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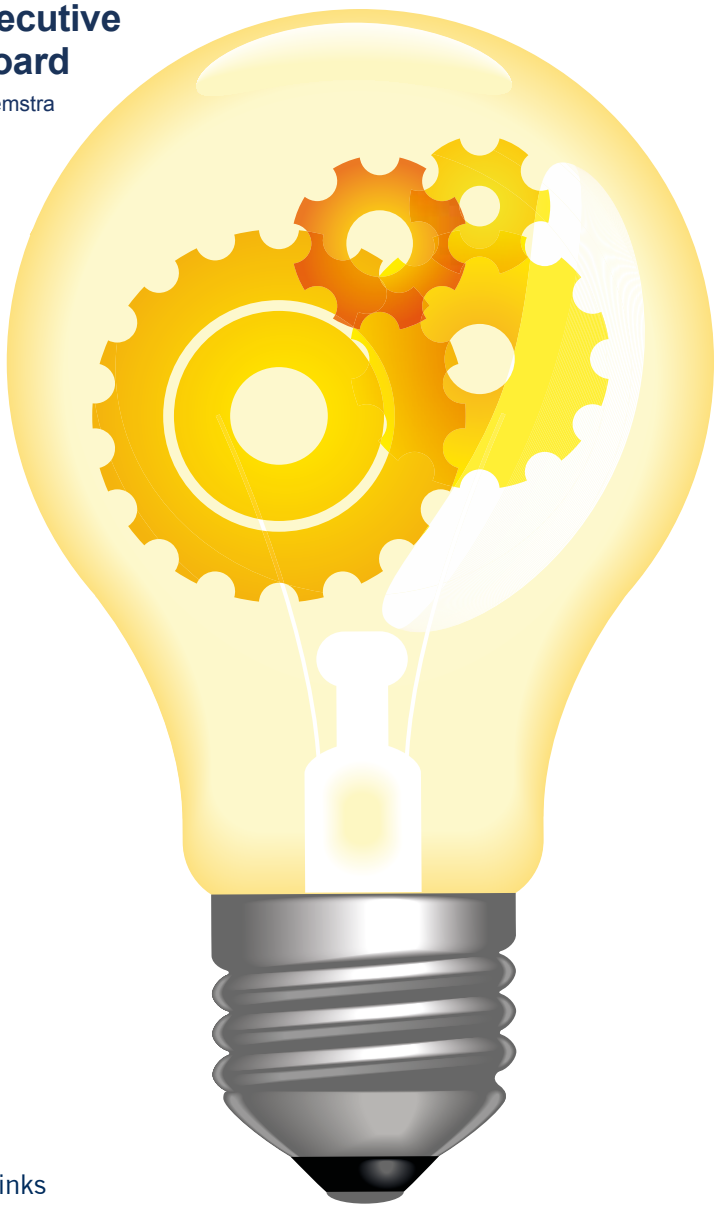

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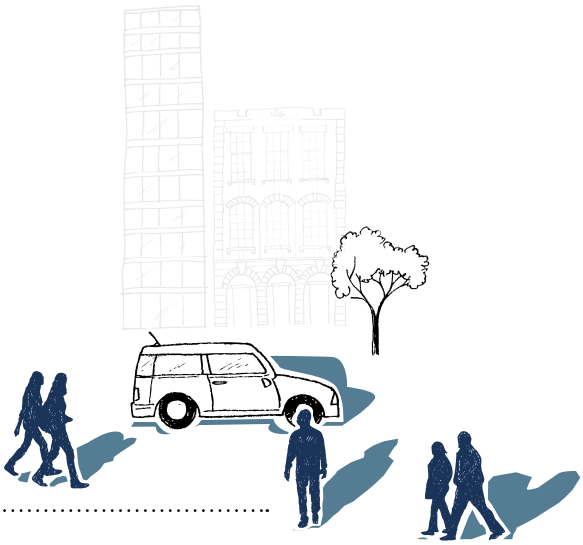
Optimisation for dynamic ride-sharing

by Niels Agatz



For decades, people have looked for ways to maximise personal transportation efficiency, especially for the regular commute between home and work. Particularly in times of economic difficulties, the primary aim is generally to reduce costs by sharing them. However, an important priority for travellers by car is also to find a substitute for inadequate public transport.

The idea of carpooling originally enabled family members or colleagues to benefit from faster, more direct routes, at the same time sharing the family car and reducing running costs, and taking turns as drivers to pick up and drop off the others according to a fixed schedule. A more flexible solution was difficult due to the lack of enabling communications technology.

Today, there are additional incentives to share transportation resources with others, and the benefits could be broader. Pools of users have widened to include people who don't know each other personally. The evolving situation naturally brings with it new requirements, which in turn offers new potential for the service providers serving these markets.

Maximised cost control and mobility, greater flexibility and real-time travel solutions are the basic aims, but real, personal added value could be achieved through linked networking and community building opportunities, not to mention reduced road congestion and vehicle emissions in the interests of society at large. And now, the technology is available.

"As yet, web-based ride-sharing tools have only begun to exploit the potential of technology-based systems."

Speed bumps

The increasing use of mobile communication devices has led to different kinds of online carpool-related services becoming available, ranging from downloadable apps to web-based platforms accessible by tablet computers and smartphones. The focus of these services is to meet the need for a way of bringing together those offering rides with one or more passengers on specific routes. As yet, in reality, they only provide access to electronic bulletin boards, requiring – like carpools – an existing group or community with similar timing and routing requirements.

