Increasing Crane Productivity

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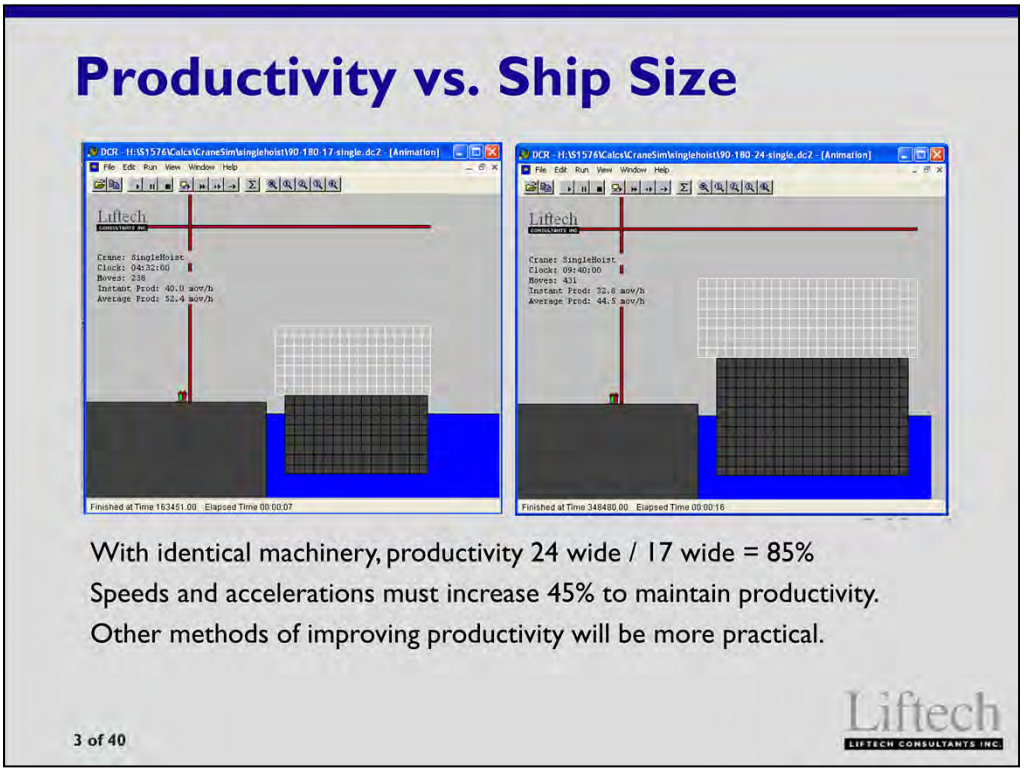
The Port of Oakland Berths 55-59 cranes are some of the world's largest single hoist container cranes. Now, even larger and heavier cranes are being designed and are in operation.

In 1959 Matson Navigation Company awarded Paceco a contract for the world's first dockside container crane shown in the foreground. Concurrently, Matson also developed the design of the first ship built to be a "Container Ship."

Liftech Engineers were fortunate to be members of the engineering team that developed the first dockside crane, and the first container ship.

Now, cranes are over three times larger in size and five times greater in weight than the Matson-Paceco crane. Ships are many times larger than the Matson ship, yet the vessel time at berth is less. Improved designs and improved operations have made this possible.

More improvements are needed to resolve the current congestion problems we face. Further improvements will be necessary to avoid more serious congestion problems in the future.



Due to the increased hoisting and trolleying distances, the theoretical crane productivity will significantly decrease when servicing future, larger ships.

Without other changes, to maintain the productivity attained when servicing a 17 container wide ship, the machinery accelerations and speeds must increase significantly.

This is impractical. Productivity gains will likely come from improved yard-crane interaction, decreased dwell times, tandem lift operations, shuttle cranes, operating cranes on either side of the ship, etc.

Tandem 40 dual hoist

Crane – Yard Interface

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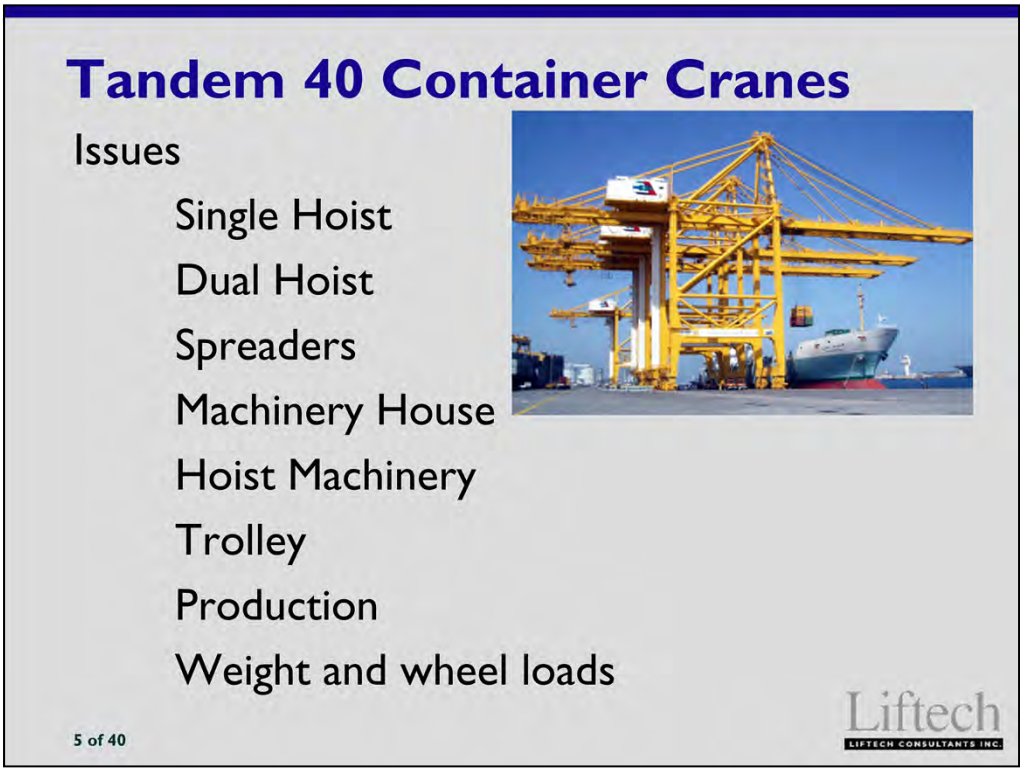
This presentation discusses emerging tandem 40 crane design being developed to reduce the vessel time at the berth and some considerations at the crane-yard interface.



Two existing tandem 40 cranes will be shown - the Port of Dubai cranes and the Shanghai cranes.

