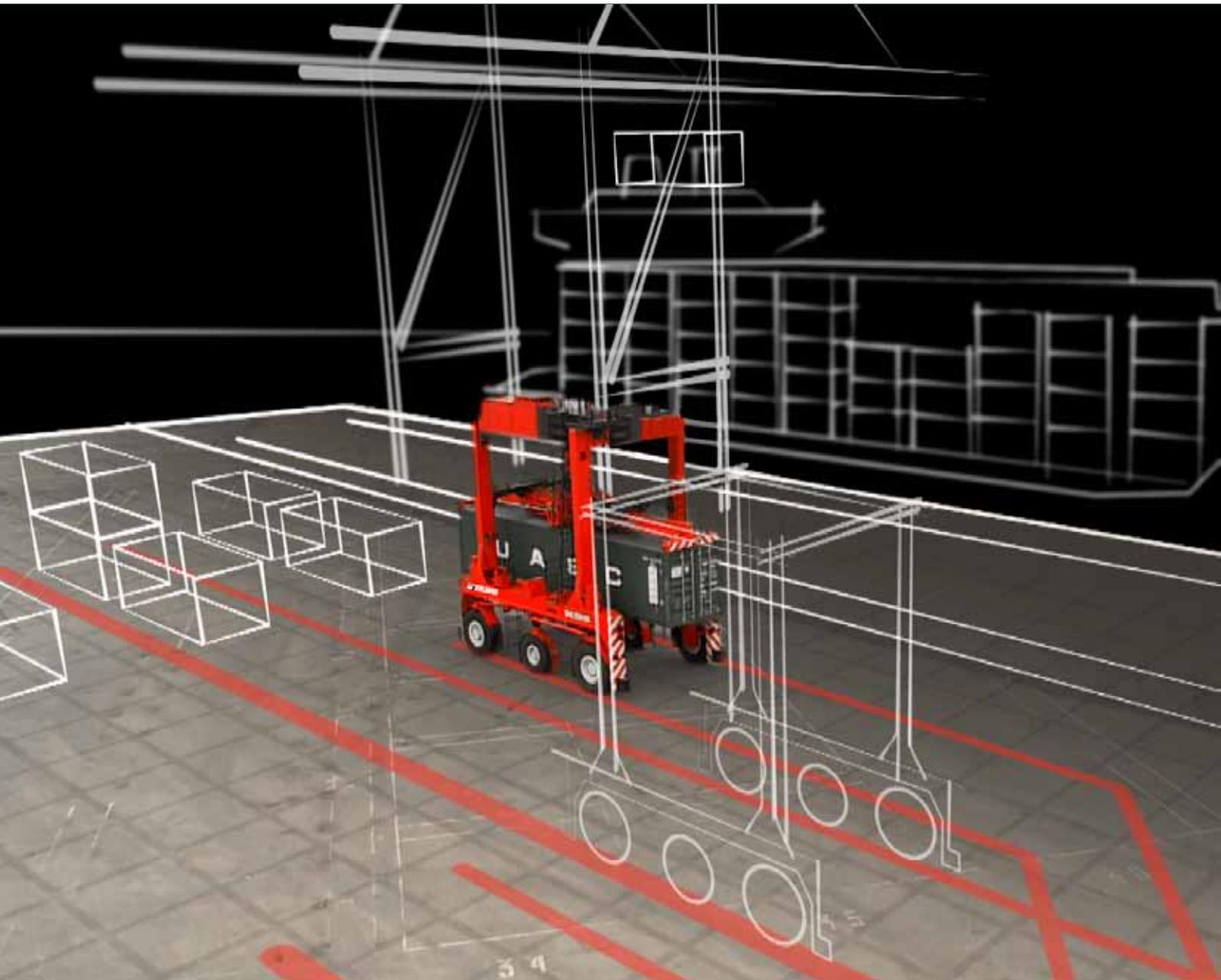


# Kalmar Automatic Horizontal Transportation System



ADDED VALUE THROUGH AUTOMATION



# Terminal automation plays a key role in planned port productivity

Terminal operators' need for greater competitiveness is increasing alongside rapid change in international trade. Pressure for terminal development is being intensified by throughput predictions, availability of land, productivity goals, environmental regulations and costs. Tougher times are expected due to the price competition already emerging in traffic routing. For example, the opening of the Panama canal is putting pressure on West coast and East coast U.S. ports.