While technology has made access to this information instantly available, prospective users are still left with the task of searching through lists to find the right match in terms of location, timing and route. Bulletin boards require constant updating: investigating different offers to verify their suitability could mean that a first choice has meanwhile been "taken" by someone else. Matching options are also limited: questions of safety, reliability, comfort and compatibility usually remain unresolved issues.

The matches that people look for now are short-term, flexible solutions adapted to changing societal and infrastructural developments, different employment and commuting patterns, and which pay attention to environmental issues. Larger numbers of employees work according to a flexitime policy, with variable working ▸

Optimisation for dynamic ride-sharing (continued)

by Niels Agatz

hours. Thus, for many, the duration of the working day is not fixed, making pre-arranged rides impossible or at best, limiting.

More women have joined the workforce, so that families often have to contend with complex, overlapping schedules for crèche and school drop-offs and collection. Public transport can't hope to meet these complex requirements, often involving time-consuming, multiple changes and restrictive schedules.

real-time, providers can be enabled to consistently offer users more balanced choices to the benefit of the companies and individual users they serve, simultaneously minimising the negative impact of congestion on the roads and excess emissions on the environment.

Computer simulations based on commuter data provided by the Atlanta Regional Commission during post-doctoral research at the Georgia Institute of Technology showed that the performance of ride-share platforms

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Pools of energy

Our on-going research into the possibilities of optimising ride-sharing draws on our expertise in the area of mathematical optimisation, transportation and logistics. Our aim is to explore options for the development of dynamic ride-sharing, enabled by today's technological connectivity using smartphones and mobile access to the internet.

Using algorithms to handle more complex driver-passenger matches in

tends to improve with the success rate of ride-share requests, which in turn depends on the existence of sufficiently large pool of users. Internet platforms may be infrequently visited, and the numbers of users too small to offer suitable real-time matching.

Equally, longer-term postings requesting a one-off ride for a particular occasion, such as a concert or sports event, could remain without response, or arrive too late for the passenger to take advantage of it. This can be frustrating, discouraging people from using the service again in the future. The unfortunate consequence is that the critical mass needed for the system to be successful is not achieved.

It's a "Catch 22" situation: insufficient users make it difficult for the system to work effectively, and users' disappointment in the results prevents the critical mass from developing. In other words, the more traffic a platform attracts, the greater the potential for improved performance. For ride-share providers, therefore, it is important to consider how to build traffic to their sites.

Travelling light

Consumption and behavioural trends in society appear to be moving increasingly towards a culture of sharing: not only ride-sharing, but car sharing, appliance sharing, house sharing, sharing creative ideas for new products, new ways of using materials, and more. What all these initiatives have in common is that they not only provide financial benefits to the users, but also bring people together and reduce their environmental footprint.

Ride-sharing becomes more attractive when it meets practical needs for fast, flexible transportation solutions, reliable connections and reduced travel costs, while minimising the negative environmental impact – and possibly offers additional benefits.

As yet, web-based ride-sharing tools have only begun to exploit the potential of technology-based systems. Traffic on ride-sharing platforms could be increased by linking the functionality of existing services to meet more users' needs for safety, reliability, also offering the possibility of sharing in a wider sense, and building networks and communities.

User profiles could be linked to social media, providing more insight into a fellow traveller's background, interests, and level of competence, helping to alleviate concerns about safety and security. Navigation and route selection is made easy with smart links to Global Positioning Systems. Ride-sharers could choose to develop networking opportunities, selecting travelling companions according to their business interests.

Multiple match options

On the principle that satisfied users return to and use a service more frequently, it is in the interests of providers to explore the potential of more sophisticated "match-making" systems. A flexible platform that allows participants more choices, and more possibilities, combines the practical benefits of ride-sharing with networking and community building opportunities.

However, systems that allow people to specify multiple requirements, or define alternative scenarios, require a more sophisticated approach than a simple formula that looks only at departure times and destinations. By broadening the options, participants increase the chances of finding a beneficial match, and a faster, and efficient matchmaking process is enabled by an appropriate underlying system structure.

Conceivably, ride-sharers could specify match criteria linking them to others in the same kind of job or profession, or even potential employees, employers, or customers. How people expand the opportunities offered by ride-sharing will depend on its proven reliability. This in turn will be established only when more people are attracted to and enjoy positive experiences of sharing rides.

Rather than trying to match the maximum number of requirements of every user, tailor-made algorithms could deliver the best possible combination of factors to achieve the optimal balance of benefits, in alignment with users' profiles: cost, time schedules, flexibility, safety, comfort, environmental impact, compatibility, networking potential. With this in mind, we would encourage ride-sharing service providers to develop more dynamic platforms, taking advantage of novel optimisation approaches. In the end, everyone benefits from balanced solutions. ■

This article draws its inspiration from the paper *Optimization for dynamic ride-sharing: A review* which was written by Niels Agatz, Alan Erera, Martin Savelsbergh, and Xing Wang. The paper has been published in the *European Journal of Operational Research* 223 (2012) 295–303. http://dx.doi.org/10.1016/j.ejor.2012.05.028

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RSM Expertise

RSM's Department of Decision and Information Systems is all about connections. For example, there's the connection between its broad content areas of Business Information Management and Supply Chain Management. Even more important is the connection between theory and business relevance, which is essential for funding as well as knowledge creation and the consequent sharing of practical insights of value to industry and society.
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