The tandem 40 design issues include:

Spreaders
- The spreaders must be controlled relative to each other at all times.
- They must be able to adjust to the vessel and shore conditions.
- They must not be damaged by a snag event.

Machinery House
- Two main hoists are needed. Should they be independent or combined?

Trolley
- Should there be two trolleys with two operators, or should there be one combined trolley with one operator?
- Should the trolley be able to operate efficiently in the single lift mode?

Production
- What will the increase in moves per hour be?
- Will the yard be able to keep up with the crane?

Weight and wheel loads
- How much?

Tandem 40 Hoist Systems

Single hoist systems

Dual hoist systems

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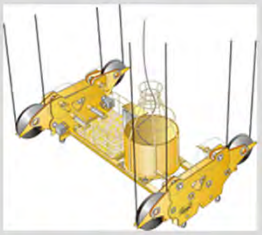
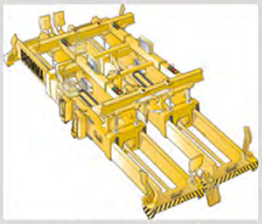
Tandem 40 Single Hoist Equipment





Bromma Headblock and Spreader
Source: Bromma Conquip AB

RAM Headblock and Spreader
Source: World Cargo News, October 2005

Stinis Headblock and Spreader
Source: Cargo Systems, December 2005

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Several manufacturers are producing tandem 40 single hoist equipment.

Tandem 40 Single Hoist Systems

Advantages

- Can use with existing single hoist systems

Disadvantages

- Cannot separate to fit into some ship holds
- Balancing

Source: Bromma Conquip AB

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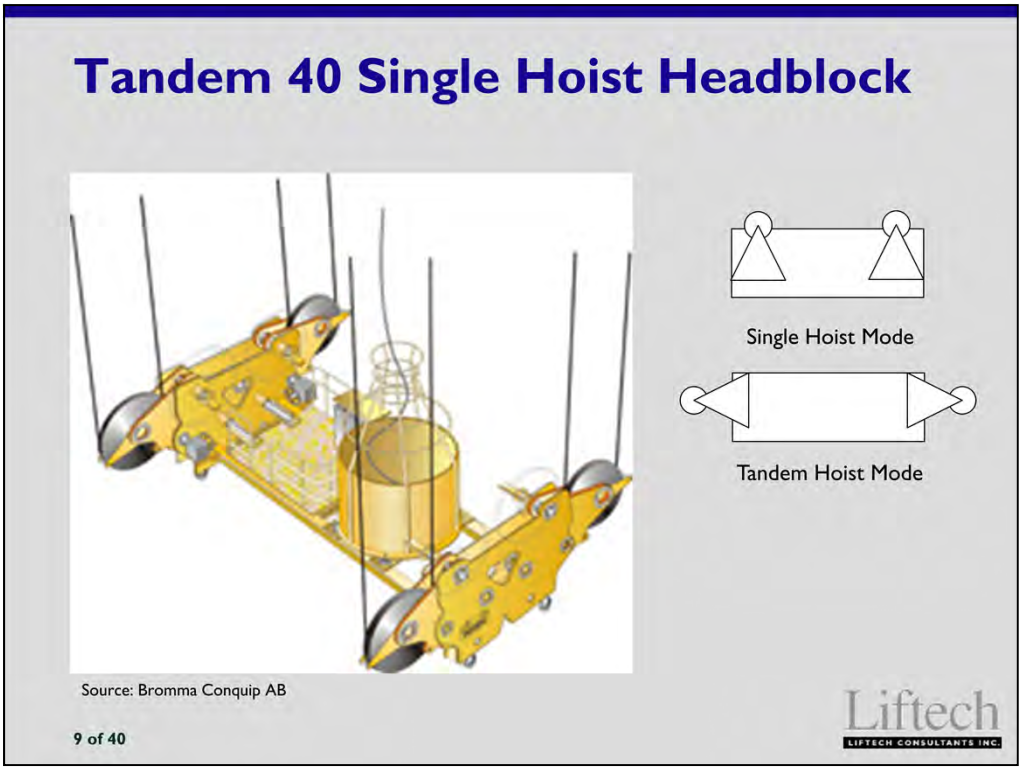
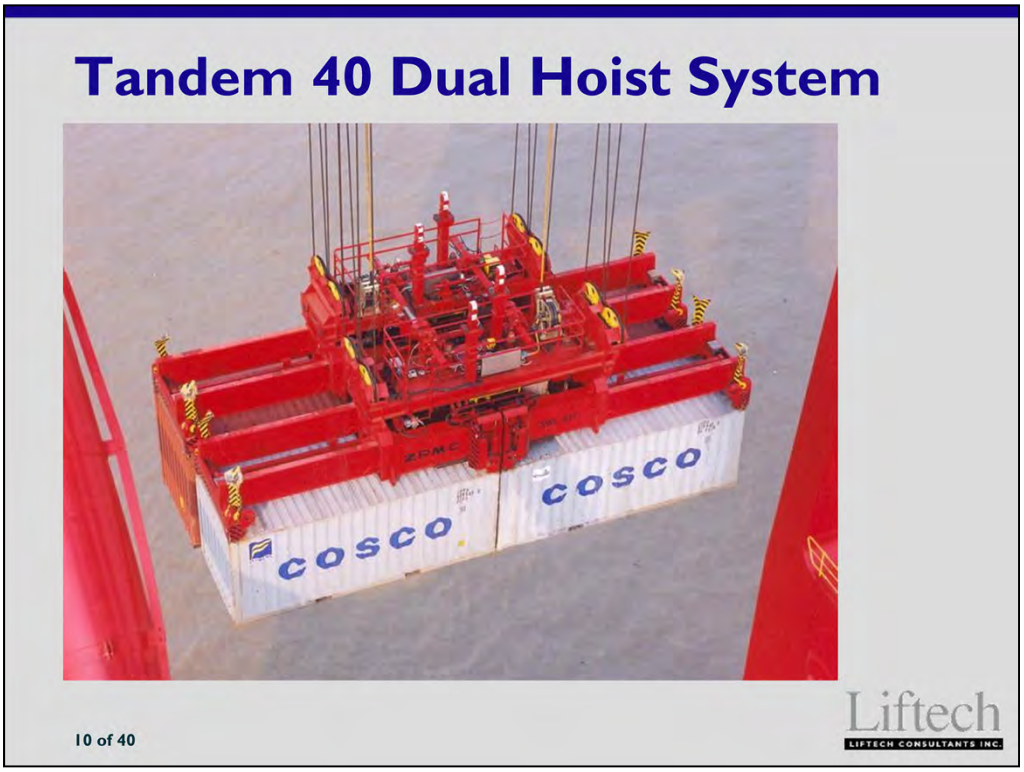
Some tandem containers are handled with one headblock and two spreaders. The single headblock tandem lift system has a significant disadvantage of needing to be balanced.

