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Cristina Dragomir

Improving Quay Cranes Exploitation by Implementing a Port Equipment Management System

Port operators use almost all type of port equipments, from a range of heavy equipments to light machines. Port activities efficiency can be achieved by improving the exploitation of the necessary port equipment for handling cargo. Objectives of research are based on establishing factors that influence management activities of quay cranes exploitation. A better exploitation management of quay cranes can be achieved by implementing a proper port equipment management system

***Keywords**: exploitation, port equipments, quay cranes, management system*

1. Introduction

In ports, efficiency of port activities is achieved by reducing the maximum ship parking time for loading and unloading cargo. Obviously, this objective can not be achieved without necessary equipment for handling cargo like quay cranes. There are almost no ports today without being equipped with such necessary installations for handling cargo from ship to shore.

Highly mechanized ports manage in short time loading and unloading ship operations, and therefore increases ship profitability. The diversification of tools and port equipment used in Port of Constanta, for example, shows the necessity of maintaining a high degree of mechanization of port equipment and the need to implement a port equipment management system in order to meet the dynamic rhythm of modern maritime shipment of cargo.

2. Improving exploitation by implementing a crane management system

An efficient solution for improving management of port equipments exploitation is by designing and implementing a management system suitable for the technical charactheristics of the equipment. For example, in the case of the modern port cranes, each quay crane is equipped by the company that produces the crane with a crane management system. This system offers online support for the crane driver and maintenance staff, and additional practical assistance for preventive maintenance, thus guaranteeing a smooth operation. A crane management system consists of the following modules: for diagnosis - settings (adjustments, pre-set modes), alert indicators and alert management containing links to the instruction manual and component specifications with user editable text; for data logger and statistics - service intervals, operating hour counter, handling and energy measurements, average travel range; a black box for recording operating history; maintenance schedule and log book and maintenance and operating instructions (help function).[1]

A crane management system can supervise and collect crane status data continually. It helps to report and analyze the cause of a fault/alarm. It also helps to recover from crane failure early, and increases crane productivity. Such a system rationalizes crane maintenance and management by preventive maintenance and collects container handling data.[2]

The crane management system monitors physical and operating conditions of the crane on a real-time basis. The parameters are logged, so that trends can be established, and the performance of equipment and crane operator can be analyzed. Often when there is a fault detected on the crane, the operator will have to contact the maintenance engineer who will then make his way to the crane and logs on to the management system to check on the fault. A lot of time could be spent on getting up the crane, troubleshooting and picking the correct spares from the workshop if required. A better way to control and monitor several cranes is to have a central location whereby all the crane management system from all the cranes are linked back to the maintenance office via Wireless LAN in order to save considerable time and labour and to increase productivity.[3]

A management system should also include capabilities of risk management. In such a system the roles of workers should be clearly defined in order to avoid accidents in quay crane operations. The system should be subordinated to the specific conditions of service arising from the process of loading and unloading ships. Quay cranes should ensure maximum handling ability in tight spaces, should have arms long enough for loading and unloading the widest vessels, but at the same time should be well consolidated by pulsed consoles. Often, cranes have to work one near the other, at the distance of 12 to 15 meters. The management system takes into account the variation of lifting force depending on how cargo is handled from 0.5 to 5 tons, 20 to 30 tons and even 80 tons for the Perrick crane. For a success-

ful and low risk exploitation, quay cranes should be verified if they are set up properly and if they are used within the manufacturers' specifications. There are often harbour employees and supervisory forgetting about the maintenance, neglecting the set-up, or expecting the quay crane to do more than it was designed to. Quay cranes are used in very different conditions of exploitation which leads to a big variation of the effective duration of functioning and of the state of loading the mechanisms. There are several persons responsible for crane operations like the safety person, the supervisor, the foreman or the port workers.[4]

The management system should indicate whether there is a need for upgrading the quay crane in order to improve exploitation. Upgrades and modifications are often implemented in conjunction with relocation to another terminal. Common modifications include strengthening the structure for increased storm winds, adding or strengthening stowage hardware, crane gage changes, and changing the power supply system. Improvement is highlighted in many modern quay cranes that include a large main hoist capacity in expectation of future conversion to a single-hoist tandem lift operation. Future tandem lift capacities are typically 80-100 t. Depending on the required tandem operation capacity, conversion to tandem lift systems may also be practicable on cranes with standard lift capacities. The structure needs to be evaluated for the increased lift system weight and increased lifted load and it may be necessary to restrict operations to empties or light containers.[5]

3. Factors influencing management activities of quay cranes exploitation

The main factors influencing management activities of quay cranes exploitation are:

- the nature of cargo operated and the type of quay crane appropriate to operate it;
- open storage and warehouse organization by types of merchandise, and their location;
- organization of front loading and unloading;
- specialized berths;
- technologic process of quay cranes loading and unloading operations.
- time calendar - the total number of days in a year when port equipments are exploited with efficiency, from a total of 365 days per year. The coefficient of calendar time - is the maximum use of a quay crane for a year. This is the main element that sets the value of productivity of port equipments. In general the value of this coefficient for port equipment used for example in Constanta Port is about 0.57 resulting from calculations, based on the following elements: time not used for exploitation during the repair planned, time not used for exploitation during the repair of accidental and time not used for exploitation, due to working port conditions.