This places a new focus on terminal development and the possibilities of automation. How to rethink operations in older ports? How to increase stacking capacity when there is simply no space for traditional manoeuvring? How to plan the next successful megaterminal with a competitive edge in international trade logistics?

## PIONEERS IN AUTOMATION

Cargotec's terminal automation experience goes back to 1988, when it produced the first industrial automated straddle carrier. This carried steel coils in a Dutch steel mill. During the same period, Cargotec developed automated stacking cranes (ASC), as well as navigation and control software for automated guided vehicles. These began operating at the first automated container terminal, in Rotterdam in the early 1990s.

In the new millennium, Cargotec has continued full steam ahead, by completing several pioneering automation projects such as the first automated Straddle Carrier terminal operation in Brisbane, Australia. Another example is the ASC System operation with a three-crane block concept, including automation and control systems in CTB, Hamburg.

## AUTOMATED HORIZONTAL TRANSPORTATION

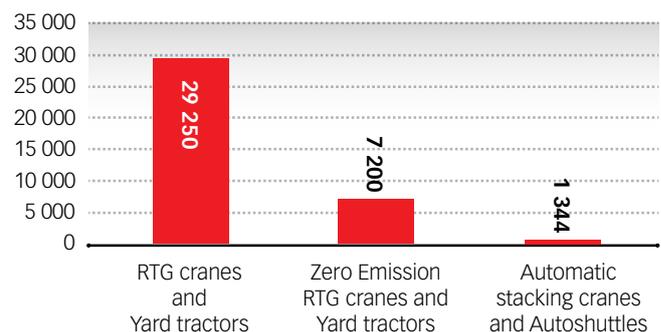
Together with the Terminal Logistic System (TLS), Cargotec's Autosshuttle concept has opened up new possibilities in developing and rearranging horizontal transportation in ports. Whether you are planning to update your older port or to plan a new one, the Kalmar Autosshuttle™ system will provide you with options on how to apply automation, as and when your volumes increase or your operations develop.

## SUSTAINABLE SOLUTIONS

We believe in more sustainable transportation, enabled by our equipment and actions.

Through automation, terminals can operate more efficiently in the future, but with less impact on the surrounding environment.

### ANNUAL EMISSIONS: CO (KG)



*Note: actual annual emission rate depends on the application and should be evaluated case by case.*





*Unmanned Kalmar straddle carriers in action in the Patrick Container Ports, in Brisbane, Australia.*

## Automation of horizontal transport adds instant value

Cargotec's solution for automating horizontal transportation (AHTS) is based on the decoupling of machine work cycles to ensure the most efficient open and optimal performance. Because container handover does not require the simultaneous presence of a crane and shuttle, waiting time is avoided and equipment utilisation rates are increased.

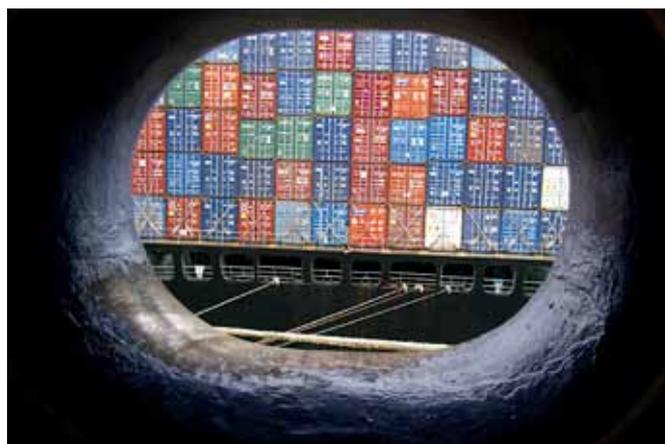
### **CLEAR DIVISION OF LABOUR IS THE KEY**

The system is based on a clear division of responsibilities and the corresponding allocation of functions. It is designed with this in mind. The main responsibility of the Terminal Operating System (TOS) is to gather information, process it and plan containers with regard to the yard, vessel, railway and trucks.

