



University of Antwerp
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ANT/OR

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

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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

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-
- ▶ The efficiency is very low today
 - ▶ Road transport will remain an important modus in the future
 - ▶ What about sustainability?



Why horizontal collaboration?

Solutions

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



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Solutions

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- ▶ Greener engines, new fuels
- ▶ Expand the road network
- ▶ **Horizontal collaboration**

But what is **horizontal collaboration** about?



What is horizontal collaboration?

Definition

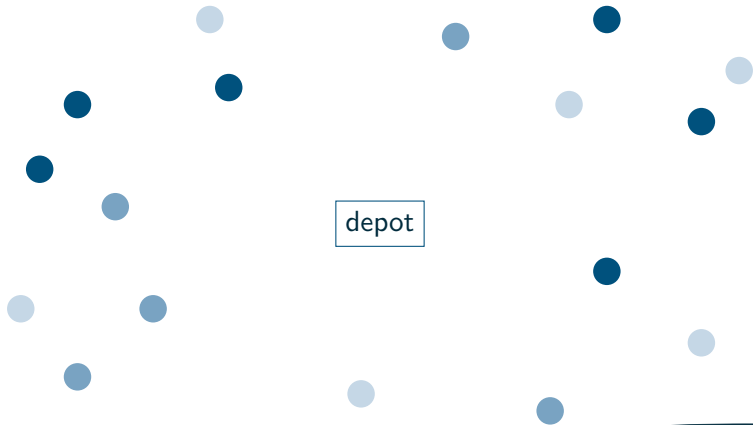
“Concerted practices between companies operating at the same level(s) in the market”

European Union, 2001

- ▶ Long-term time span
- ▶ Involves a certain level of operational integration
- ▶ Forming a strategic alliance

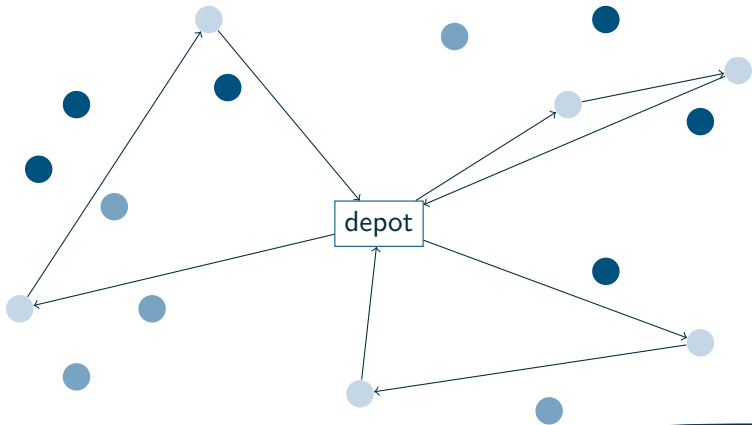


Joint route planning



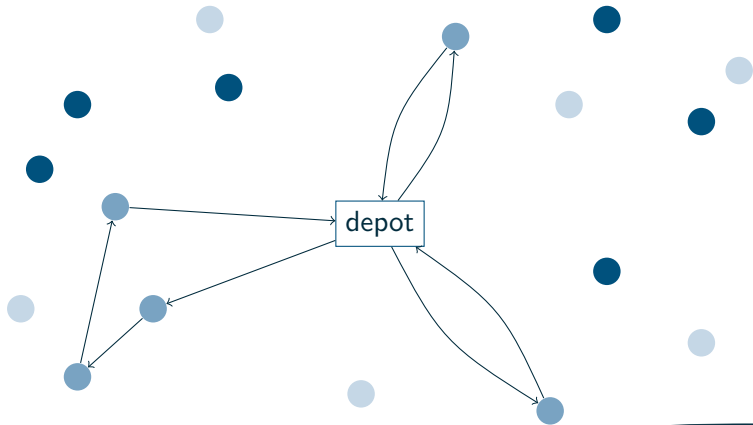


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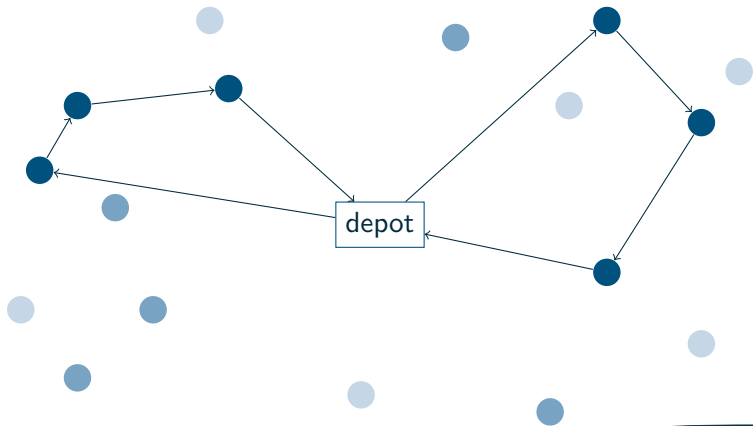


