MEGASHIP PRESSURES

ON PORT ELECTRIC AND DATA INFRASTRUCTURE

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Ultra-large vessels that operate under slow steaming are today the most efficient containerships, consuming 50% less fuel than the average main Europe-Asia route.

Currently the largest container ship is the OOCL Hong Kong, which can carry up to 21,000 twenty-foot equivalent unit (TEU), weighs 210,890 tons, is 400 meters long. It has a width of 58.8 meters alongside a maximum draught of 15.3 meters.

A trend towards utilizing larger vessels has had a major impact on operations at ports and terminals. First and foremost, current port infrastructure is under severe pressure as larger vessels require bigger approach channels and longer berths with greater water depths.

Second, larger vessels entail fewer port calls and greater peaks at terminals, which means port infrastructure has also become insufficient. Terminals must operate with greater flexibility to handle these peaks.

Both trends not only affect the biggest ports on the main ocean routes, but also the smaller ports. Current containership fleet overcapacity tends to increase the vessel size on lower-volume routes as well. Already this cascading effect has triggered a worldwide wave of crane investments, supported in many ports by container throughput growth.

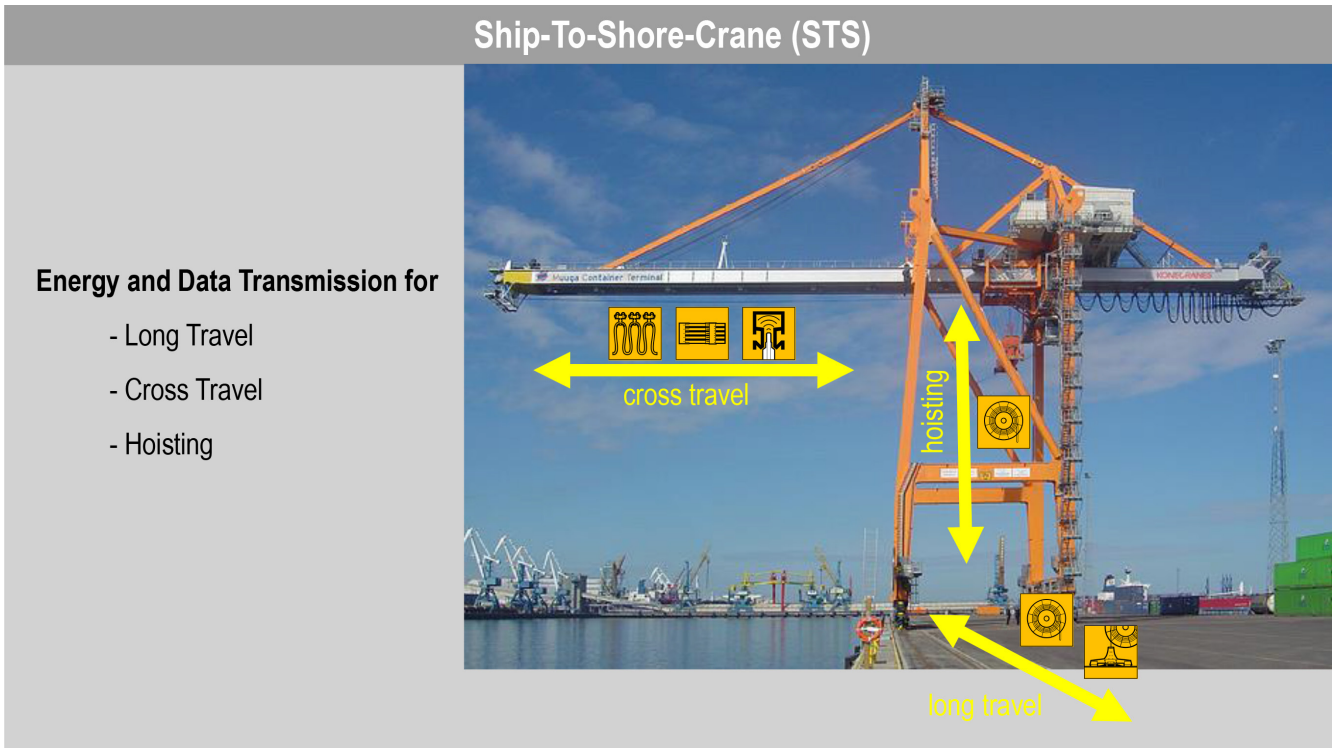
In response to larger vessel sizes, container terminal operators may decide to review their current Ship-To-Shore (STS) crane capacity and increase the degree of automation. Or, current cranes may not be large enough in terms of outreach and height and require on-site retrofit and enlargement. Likewise, current yard equipment, including Rail Mounted Gantry Cranes (RMG) and Rubber Tyred Gantry Cranes (RTGs), has to be re-examined and aligned with the larger output flow of the STS cranes.