For this purpose, buffers are created, in which containers are placed by one piece of equipment (e.g. the STS crane or ASC), to be picked up by other equipment (e.g. Autosshuttles) when available. This buffer has several, randomly accessible transfer positions, ensuring that there is always somewhere to locate the next container. Through this setup, each set of apparatus can operate at its own optimum pace and best performance level.

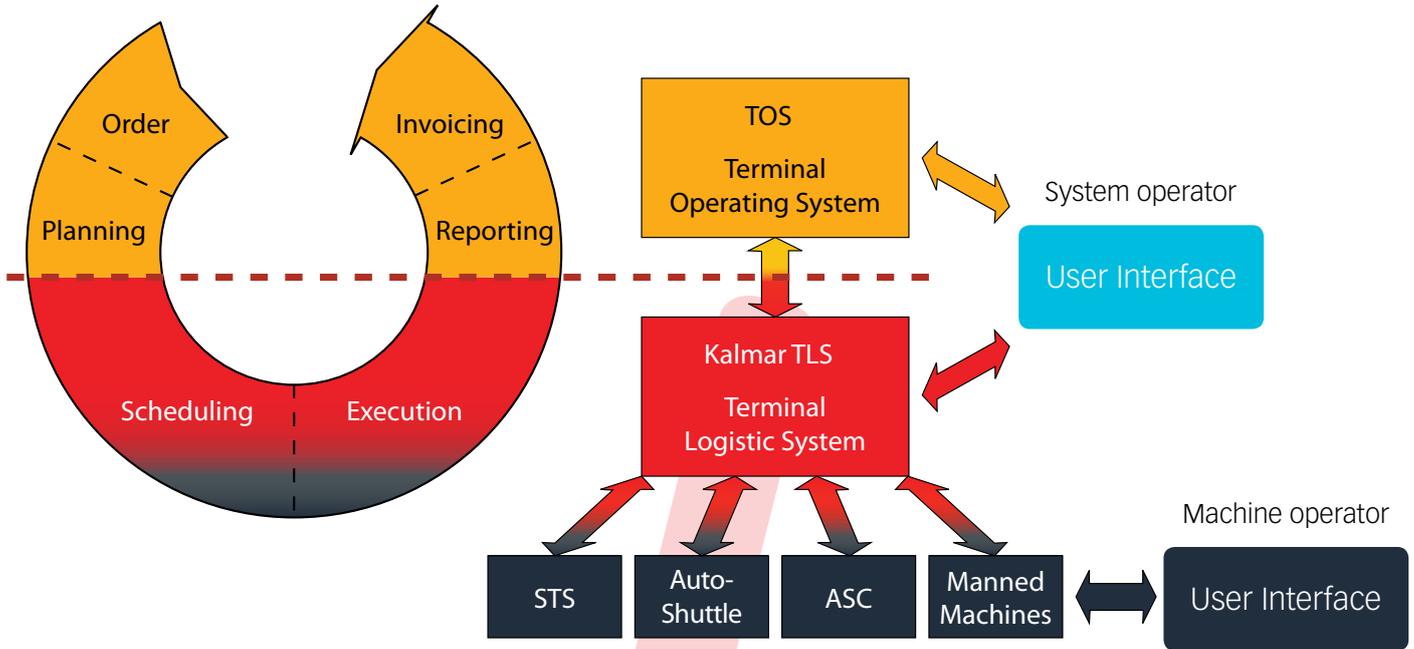
### **FEWER VEHICLES, MORE CONTAINERS**

Because Autosshuttles have a higher utilisation rate, fewer vehicles are required to transport the same number of containers, reducing both the associated investment in equipment and overall maintenance costs. A reduction of 50% is typical in comparison to an automated terminal featuring AGVs. The reduced number of vehicles on the apron also leads directly to less traffic congestion as well as shorter paths and driving times. This further optimises the performance of AGVs and shortens waiting periods.



## PRIMARY BUSINESS PROCESSES

## SYSTEMS



### Kalmar Automatic Horizontal Transportation System (AHTS)

#### Terminal Logistics System (TLS)

- extendable and scalable software architecture

#### Automation

- MMS Navigation
- Pick & Place
- Machine Control

#### Autoshuttles

- pick and place containers directly from the ground under the STS crane and water-side interchange area (next to container stacks)

#### Equipment Monitoring System (EMS)

- remote monitoring diagnostics

### KEY BENEFITS

All options are available, from manual shuttle to semi-automated solutions or fully automated AHTS.