Balancing is achieved on the system shown by moving the headblock and hoist sheave relative to the spreader.



The Bromma tandem 40 headblock has the hoist sheaves spread wide to minimize the effect of the potential lift eccentricity.



Some tandem 40s are handled by two independent, but sometimes connected, headblocks and spreaders. Balancing is not required.

ZMPC has provided dual hoist tandem 40 cranes to the Port of Dubai. These cranes are conventional and do not have special IBC connection removal platforms or a shore hoist.

The cranes designed by ZPMC for operation in Bremerhaven, Germany, have platforms and a shore hoist.

Dubai tandem 40.

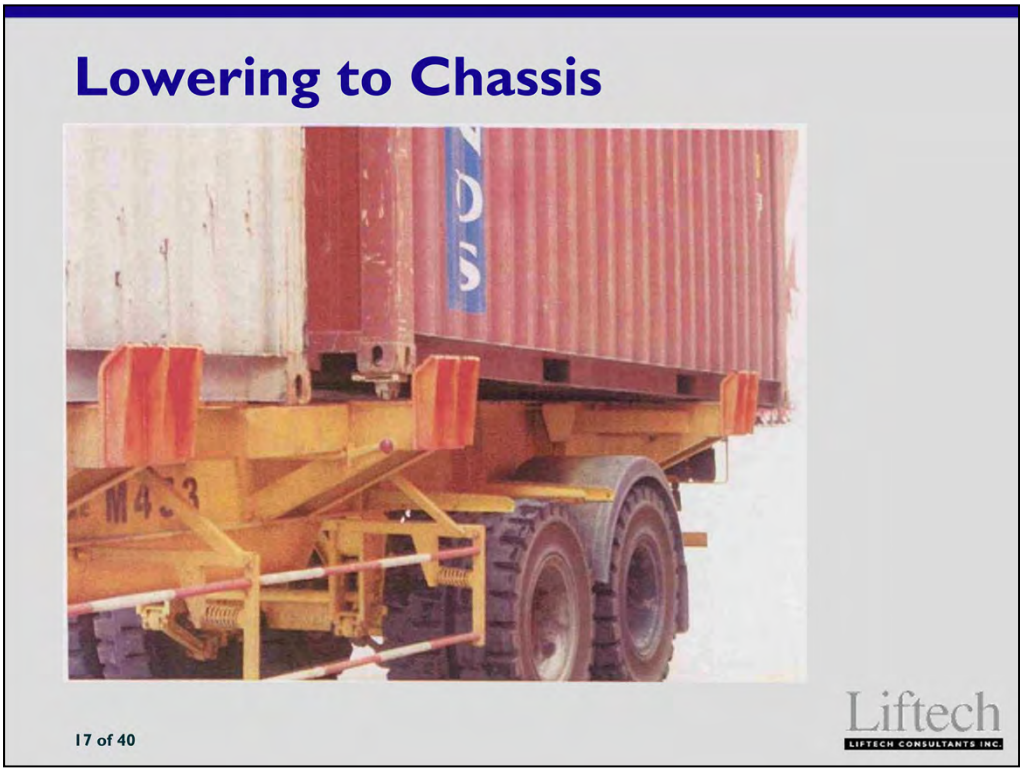
The ZPMC crane in Shanghai, China is the first tandem 40 dual hoist crane.

Many features on this crane will be used on future cranes. Some features will be improved. The rated load for some tandem 40 dual hoist cranes is 120 long tons.

The next series of slides present the arrangement of the trolley and containers during dual hoist tandem 40 operations.

Two tractors and chassis have been positioned to receive the containers. Good drivers can position the two chassis as fast as one and still meet the geometric requirements of the crane.

Removal of the interior IBCs is a problem. They can be removed at the crane, as shown here; removed at special platforms on the crane; or in the backlands.



Notice the problem: The IBC is sitting on the chassis.

IBC Removal

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Notice
spacing
cylinders
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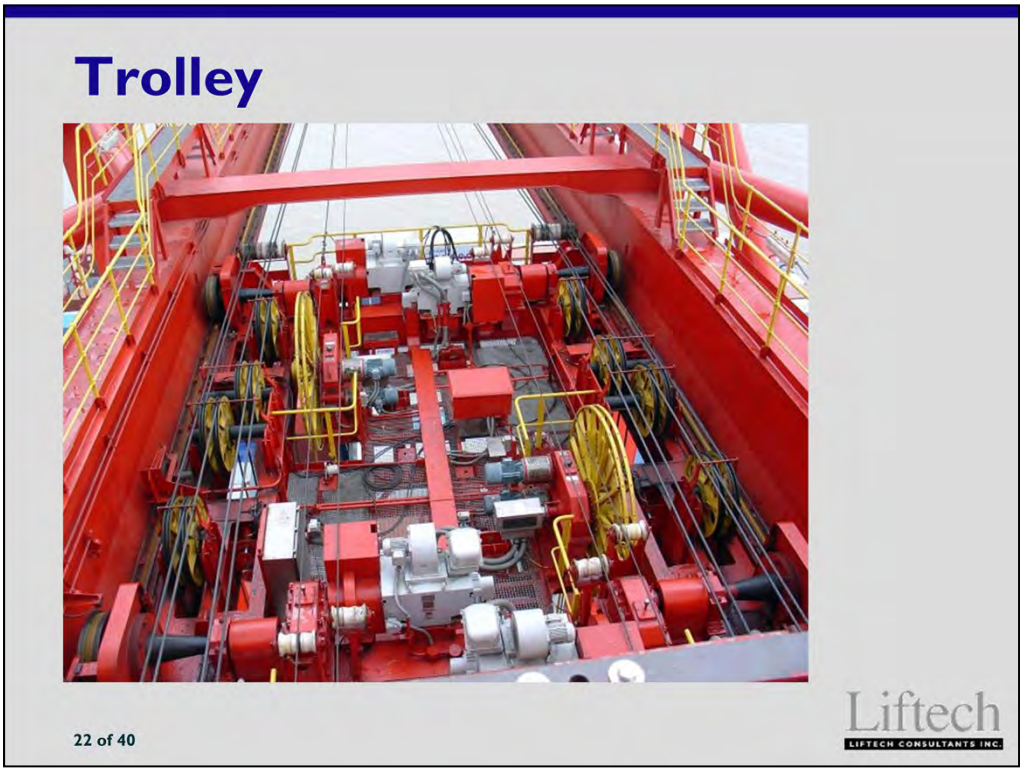
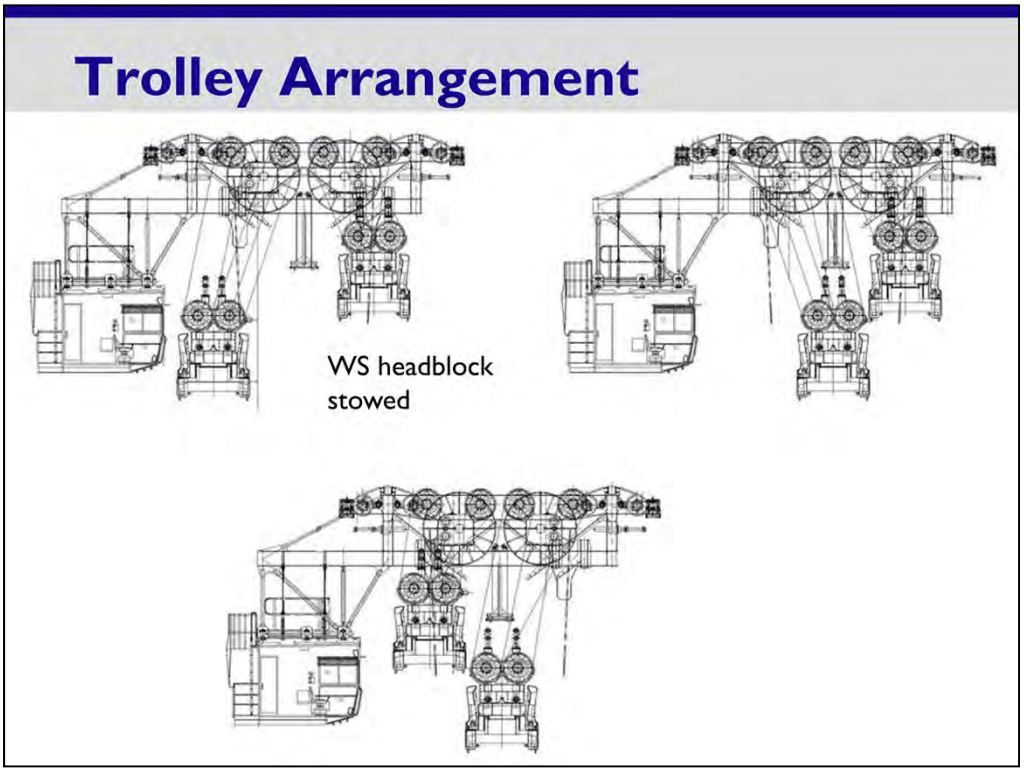
Each headblock is connected to its captive spreader in the usual way.

