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## IDENTIFICATION OF CONTAINER HANDLING PROCEDURES

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**Abstract:** *Considering that container ships represent the most dominant transportation mode in globalized supply chain networks, the identification and prototyping of effective container terminals' management processes is critical for the reliable and efficient operation of these networks. Furthermore, the identification and prototyping of containers' handling procedures is a critical success factor for the development of sea transportations and especially the container transportation which is growing in global maritime business. Under this context, the purpose of this paper is two-fold: first, to identify the key container management processes, second, the appreciation of the necessary ICT systems that should be used by any terminal's management in order to provide general guidelines for establishing effective container management operations.*

**Keywords:** *Maritime logistics, Containers handling, Process / logistics standardization.*

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### 1. INTRODUCTION

Improving the efficiency of container terminals (CTs) is critical for the development of effective door-to-door supply chain networks, as these constitute the start point of responsive and resilient hinterland connections. On this basis, the optimization of their operations may have significant value added effects throughout the whole supply chain. As the optimization of CT operations can be mainly achieved through the optimization of container management procedures and the employment of Information Technology (IT) systems, the purpose of this paper is to map: (i) the critical container management processes, and (ii) the necessary IT systems that should be employed by the port's management, in order to develop general guidelines for the design of effective container management operations.

### 2. CONTAINER TERMINAL OPERATIONS

This chapter will provide an analysis of the container management operations associated to: (i) conventional cargo containers, (ii) empty containers, and (iii) hazardous cargo containers as these are, depicted in the following Figure 1:

#### 2.1 Conventional Cargo Container Management

The management of conventional cargo containers represents a range of 50-80% of the terminal's total operations and thus, their effective management may significantly improve its overall performance. These operations are classified into the operations associated to their exports and their imports. The operations associated to their exports are the following:

- Pre-gate recording of the truck and container's weight.

- Pre-gate confirmation of the container's shipping and customs related documents.
- Pre-gate recording of the container's export information into the Terminal's IT system.
- Physical inspection of the container (inspection of its stamp, physical condition etc.) at the terminal's gate.
- Consistent checking of whether the truck and container's identity comply with the pre-check stage.
- Indication to the truck driver, of the containers' discharge position within the terminal's interchange area according to container's size/type/height, departure vessel, weight and port of discharge (If the terminal receives however instructions from the customs office to scan the container, the container passes through the scanner first and its discharge position is then indicated to the truck driver).
- Issuance of the container's discharge and storage command and its transmission to the straddle carriers (or to other alternative equipment).
- Determination of the export container ship's berthing location at the terminal's quay.
- Development of a specific container sequence, based on the order that these will be loaded onto the ship (that is based on the Master Bay Plan).
- Weighting of the empty truck at the exit (Aqaba Container Terminal, 2015).

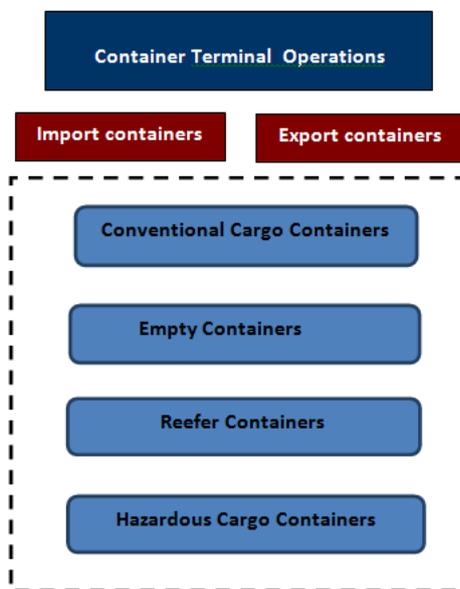


Figure 1: Container Terminal Operations

In some container terminals, its management already has preliminary information on its arrival and has thus determined its stacking position. Moreover, and if the terminal's management has instructions from the customs office for scanning, the container passes through the scanner first and is then discharged at the designated place. Specifically in the case of the container's physical inspection, and under the orders of the customs office, the terminal's staff can assist the performance of physical control (checks) of the cargo in the container. Then, the ship loading order is issued and countersigned by the customs office. The Terminal's operations associated to the import containers are the following:

- Receipt of the ship's import manifest.
- Berth allocation to the vessel.
- Discharge of the vessel's containers on the quay and further inspection of the containers in order to identify whether: (i) each container's number is correct, and (ii) its stamp is not infringed (The scanning of a container after the Customs Office's request may be performed even during ship discharge operations or subsequently).

