

THE AUTOMATED EMPTY CONTAINER DEPOT

A WORLD-FIRST FOR ROTTERDAM

Joost Achterkamp, CEO, Solid Port Solutions,
Dubai, UAE



Container terminal automation is reaching a mature stage of development and most new projects incorporate some elements of automation. One of the new areas for process optimization that until now has been mainly ignored is the handling and storage of empty containers. Whilst the optimization of empty container flows has received widespread attention, the cost to shipping lines for depots to process and handle empty containers is hidden within the total of container repositioning. The crucial role in the process of preparing an empty for delivery to the next client or for repositioning to another location is the 'Empty Container Depot'.

Traditionally depots have consisted of minimal civil infrastructure and have relied on 'Empty Container Handlers (ECHs)' with basic inventory systems and have been limited to the extent to which they can optimize their processes. Typically, empty container depot operations are

performed in an ad hoc manner and achieve low levels of efficiency.

Recognizing the mature state of container equipment automation, the Kramer Group sought to assess how to implement automated handling processes within empty container depots. In 2017, the Kramer Group assisted by Solid Port Solutions started to develop plans for the first fully automated empty depot, this resulted in the New Generation Robotized Empty Depot (NG-RED™).

WHY AUTOMATE?

The project team, consisting of staff from both KRAMER and Solid Port Solutions, was given the objective of developing a new empty depot process that would:

- Reduce the costs per container per visit
- Provide higher throughput capacity on the area footprint

- Improve the efficiency and quality of the processes and services provided

The team was also challenged to ensure the concept would utilize fully electric equipment, reduce damages and accidents, and significantly improve turnaround times for truck drivers.

With primary objectives and targets set, a business case was developed for a facility which would be focused on shipping containers with a relatively short dwell time, rather than long stay lease containers. The depot's location would be close to deep sea terminals and well connected to different transport modalities to provide the volume of throughput to justify investment in automated systems. A location within Maasvlakte, Rotterdam ticked all the boxes, with the added benefit that it would be able to be connected via the container exchange route (CER) to all deep sea terminals.

HOW DOES IT WORK?

The main principle of the design is based on well proven overhead bridge crane (OHBC) technology. The OHBC gauge of 30 metres covers four TEU wide stacks with containers stored perpendicular to the gantry driving direction. Each OHBC lane has the same specification and covers both stacking areas, as well as separate areas for empty depot services such as inspection, cleaning and repair.

The service areas are within fenced zones that allow the blocking of automated OHBCs from working within a zone when workers are present. NG-RED is a combination of existing technologies, the majority of which are commonly found in automated yard systems for deep sea terminals. The system is also comparable to those found in assembly line systems for the product fabrication of products where workers are constantly found working alongside automated equipment.

TRUCK HANDLING

A common complaint of container depots is the slow gate process which results in the frequent queuing of trucks adding to the cost of transporting empty containers and causing congestion on surrounding roads. At NG-RED this problem is solved. The truck enters the depot driving through an automated gate system with OCR and LPR, the truck will have been pre-announced, and the truck-visit is matched with the empty depot's equivalent of the terminal operating system.

The next process point is a short drive away at the entry kiosk where the driver swipes a cargo card. Next the driver gets his route plan and continues to the truck exchange point for the assigned OHBC. At this point, technology similar to the ASC exchange process at automated terminals is used with the driver leaving his truck and going to a kiosk where the driver again swipes the cargo card. The job is confirmed within the TOS and the container is handled with the OHBC in full automated mode or with a remote operator. The truck then leaves the exchange point and goes on to its next job in the depot or leaves the depot following a similar process on the way out with OCR technology and an exit kiosk.

In contrast to the process at traditional empty depots, containers delivered to the depot are not inspected prior to being dropped off, allowing the truck process to be performed very quickly and reliably and enabling truck turnaround times of less than fifteen minutes.

INSPECTION PROCESS

After the drop-off by the truck, the container is placed by the OHBC in a buffer area until it is to be inspected.

