What factors affect travellers to use ride-sharing with rail services in EU?

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Abstract

Ride-sharing services promote sustainable transport as they reduce car use and minimize negative impacts related to environment and transport efficiency. Several studies have focused on understanding travellers' attitudes and characteristics toward using ride-sharing services; however, just a few have focused on the travellers' behaviour and ride-sharing services that are organized to feed public transport. This research investigates the factors that may affect travellers to accept a ride-sharing ride, as part of their trip, to/from public transport stations (i.e., rail, tram and metro). A survey is conducted in EU27 and the UK, by means of a conversational survey. In total 565 questionnaires are completed capturing travellers' preferences when using ride-sharing with public transport. An analysis is performed on the basis of four user types: Household work user, Solo work user, Education user, and Recreation/entertainment user. A set of 33 factors is defined based on the set questions, that represent the reasons, motives and constraints the travellers may consider when using ride-sharing with public transport. Useful insights are provided by using descriptive and bivariate statistics to explore the relationships between individual variables and defined factors. Binary logit models are built to explore and estimate the likelihood of using ride-sharing with public transport as a traveller. The analysis shows that although socio-demographic variables are not correlated with ride-sharing, other factors in this report are found to be significant in planning of ride-sharing services with public transport. A sample of important recommendations include: the availability of the ride-sharing service through a smartphone application; availability of services in areas that lack or with low frequency of public transport;

the reduction of journey cost; the accepted delay time - less than 5 minutes; the accepted ride-sharing time – 15 minutes; the ability to check the driver's ID through the application and the availability of driver's experience to all users upon request.

Keywords: ride-sharing, carpooling, factors, attitude, public transport; intermodal.

1   Introduction

Ride-sharing services promote sustainable transport as they reduce car use and minimize negative impacts related to carbon emissions, travelling costs and congestion. Several studies in the past focused on understanding users' attitude and characteristics towards encouraging them to use ride-sharing services.

In this study, ride-sharing refers to a mode of transport in which individual travellers (i.e., driver and passengers) share a vehicle for a trip and split travel costs, such as gas, tolls and parking fees, with others that have similar itineraries and time schedules [1,2]. The drivers are considered independent private entities, and they do not transport people for any kind of profit [2].

The relationship that exists between demographic and behavioural characteristics, and ride-sharing appears to be controversial, according to the findings of the surveyed literature. Ride-sharing research results on passengers' characteristics and attributes tend to refer to identical factors, which can be categorized in various ways. This study aims to contribute to the literature related to ride-sharing by investigating factors that affect passengers to accept a ride-sharing ride, as part of their trip, and transfer passengers to/from public stations. The ride-sharing service aims to organize rides that take passengers to/from the rail/metro/tram station to complete the first/last mile of their journey. Thus, in the remainder of the paper, public transport refers to rail modes, such as rail, suburban rail, metro and tram. The measurement and comparison of these factors will contribute to the development of successful ride-sharing services that will potentially increase ridership of public transport, thus creating a more sustainable transport system.

A survey conducted in EU27 and the UK to capture passengers' preferences when using ride-sharing with public transport by using a set of 33 factors [3]. Defined factors represent reasons, motives and constraints that passengers may consider when using ride-sharing with public transport. An analysis was performed on the basis of traveller types:

• Household work user: Trip to work with at least one other worker from the same household;
• Solo work user: Trip to work with unrelated individuals;
• Education user: Trip for educational purposes with or w/o unrelated individuals;
• Recreation/entertainment user: Trip for recreation and entertainment purposes with or w/o unrelated individuals.

2   Methods

The questionnaire was conducted by means of a conversational survey. The survey was conducted in all the 27 EU countries and the UK, with individuals in each country asked to answer questions. The survey was addressed to all travellers, including passengers and drivers. However, this paper focuses only on passengers. The survey was divided into five sections.

• The first section included questions on general and sociodemographic characteristics, such as home country, gender, age, income, educational level and professional status.
• The second section provided the definition of ride-sharing and three more questions relative to ride-sharing, such as the participant's area of residence (i.e., urban, semi-urban or rural), ownership of a smartphone and previous experience with ride-sharing services. Respondents without previous ride-sharing experience were forwarded directly to the following section, whereas respondents with previous ride-sharing experience were first directed to answer four additional questions to rate their last ride-sharing experience, their trip purpose, with whom they travelled and the modes they selected to use together with ride-sharing in their last journey (if any).
• The third section concerned the participant's travel habits by focusing on a usual journey of theirs.
• The fourth section was available only to passengers concerned the utilization of ride-sharing and public transport (e.g., rail, tram or metro). In this section, the respondents were introduced to the hypothetical scenario. The scenario stated: "For this journey you are ride-sharing as a passenger and you are using a mobile app to plan your journey. Through the app you are able to find a driver and arrange a ride-sharing to take you to/from the rail/metro/tram station to complete the first/last-mile of your journey." A set of questions followed for passengers.
• The fifth section was available only to drivers (i.e., driving license holders and car owners), and it concerned the reasons why potential drivers would accept to use their personal vehicle the presented scenario. Nine questions followed that represented nine potential factors for drivers.