- Electronic recording of the container's receipt.
- Generation of a delivery sequence list based on the stacking of the container in the container yard.
- Delivery of the containers to the terminal's container yard.
- In the case of partial cargo loads (groupage), their receipt is conducted by the terminal's warehouse, based on the mailing list supplied by the cargo's agent and after their inspection with respect to their brands, and their quantity stated at the bill of lading.
- After the containers' and the partial cargo are received, an "Execution Report" is formed and passed to the cargo's agent and the Customs Office.
- When the importer's agent carries out customs formalities and receives the delivery order of each container, sealed by the customs office for release, the cargo is delivered to the Port Authority.
- The importer then pays the General Port and Warehouse Rights, and an invoice is issued by the Port Authority.
- The terminal's documentation staff releases "hold" in EXPRESS for import delivery after relevant payment is cleared.
- Documentation staff updates the weight and B/L number in EXPRESS and scans a copy of B/L into a designated network share folder with the B/L number as file name.
- The truck that will receive the imported container goes through a weighbridge in order to obtain a weight ticket that shows the weight of empty truck.
- Truck driver presents its entry permit to the pre-gate staff.
- The pre-gate staff then prints a "gate pass" to the truck driver.
- The in-gate staff checks the consistency of the truck number with that on the entry permit and gate pass and makes a gate-in.
- The yard dispatcher dispatches equipment to load the import container onto the truck.
- The weigh staff will weigh the truck with the container and print the weight on the same weight ticket.
- The pre-out gate staff will check the weight of the container and compare it with the scanned B/L in the network folder.
- The truck will be sealed by Customs and its entry permit will be recorded.
- Out-gate staff will compare the truck and container number with that on the entry permit.
- Truck has to wait if it is over loaded, or else it departs (Aqaba Container Terminal, 2015).

For both import and export containers that employ rail transportation, the terminal's operations are the same as those for trucks, with the difference that we now have wagons instead of trucks. In some container terminals, after the container discharge from the ship, the port issues documents for the customs office and the agents of the imported containers, namely: (i) The General Act, (ii) The Notification Act for differences in seals, and (iii) The Container Interchange Report. Moreover, the Scanning of a container at the customs office's request may be performed even during ship discharge operations or subsequently. Customs-cleared containers can be shipped on trucks or can be stripped. Loading of full containers on trucks for further shipping is done on the basis of previously submitted by the agent numbers of cars. Finally, at the container release stage, the numbers and the integrity of seals are checked.

## 2.2 Empty Container Management Procedures

The required procedures associated to the export of empty containers are the following: In Gate – gate staff will check the container's condition, In Gate – staff will check the agent's request note and entry permit, and register it into the system, Yard staff will inform the empty container handler to unload the container to the projected position according to the line operator, the container's size and type, Out Gate – gate staff will confirm that the container is discharged, and

stamp on the entry permit. (Aqaba Container Terminal, 2015), and the empty containers will be then stored in the Terminal's empty container slots until loading on the ship. The required procedures associated to the import of empty containers are the following: The exporter sends trucks to collect the empty imported containers. The exporter's agent sends an EDI message to the Port's management indicating the number of empty containers he intends to receive. After relevant payment is cleared, the Terminal approves the empty container's release, and the yard dispatcher loads it on the transportation mode employed for its re lease.

### **2.3 Hazardous Cargo Container Management Procedures**

Hazardous cargo can be classified to the following categories: Petroleum in accordance with Annex I of the International Convention Marpol 73/78, Gases as defined in GC Code, Noxious liquid substances/chemicals, including waste, as defined in the BCH Code and Annex II of the International Convention MARPOL 73/78, Solid bulk cargoes which exhibit chemical risk in accordance to the BC Code, Harmful substances in packaging covered by Annex III of the International Convention MARPOL 73/78, and Packed hazardous goods: substances, materials and articles as defined in the IMDG Code. The packaging and transport unit of hazardous cargo should carry warning labels, depending on the category of the cargo's risk, in order to communicate the potential dangers throughout all stages of the supply chain and thus handled accordingly. The empty uncleaned packages should be also treated as hazardous cargoes, sufficiently purged by residues of their dangerous cargo and evacuated from hazardous vapors.

#### **2.3.1 Legislation for Hazardous Cargoes**

The management of hazardous cargo should cope to the following international legislative frameworks: International Maritime Dangerous Goods Code (IMDG Code), International Bulk Chemical Code (BCH Code): International Code for the construction and supply of ships carrying dangerous chemicals in bulk, International Bulk Gas Carrier Code (GC Code): International Code for the construction and equipment of ships carrying liquefied gases in bulk, International Convention for Safe Containers (CSC Code), International Ship and Port facility Security Code (ISPS Code), International Convention for the Safety of Life at Sea (SOLAS) and International Convention for the Prevention of Pollution from Ships 73/78 (MARPOL 73/78).