Packaged solution which can be applied with minimum customisation

Development projects are at lower risk when sensible roadmap planning is applied

Lower total cost of ownership

Operational efficiency through decoupling of work cycles

Cargotec's equipment diagnostics prevents major problems and helps in planning for necessary maintenance

Covers operational needs, from waterside to stackside and landside

Operational safety is based on thorough testing and proven technology from Cargotec



*Automated Kalmar stacking cranes at Container Terminal Burchardkai, Hamburg, Germany*

# Terminal Logistics System enables smooth terminal management

## **KALMAR TLS LINKING AUTOSHUTTLES WITH TOS**

Kalmar TLS is designed to schedule and execute job orders. Because the system communicates with the equipment, it has comprehensive, real-time information on the equipment's position and status. This knowledge is used for planning and scheduling, when Kalmar TLS translates the container moves received from TOS into equipment moves.

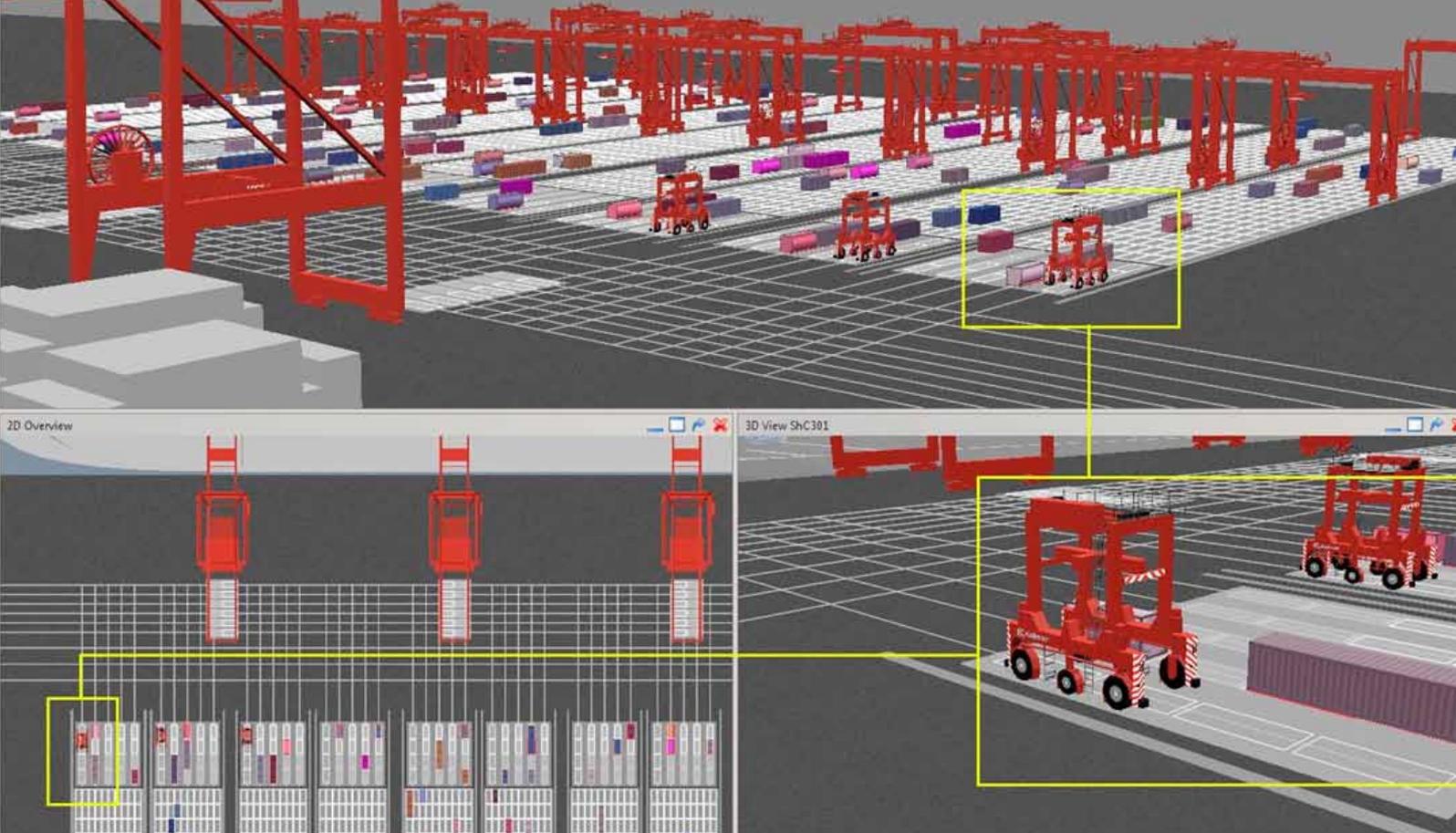
It selects the equipment best suited for each transport type and plans refuelling well ahead. In this way, it ensures the continuous availability of sufficient equipment. It also determines the time and order of delivery within the given STS workflow constraints. Use of buffers makes such flexibility possible. Finally, Kalmar TLS dispatches orders and routes to the Autoshuttles, thus controlling traffic on the apron and managing the buffer areas. This ensures safe interchange of containers between manned and unmanned equipment.

