IMPACT ASSESSMENT OF DYNAMIC RIDESHARING - A NORWEGIAN CASE STUDY

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1. BACKGROUND

A Norwegian ridesharing initiative focusing on work journeys has been deployed and supported in a three-year collaborative programme including road authorities, technology providers and local employers. This paper presents an assessment of the ridesharing activities' impacts on travel behaviour. The research study is conducted by SINTEF and financed by the Norwegian Public Roads Administration.

2. INTRODUCTION

In dynamic ridesharing, a car driver and passenger(s) share a vehicle based on an automatic ride-matching process. The car driver has his/her own trip plans and offer unoccupied seats for passengers going in the same direction at the same time, at the reimbursement of travel expenses. The ride-matching is facilitated by a matching agency, based on offers and requests from drivers and passengers respectively. Smartphones with GPS navigation systems has enhanced the efficiency of such ridesharing services, allowing shared trips to be planned and organized by using dedicated smartphone applications ("apps").

The main objectives of promoting ridesharing solutions are usually expressed in terms of impacts on environment, road capacity and/or mobility:

- Obtaining environmentally friendly transport solutions by reducing fuel consumption, emissions and pollution
- Increasing transport capacity by mitigating traffic congestions and request for parking areas
- Improving mobility by offering a convenient mode of transportation (time saving, cost saving)

Dynamic ridesharing has obvious potential benefits for society and individual travellers. It has however proven difficult to obtain a sustainable market of drivers and passengers in order to achieve a successful ridesharing service (see e.g. www.dynamicridesharing.org for a synopsis of current and past ridesharing projects). Inhibitors comprise e.g. challenges concerning driver attitude, economic conditions, legal and regulatory status and technological challenges (Furuhata et al., 2013; Agatz et al., 2012; Correia and Viegas, 2011; Deakin et al., 2010). Several incentives, including tax or toll reductions, access to dedicated parking spaces or areas, access to ridesharing lanes etc., are suggested in order to encourage ridesharing.

3. THE NORWEGIAN RIDESHARING INITIATIVE

The Norwegian ridesharing initiative involves nine companies with more than 7 000 employees located at the outskirts of the city of Bergen. The initiative is supported and promoted by local road authorities and technology providers (ridesharing matching agencies), and has received grants from a national agency that promotes future-oriented sustainable mobility solutions.

The site, Kokstad/Sandsli, is an area consisting of mainly business offices, located about 15 km south of the city centre of Bergen. According to a recent travel survey for the Bergen area (Meland et al., 2014), the car share of the commute trips to this part of town is about 73 %. During the morning and afternoon peak hours, the traffic volumes result in congestion and delays in the transport system leading to and from this area. In addition, several of the participating companies have insufficient parking capacity. On the main road between the city centre and the test site, there is a 3 km public transit lane also open for high-occupancy vehicles (HOVs) with minimum two passengers per car in both directions. Road capacity problems during rush hours, combined with access to dedicated ridesharing lanes make the test site particular suitable for ridesharing activities targeting the commute trips.

The dynamic ridesharing solution was first deployed in 2011, and has since been followed up with promoting activities on a regular basis in order to attract new users and motivate existing users. The main technology applied for ride matching is the Carma carpooling application for smartphones (www.car.ma). For each trip a distance based cost is calculated, and a transaction is made from the passenger account to the driver account. However, during the test period the travel expenses for ridesharing is covered by the project, meaning the passenger rides for free, while the driver receives a small reimbursement.
For the local road authorities, the main goal for the ridesharing initiative is to achieve a 25 % reduction in the number of commute trips by car during a three-year period. The long term perspective is to increase the occupancy rate in cars in the city of Bergen from the current 1.15 passengers per car to 1.4 passengers per car by 2030.

4. EVALUATION METHODOLOGY

The Norwegian ridesharing initiative is being evaluated in an on-going research study, with the aim of assessing the impacts on travel behaviour and identifying the inhibitors and success factors of the ridesharing concept. The ultimate goal of the research study is to assess potential impact of ridesharing as a measure to manage transport demand and reduce congestion in the future. As illustrated in Figure 1, the evaluation is being carried out over two dimensions: attitudes and behaviour.

