ADDRESSING CONTAINER STACKING IN INDONESIAN MAJOR PORTS

Problems and Idea to solve

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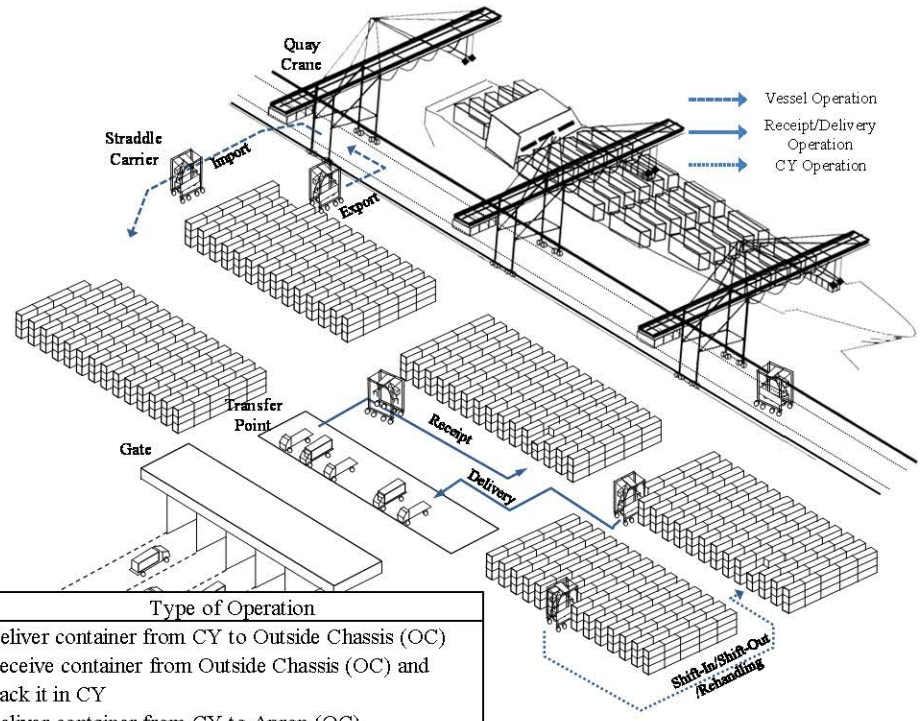

Code	Denomination	Type of Operation
1	Delivery	Deliver container from CY to Outside Chassis (OC)
2	Receipt	Receive container from Outside Chassis (OC) and stack it in CY
3	Export	Deliver container from CY to Apron (QC)
4	Import	Receive container from Apron (QC) and stack it in CY
5	Shifting	Stack and unstack of a container in CY (including rehandling, shift-in, shift-out)

Remark: CY: Container yard, QC : Quay crane, OC: Chassis from outside

Fig. 1 Operation work code in container terminal

Source: Hangga and Shinoda (2014)

Problems

In container terminal systems, Container stacking is either performed by gantry cranes or by straddle carriers. Historical and cultural reasons have to be considered if container terminals are enhanced or modernized. Because space is becoming a scarce resource, a tendency for higher storage is to be foreseen (Stenkeen et.al, 2004). Temporary container stack because of transshipment or yard marshalling could be a pain in the head for any yard planners. The effort to reduce the amount of movement for temporary containers can help to reduce yard occupancy ratio.

The low cost of storing containers in stack is counterbalanced by the limited accessibility of the containers. It is then logic to say that retrieving the upper stack would less costly than the lower stack, giving the lowest stack the most costly to retrieve.

Another problem also would arise when dealing with where to temporarily storage the non-target containers placed on the top of the target container. The non-target containers is called over stowed and activity of removing and temporarily storing those containers is called

rehandle activity. Several reasons can be given to explain why containers can be overstowed. Recent term for this problem is called CONTAINER STACKING PROBLEM.

The problem is defined either as NP-hard or NP-complete depends on the point of view wether dynamic or static problem. Common problem that leads to container rehandling are:

1. For Import containers, the pick-up schedule from consignee by using outside trailer generally is unknown. Even if it is, the pick-up schedule would be informed to terminal in after the containers are stacked in storage area/yard by the terminal operator. It is uncommon practice to conduct truck-loosing in a modern container terminal, so import containers need to be stored in designated import storage area inside the yard as soon as it came. This behavior leave no choice to container terminal to do rehandle operation because of different retrieval schedule of each container stored in the yard.

2. For export containers, there are several problems dealing with FIFO.
   Export containers arriving at the terminal are usually stacked based on the following basis.
   a. Designated ship. It is not the terminal problem to where the cargo will be shipped, but it is important to know which ship is going to carry it. The export containers for the same designated container ship will be grouped and storage in the same area or near to each other at the very less.
   b. Weight. Stacking involved the decision process for the safety of the cargo. This means, the weight of containers is important to design the stacking arrangement of the export containers. Heavier containers will be placed on the lower tier and lighter containers will be placed on the top of it until reach the maximum stacking tier.
   c. Destination. More advanced method in improving efficiency of container terminal is by integrating the handling system in container terminal with the ship stowage plan. As bigger container ship is tends to sail in a tramper rather than liner, the end port destination of every containers in the ship might be different. Stowage plan of the ship is important information that needs to be integrated with container stacking in the container terminal, since the container ship will have an initial stack position once it arrived.

