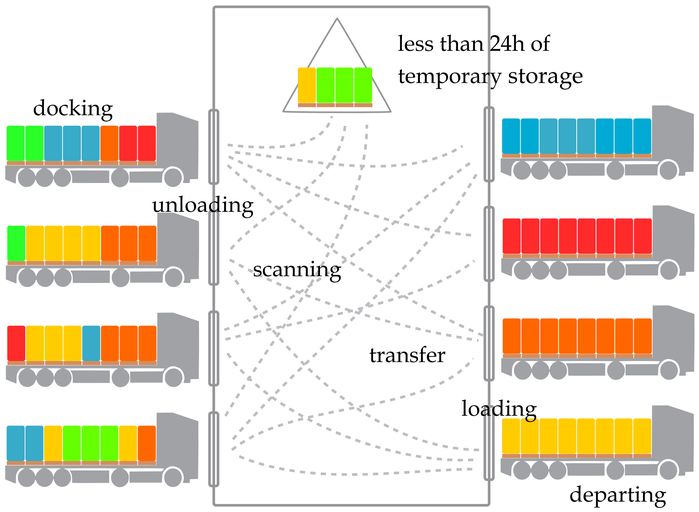
Cross docking operations: a simulation model for the validation and robustness assessment of IP-based truck schedules

Anne-Laure Ladier[a], Allen G. Greenwood[b], Gülgün Alpan[a]

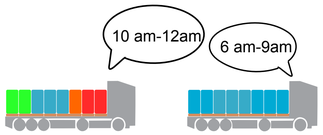
[a] G-SCOP UMR5272 Grenoble, F-38031 46 avenue Félix Viallet, 38000 Grenoble, France

[b] Department of Industrial and Systems Engineering, Mississippi State University, MS 39762, USA

What are the cross-docking operations?



An IP-model for a truck scheduling problem [1]



Reservation system: the transport providers provide their desired arrival and departure times for all trucks

Objective

Find an inbound and outbound truck schedule that

- maximizes the transport providers' satisfaction
- minimizes the quantity in temporary storage

Decisions variables

- Number of units moving from point to point (incl. storage)
- Reserved time windows for the inbound and outbound trucks

Assumptions for the IP-model

1. The door service mode is exclusive (inbound or outbound, not both).
2. The content of the incoming trucks (#pallets/destination) is known.
3. The door-to-door distance for the transfer is not taken into account
4. Internal operations are done in masked time, within one time unit.
5. Once unloaded, the pallets can be picked from the floor in any order.
6. Outbound trucks have a fixed capacity.
7. Outbound trucks leave only when they are fully loaded.
8. A pallet whose matching truck is not available is put into storage.
9. The storage capacity is unlimited.

Is the IP-based schedule actually applicable?

Validity range of the assumptions made in the IP-model

Check the impact on the resulting operations when varying:

Assumption 3: transfer times

Assumption 4: docking, unloading, scanning process times
loading, departing process times

Assumption 5: order of the pallets inside the inbound trucks

Robustness of the schedule against stochastic events

- **Truck ponctuality**

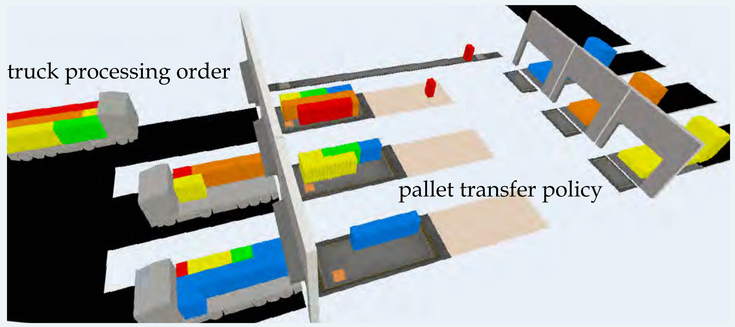
Decide how to handle the trucks and pallets when the original schedule is perturbated (some trucks arrive earlier or later).
Check the impact on the resulting operations.

- **Content of the inbound trucks** (assumption 2)

Check the impact on the resulting operations when the content of the inbound truck differs from what was expected.

Simulation model using FlexSim

Input of the simulation: truck schedule from the IP-model



We compare the outputs of the IP model and the simulation for:

- trucks arrival and departure time
- amount in storage
- pallet transfers

Results and conclusion

Current results

- Validation phase ongoing
- Sensitivity to variability in transfer time
- Importance of the policy chosen for the pallet transfer

Perspectives

- Refine the IP model to improve its robustness
- Combine this work with a employee scheduling model

References

[1] Anne-Laure Ladier and Gülgün Alpan. Scheduling truck arrivals and departures in a cross dock: earliness, tardiness and storage policies. In *International Conference on Industrial Engineering and Systems Management, 2013*. To appear.

Acknowledgment

This work has been funded by RhôneAlpes Région

Contact

Anne-Laure Ladier
Anne-Laure.Ladier@g-scop.fr
g-scop.grenoble-inp.fr/~ladiera