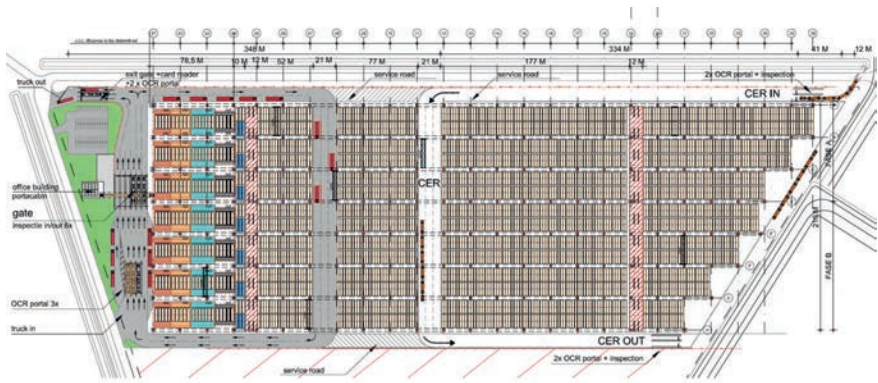


Figure 1. Masterplan NG-RED depot

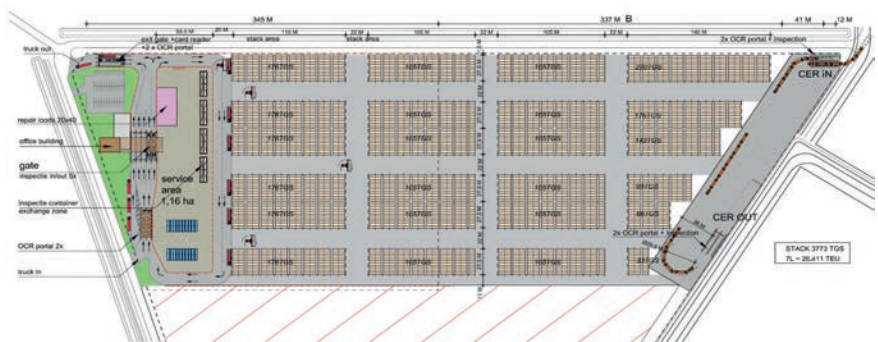


Figure 2. Traditional design on same footprint

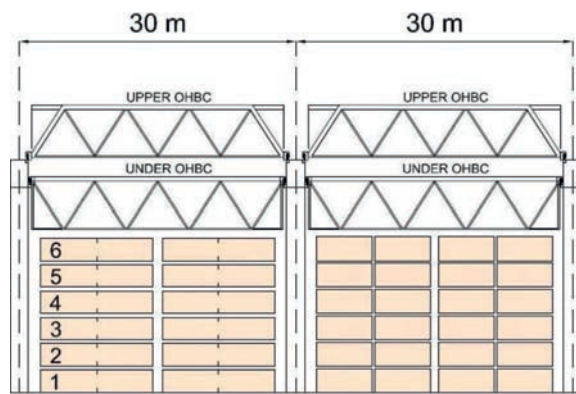


Figure 3. OHBC Principle

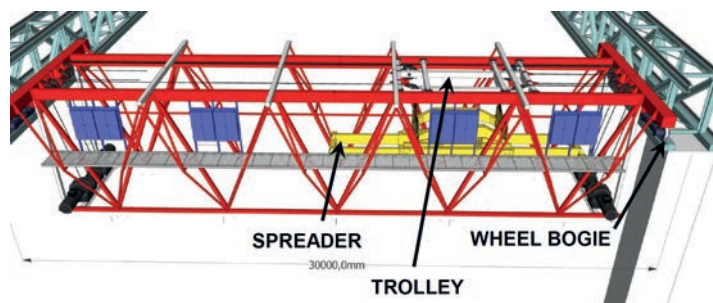


Figure 4. Lower OHBC

Prior to inspection, the container is transferred by the OHBC to the inspection area where it is placed on steel frames. Each inspection area has capacity for six containers, allowing surveyors to be given job assignments when the buffer area is full and the OHBC is blocked from entry or passing overhead. The steel frames provide access by qualified surveyors to carry out a full inspection of the boxes including the bottom and roof. The inspection is carried out without the time pressure or safety risks of working in an area of queuing trucks waiting to be served, or being repositioned to align themselves with the ECHs, by which the workload of surveyors can be managed more evenly. The condition of the container can then be reported, and it will be decided in communication with the shipping line which services are to be performed prior to releasing the container in good condition for its onward move.

SERVICES PROCESS

After being inspected, the container can be transferred back to the buffer area or directly to the designated service area for cleaning or repair – all movements of the container being carried out by the fully automated OHBC. Each OHBC lane has the same services area to avoid moving containers between stack rows. The service areas are worked according to the same principles as the inspection areas, they can be claimed by the OHBC or by the people working in the area and are fenced with a controlled access gate. The layout of the service areas is such that service areas requiring longer processing are located further away from the buffer area. Included within the solution is the pre-trip inspection (PTI) for refrigerated containers with racks equipped and with electrical plugs being also serviced by OHBC.