STS CRANES

The main container-handling hubs require bigger and faster STS container cranes to manage the growth of container ships, and largely choose to invest in new equipment, while regional and local hubs choose to add capacity and height to their existing cranes.

The replaced cranes from the major hubs are very often modernized and revamped for sale to smaller local ports. Crane upgrade projects also have an impact on the energy supply and data transmission components of STS cranes.

OEMs are currently in need of very high performance, state-of-the-art power and data transmission systems for their new cranes, as terminal operators must exchange power and data transmission systems for container cranes that have been enlarged through retrofitting or replacement.



Energy and Data Transmission Systems on STS Container Cranes

Optimizing cranes for factors such as automation or farther cross travel to reach across wide ships can be completed safely by installing the following transmission systems for various types of crane projects outlined in this paper.

HIGH-PERFORMANCE STS CRANES:

- Long Travel – Motor Driven Power Cable Reels (PCR) Real-time transmission of high data rates is an absolute precondition for remote operation and automation. A PCR for long or gantry travel increases power to the STS cranes, while adding high availability and also securing steady data transmission through fiber optic rotary joints to enable the integration of the crane into the Terminal Operating System (TOS). The PCR protects the combined medium voltage cable in harsh conditions.
- Hoisting – Spreader Cable Reels (SCR) Selecting high quality motors with high grade windings is the first step in preventing breakdowns during ship loading and unloading operations. These cable reels, for hoisting work at up to 240 metres per minute over 80 metres, are optimized for high dynamic applications. Redundant motors allow the continuation of ship unloading at full speed in case of motor failure, using remote motor switchover. Cameras and electronic devices installed on the spreader are used to enable automated or remote STS operation. This requires data transmission via fiber optics to the control center, such as Conductix-Wampfler's Fiber Optic Transmitter TFO with only 300 millimeters depth.
- Cross Travel speed and the acceleration of the STS trolley are crucial issues. Trolley speeds up to 500 metres per minute are no longer a rarity. This means that the complete structure and all movable components needs to be designed for that heavy-duty challenge. Especially the components that provide power and data to the moving crane trolley, which can be a restraining factor. So far, festoon systems have been the common standard on STS cranes; however, energy guiding chains and conductor rail systems are also feasible solutions. In particular, the conductor rail systems enable very high crane trolley speeds and high acceleration of the trolley. Combined with the low necessary maintenance of conductor rails, this technology offers some advantages compared to festoons or energy guiding chains. This will lead to wider use of conductor rails especially on STS container cranes with rope-driven main trolleys.

REMOTE CONTROL AND PROFIDAT:

One of the key developments in the evolution of container ports is the remote control of STS cranes. Benefits of remote control are manifold, including the increase reliability and safety. Remote operation also provides crane operators with a more ergonomic and comfortable working environment. Currently working conditions in a crane driver's cabin can be distressing due to high temperatures, lack of fresh air, and heavy physical demands.

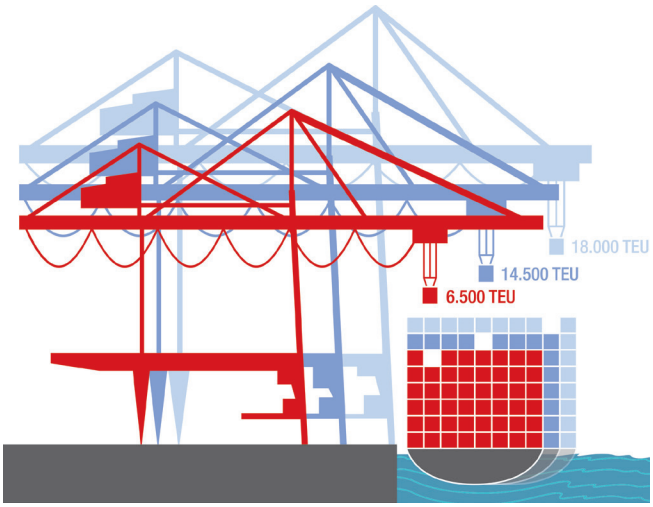
For a crane operator sitting in a small crane cabin, far above ground and a long way from the containers, the ability to operate the crane with speed, precision, and consistency is almost impossible. It is physically demanding, frequently causing motion sickness and stress to the back and neck and potential absenteeism.