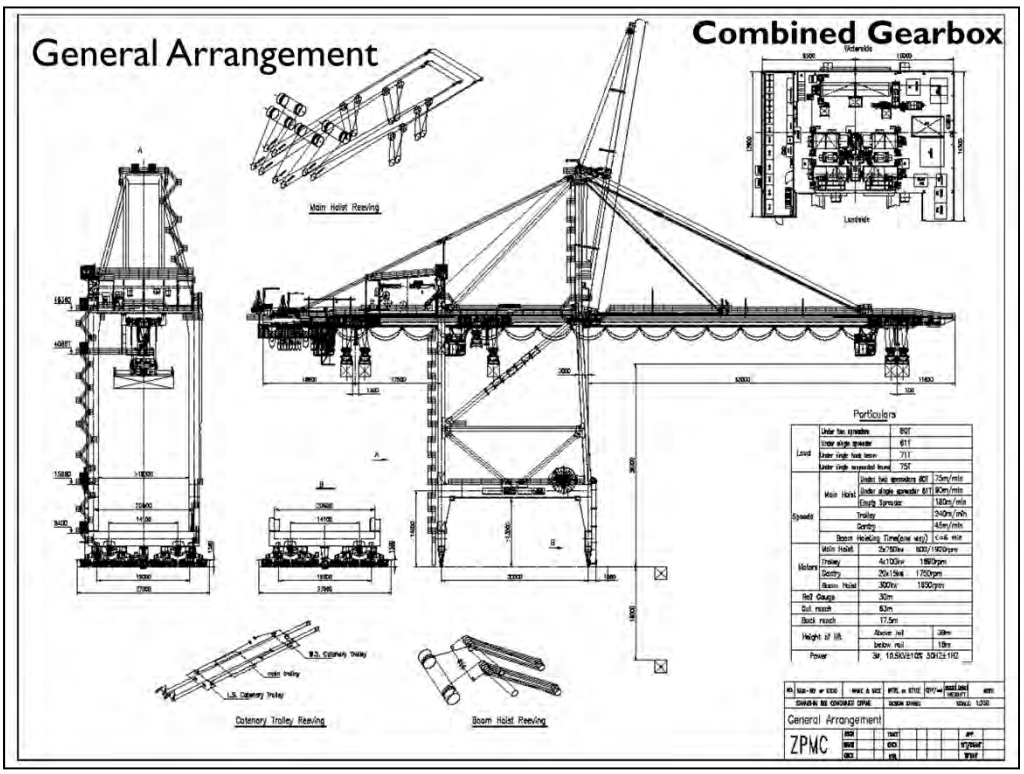
The headblocks include special cylinders to position them to each other. The connection between the headblocks must release quickly, in less than 0.1 second, if one spreader snags in the ship's hold.

To accommodate different height containers, the cylinder allows for a headblock elevation difference of about 18."