Kalmar TLS is therefore the intermediate system between the planning and scheduling of containers by TOS and scheduling and execution using Kalmar TLS equipment.

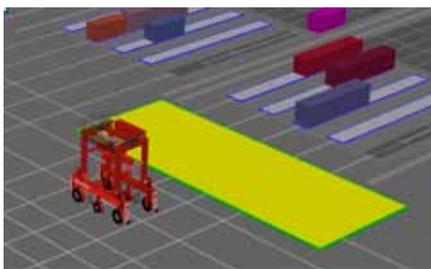
## **TERMINAL LOGISTICS SYSTEM (TLS) ENABLES FLAWLESS TRANSITION FROM MANUAL TO AUTOMATED EQUIPMENT.**

- Interfaces tested and operational in early stage
- Organisation is geared for automation
- Infrastructure prepared for automation
- Operators trained from day one to work with TLS
- User interfaces adopted early
- Avoids disturbance of operations during transfer

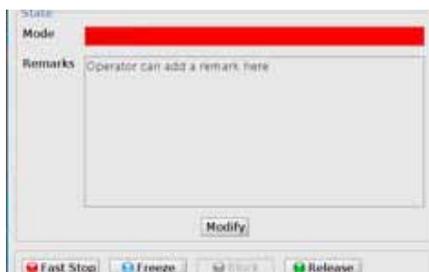
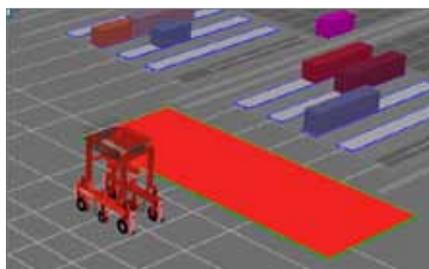
Terminal Logistics System (TLS) is based on scalable and extendable software architecture, to optimise usage of delivered automated systems, in addition to the required system-level integration.



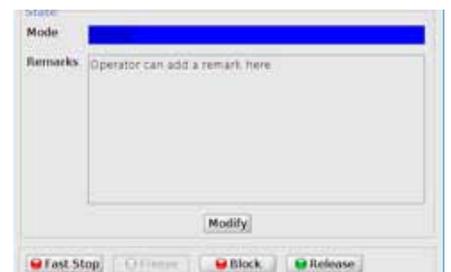
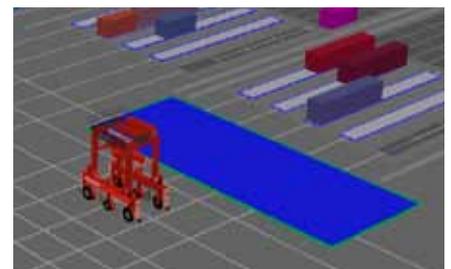
## AREA MANAGEMENT WITH TERMINAL LOGISTICS SYSTEM



