The effect of customer characteristics on coalition gains in collaborative vehicle routing

Christof Defryn    Christine Vanovermeire    Kenneth Sörensen
ORBEL 27 / February 7–8, 2013
Outline

Why horizontal collaboration?

What is horizontal collaboration?

Joint route planning

Econometric study

Results

Further Research
Why horizontal collaboration?

Facts

- 25% of European trucks are driving empty (*Pasi, 2007*)
- Average truckload is around 50% (*Institut für Energie- und Umweltforschung Heidelberg, 2008*)
- 46% of European freight transport occurs by road (*Goel, 2009*)
- Between 2007 and 2020, the length of traffic jams on Belgian highways will increase with 54% (*Maerivoet & Yperman, 2008*)
- The efficiency is very low today
- Road transport will remain an important modus in the future
- What about sustainability?
Why horizontal collaboration?

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Why horizontal collaboration?

Solutions

- High-Tech, more efficient and aerodynamic trucks
- Greener engines, new fuels
- Expand the road network
- Horizontal collaboration
Why horizontal collaboration?

**Solutions**

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Solutions
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But what is horizontal collaboration about?
What is horizontal collaboration?

Definition
“Concerted practices between companies operating at the same level(s) in the market”

-European Union, 2001-

- Long-term time span
- Involves a certain level of operational integration
- Forming a strategic alliance
Joint route planning
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Joint route planning

- **Cost reduction**
  Total cost of the coalition is lower than the summed stand-alone costs of the players

- **Sustainability**
  Through better optimization of the routing, total CO₂ emission can be reduced
The study

Problem
- High variability in the profit of a joint route planning
- Can we know profits beforehand?
- Who is a good partner for me?
- We do not want to share too much information
The study

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Research question

- Predict the profit of a joint routing problem
- Based on basic business characteristics
- Partner choice
Data

- Own-generated test instances (two-party collaborations)
- Client coordinates are randomly chosen

<table>
<thead>
<tr>
<th>Variable</th>
<th>Low</th>
<th>High</th>
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<tbody>
<tr>
<td>Average order size (AO)</td>
<td>50</td>
<td>120</td>
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<tr>
<td>Standard deviation of order sizes (SD)</td>
<td>5</td>
<td>30</td>
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- VRPH - algorithm
Data

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- Profit = Reduction of the kilometres driven
- Variables and Profit = input regression analysis
Results

- Standard error of the order sizes
  No significant impact

- Average order sizes
  Complementarity with respect to FTL
  - Companies with low order sizes need to look for a partner with high order sizes
  - Companies with high order sizes need to look for a partner with low order sizes
  - On average they reach together a high load factor

- Number of clients
  Find a similar partner
Results – Average order size

Graph showing the relationship between expected profit and average order size.

- AO 1 = low
- AO 1 = high

Expected Profit

Average Order 2

40 43 46 49 52 55 58 61 64 67 70 73 76 79 82 85 88 91 94 97 100 103 106 109 112 115 118 121
Results – Number of clients

Expected Profit

Number of clients 1

Clients 2 = High

Clients 2 = Low
Further research

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- The development of new metaheuristics is necessary to solve collaborative vehicle routing problems
- A fair gain sharing mechanism needs to be incorporated that rewards flexibility of the parties
- Tactical decision making
  - Which combination of market environments and strategies is profitable?
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