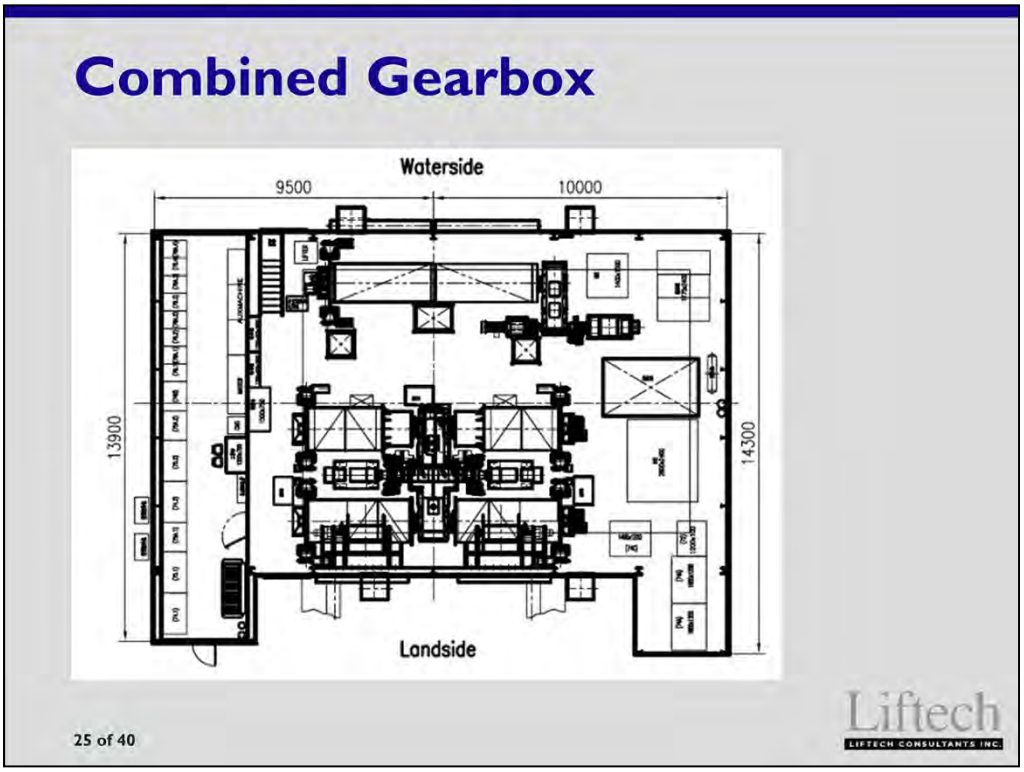
The trolley – a duplex of a single hoist rope trolley.


Trolley Arrangement
WS headblock
stowed



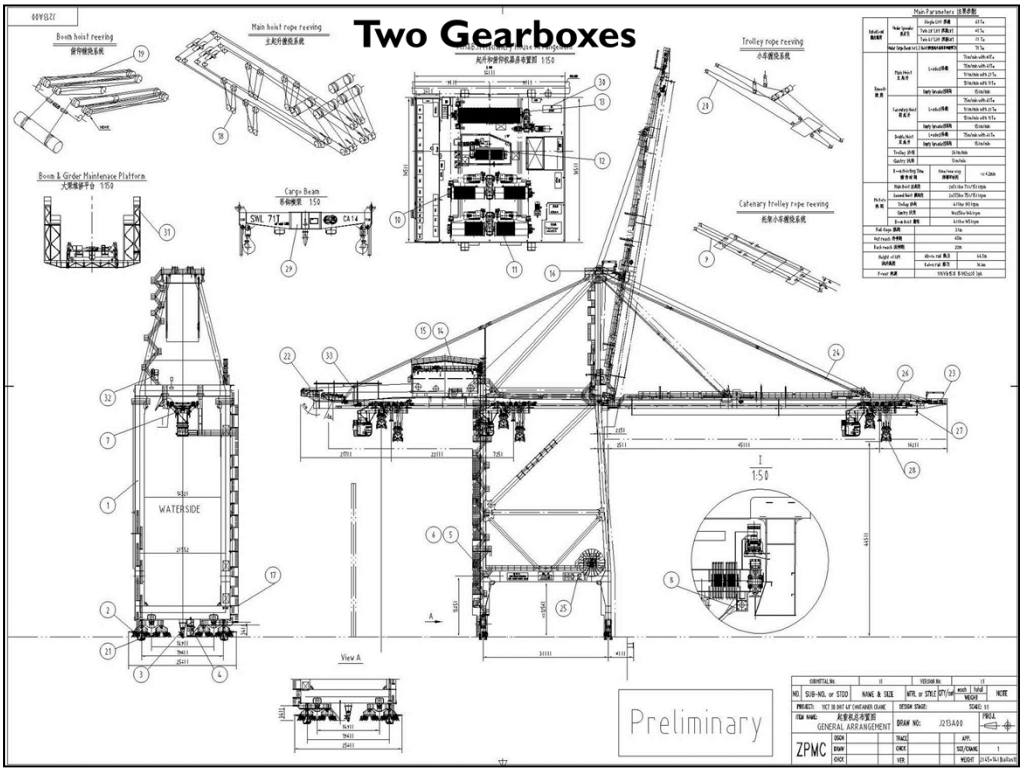
The following arrangement is of a tandem 40 dual hoist crane with a single, combined gearbox for both hoists.

The combined gearbox must operate all the time; even when lifting a single container.

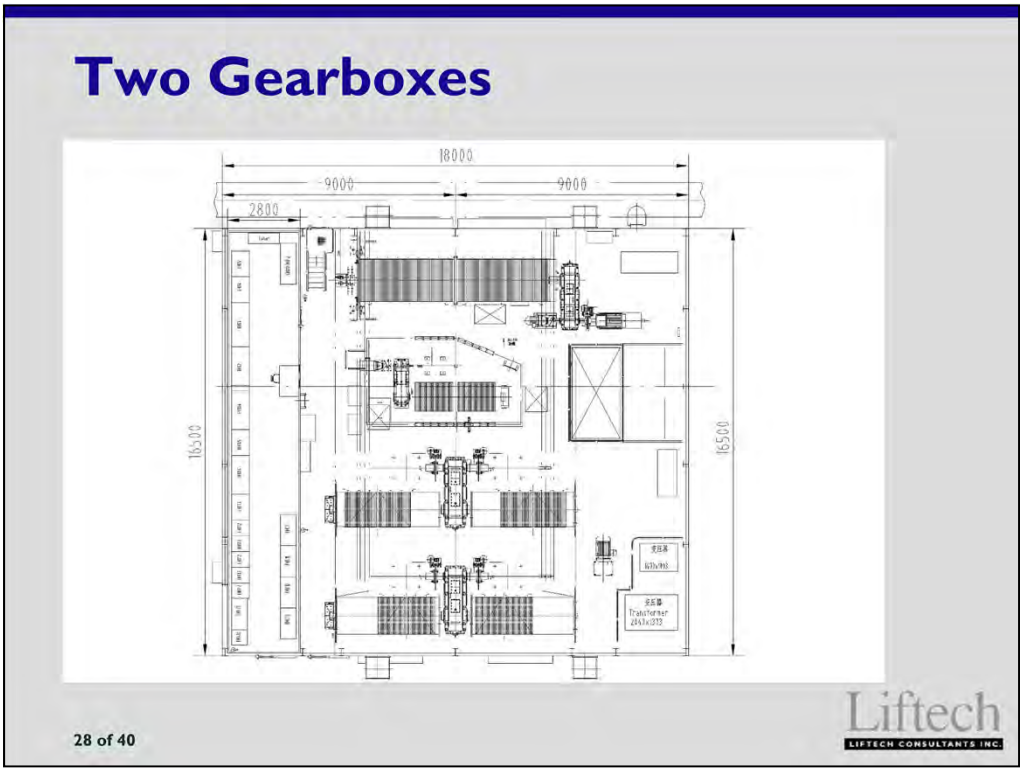


The combined gearbox design cannot be easily converted to a single hoist system.