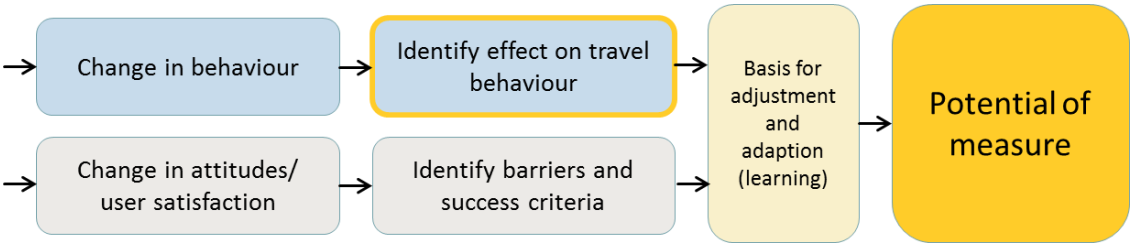

Figure 1: Focus areas of the evaluation process

The research methodology involves both quantitative and qualitative methods of data collection, including:

- A web-survey among the employees in eight companies participating in the ridesharing initiative.
- Operational statistics from the ride-matching agency including data on all ridesharing trips.
- Operational statistics on promoting activities and incentives used in the ridesharing initiative.
- Interviews with companies that are participating in the ridesharing initiative, including i) members of the management, ii) dedicated ridesharing ambassadors.
- Focus group interviews with i) employees that rideshare on a regular basis, ii) employees that have tried ridesharing , but do not rideshare anymore, and iii) employees that have not yet tried ridesharing .

The collected data comprises a comprehensive and complex research material, including aspects such as travel behaviour, user acceptance, organisational constraints and technology readiness, with impacts on travel behaviour being the focus in this paper.

5. RESULTS

5.1 Ridesharing statistics

As mentioned, the ridesharing activities at the Bergen site started in 2011. In September 2012 Carma (then Avego) released a new version of the ridesharing app with major improvements in functionality and user friendliness. In this project, data related to the use of earlier, less mature, versions of the application have been excluded. Our data material thus commences with October 2012.

According to operational statistics from the ride matching agency, a total number of 7 034 individual ridesharing trips were carried out during the period from October 2012 to February 2014. Figure 2 illustrates the number of registered users and the number of ridesharing trips carried out per month during this period.

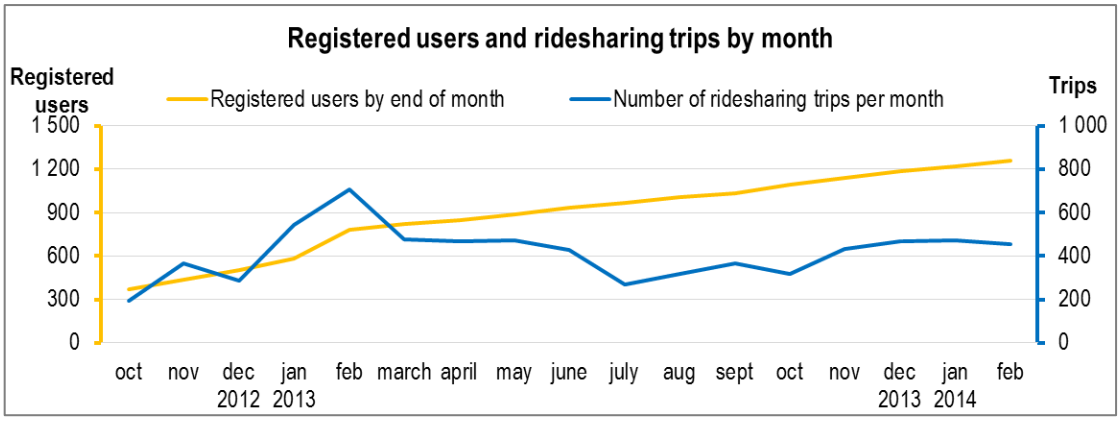

Figure 2: Ridesharing activity in terms of registered users and trips performed

The statistics reveal a steady increase in number of registered users in the ridesharing solution, from 370 by the end of October 2012 to 1 259 individual users by the end of February 2014. The number of ridesharing trips is however somewhat fluctuating, with a peak of 705 trips in February 2013. The increase in ridesharing trips during winter 2013 was congruent with a specific environmental campaign run by the main newspaper in the city of Bergen, addressing the travel behaviour of inhabitants in order to counteract severe seasonal environmental problems in the city.

