Research School for
Operations Management
and Logistics

Towards automated container allocation at a tank container operator

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We study the allocation of empty tank containers to transportation requests at a logistics service provider. Planners handle requests one at a time and select, for each request, a container that meets the customer's technical requirements from those available at the depots. Based on a two-year placement of the first author at Den Hartogh, we identify three features that a model of the decision needs. The operator avoids repositioning between depots, so that allocation has to do the rebalancing. Requests reach the planners on the spot, a day ahead, or longer, so that when to commit is a decision whose options expire with travel time. And containers and requirements are heterogeneous, so that which container fits a request best may depend on geographical factors as well as container type, rendering the decision complex. We formulate a semi-Markov decision process with these features and show that, without loss of optimality, allocations need only be considered at a few cutoff points per request. We compare rolling-horizon optimization with learning-based policies, including deep reinforcement learning, on small instances calibrated to the operator's utilization. Which method best depends on how far ahead requests are known: learning when requests arrive on the spot, optimization when they are known a day or more ahead. Neither carries over to the real network as it stands. We discuss what would be needed and which behaviors of the learned policy planners can adopt today.