Large combined gearbox.



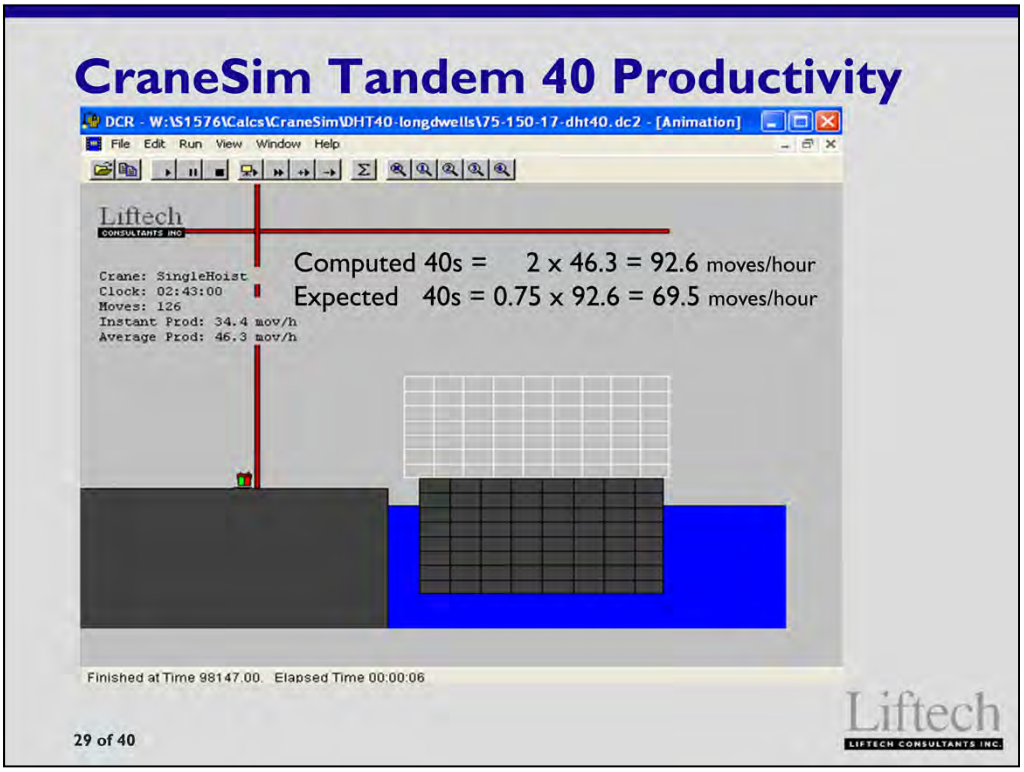
The following arrangement is of a tandem 40 dual hoist crane with two conventional hoist systems, i.e., two hoist gearboxes.



With two gearboxes, the crane can be operated similarly to a conventional single hoist crane.

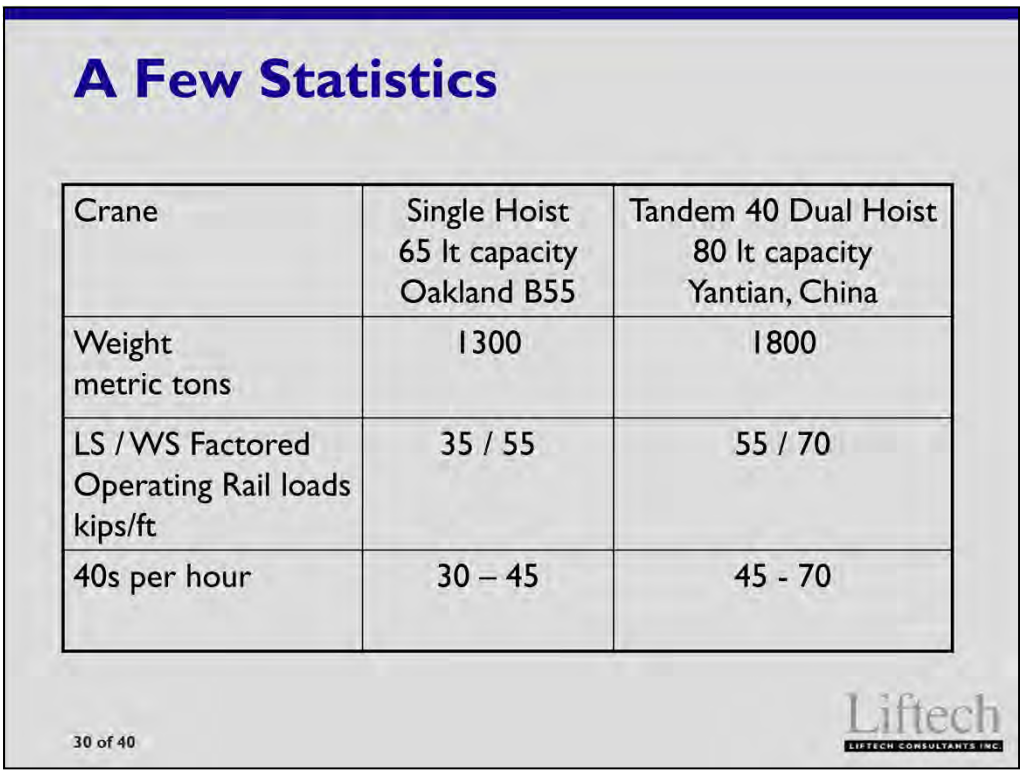
Why is this a consideration?

This design permits use of conventional machinery and allows the option of adding the second hoist machinery in the future. The capital risk is less with the independent gearboxes.

