

Achieving maximum productivity with older cranes

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As ports face the continued push to reduce port of call mooring time, an overall productivity improvement may be necessary to remain competitive in the container shipping industry. Improvements in productivity may involve container crane performance upgrades, yard management integration, and many other add-on enhancements that improve crane operator productivity, and flow of product through the terminal.

Container crane availability is also a key factor to terminal operators. This factor affects the vessel turn around time and the terminal operator's ability to maintain existing customers and compete for new customer business. Upgrading to the latest technologies minimises downtime associated with spare parts availability.

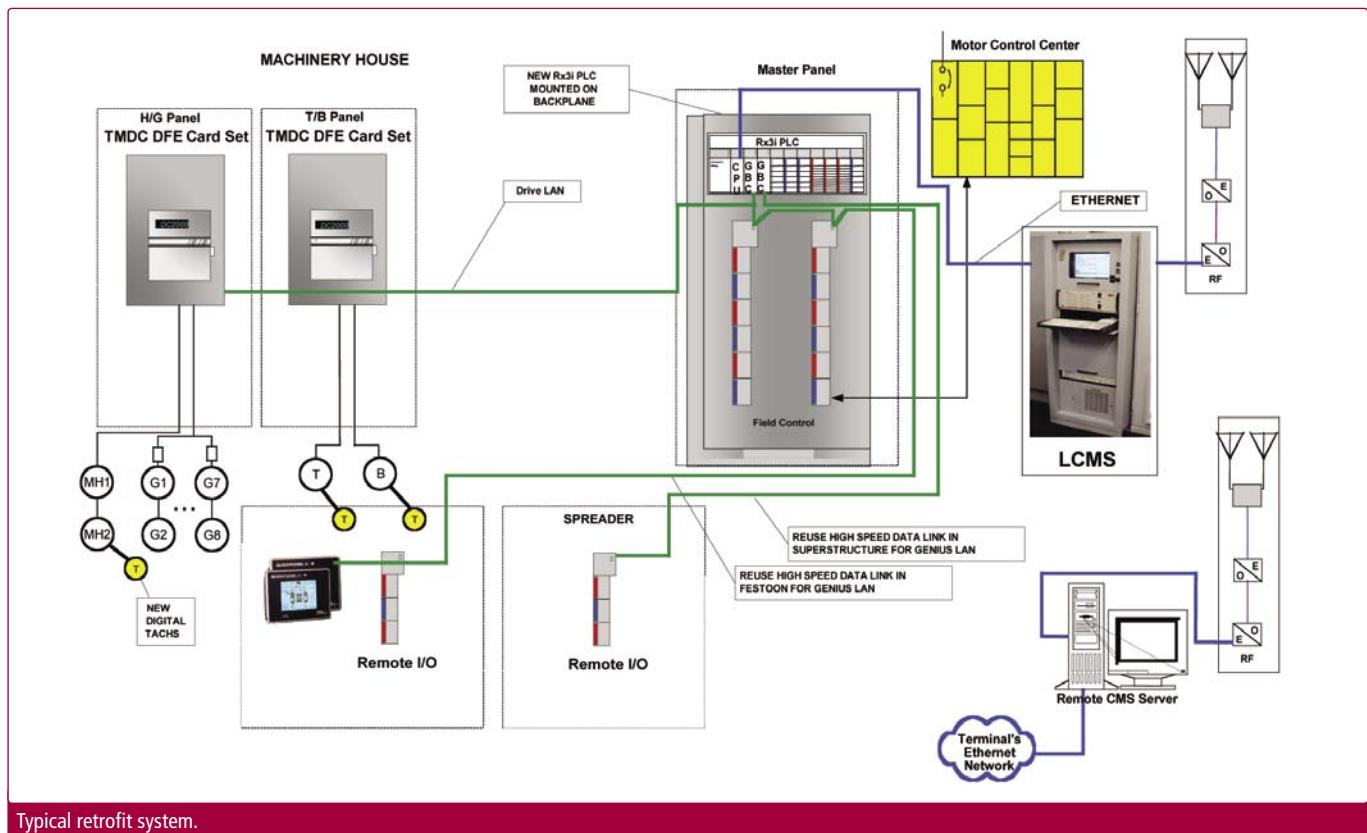
Crane modernisation basics

Crane modernisation for enhanced productivity is a key component in improving throughput at today's ever busier ports. The first phase in any modernisation is to update existing drives and controls to the latest electronics technology. TMEIC GE has had great success in enabling system productivity enhancements through the upgrading of older hardwired relay logic systems or obsolete PLC-based systems with a state-of-the-art PLC based master controller system. Optionally, remote I/O stations may be added to enhance local troubleshooting and monitoring, e.g. waterside and landside gantry I/O stations, boom operator stations, operator's cabin/trolley I/O stations, etc. This type of

modernisation has many advantages, all of which ultimately improve the overall productivity of the port.

