Ridesharing Impacts

Subjects: Transportation

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Ridesharing is part of the innovative shared transport regime which aims to maximize the utilization of mobility resources. Gaining knowledge of ridesharing's impacts and how to assess them may significantly improve such services and thus contribute to their adoption among broader groups of travelers and to travel behavior change.

Keywords: ridesharing ; carpooling ; ridesharing demonstration ; demo outcomes ; impact assessment

1. Introduction

Ridesharing is associated with social, environmental and behavioral impacts [1][2][3][4]. A common framework for assessing ridesharing impacts typically defines categories in which impacts are expected (e.g., economic, social, etc.) and measures specific indicators which are grouped within those categories [3][5][6]. Studies that do not use empirical ridesharing data to estimate impacts tend to use statistical and survey data to model environmental and transport impacts [2][7][8]. The remainder of this section presents ridesharing impacts by focusing both on pilot projects and modeling results.

2. Impact Assessment of Ridesharing Pilots

The CIVITAS "Alternative Car Use" initiative showcased significant advancements in sustainable car use by establishing or enhancing existing ridesharing services within the European Union [5]. For assessing the impacts, three different impact categories were considered: (a) Economy, Energy, Environment; (b) Transport; and (c) Society [5]. The majority of pilots in this CIVITAS initiative monitored changes in energy and emission for a period of two years (2005–2007). The implementation of ridesharing services at the Krakow University of Technology (Poland) resulted in a reduction of 27% in operating costs and of 32% in fuel consumption between 2007 and 2008. In addition, it was claimed that the average car occupancy during workdays and ridesharing trips increased by 7% and 18%, respectively. Regarding societal impacts, awareness of ridesharing raised from 34% to 66%.

A ridesharing scheme was established in Norwich, England, and members of business and educational organizations were recruited. Between September 2005 and May 2008, collective fuel and car cost savings of EUR 99,369 were reported. In addition, around 304 tons of CO_2 and 993,690 vehicle miles were saved, and 1646 car trips were avoided during peak time [5]. Similar impacts were recorded between 2005 and 2007 in Toulouse, France, where total cost savings of EUR 321,880 and a CO_2 reduction of 0.338 kg of per km were reported for a medium-sized car [5].

Similarly, for the evaluation of ridesharing service for students in Debrecen (Hungary) [6], three different impact categories were defined: (a) transport system, (b) quality of service and (c) acceptance. Interviews conducted with participants and data (e.g., daily users) were utilized as a means of measuring impacts.

The EU-funded "Changing Habits for Urban Mobility Solutions" project (CHUMS) developed and deployed a methodology to assess the impact of the project; a set of indicators was defined and evaluated. These indicators were divided into three main groups: (a) contextual information, (b) target group information and (c) effects on mobility and the environment [3]. Based on before/after assessment, the attitude toward ridesharing for most target groups changed in a positive way. As far as the impact on travel behavior is concerned, the number of registrations increased by 2397 new users. It was estimated that 55,000 new ridesharing trips were generated, resulting in more than 640,000 extra ridesharing kilometers. The CHUMS measured a ridesharing share of 1.45% (between 0.01% and 36.17% for different user groups). Concerning the environmental impact:

- In Norwich (England), 57,192 Vehicle Kilometers Travelled (VKT) were saved (i.e., savings of 0.1% in CO_2 emissions).
- In Toulouse (France) 127,037 VKT were saved (i.e., savings of 0.09% in CO_2 emissions).

- In Perugia (Italy), 998 VKT were saved (i.e., savings of 0.01% in CO_2 emissions).

Two different methodologies were adopted in the EU SocialCar project to assess the impact of ridesharing: a citywide impact assessment modelling and a real-life testing of the RideMyRoute app [9]. The citywide impact assessment estimated the share of citizens who were willing to utilize the RideMyRoute app and studied the variation in mobility patterns among societal groups. Different scenarios were built, and the (%) change in car and PT share was calculated. The second method measured the RideMyRoute app impacts in four pilots. The impact assessment involved the evaluation of the smart app through [10]:

- Data collected by the app SocialCar;
- user acceptance surveys with formal testers, before and after testing;
- focus groups to capture more qualitative feedback and explore attitudes toward use in the future.

Finally, the INDIMO project focused on broadening the advantages of digitally interconnected transport systems to individuals who currently encounter obstacles in utilizing or reaching such solutions. One of its pilots included on-demand ridesharing services (door2door service) in Berlin. The general evaluation framework of INDIMO project was structured around five pillars: (1) user acceptance, (2) inclusivity and accessibility, (3) cybersecurity and personal data aspects, (4) process evaluation of the INDIMO Inclusive Digital Mobility Toolbox and (5) applicability and transferability assessment [11].

Regarding future ridesharing, electric vehicles (EVs) and autonomous driving are gaining momentum. MOIA, which is a subsidiary of the Volkswagen Group, is currently offering ridesharing service using Evs in Hanover and Hamburg. Its first ridesharing pilot project was carried out in Hanover in October 2017, and by July 2018, it became a public operation. MOIA's ridesharing scheme was also implemented in Hamburg in 2019. During these four years, approximately 1,000,000 registrations have been made, and 8,385,000 passengers have traveled in Hamburg, while the application has been exceptionally ranked (4.9/5). Since January 2023, MOIA has operated as a scheduled on-demand service within the public transport system in Hamburg. In this context, MOIA is considered to be partner of cities and public transport companies [12]. The ALIKE project aims to evaluate autonomous shuttles that can be conveniently reserved through a mobile app. These shuttles are designed to pick up passengers and transport them to their specified destinations. The operating phase is expected to start in 2025 [13].

