Optimizing shared on-demand passenger and goods mobility

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The market for on-demand transport services is rapidly growing, for both person and goods delivery. The ability to travel, or to order food or non-perishable products, conveniently without advance planning is attractive to those with unpredictable schedules or restricted mobility. Currently passengers and goods are travelling separately; combining the two could lead to more efficient use of vehicles and road networks.

Research questions:
- What are the effects of combining passenger and goods in the same scheme?
- How can the performance of a co-modal system be improved?

Benefits of shared mobility

<table>
<thead>
<tr>
<th>Shop-specific (base case)</th>
<th>Collaborative</th>
<th>Co-modal</th>
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<tbody>
<tr>
<td>Taxi</td>
<td>Taxi</td>
<td>Shared passenger/delivery van</td>
</tr>
<tr>
<td>Shop-specific van</td>
<td>Shared delivery van</td>
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Simulations using MATSim to explore effects of scenarios and changing demands, using realistic data from Melbourne

Proposed routing optimization method

1. Represent the problem as a directed graph network

2. Introduce fictitious demands based on historical data to anticipate ad-hoc demands

3. Create the initial route plan by using a robust optimization approach by treating the number of passengers of the fictitious demands as probabilistic.

4. Use an insertion algorithm during execution to incorporate ad-hoc demands.

Other features of the optimization

- Optimization of multiple vehicles.
- Generic optimization formulation to allow flexibility in objective trade-off (user vs. operator).
- Constraints can be either hard or soft.
- Considerations of: operating cost, user constraints, fleet size minimization

Conclusion & future work

- Co-modality, i.e. shared vehicles for passengers and goods, has the potential to improve the efficiency of a demand-responsive transport service.
- Careful routing optimization are required to guarantee service quality to customers and maintain the feasibility of such service.

Acknowledgements and references:
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Expected outcome

The potential benefits of better ad-hoc demand anticipation:
- Decreased waiting time
- Increased service flexibility, i.e. fewer constraints violation and/or demand rejection.
- Savings from lower number of vehicles required to service non-typical demand.
- Higher average occupancy of each vehicle.