In total 565 questionnaires were completed; partial completions (surveys that were not completely filled out) are not used in the analysis of the results. The relationship of the selected factors with demographic characteristics was further described using cross-tabulations. Bivariate statistics were computed to explore the relationships between explanatory variables and individual passenger characteristics. Multivariate modelling was conducted to explore the likely collinearity between the factors and the likelihood of using ride-sharing as a passenger.

3   Results

Table 1 summarizes the frequency and percentage of travellers' characteristics among the sample. The respondents are almost equally divided by gender (male and female), while the majority of them belongs to the age group of 35-50. Among those recorded,

the majority of the respondents are from Slovakia, Czech Republic, Finland, Greece and Italy.

Variable	Measure	Frequency	Percent
Gender	Male	302	53.5
	Female	258	45.7
	Other	3	0.5
	Not say	2	0.4
Age	Less than 18	4	0.7
	18-24	134	23.7
	25-34	167	29.6
	35-50	184	32.6
	51-65	65	11.5
	More than 65	11	1.9
Education	Basic education	6	1.1
	Higher education	118	20.9
	Bachelor's Degree	136	24.1
	Master's Degree or higher	296	52.4
	Prefer not to say	9	1.6
Occupation	Employed full time (40-more hours/week)	328	58.1
	Employed part time (max 39 hours/week)	28	5.0
	Unemployed and looking for a job	10	1.8
	Unemployed and not looking for a job	7	1.2
	Student	147	26.0
	Self-employed	36	6.4
	Unable to work	3	0.5
	Prefer not to say	6	1.1
Smartphone	Yes	552	97.7
	No	13	2.3
Residence	urban	405	71.7
	suburban	105	18.6
	rural	55	9.7
RS experience	Yes	138	24.4
	No	427	75.6
Journey purpose	work	433	76.6
	education	68	12.0
	leisure-entertainment	52	9.2
	other	12	2.1
Journey	Alone	410	72.6

Variable	Measure	Frequency	Percent
	With family members	77	13.6
	With co-workers	19	3.4
	With friends	59	10.4
PT use	Really unlikely	63	11.2
	Unlikely	110	19.5
	Likely	180	31.9
	Totally likely	212	37.5

Table 1: Traveller summary statistics.

The distribution of traveller types per country is shown in Figure 1. The majority of travellers are solo work users for all countries; however, the second highest user type changes per country (e.g., Slovakia-education, Czech Republic-Leisure, Servia-Household worker).
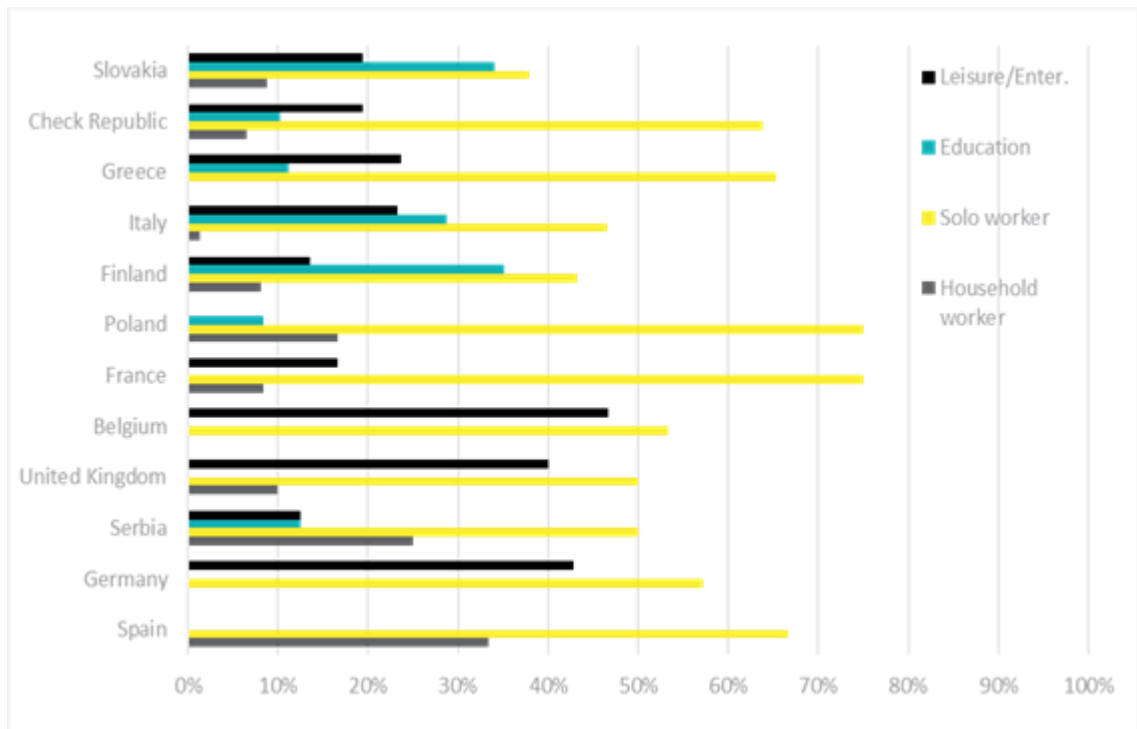

