Dock Assignment and Truck Scheduling Problem ; Considering Multiple Scenarios with Resource Allocation Constraints

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1 Introduction

The notion of 'resource' plays an important role in the overall efficiency and performance of most cross-docks. The processing time can often be described in terms of the resources allocated to different trucks. Conversely, for a given processing time, different combinations of resources can be prescribed. We study the problem of truck scheduling and dock assignment in the presence of resource constraints. In the absence of a closed-form (or well-defined) linear formulation describing the processing times as a function of resources, expert' knowledge has been mobilised to enable modelling of the problem as an integer linear model. Two cases are taken into account : 1)the expert believes in his/her estimation of the processing time for every truck and only proposes a different combination of resources for his/her estimation, while 2)the expert proposes a limited number of resource deployment scenarios for serving trucks, each of which has a different combination of resources and different processing times. We propose a novel compact integer programming formulation for the problem, which is particularly designed with an embedded structure that can be exploited in dual decomposition techniques with a remarkably computationally efficient column generation approach in this case. The case in which a scenario with invariant processing time is considered and modelled as a special case of the proposed model. Since a direct application of commercial solvers such as CPLEX to solve instances of this problem is not realistic, we propose a branch-and-price framework and, moreover, several classes of valid inequalities are also introduced to improve the mathematical formulation of the problem. Our extensive computational experiments confirm that the proposed exact solution framework is very efficient and viable in solving real-size instances of the practice, in a reasonable amount of time.

1.1 problem description, mathematical model, conclusion and perspectives

The two figures 1 and 2 shed more light on how we undertake the real problem and propose a feasible solution is made. The proposed model is not included in the long abstract, for not violating the maximum two pages limit.

In this study, we proposed a mathematical programming model for the dock assignment and truck scheduling problem, while multiple resource deployment scenarios are considered for every truck in the system. The proposed model is tailored for conservative decision makers and considers different scenarios having different processing times. The proposed model is particularly designed to be exploited in a dual decomposition framework such as Dantzig-Wolfe

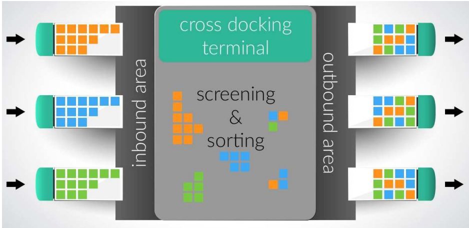

FIG. 1 – Cross-docking operations (source : https ://www.odoo.com/)

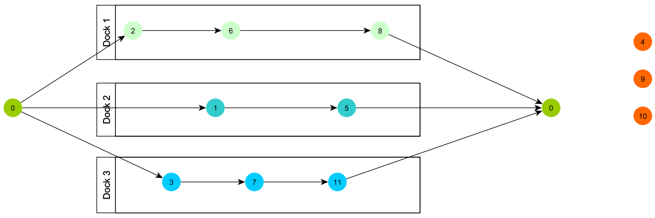

FIG. 2 – A graphical representation of the modeling approach.

	List of parameters used to build the model
$S = \bigcup_{j \in \mathcal{J}} \mathcal{S}^j$	set of all scenarios,
$\mathcal{D} = \{1, \dots, D\}$	set of dock doors,
'0'	dummy truck,
$\mathcal{J}$	set of trucks, $\mathcal{J}^\circ = \mathcal{J} \cup \{0\}$,
$\mathcal{T} = \{0, 1, 2, \dots, T\}$	planning horizon,
p_j^s	processing time, the time required to serve truck j under scenario s,
r_j	arrival time of truck j,
g_j	penalty cost for not serving truck j,
δ_j	setup time to align a truck in front of the gate and other preparations,
d_j	latest departure time of truck j,
f_i	penalty cost per every unit of time that truck i is waiting idle,
R^p	maximum number of available personals,
R^e	maximum number of available equipments,
R^v	maximum number of available vehicles ,
n_p^s	required number of workers in scenario s,
n_e^s	required number of equipments in scenario s,
n_v^s	required number of vehicles in scenario s,
$\mathcal{S}^j$	set of all possible scenarios for serving truck $j \in \mathcal{J}$.

TAB. 1 – The parameters

and branch-and-price algorithm. While the compact model do not show very interesting computational behaviour if directly given to CPLEX, the proposed Dantzig-Wolfe reformulation and the branch-and-price approach equipped with a warm start initial column heuristic that we proposed, are shown to be very efficient in solving real-size instances of the problem in reasonable time.

Références

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