The monthly average total number of ridesharing trips is 414, corresponding to about 100 ridesharing trips per week and 20 trips per working day. On average, each registered user complete 0.5 ridesharing trips per month.

5.2 Web survey

A web survey among employees in eight of the nine companies participating in the ridesharing initiative was conducted in January 2014, resulting in a total of 1 170 respondents.

Ridesharing participation

A key topic for this survey was to which extent the employees were aware of and had made use of the ridesharing solution offered in the initiative. This was explored through a question reflecting the necessary stages in the process of recruitment to the ridesharing activities. In order to become a participant in the ridesharing activities on a regular basis, the participants have to go through four stages/points of decision:

1. *first* receive and notice the offer to participate
2. *then* decide to sign up
3. *then* actually try ridesharing
4. *finally* decide to continue to rideshare

Based on this structure, the respondents have been divided into five groups describing their level of involvement with the ridesharing activities:

1. In spite of extensive promotion and marketing activities within the companies, as many as *63 % of the respondents stated that they had not received information about the ridesharing program*.

2. Further, a share of *26 % of the respondents had received the offer, but decided not to sign up* to participate in the activities, leaving only 11 % having signed up for the ridesharing solution.
3. *4 % of the respondents had come so far as to sign up* to participate, but *did not actually try ridesharing*.
4. Another *5 % of the respondents had tried out the ridesharing, but then decided not to continue ridesharing*
5. Finally, only *2 % had gone through the full path from learning about the activity, signing up, trying it out and deciding to continue to participate in the ridesharing activities on a regular basis*.

The uptake of information and use of ridesharing is illustrated in Figure 3.

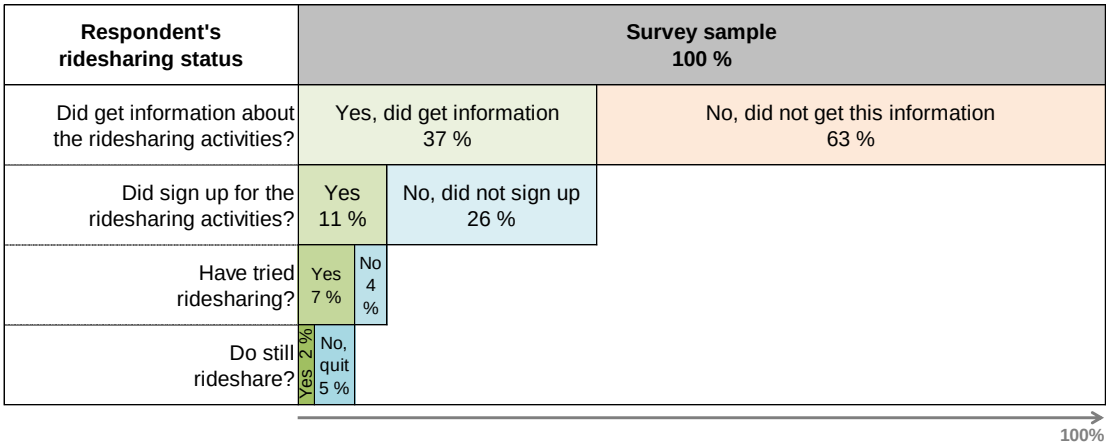

Figure 3: Uptake of information and use of ridesharing

There are some slight differences between the respondent groups, with those having actually *tried the ridesharing* solution being a bit *younger* (average 39 vs 44 years old) and with a *higher share of women* (8 % of the women have tried ridesharing vs 5 % of the men in the sample).

For assessing the general potential of a dynamic ridesharing initiative one might disregard the group that have not received/perceived the offer to participate in the ridesharing activities (although one should keep in mind that the sample is probably biased with those not noticing the offer, also being less interested in participating.) However, including only those respondents who state that they have received information about the initiative, the influence of ridesharing still seems rather modest, with 6 % of the employees ridesharing on a regular basis. See details in Figure 4.