AVAILABLE YARD

A container can go to the available yard when it gets the status “Available” directly from inspection or after the required services are executed. The main advantage of the yard system is the density; there is no space needed for roads for the ECH’s and containers can be piled eight high. The storage capacity is calculated to be at least 40% more than traditional depot systems. The containers will be stored in blocks of the same client, type size and condition for use. In such blocks, the containers can be densely stacked with the automated OHBC minimizing wasted space between container tiers. The blocks can vary in width, but are planned to be a maximum of six wide to support the use of FIFO (first in, first out) principles to prevent aging of certain boxes.



Figure 5. Truck Gate



Figure 6. Truck handling lane



Figure 7. Inspection & Services areas

SPECIAL FUNCTIONALITIES

For optimizing the process and the system productivity, the following special design functions are included:

- To move containers from lane to lane, an automated 'shifter' system is available
- The OHBC's are designed with an "UPPER" and a "UNDER" crane that can pass each other independently
- A separate road lower the OHBC lanes will be used to handle the (automated) vehicles arriving via the CER from the deep-sea terminals

BUSINESS CASE

The ROI of the system will be based on two principles. Firstly, the cost per move will be much lower because of the use of fully electric automated OHBC cranes. Secondly, the throughput per hectare will increase by about 40% due the higher stacking density of the solution. A differential financial comparison of a traditional concept with the NG-RED system on the same footprint showed that the payback period of the automated system will be around eight years. It works two ways; the revenues will be higher and the operational cost lower.

THE PROJECT

The Kramer Group NG-RED™ terminal at the Maasvlakte Rotterdam will be realized by a team of experienced companies including ZPMC for mechanical and crane structures and SIEMENS for the electrical and automation solution, both with a proven track record in the automation of container terminals. Solid Port Solutions will participate as designer and project manager. The terminal is planned to be operational at the end of 2020.



Figure 8. Highest density in the "available" yard

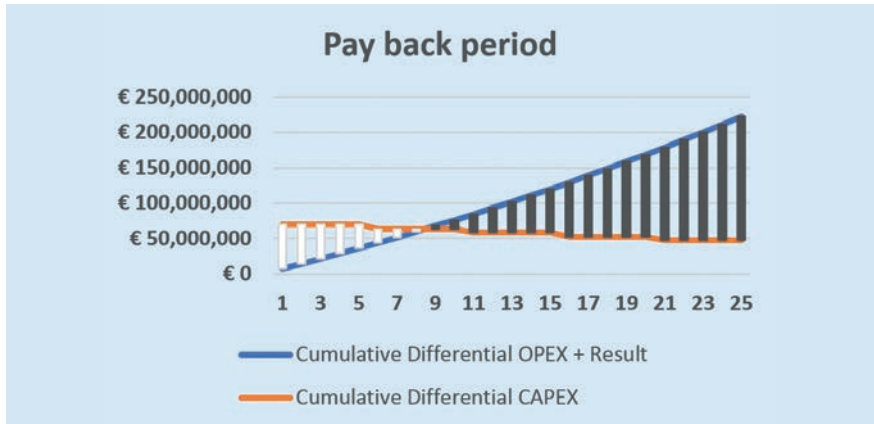


Figure 9. Financial Comparison Traditional with NG-RED



Figure 10. Project Location Maasvlakte Rotterdam, Netherlands

ABOUT THE AUTHOR

Joost Achterkamp is the founder and CEO of Solid Port Solutions. He has worked on several automated container terminals and has operational as well as engineering knowledge. After finishing his civil engineering study in 1981 he started as a structural engineer for the Rotterdam municipality. He joined Europe Container Terminals (ECT) in 1992 as a Project Leader on the civil construction of automated container terminals. In 1997 he switched to the position of Operations Manager at

the first fully automated container terminal in the world. By the end of 2001 Joost became the Project Manager Operations of the Euromax Terminal, responsible for the operational design of the next generation fully automated container terminal. In 2009 he joined ADPC to design and build Khalifa Port, the first semi-automated terminal in the Middle East.

ABOUT THE ORGANIZATION

Solid Port Solutions was established by Joost Achterkamp in 2013 and is made up of high-

level technical and project management experts in the ports, transport and marine industries. The company is based in the UAE with most of the members European. Their expertise is based on practical experience and knowledge gained over 25 years in a wide range of countries.

ENQUIRIES

Web:
www.solidportsolutions.com/index.html