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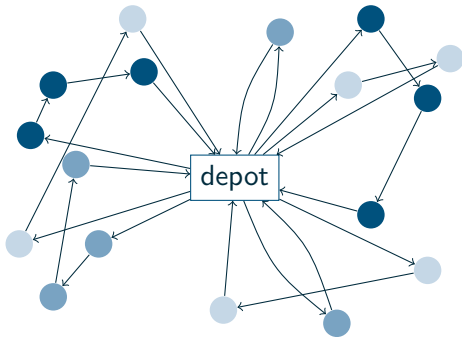


Joint route planning



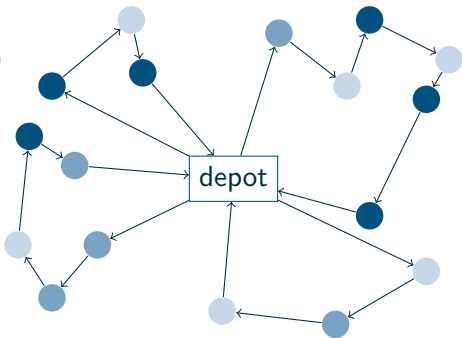
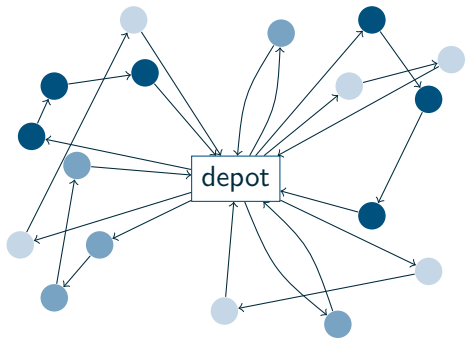


Joint route planning





Joint route planning





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



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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

Variable	Low	High
Average order size (AO)	50	120
Standard deviation of order sizes (SD)	5	30
Number of clients (CL)	5	20

- ▶ VRPH - algorithm



Data

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Variable	Company 1	Company 2
Average order size	Low	High
Standard deviation of order sizes	Low	Low
Number of clients	Low	High



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

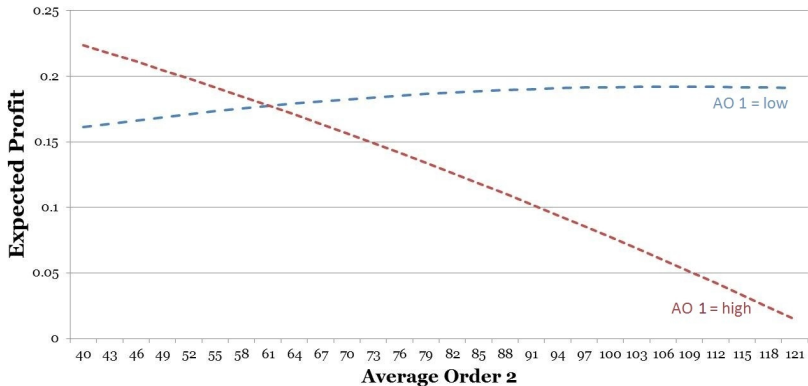


Results

- ▶ **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

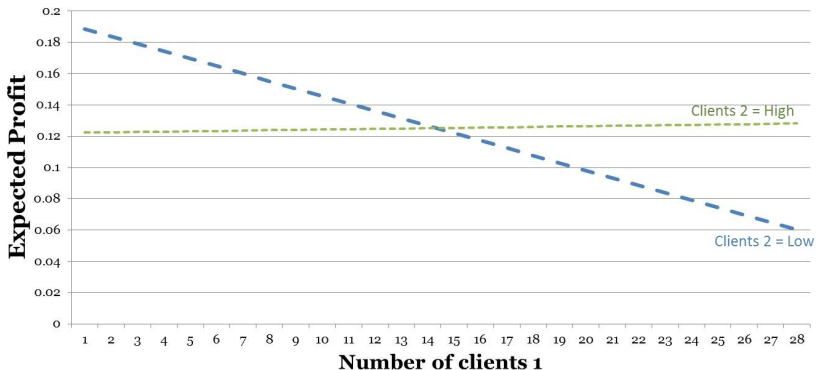


Results – Average order size





Results – Number of clients





Further research

Existing routing algorithms	Horizontal collaboration
a single company a single market environment a single strategy	multiple companies multiple market environments different strategies



Further research

Existing routing algorithms	Horizontal collaboration
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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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