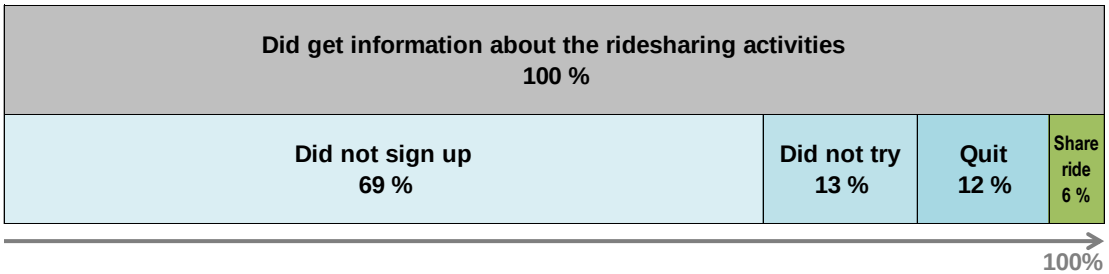

Figure 4: Involvement in ridesharing among those who acknowledge having received information and offer to participate

Travel options for the commute
The average distance between home and work is 18 km. The small group of active ridesharers have a somewhat shorter commute - 14 km on average. Based on information about travel times with the different modes, using a *bicycle* or *public transport* seems to be considered relevant for a higher share of participants in this group than among the total group of respondents, while the use of an *MC/moped* or a *combination of private car and public transport* is relevant for a higher share of the non-active respondents than for the active ridesharers.

Mode choice for the commute trip
The respondents were asked to describe which modes were used for their commute to and from work for three consecutive days. Comparing mode choice for the small group of active ridesharers to that of the majority who did not go through the entire process towards active ridesharing, suggests differences in share of trips as car driver and car passenger in line with the intentions for the ridesharing activities: the ridesharers show higher share of car passenger trips and lower share of trips as car driver. It is also worth noticing that the active ridesharers use public transport more frequently than the non-participating majority.

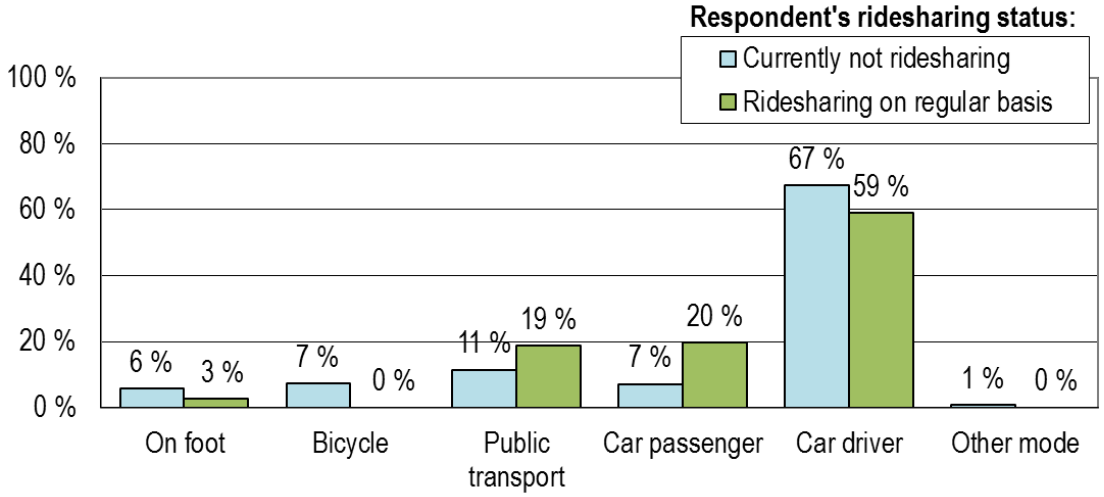

Figure 5: Reported modal share for commute trips, three workdays, ridesharers and non-ridesharers

For the mode choices including the use of a car, the survey also gives information about whether or not the car drivers was alone in the vehicle for the commute. Further, for the car drivers who had passengers and for the respondents who were car passengers, there is information about whether or not the application for dynamic ridesharing was being used for the trips in question. These details are shown in Figure 6.

The ridesharers use the application for almost all car trips involving taking on or being a passenger for the commute. The data describes a total of 66 individual ridesharing trips over the three days, of which 31 trips were car passengers using the app, and 35 were car drivers using the app.