#### **2.3.2 Important Issues on Hazardous Cargoes for Port Authorities**

The port authorities must be informed in advance regarding the characteristics of the hazardous cargo. Specifically, the shippers or consignees must submit the following information to the Port Authority. Specifically about: Technical name (Proper shipping name), Class and subsidiary danger, UN Number, Packing Group, Number and kind of packages, Total quantity of dangerous goods, Auxiliary descriptors such as : Marine pollutant, elevated temperature, etc. Specific information for classes: 1, 6.2 and 7, for some cargo types of classes 4.1 and 5.2 and for fumigated units (Minimum flashpoint, if the temperature drops below  $\leq 61$  Celsius, indication of uncleaned packaging that contained dangerous goods, and any information that is necessary for the safe handling of the cargo in the terminal's area.

#### **2.3.3 General Principles for the Management of Hazardous Cargoes**

The management of hazardous cargo requires the adoption of measures for its safe loading and discharge. Such measures involve:

- Identification of specific positions for the ship's discharge and loading, which further meets safety distance requirements from sites of industrial facilities, residential regions, shipbuilding areas, and any other work site that could be affected by these dangerous cargoes.

- Safe mooring of ships at piers.
- Responsive information sharing on the dangerous cargoes that will be loaded / discharged or remain in the harbor area.
- Emergency response plan in the case of an explosion, fire, and water or gas or solid dangerous goods leaks.
- Constant monitoring of the hazardous cargo storage areas along with appropriate warning signs on potential dangers.

Specific hazardous cargo classes require special treatment. Regarding explosive cargoes (Class 1) the following shall apply: 1) The explosive substances and cargo types (other than class 1.4s) should be accepted only for immediate delivery / receipt, 2) Their residence in terminal's area requires special facilities, and Their loading and discharging should be: monitored by specially authorized personnel, conducted with extreme caution, made with the use of explosion-proof equipment (e.g. electric forklifts) and the appropriate workers' gear and clothing. For radioactive cargoes (Class 7), the following processes should be followed: They should be accepted only for immediate delivery / receipt, their residence in the terminal's facility, even for a few hours, requires a special storage area, which must be isolated and not accessible by unlicensed individuals and their loading and discharge should be monitored by specially authorized personnel, and conducted with care, along with the use of appropriate gear and clothing. For temperature controlled cargo, such as automatic ignition substances (Class 4.1), organic peroxides (Class 5.2), and some infectious substances (Class 6.2), the following should apply: These cargoes should be accepted only for immediate delivery / receipt and their storage in the terminal should be made in specific, specially designed areas that incorporate temperature-control devices for dealing with exceptional cases of high temperature increases.

### **3. IT SYSTEMS FOR EFFECTIVE CONTAINER MANAGEMENT**

Effective container management procedures require the installation of Integrated Information Systems, in order to diffuse the necessary information between the terminal's staff. The most critical IT systems, as presented by Sxoinakis and Koukouloudi, (2004), are the following:

- Centralized Information Management System: This system supports the dynamic movement of data and information between the terminal's subsystems. The purpose is the collection and distribution of data between different sources.
- Official Document Filling System: This system supports the downloading process of the necessary documents for the delivery and receipt operations of containers.
- Administrative work system: This system supports the issuance of exit, loading and transit permits, the maintenance of records and the submission of customs clearance documents.
- Pricing system: This system supports the estimation, publication and management of invoices, with respect to the terminal's storage and loading/discharge rates.
- Entry/exit control system: This system supports the automatic control of containers and its vehicle using a smart card and by automatically releasing the gate after a successful cross-check of the vehicle's necessary documentation.
- Control of loading/discharging: This system supports the management of loading/discharge operations through the employment of wireless terminals, and by electronically monitoring the loading and discharge movements performed.
- Geographical information system: This system supports the graphical representation of container's movements within the terminal in real time.
- Inventory system: This system supports the electronic confirmation of the position of the container in the terminal's stowage area.
- Stowage planning system: This system supports the distribution of container's in the stowage area.

- Equipment Management System: This system supports, via wireless terminals, the stowage plan system, while passing the necessary instructions to the straddle carriers for container movements.

#### **4. SUMMARY**

Considering that container ships represent the most dominant transportation mode in globalized supply chain networks, the development of effective container terminals' is critical for the reliable and efficient operation of these networks. Under this context, the purpose of this report is to identify key container management processes, along with the necessary IT systems that should be used by any terminal's management in order to provide general guidelines for establishing effective and sustainable container management operations.

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