In addition to upgrading the control system to the latest technology, substantial operational benefits can be derived from upgrading the drives themselves. This can be done in one of two ways; a complete drive replacement including the rectifier bridge and electronic controls or a simpler upgrade of the electronic control only, which TMEIC GE calls a Digital Front End (DFE) retrofit. The decision between the two possibilities is dependent upon the age and condition of the existing rectifier equipment. TMEIC GE finds that many customers can gain the productivity enhancements they desire with the simpler DFE retrofit. Either approach combined with the PLC upgrade provides a wide range of productivity enhancements:

- Acceleration and deceleration rates can be increased due to the introduction of the plugging field exciter. The resulting decrease in acceleration time to top speed improves productivity.
- High speed network connections are added directly between the new or modified drive and the new Local Crane Management System (LCMS) computer. These provide a significant improvement in system drive diagnostic capabilities and reduced downtime to repair drive or drive associated problems.
- Proprietary network connectivity between the PLC master controller and the drives is replaced with a more robust network that interfaces through a standard, lower cost PLC communication card that is readily available.



- Automation related functions such as smart slowdowns (Look Ahead Distance), position to point, hoist smart slowdown over dock, position tracking, position homing and recalibration flag validation routines, position reporting, etc. are available in the drive configuration. All of these features can reduce the cycle time thus increasing throughput.
- Digital tachometer speed feedback can be added to the Trolley and Boom Hoist motors, and the analogue tachometer on the Main Hoist can be changed to a high resolution digital tachometer. These enhancements facilitate speed regulation of the Trolley and Boom Hoist motions (formerly CEMF regulators). Speed regulation accuracy and resolution is improved on all motions.

A final and very real benefit of PLC and Drive upgrades is that the new system can be more easily maintained due to the improved parts and service availability with the newer system. Lack of parts and service availability can be a major contributor to increased downtime for older crane systems.

Reduced downtime through enhanced system diagnostics

A Local Crane Management System (LCMS) is typically added as part of an upgrade to state of the art drives and controls. The TMEIC GE engineering team pioneered the development of the first PC-based LCMS systems to include advanced diagnostics, advanced troubleshooting and monitoring aids, productivity reporting, preventative maintenance screens, alarm and event logs, and customised, animated, graphical monitoring screens. LCMS systems are installed on each crane for local system analysis and trouble-shooting. Most customers find the LCMS to be an easy and comprehensive trouble-shooting tool which substantially reduces the time to isolate and repair a system issue.

Remote Crane Management Systems (RCMS) consisting of a single viewer with a global data base capability may be installed at a remote location capable of monitoring multiple cranes. Network

connectivity to the RCMS can be achieved via optical fiber for cable reel fed cranes, or by RF wireless connectivity for cranes without a cable reel or those fed by an underground collector bar or diesel engine powered cranes. TMEIC GE customers have experienced substantial reductions in downtime due to the ability to remotely identify problems before dispatching the correct maintenance personnel, tools and parts.

Additional modernisation options

Cranes which were originally supplied with or have been upgraded to state-of-the-art PLC-based master controller systems with network or LAN connections to the drives are candidates for the implementation of a number of system automation enhancements, all of which can have substantial positive impacts on productivity.

Sway control

Control of load sway in the trolley travel direction is the greatest challenge a crane operator faces and most significantly affects the cycle time and resultant productivity of the crane. Electronic sway control can be implemented using either sensor based systems (sway angle measured by an external vision based system), or by the TMEIC-GE patented sensor-less sway control system. Sensor-less sway control offers many benefits including improved performance in inclement weather, lower maintenance costs due to fewer parts and improved performance due to inherent system delays. Sway control can improve productivity significantly dependent upon the quality and experience of the specific crane operator.

The cranes have eyes

To further improve productivity, ports may choose to add vision systems that permit automatic landing of containers onto unmanned vehicles such as Automatically Guided Vehicles (AGVs). The investment for this technology is significant and the port must be staffed with personnel capable of handling the increased level of complexity.

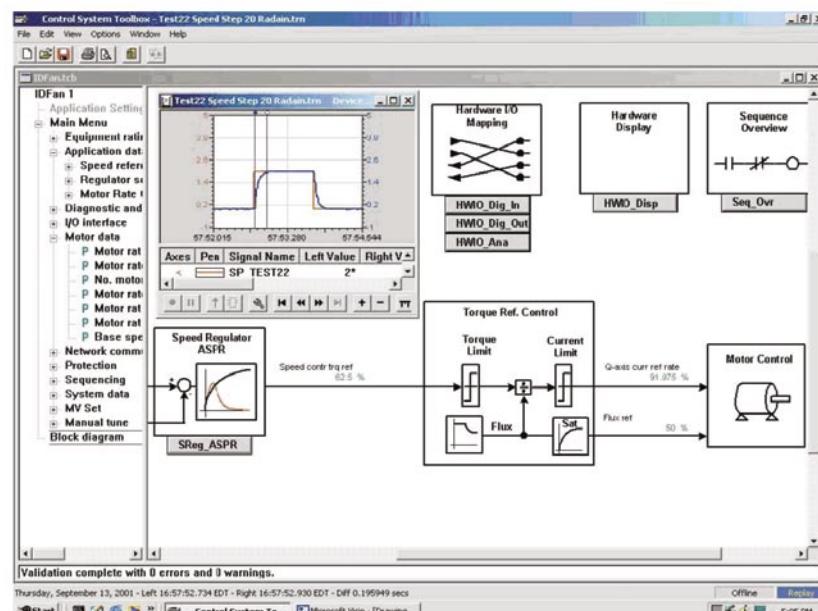
Outline View
Functionally organised parameters and related variables