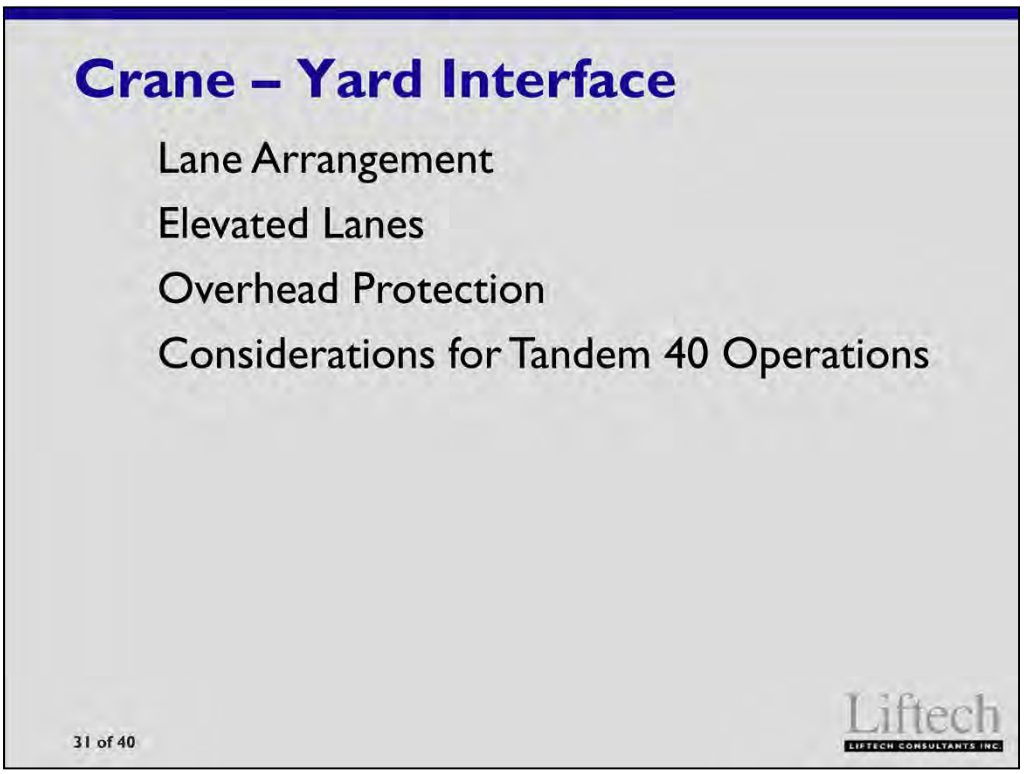


The theoretical productivity calculated by Liftech's CraneSim indicates tandem 40 production is approximately 80% greater than the single 40 production for 18-container-wide ships.

Actual production is usually about 70-80% of the CraneSim calculated theoretical production due to yard delays, crane movements, etc.



120 long ton capacity cranes will be about 5% heavier than the 80 LT capacity crane.



Increasing crane productivity will require an equal improvement in the crane-yard interface.

Considerations include:

Additional lanes under the crane

Elevated lanes to separate traffic and personnel on the wharf

Overhead protection to permit hoisting over personnel on the wharf

Tandem lanes

Landside Lanes

Source: ZPMC

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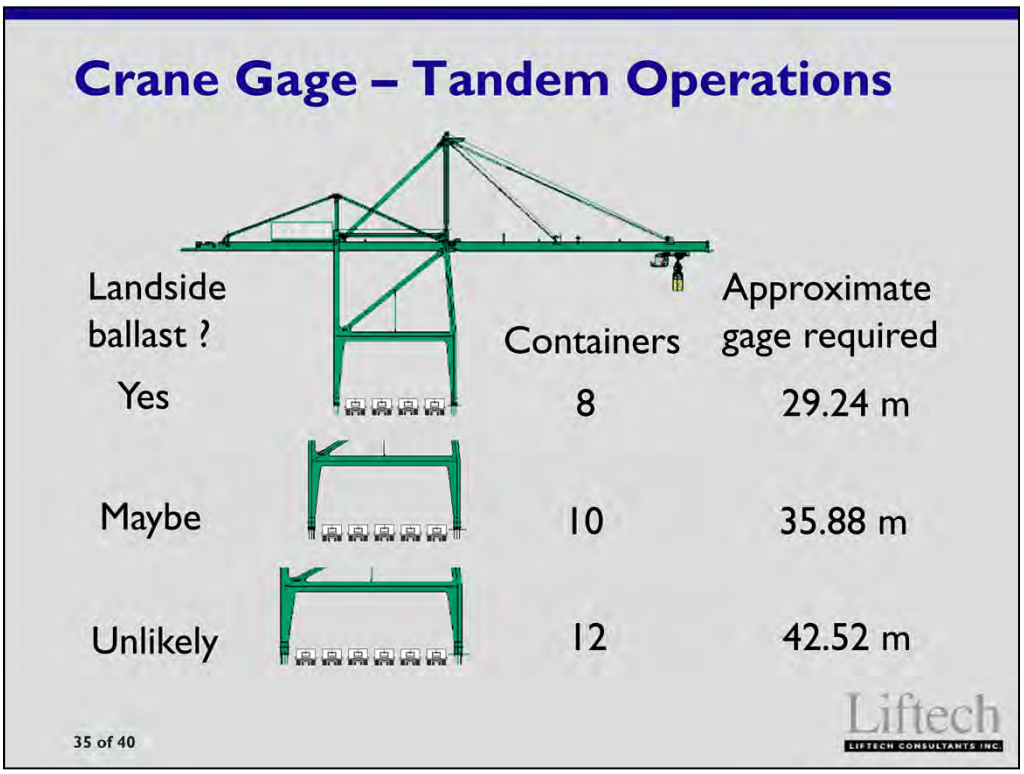
Additional lanes landside of the crane may be required.

Overhead protection permits simultaneous crane and wharf operations.

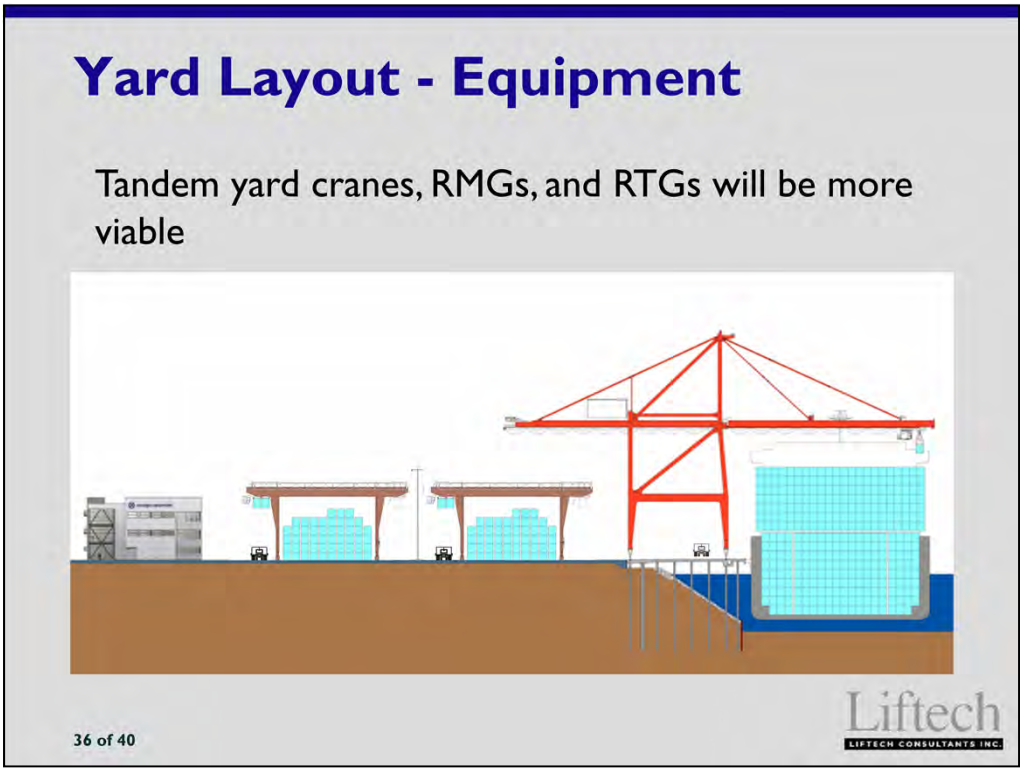
Tandem trailers are also used in Dubai.

