallback strategy is defined. This way, the automated system can be bypassed to continue operation in case of failures.

5. TROUBLE OPERATING A HYBRID TERMINAL WITH 2 DIFFERENT MODES

Automating the terminal is not done within a day. Instead, there typically is a phasing period during which an increasing share of the terminal becomes automated. During this period, a hybrid operation could exist, utilising both manned and automated equipment. This is difficult to manage from both a planning and operating perspective. However, shutting down a large part of the terminal is very costly and interruptions must be avoided.

When operating with multiple modes of horizontal transport or stacking concepts, one should consider that there are two separate terminals. For example, consider the terminal shown in Figure 3. This terminal has two different types of stacking concepts, Automated Stacking Cranes (ASC) and Rubber Tired Gantry Cranes (RTGs). Also, two types of horizontal transport are used by this terminal: Shuttle carriers and Terminal trucks. When loading from the ASC modules,

FIGURE 2. A phased transition path from straddle carriers to automated stacking cranes

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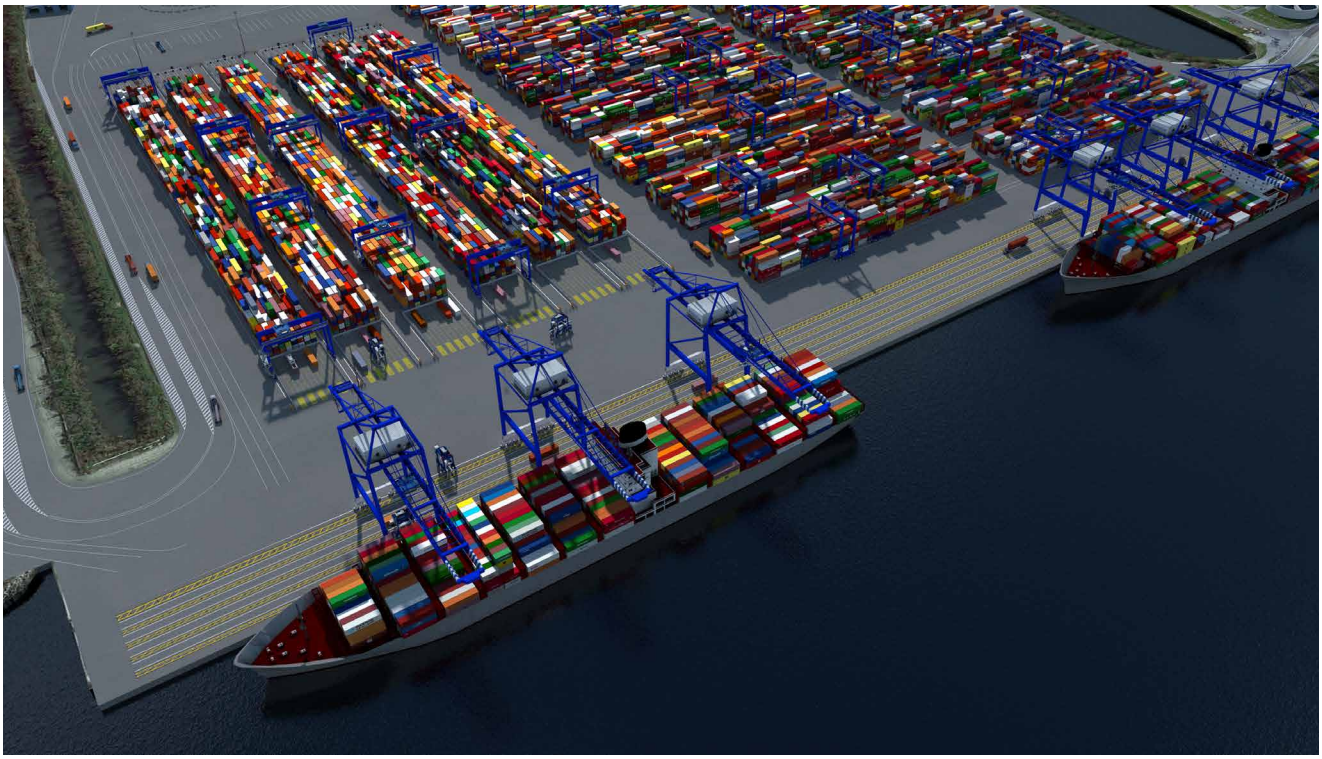

the terminal uses Shuttle carriers, which place containers underneath the quay crane. This is a different type of operation and does not mix. Hence, when containers are placed in the RTG stacks, but must be loaded to the quay cranes served by ASCs / Shuttle carriers, a handover must take place.

Using detailed operational planning and analysing the impact on all systems that are influenced by such a hybrid operation, the risk of overspending can be reduced or avoided.

FIGURE 3.
Visualisation of a container terminal converting van RTG + TT to ASC + ShC in a hybrid operation

CONCLUSION

Manually operated container terminals are currently researching how to either partly or fully automate their operation. Automated existing equipment, such as Automated Rubber-Tyred Gantry cranes or Straddle carriers, could make the automation process more straightforward and less risky. However, at Portwise, we have seen that the discussed points in this paper are often not considered in a sufficient level of detail, resulting in severe project delays and additional costs.

Before starting your automation project, or even signing with suppliers, these 5 major pitfalls should be extensively noticed, discussed and evaluated. By taking the aforementioned points into account in the planning phase of automation projects, a stronger start to the process can be guaranteed. In addition, expectations within the organisation of what automation may bring can be managed well, which is key to the success of an automation project.

Portwise has years of experience with automation projects, both in the preplanning phase, project initiation phase and the implementation and go-live phase. We provide valuable automation consulting to mitigate risks and delays and to ensure project success. In this way, we guide terminal operators along the journey towards automation.

ABOUT THE AUTHORS:
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ABOUT THE COMPANY:
Portwise, formerly part of TBA Group, is a world-leading consultancy and simulation firm that combines extensive automation and operational knowledge with proven simulation tools to create a future-proof plan for your port, terminal or warehouse operation.