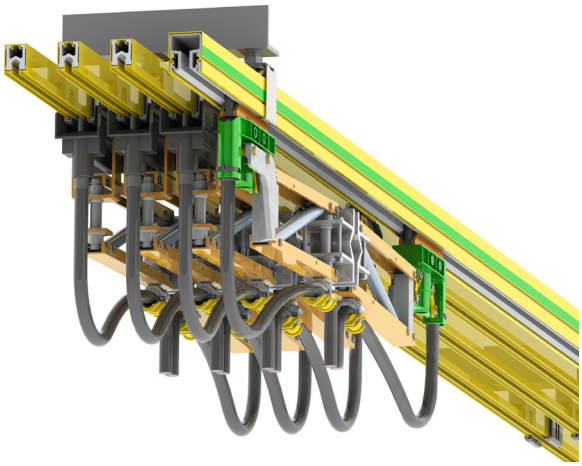
Therefore, remote control operation becomes more and more in demand. Several cameras on the trolley, the spreader, and the crane itself are needed - providing superior visibility, improving performance, and enabling operators to supervise the process. The video signals and control signals need to be transmitted reliably and in real time. Therefore, the latency of the data communication system has to fulfill the real time requirements.

Conductix-Wampfler, for example, has recently developed data transmission solution called ProfiDAT that provides fast and reliable data transmission to the crane trolley. It achieves transfer of mixed data - using video, audio and control signals - at high data rates using slotted waveguide technology. Certain conductor rails can also be upgraded to use ProfiDAT without the need for much installation work.

ADDING HEIGHT TO STS CRANES

Power Cable Reels (PCR) that are mounted onto the girders of STS cranes must often be lifted to a higher position. That means an original installation height for the





Left: Container ship sizes; Right: Four pole energy and data transmission system; conductor rail system 0813 series with ProfiDAT profile with integrated ground rail / protective earth (PE)

cable reel of 8 metres could be raised to 15 metres. Adding 7 metres impacts the cable and the motor driven cable reel. Depending on the type of cable reel, this must be exchanged with a more powerful system that can handle the extra 8 to 10 metres of cable properly. If the original cable reel is strong enough to cope with the increased load, the system can still be used, however, it will then have a reduced travel length equal to the degree to which the crane has been made taller.

In order to add height to the STS, the Spreader Cable Reels (SCR) will also have to be exchanged to handle an extra of 10 to 15 metres of cable, and operate the spreader with standard hoisting speeds of 180 metres per minute. To do this level wind reeling drums must be replaced by monospiral spools that better preserve the spreader cable.

BOOM EXTENSION

STS cranes not only need to be retrofitted to be taller, but also the crane boom has to be extended to enable loading and unloading the wider container vessels. The expansion of a conductor rail system along the extension of the boom is eased by using cable reels instead of other energy and data transmission systems, as in the case of using cable reels only the extension of the rail is necessary. For festoon systems and energy guiding chains, a completely new system is needed as the existing cables of the system can't be extended.

YARD CRANES

Over the last few years, container terminal operators particularly at greenfield terminals have embraced increasing numbers of Automated Stacking Cranes (ASC). This underlines the trend of increasing remote-controlled yard crane operation, for example, at DP World Jebel Ali Terminals 3 and4, and APM Terminals in Tangier.

Not only are ASCs being increasingly automated through remote control operation, but also RTGs and RMGs are being increasingly operated remotely as well.

The technical complexity of operating RTGs remotely is much more challenging than it is for RMGs. What is mandatory for both types of yard cranes for automation is safe data transmission, accomplished through rapid data transmission rates of 100 megabytes (MB) per second with secure connectivity to the TOS.

Another technology yard cranes may require is secure power grid connections for electrification. Two main solutions for the electrification of RMGs and RTGs are motor driven cable reels and conductor rail systems.

For automated RMG applications, commonly selected by greenfield projects and for new crane orders, the main electronic solution is a variable frequency driven motorized cable reel with a fiber optic rotary joint.

On the other hand, approximately 80% of electrified RTGs are equipped with an automated drive-In technology based on a conductor rail system. With this solution, the RTG crane keeps its operational flexibility. The data transmission system ProfiDAT, launched in 2016 for RTGs, supports the sufficient remote controlled operation of yard cranes.

In the past, one of the biggest hurdles for cable reel solutions in RTG operation was the long downtime of the RTG in case of a block change, due to a manual plug in/plug out process. It was also necessary to have additional ground staff that were trained for working in medium voltage environments. To enhance efficiency of cable reel solutions, it is important to reduce downtime during block changes and provide a solution for an un-manned plug in/plug out process. Conductix-Wampfler's recently developed Cable Auto Plug System for E-RTGs (CAP) shows nearly the same operational performance as conductor rail drive-In solutions, and furthermore reduces downtime while preserving high data transfer rates. CAP technology accordingly opens up new possibilities for existing terminals to retrofit their non-electrified and non-automated yard cranes.

Efficient energy and data transmission systems are crucial for the safe and reliable operation of container terminals.

ABOUT THE ORGANISATION

Conductix-Wampfler is one of the world's leading suppliers of energy supply and data transmission systems for moving machinery and offers all available technologies and products to meet flexible and mobile energy

and data transmission requirements, all from one source. Energy and Data Transmission Systems play a very crucial role in these operations and they receive special attention by the operators, as well as by the equipment
manufacturers and consulting engineers.

ENQUIRIES

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