Notice the bomb carts allow for IBC removal after the crane sets the containers.



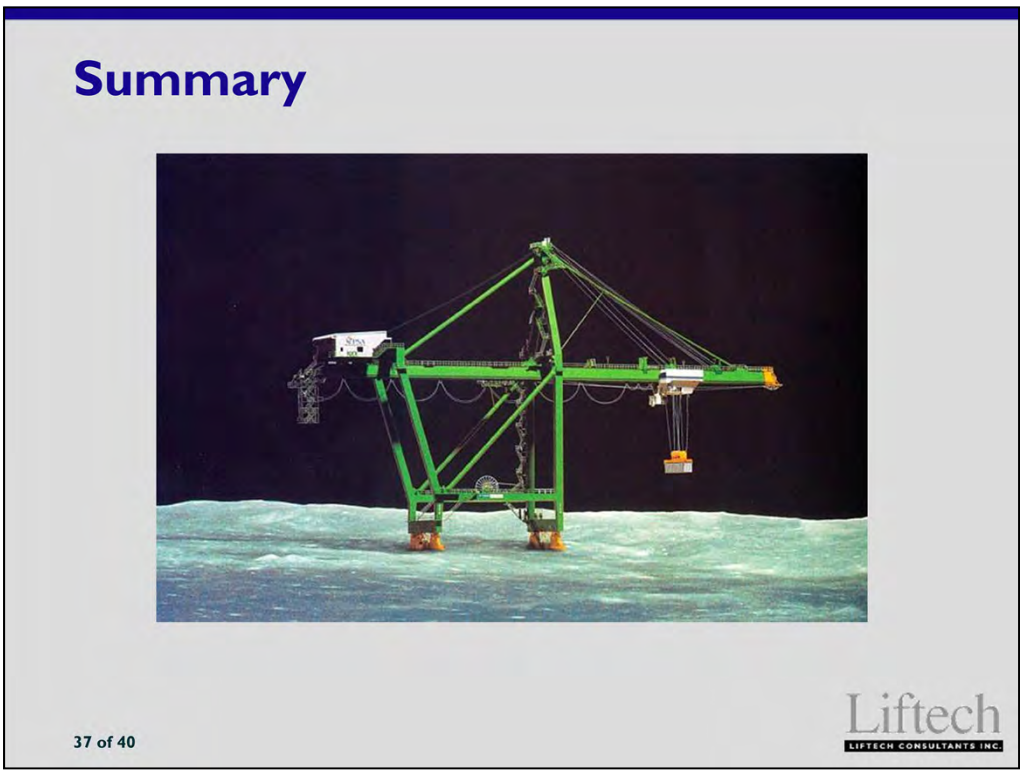
If lanes are added, increasing the rail gage should be considered. Increased rail gage will improve the crane stability decreasing ballast requirements.

Tandem lanes will increase the number of containers that can be located between the crane legs.



Tandem trailers may require revised yard layouts.

Bridge cranes, RMGs, and RTGs with tandem capabilities will be more viable.

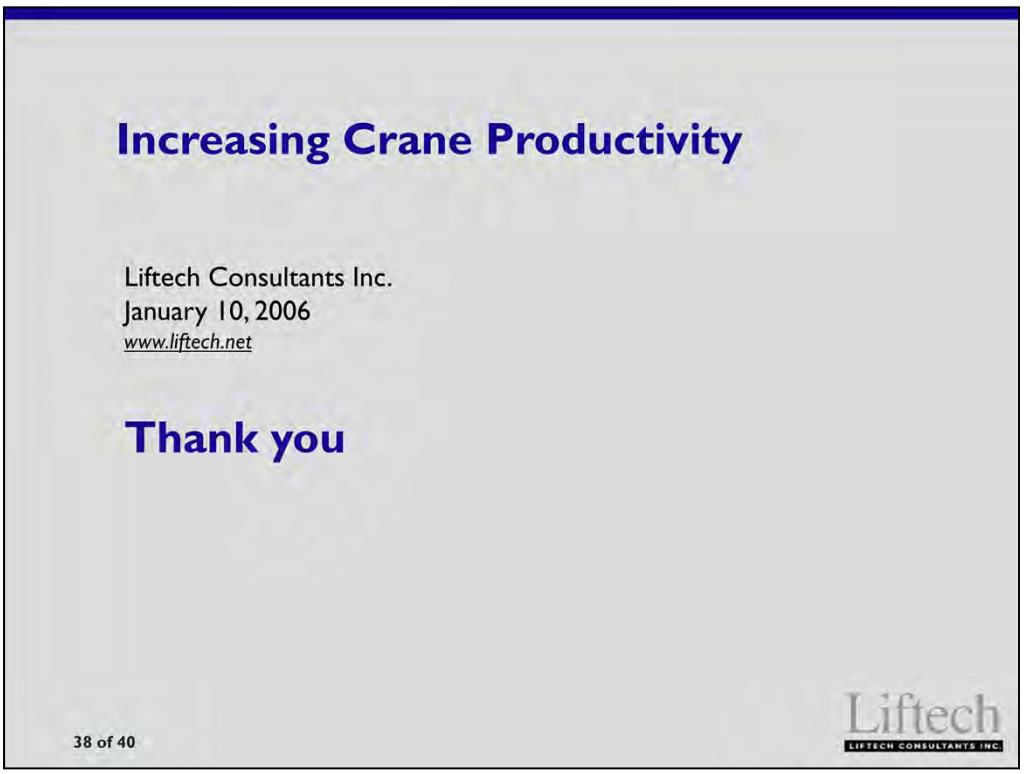


Dockside cranes will continue to be larger and more productive.

Two designs that will significantly increase crane productivity have been presented today:

Tandem 40 cranes with potential productions of 50 or more moves/hour; a system in the infancy stage of development.

Floaterm; a concept with production of 60 to 70 moves/hour per pair of opposite cranes.



Feel free to contact us with questions.

Thank you.

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