Trend Window

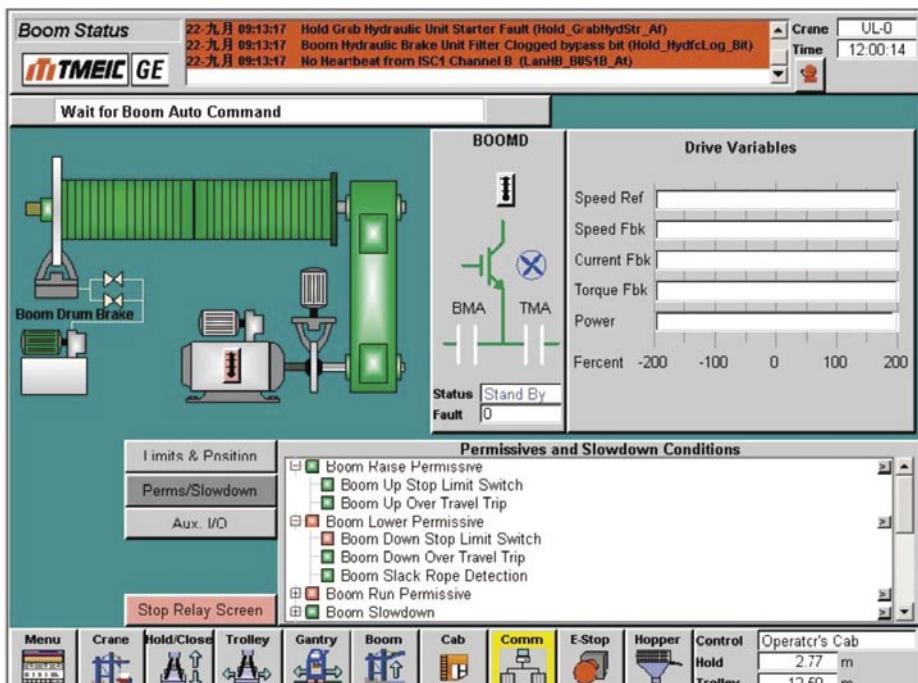
- Time based trend of drive variables
- Dual cursors
- Several forms of data collection

Automated Block Diagrams

- Configuration parameters and variables
- Hyperlinks for parameter editing
- Animated diagrams with actual values of the variables



Drive Toolbox within LCMS for drive set-up and advanced diagnostics.



Typical LCMS status display.

The addition of equipment such as TMEIC GE's MaxView™ vision system enables the port to choose from a number of advanced automation possibilities including the aforementioned Automatic Loading System (ALS), Profile Scanning System, Automatic Position Indication System, and Sway Position and Skew Angle Feedback System. Each of these systems can incrementally improve the productivity of the crane system, but the added complexity must be carefully weighed against the expected gains.

OCR systems

Optical Character Recognition (OCR) is the latest development in providing data for tracking containers in a container yard. The system consists of several cameras located around the wharf area in order to capture identification data from the container when landed or lifted from a chassis.

TMEIC GE has developed and installed at numerous sites, an interface to work in conjunction with various manufacturers' OCR systems to capture the hoist and trolley position information along with signaling the OCR system when to read the container data. This data is then transmitted to the OCR system for use in the container tracking database.

There are many other options and benefits to crane modernization including power system improvements, interfacing to yard management systems and enhanced safety systems. However the productivity enhancements gained through a basic drive/PLC system modernisation offers the quickest and easiest boost to crane productivity and is the first step towards incorporating today's latest crane automation technologies.

Time-stamped Alarm Log

Animated Process Graphics

- Dynamic Bar Charts
- Dynamic Power Flow
- Mechanical Animation

Permissive Diagnostic Display

Navigation Icons

ABOUT THE AUTHOR

Steven R. Blomquist is an Electrical Engineer from Penn State University and is currently the Director of Marketing for TMEIC GE in Salem, Virginia. During his nearly thirty year career in the systems integration business, he has held numerous senior management positions with several companies all involved in the implementation of drives and automation systems. He began his career as a control systems engineer, moved into technical management and has spent much of his career focused on drive and control system retrofits. He has recently led a number of successful crane retrofit projects for TMEIC GE.

ABOUT THE COMPANY

TMEIC GE is a global joint venture between industry leaders Toshiba, Mitsubishi Electric and GE formed to focus their combined product and application expertise on the industrial drive systems business. With a large staff of industry leading application experts, TMEIC GE has a long history of successful crane automation system installations at nearly every port around the world. As the global leader in Crane Automation solutions, from simple drive upgrades to fully automated cranes, TMEIC GE is committed to "Delivering Customer Success, Every Project, Every Time".

ENQUIRIES

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