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EMPTY CONTAINER STACKING OPERATIONS: CASE STUDY OF AN EMPTY CONTAINER DEPOT IN VALPARAISO CHILE

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ABSTRACT

This study analyzes the handling operations performance at an Empty Container Depot that serves different shipping lines operating with the port of Valparaíso, Chile. With the aid of a discrete event simulation model built in Simio that interacts with an SQL Server database, we seek to improve container stacking policies and to redesign the depot's layout such that truck turn-around times decrease.

1 INTRODUCTION

International trade has been a key factor in the development of world economies. Two important elements for the efficiency of this logistics process are inland transport of cargo and empty container handling. In this work, we present an analysis of the current handling operations at an Empty Container Depot (ECD) that provides services for shipping lines that operate with the large port of Valparaíso.

In their recent survey, Carlo et al., (2014) distinguish between the following main decision problems that arise in storage yard operations: (1) yard design, (2) storage space assignment for containers, (3) dispatching and routing of material handling equipment to serve the container storage and retrieval processes, and (4) optimizing the remarshaling of containers. The problems we consider are the layout design of the depot (in terms of the dimensions of the stacking areas), the assignment of block space for each customer of the depot, the traffic flow of trucks, and stacking and retrieving policies.

The aim of our analysis is to determine the current performance of operational policies related to the stacking of empty containers at the yard and to derive recommendations for improved stacking policies and, potentially, yard layout re-design. Stacking operations at this empty container depot are strongly influenced by the marketing strategy of the depot and the contracts in place with shipping lines. These contracts include a non-fee storage period, which creates a motivation for a FIFO (First In, First Out) policy for the dispatching of empty containers. This characteristic differs with respect to the operations at yards of a Port Container Terminal. For this reason, our work presents a novel contribution by analyzing a different application of stacking policies in an enterprise (ECD) rarely studied in the literature.

2 PROBLEM DESCRIPTION AND MODEL

The Valparaíso depot is divided into two main areas: reefer (refrigerated) and dry containers. We consider only the operations of the dry-container area. Figure 1 presents an overview of the ECD. Both empty and loaded trucks arrive through the Dry Access entrance and reach the Gate Control where gate-in and gate-out operations are processed. Incoming containers are inspected on the main street where they are segregated by type (20´ or 40´) and classified into Operational or Damaged. Trucks access the inspection zone through Street 1 (one way). All other streets are 2-way and wide enough for *toplifter* cranes to transport either type of container. There is a maintenance area where containers are repaired. The back street is used as the access lane for gate-out trucks retrieving a container from a particular block, and as the exit lane for all trucks. Different sections are organized into container blocks with a capacity of eight containers deep and seven containers high, each assigned to a particular customer according to size and class.

We use a discrete-event simulation model with a related database to evaluate different stacking policies and depot configurations. The main performance measures include expected truck turnaround times, container dwell time and yard crane utilization.

Figure 1 Layout of the Empty Container Depot

To represent the operations at the depot, data was collected from three sources. First, we used a study run by the ECD that collected arrival process data. Second, we collected our own field data on different process times, and, third, the depot provided access to data in their ERP database. Using this information, we set the following simulation scenario. Operating hours are from 8:00 AM to 6:30 PM. In days of high demand, the work shift is extended to operate during the night (24 hour operations) but only for dispatching. During lunch, service capacity is reduced by half. The existing four *toplifters* operate using a FIFO request order. Container remarshaling operations occur during low demand times intervals. The service of trucks arriving to the depot is FIFO with the exception of massive runs (generally associated with repositioning operations of a shipping line). Each block of the yard is assigned to a single customer and containers are segregated according to condition class (the two classes can be mixed in the same block if there is crowding at the yard). Damaged containers are moved to the maintenance area, and repaired containers are taken back to the yard and stacked at appropriate locations.

The simulation model is integrated with the SQL database we created out of the compiled data. One key aspect in a crane's service time is the position within a block of the container it is retrieving. Several containers might have shifted locations and their new positions must be updated. The purpose of the database is to hold the current state (location) of all containers. The simulation interacts with the database to update the state of the system and to perform calculations regarding container movement times involved in retrieving a unit, or remarshaling and reorganizing a block.

The initial experimental design includes several levels of the following factors: number of remarshaling activities and policy for gate-out container retrieval. Initial results reveal relevant tradeoffs between truck turnaround time and block remarshaling frequency (and these impact crane utilization), and between flexibility allowed in the operational retrieval policy and container dwell time.

Additional experimentation will include evaluating different remarshaling policies (addressing the conditions to reorganize a block, the order in which blocks are remarshaled, the resources assigned to this task, the frequency and time allowed for the task, etc.). A second group of factors to be evaluated are the yard position assignments for different classes of container and the general layout design for the depot. Also policies for positioning gate-in containers and for obtaining appropriate gate-out containers will be modified.

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REFERENCE

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