The main factors influencing the work duration of port equipments are the following:

- Bad weather - the leading cause of time spend while not operating port equipments - due to weather factors that directly influence the functioning of the equipment. Wind pressure limits the equipment exploitation over a certain value. Ports are located in open areas exposed to wind, that influence operation of machinery with a special weight;
- Frost ports etc.

The statistical analysis showed that the duration of restraint in our country, due to unfavourable time is about 10% of calendar time;

- Ship manoeuvres wagon fronts (berths) operative also leads to the stationing of port equipment;
- Other reasons that influence these machines exploitation are power interruptions, changing shifts, changing from one barn to another of the machines working in ships etc.

Another factor, the coefficient of lift capacity, represents the degree of load-lifting capacity to operate both general goods and bulk cargo. The operation rate of bulk goods and the degree of filling for clamshells decreases as they reach the bottom of the download store.

Finally, working cycle of the equipment is also one of the main elements that characterize and influences the exploitation management system of a port machine. The quay crane cycle is made of full working operations and is expressed in minutes and seconds. In order to establish practical operating life cycle is essential to assess each stage of the machine's working operations. A port equipment management system should analyze the quay crane working cycles diagrams to observe the overlapping stages of work in order to reduce the duration of operation and to improve exploitation.[6]

4. Example of a Crane Management System

The main benefit of using Crane Management System produced by Siemens Company is the accurate and fast fault reporting, online status information, automatically triggered maintenance warnings and documentation available online. The system drastically reduces any (unexpected) downtimes of equipment. Maintenance engineers can trace the faulty equipment within seconds and they can use the right tools and/or spare parts. The system has a modular design. Up to twenty general and/or sector-specific function modules are already available to assist users, who may have diverse requirements: operation levels with modules such as Fault, Online Cameras and Online Process Graphics, Maintenance levels with modules such as Service Maintenance, Trace, Monitoring Drive Systems, management levels with modules such as Operation Data and sophisticated report facilities.

Fault Diagnostics Module controls recognition and handling of faults that arise while the system is in operation. Particularly noteworthy is the strict separation of stored messages (alarms, operating statuses, etc.) according to recording time. In addition to dealing with faults, operators can correct faults by drawing on their own knowledge of the equipment filed in a user notebook, sorted by location, possible causes and correction.

With the aid of the service maintenance module preventive maintenance schedules in combination with the 'intelligent' device status, the maintenance staff can effectively plan their working schedules. Because the data of the service maintenance module is also available on wireless connected handheld devices (PDA, Tablet-PC) time consuming administrative paperwork will be eliminated because information is available at the working location and data entry is done directly into the maintenance system.

Operation Data Module displays equipment-operating data in text and graphical form. As the data structure can be individually defined, for instance in relation to the turnaround cycle, it is possible to estimate the loading capacity and service life of the crane. Important features of the module are its reporting and statistical evaluation facilities. In addition to standard evaluation routines, individual data evaluation formats can be designed at will.

Trace Module contains the time trend analysis and stores process signals triggered by certain events in the system. Process signals are transmitted to the module through high performance ring buffers. Using the system database, the stored signals can be processed as required. With the online trend function a selection of all available data addresses can be recorded and saved for longer periods eliminating the need for installing external data addresses recorders.

Container-Positioning Module makes it possible to increase the automation level of the crane. Together with the HIPAC swaycontrol system, containers can be loaded or offloaded in an automatic sequence. All relevant data, such as vessel layout and load plan, is available in the system database and communicated via the yard planning system. An online status display of the status and next planned operation is available in the operator cabin.

The video control module supports the real-time monitoring of critical or otherwise inaccessible system areas. Cameras can be connected directly to a PC, with additional cameras connected externally. Overall camera control takes place using the mouse.

Using the teaching mode in the module, motorized camera positions can be adapted to local conditions and results stored for later use. When a specific condition is repeated, the camera will automatically return to the stored position.

Online Information Module makes all kinds of digital information available via the internet browser. Electrical, mechanical and hydraulic diagrams are provided in software form. Users can retrieve directly from other system modules the requested electrical drawing, showing the faulty device user manuals, internet sites, etc. Because it is possible to retrieve information from the internet sites of

different manufacturers, users always have the most up-to-date information at their fingertips.[7]

Conclusion

An efficient solution for improving management of port equipments exploitation is by designing and implementing a management system suitable for the technical charactheristics of different port equipments and particular for quay cranes. Management of exploitation should reach a high level of technicality required by the speed with which port equipment must execute loading and unloading operations. Also, an efficient management system should take into consideration the objective of minimizing the physical effort of port workers, risk management capabilities and whether there is a need for upgrading.

Management exploitation system leads to a better productivity considering exploitation rhythm, technological processes and balanced quality and quantity factors.

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Address:-

- Cristina Dragomir, Constanta Maritime University, Mircea cel Batran nr.104, cod 900663, Constanta, economie.umc@gmail.com