- Block selected
- Blocked is pending until shuttles in the area are out
- A blocked area is empty, with the possible exception of a faulty shuttle



- Area is now blocked
- No vehicle can enter
- Operator may release later



- Freeze Area
- Not principally empty
- All vehicles in area stop
- Other vehicles cannot enter
- For short periods



*Kalmar Autoshuttle™ in action at the Cargotec competence and technology centre in Tampere.*

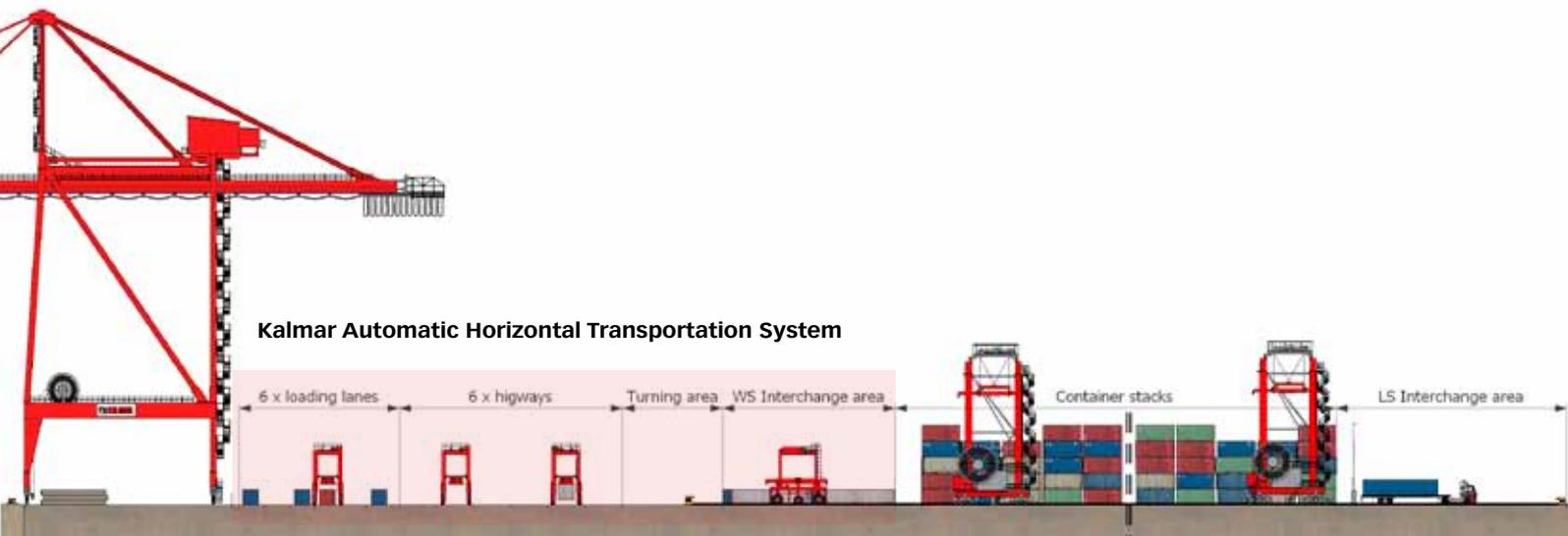
# Kalmar Autoshuttle™ streamlines horizontal transportation

Kalmar Autoshuttle™ picks and places containers directly from the ground under the STS crane, thus creating a buffer under the crane. Flexible use of buffers enables the STS to support twin lift, tandem lift and dual cycling. Twins can be carried as a unit by Autoshuttles, or composed at the transfer position when the containers are carried in turn by two shuttles.

Tandems are executed as two single moves by Autoshuttles: the layout of the buffer and the width of the Autoshuttle is adapted to the distance between the two containers of a tandem. Autoshuttle operation normally takes place under the STS crane backreach. This leaves space for manual operation under the STS portal. The automated and manual areas are separated by a fence.

Kalmar Autoshuttle™ transports containers between the vessel side and stacking area. In the same way, Autoshuttles pick and place containers from dedicated shuttle lanes in the ASC block's waterside transfer area. This shuttle lane buffer area can be several TEU slots deep. One ASC block can have several independent shuttle lanes.