   Problem will arises since that yard stacking is only a temporary stacking and it will soon need to be moved to inside the cell of arriving container ship. This means, the same rules (b) and (c) will be applied for stacking the containers on the ship. Specifically discussing about the rules (b), we can agree that the lower tier in yard stacks will have to retrieve earlier than the other on the top of stack and it will increase rehandle activity of overstowed containers.

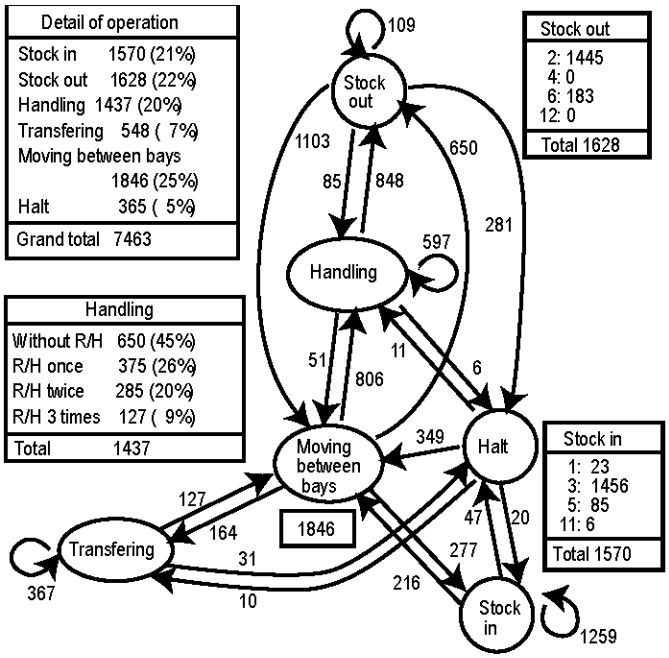

Fig. 2 Example of Markov Chain model for Transfer Crane showing the amount of Rehandling

Source: Shinoda and Hangga (2012)

3. Rehandled containers that is placed back to its initial deck position might not be the best solution as it still vulnerable for the lighter containers for rehandle repetition once the heavier containers is scheduled to be retrieved (Shinoda and Hangga, 2012).

Some definitions follow

   a. A container is overstowed when it blocks the retrieval of another container scheduled to be retrieved while the former still in the deck of stack
   b. Rehandle of a container is a temporary removal of a container from and placement back on to the initial deck position.

4. There is different container reshuffling method for block system (serve by RTG/RMG) or line system (serve by straddle carrier).

5. Containers that are placed on top of the required one have to be removed first. Reshuffles (or rehandles) may occur due to several reasons; the most important ones result if data of containers to be stacked are wrong or incomplete. At European terminals up to 30% of the export containers arrive at the terminal lacking accurate data for the respective vessel, the discharge port, or container weight – data which are necessary to make a good storage decision. Even after arrival, vessel and discharge port can be changed by the shipping line. For import containers unloaded from ships

the situation is even worse: the landside transport mode is known in at most 10-15% of all cases at the time of unloading a ship, e.g., when a location has to be selected in the yard.

6. It is possible to give extra space for marshaling export (loading) containers and import (unloading) containers. Because pre-stowage needs extra transportation and extra space allocation which cannot be achieved due to lack of area, it is cost expensive and terminals normally try to avoid it by optimizing the yard stacking, but it is executed when ship loading has to be as fast as possible. Storage and stacking logistics are becoming more complex and sophisticated.

7. The productivity difference between quay crane and yard crane is another problem, thus inside truck scheduling is important to minimize queue in either export or import containers. In straddle carrier system case, it also need several amount of straddle carrier to serve a single quay crane.

8. In large container terminal where transshipment cargo is recorded up to 60-70% of total cargo, the container stacking area is scattered, cannot be specifically dedicated to specific ship or destination, therefore container rehandling/reshuffling cannot be avoided.

Idea to solve

1. To Study about the effect of VERTICAL MOVEMENT Vs HORIZONTAL MOVEMENT of transfer crane
2. Study why concepts for container stacking (dedicated stacking, scattered stacking, etc.) and search the strength and weakness of those concept as well as why it fails to deliver optimum productivity.
3. To make a preliminary vision the container handling system, i.e: double cycle transfer crane that can hold the overstowed container while the target containers is retrieved from the stacks without have to temporary stack the overstowed container on another available stack. The same method had been proposed for gantry crane by Goodchild and Daganzo (2007)
4. Another vision for container handling system is an equipment to hold the upper level of overstowage container in order to retrieve the lower container.
5. Measure how much can be saved (in cost saving, and time valuation) if we could reduce the rehandle problem. How significant is the saving if compared to increase the amount of handling gear.
6. Examine the container buffering concept as a bridge to manage the productivity gap between quay crane and yard crane.

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Disclaimer

Some part of the manuscript expressed the opinion of the author based on field experiences and research during employment period by a major container shipping company in Indonesia. The author encourages a detail point-to-point examination to prove some hypotheses stated in the manuscript.