The total share of trips involving the use of a car is quite similar in the two groups, but the graph clearly illustrates difference in vehicle occupancy: Among the active ridesharers driving a car to work, the driver is alone in the vehicle for 65 % of these trips, while the corresponding ratio is 88 % for the majority group, not being active ridesharers.

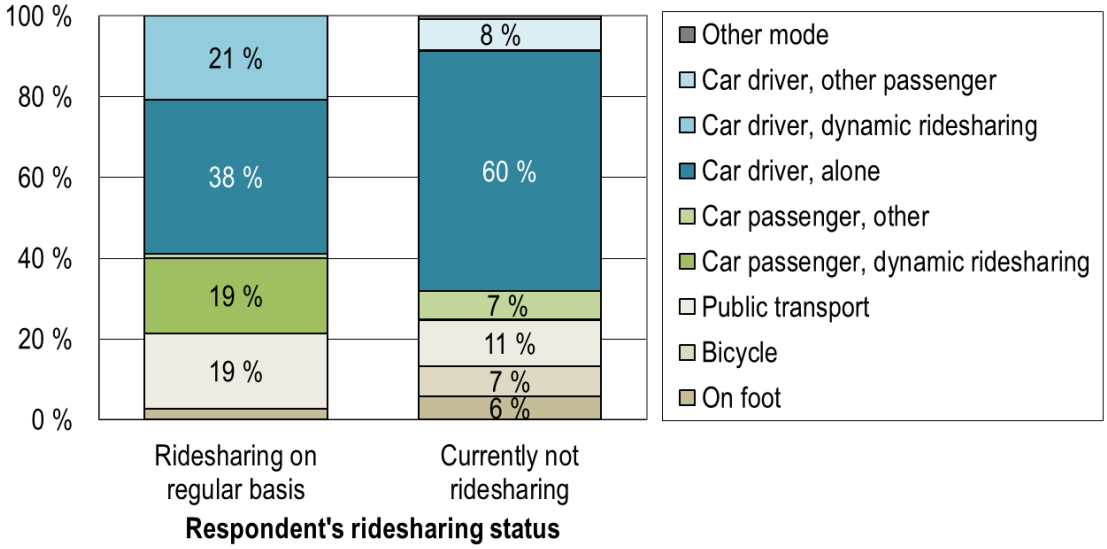

Figure 6: Reported modal share for commute trips, three workdays, ridesharers and non-ridesharers, with details about the trips involving car

Vehicle occupancy

Based on the modal shares shown in Figure 5, one can derive a car passenger/car driver ratio suggesting higher vehicle occupancy among the respondents who are involved in the ridesharing activities: Among the majority who are not participating, there are 0.11 passengers for each driver, whereas for the active ridesharers, the corresponding ratio is 0.33. When the driver in included in the equation, the resulting average vehicle occupancy is 1.33 - not far from the target of 1.4 persons per vehicle. As shown in Figure 6, there is a nice symmetry with respect to share of car driver trips including passengers, and the share of trips as car passenger within both the respondent groups in question. This suggests that the car passenger/car driver ratio can be considered a quite reliable proxy for car occupancy. Further, this indicates that the ridesharing activities have contributed to reaching the goal of increasing the car occupancy, with three times as many passengers per driver than in the majority group. However, the majority of the active participants in the ridesharing activities stated that this initiative has *not caused a change* in how often they drive a car to work. This suggests that the differences between the groups in terms of modal distribution for the commute trips may not have been caused by the ridesharing activities, but was present also before this initiative was launched. This can also suggest that the ridesharing passengers have been recruited from other modes than car. As shown earlier, the group of active ridesharing participants is very small (21 respondents out of the more than one thousand in the total survey sample), and the two respondents in this group who actually stated that the initiative had caused them to drive a car to work less frequently, do not provide a sufficient basis for further analysis on

the type of changes in travel behaviour the active participants have undergone after joining the initiative.

Alternatives to dynamic ridesharing
As mentioned, a total of 66 of the reported trips involved the use of an application for dynamic ridesharing. 31 of these individual trips were car passengers using the app, and 35 were car drivers using the app. The respondents were asked about what the most likely travel alternative would have been for these trips, if they were not to use the ridesharing application (Figure 7). With the very modest number of trips these results relate to, the results can merely be considered as indicative for some overall patterns.