3. Impact Assessment of Ridesharing through Modeling

In addition to pilot demonstrations, several studies have investigated the assessment of ridesharing impacts using statistical and modeling data. For example, Nechita et al. [14] simulated the fuel consumption and CO_2 emissions of commuters during a working day in Bacau (Romania). Results showed that during the morning peak time of 06:00–10.00 a.m., the total fuel consumption and CO_2 emissions from solo-driving commuters was 28.25 L and 64,561 g, respectively. Adding one passenger per vehicle results in a total fuel consumption of 13.11 L and CO_2 emissions of 20,174 g, which corresponds to over 50% savings in fuels and CO_2 emissions.

The Jojob is a carpooling application that assessed impacts related to: (a) CO_2 emitted by cars, (b) the number of vehicles on the road and (c) economic savings for commuters [15]. Application data (e.g., number of shared trips) were used to estimate a reduction of 275 tons of CO_2 in 2020, 66,702 journeys shifted from private means of transport, and EUR 462,550 saved by individual users who shared rides.

A stated preference survey was conducted in the Tehran Metropolitan Area (Iran) to estimate ridesharing impacts in energy efficiency and fuel savings [2]. IT was found that: (a) 44% of the participants would share a ride regardless of knowing someone to ride with, (b) 14% expressed a willingness to share a ride only if they could share it with someone they knew and (c) 26% were willing to share a ride (regardless if they knew someone to share with) to reduce their travel time. The annual fuel savings were calculated and are summarized in **Table 1**.

Table 1. Estimation of annual fuel saving for different scenarios in Tehran (Source: [2]).

Participants Willing to Share Ride (%)	Daily Trip Reduction (Morning Peak Hour)	Daily Fuel Saving (Liters)	Annual Fuel Saving for Working Days (Million Liters)
44	773,748	1,294,325	336.5

Participants Willing to Share Ride (%)	Daily Trip Reduction (Morning Peak Hour)	Daily Fuel Saving (Liters)	Annual Fuel Saving for Working Days (Million Liters)
14	225,088	376,517	97.9
26	680,185	1,137,813	295.8

The effect of ridesharing depends on the vehicle ridership and the number of vehicles they reduce. Adding one additional passenger per 100 vehicles, if no additional trips are required, could result to potential fuel savings of 0.80–0.82 billion gallons of gasoline per year [8], whereas the same research indicated that if one additional passenger was added to every 10 vehicles, it could result in annual fuel savings of 7.54–7.74 billion gallons in the U.S. Ridesharing can significantly reduce greenhouse gas emissions by lowering fuel consumption. According to the same study, if one more passenger joined every 100 vehicles, it could result in an annual reduction of 7.2 million tons of greenhouse gas emissions in the U.S. Furthermore, if one passenger was added to every 10 vehicles, it could lead to an annual reduction of 68.0 million tons of greenhouse gas emissions [1].

Yin et al. (2018) [7] built four different ridesharing scenarios to appraise ridesharing benefits in the Paris region (France). The initial scenario (2015) defined the baseline situation, while the other three (for year 2030) differed regarding the vehicle occupancy and the cost parameters. The second scenario considered a uniform growth of vehicle occupancy by 50% for all trips. The third scenario assumed that ridesharing was more likely to develop over long-distance trips, and thus the vehicle occupancy varied. The results for three indicators are presented in **Table 2**.

Table 2. Change (%) of KPI values for different ridesharing scenarios in the Paris region compared to 2015 (Source: [7]).

	Ridesharing Scenarios		
	1	2	3
Traffic volume	MRH: +1.3%	MRH: −22.7%	MRH: −29.4%
	ERH: +1.0%	ERH: −21.3%	ERH: −28.5%
Road network congestion ratio	MRH: −1.5%	MRH: −10.9%	MRH: −19.9%
	ERH: −1.4%	ERH: −4.6%	ERH: −14.8%
CO_2 emissions	MRH: −1.5%	MRH: −18.4%	MRH: −35.6%
	ERH: −2.3%	ERH: −11.0%	ERH: −28.9%

MRH: morning rush hour, ERH: evening rush hour.

Synthesizing the literature data, it was concluded that ridesharing impacts may be grouped in three impact areas (**Table 3**).

Table 3. Categorization of ridesharing's impacts and description of measuring methods.

Impact Area	Goal	Measuring Methods and Tools
Socio-economic	Reduction of travel costs due to shared travel costs	Questionnaires/surveys combined with statistical analysis, focus groups before and/or after the pilot
	Reduction of commute stress	Recruitment and engagement of formal testers
	Awareness raising toward ridesharing/sustainable mobility	Data recording through ridesharing application
Environmental	Fuel saving/reduction of CO_2 emissions	Simulation combined with survey and other data
	Reduction of vehicles on the road	Modelling combined with survey and other data

Impact Area	Goal	Measuring Methods and Tools
Transport	**Congestion mitigation**	
	Decrease of single occupancy car trips	**Direct air pollution measurements**
	Decrease in car mode share/increase in PT mode share	**Simulation combined with survey and other data**
	Reduction of parking infrastructure demand	**Modelling combined with survey and other data**

The research indicates a lack of a structured framework to provide guidelines for evaluating ridesharing services. Moreover, the examined ridesharing services concentrate on citywide travel and neglect the aspect of first- and last-mile trips. Impact assessment at the pilot level incorporates data collected through dedicated ridesharing applications to quantify KPIs related to environment, as well as participants' feedback to assess qualitatively the ridesharing service. This research aims to contribute to the ridesharing field by outlining the methodological framework that was used in a pilot city case and presenting empirical data and constraints to support forthcoming ridesharing demonstrations.

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