KEY BENEFITS OF AUTOSHUTTLES
Decoupling of vessels and yard operations
Reduction of traffic congestion
Better space utilisation behind a STS crane
Higher buffer capacity in front of yard stacks & STS
Remote control: onsite monitoring -control, timing, manning
Automatic operation: lifting, grounding, single, twin
Extremely agile
Fast and accurate
Enables one-over-one or stacking of two containers



**Kalmar Automatic Horizontal Transportation System**

**PICK & PLACE**

Automatic Pick and Place (APP) uses sensors located onboard the Autoshuttle to detect precise location of container on the ground and controls the pick-up procedure in such way that the containers can be picked and placed with high reliability and accuracy.

**MACHINE CONTROL**

Machine Control utilizes sensors onboard the Autoshuttle to guide execution of the commands it has received from the Terminal Logistics System (TLS) with the highest performance. The system provides also advanced diagnostics features for detecting exceptions in the operation.

**MMS NAVIGATION**

Magnet Measurement System (MMS) Navigation is based on a grid of permanent magnets providing accurate and reliable measurement of equipment positions. The system enables free-ranging navigation, which means that routes are not fixed.

**EQUIPMENT MONITORING SYSTEM (EMS)**

Equipment Monitoring System (EMS) enables real-time control over machinery and assists in advance planning of service. It provides you with up-to-date information about machine status and fault diagnostics, whether you need to consider service or plan other action. The information displayed from the monitors in the control room are arranged in a user-friendly way enabling you to scan the situation easily.





## References

### AUTOMATION LEADS TO SUCCESS

**Case: Patrick Container Ports, in Brisbane** was declared Terminal of the Year at the 15th annual Lloyd's List DCN Shipping and Maritime Industry awards, in November 2010. Patrick is the world's first and only free-ranging robotic straddle carrier terminal, pioneered by Cargotec together with Patrick terminal operations and Patrick Automation. Patrick's unmanned fleet consists of 27 fully-automated Kalmar EDRIVE® straddle carriers. The automated facility is one of the maritime industry's safest working environments, achieving a record of more than 230 accident-free days. The terminal's quay crane productivity continues to improve, reaching well above the government's benchmark of 25 net moves an hour.



### RIGHT TECHNOLOGY IMPROVES RESULTS

**Case: Port of TTI Algeciras S.A., Spain**, has already long benefitted from its 20 Kalmar SHC240H shuttle carriers. These provide a single-lifting capacity of 40 tonnes and can stack containers two-high. The shuttle carrier fleet serves the needs of the new Algeciras terminal, by providing fast and flexible transportation between ship-to-shore (STS) cranes and automatic stacking cranes (ASC). The key productivity benefit of the shuttle carrier is its ability to pick and place containers from the ground, thus eliminating waiting times. This combination of manual and automated equipment achieves high productivity, using the lowest number of horizontal transportation vehicles.





## Terminal Development for the Future

The changing face of terminal operations and international trade logistics is challenging both operators and equipment providers. Terminal designs must apply to much more than container volumes and their efficient management.

Among other issues, sustainability and operational safety must be high on the priority list when proposing new terminal projects. Automation is the current buzzword. How can we make automation work for our benefit?

All development in advanced and automatic container handling and transport equipment is the result of ongoing cooperation between operators, the equipment industry and consultants.

It is vital that the automation system supplier is involved in a planning project at an early stage, so that the right decisions are made on e.g. terminal layout design.

For years, Cargotec has been involved in challenging and advanced terminal planning projects. We provide our customers with advisory services, covering everything from manually operated terminals to semi-automated as well as fully automated solutions. These services cover items such as equipment recommendations, estimates of required equipment quantities, overall cost analysis, terminal layout proposals and operational simulations. We aim to ensure that you can optimise the benefits of automation.



Global presence and local service bring  
our solutions closer to our customers.



*Cargotec improves the efficiency of cargo flows by offering solutions for the loading and unloading of goods on land and at sea – wherever cargo is on the move. Cargotec's main daughter brands for cargo handling are Hiab, Kalmar and MacGregor. In addition, Cargotec's global network offers extensive services that ensure the continuous and reliable performance of equipment. [www.cargotec.com](http://www.cargotec.com)*



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