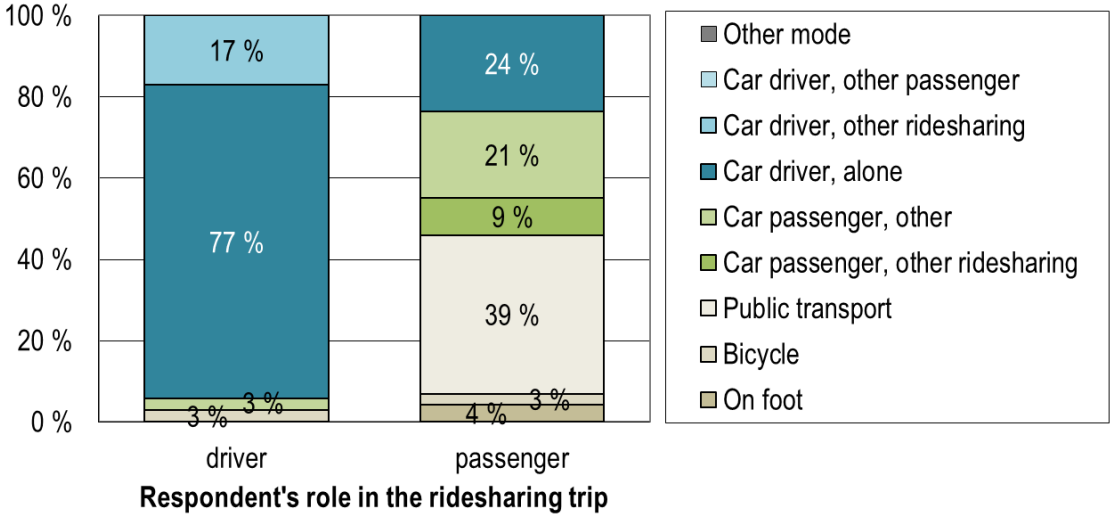

Figure 7: Most likely alternative modes for the reported trips involving use of application for dynamic ridesharing

Three out of four ridesharing car drivers would continue using the car, but without passengers. Most of the rest would continue taking passengers, but with other ridesharing arrangements. The switch to other modes than the car is marginal for this group. That is not the case for the ridesharing passengers. For one out of four the most likely alternative would be to drive their own car, while one out of three would continue as car passengers, using other arrangements. Nearly half of the ridesharing passengers would switch to other modes – mainly public transport.

6. DISCUSSION

The dynamic ridesharing initiative in Bergen addresses the daily commute for approximately 7 000 employees. Operational statistics from the test period show an achievement of 20 individual ridesharing trips per weekday on average over more than a year of operation. This is far from the original project goal to reduce the daily number of work trips by car by 25 %. Even if all ridesharing trips would replace a car trip, the impact on work trips by car would only be about 0,2 % (given a rate of 67 % car trips for commute trips to this area).

Only 7 % of the employees in the ridesharing program have tried dynamic ridesharing as a mode of transport, and a mere 2 % state that they still do rideshare. This suggests that only one third of those being persuaded into actually trying the service finds it satisfying enough to continue using it on a regular basis.

Reports on actual mode use for three days of commute suggest a lower share of car drivers among the active ridesharers than among the non-participating employees, and an opposite difference with regard to share of car passengers. This is in line with the intentions for the ridesharing activities, and can be interpreted as an indication of the ridesharing initiative having the desired effect in terms of number of car trips and increased vehicle occupancy. The majority of the active ridesharers however state that the ridesharing initiative has not caused them to change how often they drive a car to work, thus suggesting that the difference in car driver share may have been present before the ridesharing initiative was launched, and that either the vehicle occupancy was higher from the start, or the ridesharing passengers have been recruited from other modes than car. The latter assumption is supported by the indicated alternatives to trips arranged through the use of the dynamic ridesharing application. For almost half of the dynamic ridesharing trips, other modes (mainly public transport) were considered to be the most likely alternatives.

