Inter-Terminal Transportation

Worldwide containerization trends show a high growth in container turnover. Resulting from this are increased port authorities, but especially the ones of the world’s leading ports face the challenge of transporting more and more containers from one ship to another or from ships to hinterland transportation systems. For instance, this challenge is addressed at the ports of...

Exemplary means of transportation used in all three ports:

- Automated Lifting Vehicles
- MTS - Multi-Trailer System
- Automated Guided Vehicles

...Hamburg...

...Shanghai...

...and Rotterdam.

We developed a mathematical model of Inter-Terminal Transportation

1. The first mathematical model of IIT, optimization based or otherwise.
2. A modified solution mechanism for solving IIT problems in which we solve the container flow problem without vehicle constraints first and use it in guiding the solution to the full problem.

Conclusion

Preliminary study
Slow speed of ALVs hurts performance with few vehicles
Fast flow time of ALVs supports MTS with many vehicles
High capacity of MTS gives stable performance regardless of number of vehicles
In our model, if solutions are feasible there nearly any delays experienced

Comparison to Terms of Reference Document

What we model:
- Access routes to IIT
- Business for IIT
- Vehicle interchange through number of moves restrictions
- Congestion interactions between IIT vehicles
- With the capability to model outside interactions, too

What we do not currently model, but the model supports:
- Access routes to IIT
- Business for IIT
- Vehicle interchange through number of moves restrictions
- Congestion interactions between IIT vehicles
- With the capability to model outside interactions, too
- Enforces ‘monopolists’ from dominating the system (game theoretical analysis)

Future Work and Vehicle Alternatives (Not yet considered)

We can model new infrastructure (tunnels, bridges, monorail)
Our model could be used as input to a discrete event simulation model
We can consider costs in the objective
Vehicle count optimization
Balancing vehicle cost and delay is possible

Poster created by Julia Bachmann