Figure 1. User groupe share per country.

A detailed analysis is performed for the four traveller types: 1) Household work traveller, 2) Solo work traveller, 3) Education traveller, and 4) Recreation/ entertainment traveller. At individual level, we found that socio-demographic variables are not associated with the likelihood of ride-sharing with public transport. As a final aspect of the specific user category, Fisher's exact test was run for comparing factors with ride-sharing users/non-ride-sharing traveller. A binary logistic regression analysis was applied to predict the participation of passengers in a ride-

sharing system that take a passenger to/from the rail/metro/tram station to complete the first/last mile of their journey. The predicted values were "No" (0) and "Yes" (1). All variables found to be significant were tested in the model. The factors that are mostly related with/without ride-sharing are:

• For the household work users, the most important factors to be addressed are the lack of public transport or low frequency, the walking time and the driver's experience.

• For solo work users, the most important factors to be addressed are cost reduction, convenience, lack of public transport or low frequency and availability of the service.

• For education users, the most important factors to be addressed are using a sustainable mode (this is the only traveller type for which the specific factor was found to be significant, probably because students and young people tend to be more sensitive towards these issues), the duration of the journey, the availability and using the service during daytime.

• For recreation/entertainment users, the most important factor to be addressed are the availability of public transit, cost increase and travel companion (not knowing the co-traveller). The specific user group was the one with the most changed opinion towards ride-sharing before and after the COVID-19 pandemic probably because a large share of them preferred using public transport before COVID-19.

4   Conclusions and Contributions

The most important findings of the study are used to shape recommendations that may be used to develop and implement a successful ride-sharing system. These should be integrated in applications by developing algorithms to provide optimized ride-sharing services to passengers. In summary:

- **Cost reduction** is an important factor based on which travellers may decide to choose a ride-sharing service for part of their trip.

- **Convenience** is important in the sense of being able to easily find a ride, quickly and with pick up locations nearby to the origin point. In general, travellers mentioned that they would be more likely to use the service if they could arrange a last-minute ride, through their smartphone and at a near pick-up point, while ideally, they would prefer a guaranteed trip back.

- The **lack of public transport modes or their low frequency** is another reason (factor) for which users would agree to ride-share. It is up to planners to design a ride-sharing system that will benefit of this condition and provide services (in terms of availability and frequency) in particular areas.

- When it comes to **journey duration**, users accept a ride-sharing journey of up to 15 minutes, while in terms of delay they agree to have their overall trip duration increased by only 3 minutes.

- **Safety** is an important factor. Travellers stated that they would agree to ride-share during the afternoon and the evening, but not at night (this is especially

relevant for women). Based on the outcomes of the survey, the ride-sharing app does not need to be available during the night, as the potential demand is very low. Respondents mentioned that they would like to check the driver's ID through the app, strengthening this way the "decision" that the service should be provided though an app. Other means of checking the drivers' ID, such as Facebook or other social media, are accepted, but not preferred.

- Relevant to both factor of **convenience** and **safety**, is the fact that users would accept to ride-share when there are up to 4 passengers (including the driver) in the car.

Rewards are also important, as they incentivize passengers to use a ride-sharing service. This could be achieved through the provision of redeemable points (like miles in airlines services) that can be used in public transport modes or for future ride-sharing rides.

Acknowledgements

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