The modest impact of the ridesharing activities come to pass despite the expectations of the test area being particularly suited for ridesharing. Former research implies that success factors for dynamic ridesharing solutions include focusing on work trips related to large companies, active promotion, ridesharing lanes to reduce travel time, limited parking conditions, sufficient sponsorship to encourage ridesharing (www.dynamicridesharing.org; Amey, 2010; Deakin et al., 2010).

One could argue that the goal of the ridesharing initiative seems to be far too ambitious. Research on and experience with dynamic ridesharing worldwide, shows a common challenge in attracting a critical mass of users (see e.g. Agatz et al., 2012; Deakin et al., 2010). Although scientific reports on actual impact on travel behaviour are sparse, it seems to be very difficult to obtain a sustainable dynamic ridesharing scheme.

Deakin et al. (2010) conducted a feasibility study to assess the potential for a dynamic ridesharing program in Berkeley, California. Combining surveys on travel preferences, geographic analyses and simulations to estimate the daily use of ridesharing, they found that about 15 % of drive-alone commuters would be interested in using dynamic ridesharing at least occasionally and were living in areas where matches could be found. The study concluded that out of approximately 70 000 workers and students at the University campus (representing 12 000 daily drive-alone commuters), the market for dynamic ridesharing comprised up to 1 200 potential participants (2 % of sample, 10 % of car users), and only 700 (1 % of sample, 6 % of car users) if the program were limited to those living outside of walk-bike-transit zones. One should also keep in mind that most people engaged in ridesharing would only use it

occasionally. In this context, the modest impacts of the ridesharing initiative in Bergen should not come as a surprise.

A bit more unexpected however, was the significant share of employees that stated not to have received information about the ridesharing program. The project has strongly emphasized promotion activities, both on an organizational level (management involvement, designated ambassadors among employees, dedicated workshops for start-up support and more) and through widespread use of information campaigns and competitions with diverse awards as incentives. The fact that only 37 % of the employees have actually perceived the offer to participate in the ridesharing program might imply an unreleased market potential, but is also a proof of how difficult it is to attract potential users.

The dynamic ridesharing activities in Bergen have not reached a critical mass of participants. Although the users mainly travel to the same destination and within the same period of time, the demand for ridesharing is limited, which may lead to a low rate of match response on trip requests. For dynamic ridesharing to succeed there has to be sufficient demand to keep up the interest of posting trip requests by both drivers and passengers. Once crossing the threshold of critical mass, however, a ridesharing program may benefit from networks effects and economies of scale.

7. CONCLUSIONS

The dynamic ridesharing initiative in Norway demonstrates the difficulties in changing travel behaviour related to work trips. In accordance with other ridesharing pilots in Europe and USA, recruiting participants for the ridesharing program has proven to be quite demanding. Even with extensive effort on promotion activities and a test site with incentives well suited for ridesharing, the actual deployment of ridesharing is sparse. Only 37 % of the employees at the companies involved in the program acknowledged to have received information about ridesharing after three years of program participation. With 11 % of employees signing up for ridesharing, not more than 7 % actually tried to rideshare and only 2 % states that they still do rideshare on regular bases. Even those engaged in ridesharing only use this mode of transportation occasionally; hence the impact on modal split is quite modest. Based on 7 000 employees, the ridesharing initiative has obtained a scope of 20 ridesharing trips/day on average. This represents up to a maximum of 0.2 % of the daily commute trips by car in the area. One of the main intentions with the ridesharing initiative has been to reduce number of cars during the rush hours. Results from the employee survey suggest that this may be the case to some degree, but that a larger portion of the ridesharing passengers may have been recruited from other modes than the car driver alternative: mainly public transport, but also the soft modes. This is not in line with the intentions with the scheme.

Despite the logic in better exploitation of the surplus capacity in private cars, most dynamic ridesharing solutions have not yet proven to be sustainable

beyond the pilot period. Few, if any, projects can demonstrate impacts on travel behaviour to an extent indicating that dynamic ridesharing alone could manage traffic demand and reduce congestion in the future. So far, it would be more realistic to expect dynamic ridesharing to be one of several travel behaviour measures involved in environmental programs.

8. ACKNOWLEDGEMENTS

The research presented in this paper was funded by The Norwegian Public Roads Administration, and conducted with much appreciated collaboration and effort by the members of the ridesharing initiative in Bergen.

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